The role of leadership in adopting the Fourth industrial era technologies in developing economies

Authors:

Queen Mpofu[5] and Paul Nemashakwe[6]

Abstract

The study explored the role of leadership in adopting the Fourth Industrial Revolution (4IR) technologies in emerging technologies. This was prompted by the fact that in emerging economies, the adoption of 4IR is at infancy stage and not visible across the globe. The fourth industrial revolution has the capacity of providing opportunities to emerging economies. However, there are challenges embedded in new technologies which might limit the possibilities to operate in an 4IR era. This implies that benefiting from new technologies will not be automatic, but with competent leadership, emerging economies can take advantage of digitalisation to fast track their growth and development. The study utilised a semi-systematic literature review approach. A qualitative/ narrative approach was utilised to establish themes. A thematic inductive method was used to analyse the data. The clusters of data pertaining to the subjects of inquiry served as the basis for the creation of themes. The findings of the study revealed that the role of leadership in the adoption of 4IR technologies is crucial and multifaceted. The key aspects of their roles are as follows: vision and strategy; change management; resource allocation; collaboration and partnerships; risk management and governance; stakeholder engagement as well as continuous learning and innovation. In addition, it is recommended that key stakeholders need to support leadership to become better 4IR-aligned leaders in emerging economies. That is, leadership upskilling and re-skilling in emerging economies requires an effective governmental, and institutional framework.

Key terms: leadership; fourth industrial revolution; emerging economies; leadership roles; technologies.

[5] Queen Mpofu (PhD). Lecturer - Department of Accountancy, National University of Science and Technology (NUST). Email: queen.mpofu@nust.ac.zw.

[6] Paul Nemashakwe (PhD). Lecturer - Faculty of Commerce, Innovation and Technology (FCIT), Catholic University of Zimbabwe. Email: paulnemashakwe@cuz.ac.zw.

Introduction

The Fourth Industrial Revolution (4IR) is an era that has changed the way people live, work and interact with each other. Its development is based on the foundations of the first, second as well as the third industrial revolutions. 4IR has gained momentum across the globe and it has accelerated human capital development, supported and empowered by digitalisation. The major features of the 4IR technologies include; Big data, Internet of Things (IoTs); Automation, Artificial Intelligence, 3D printing, Robotics and so on. According to Rotatori, Lee and Sleeva (2021) these technologies of the 4IR era contribute immensely on all sectors of the economy and stimulating the societal systems. The result is a fundamentally different period of societal change that extends in size and scale beyond previous periods of industrial revolution. Shiller (2013) adduce that “you cannot wait until a house burns down to buy fire insurance on it”. This statement clearly stipulates the necessity of humankind to be more proactive rather than reactive in any given situation. It is a grave mistake to wait for major dislocations to happen in organisations and communities at large, to prepare for the 4IR (World Economic Forum (WEF), 2021). Organisations, through training and development programmes should be in a position to prepare and train their workforce for the fourth industrial revolution era (Mpofu & Nemashakwe, 2023).

In addition, there is a need to also assess and establish the role of leadership in business and how does it fit in the adoption of 4IR. This is because the 4IR has immensely affected the day-to-day activities of organisations, including the control environment within the domain of leadership. According to WEF report (2021) leaders as well as their workforce are at a point where they are asking their purpose and relevance in the fourth industrial revolution era. Some of the individuals are of the view that 4IR will eventually make humans redundant, leading to socio-economic problems. However, some of the scholars dispute the statement, citing that human capital will never be made jobless (Sutherland, 2020). For humans to remain relevant in 4IR, the world requires more realistic leaders, who understand and execute their duties and responsibilities meticulously. Leaders need to understand that digitalisation is inevitable, whether people like it or not, there is no escape regarding new technologies. It is an unstoppable force that has a huge impact on the way people live, connects and work.

According to the Delloite report (2021) “leaders of business should be focussed on the challenges they face now and will face in the future, and then they must strategize with actions that will lead their business into the 4IR”. This implies that the value creation and financial performance of organisations as well as fulfilment of employees’ individual needs is largely dependent on those charged with governance’s (leadership) systems and policies. It is imperative for leaders to take a stand and assist their workforce adapt to new technologies, move with time, either through education and intensive training or by human connectivity. This is despite the fact that the majority of leaders in emerging economies suffer from technophobia and others are struggling to understand all the new-technology opportunities and threats. It is against this background that, this paper aims to establish the role of leadership in adopting the fourth industrial revolution era technologies in the developing economies.

Unpacking Fourth industrial revolution

According to Schwab (2016) 4IR era can be defined as an “ongoing transformational period characterized by the fusion of technologies, digitalization, and automation across the globe”. This revolution is considered disruptive compared to previous industrial revolutions due to the speed and scale of its impact. Digital technologies have accelerated the 4IR which has also led to industries and societies reformation. These new technologies are interrelated and intertwined, allowing innovativeness and creativeness across industries. Examples of 41R technologies include artificial intelligence (AI), Big data, Robotics such as machine learning, Internet of Things (IoTs), Automation, Blockchain, Cloud computing as well as Nanotechnology. According to Kommunuri (2022) and Kumar et al. (2022) AI technology is a primary driver of the 4IR, which is described as a novel, controversial, innovative, avant-garde, and influential technologies emerging from 4IR with the ability to foster transformative change in the business environment. Kommunuri (2022) further states that “AI technologies enable systems to perform tasks traditionally requiring human intelligence, such as pattern recognition, decision-making, and complex problem-solving”. This contributes immensely to industries such as mining, healthcare, banking and finance, manufacturing, education as well as in transport sector.

IoT is another new 4IR technology that has heightened the connectivity across the globe. According to Schwab (2016) IoT can be described as the network of computing

devices, vehicles, appliances, and other things embedded with sensors, software and internet. These hardware, software and internet when interconnected allow the sending and receiving of information/data. They make the data cycle processing easier and enables production of enormous volumes of real-time data, facilitating data-driven decision-making and enabling new services and business models.

Automation and robotics are also pivotal components of the 4IR. Advances in robotics allow for increased efficiency and productivity, particularly in manufacturing and logistics. Robots are becoming more intelligent and capable of performing complex tasks, leading to the emergence of collaborative robots (cobots) that work alongside humans.

In addition, big data analytics is another key aspect of 4IR era. According to Mpofu-Sebele (2023), big data and big data analytics allow for large volumes of data that are often complex (data of high volume, velocity, and variety) to be analyzed quickly, accurately, and efficiently. Schwab (2016) cites that enormous amount of data generated by digital systems and IoT devices provides opportunities for insights and predictions. It can be concluded that if this data is analysed appropriately, the following results might be obtained: economic decision making; optimal use of resources; new product development as well as services.

From literature analysis, it was revealed that the 4IR era has the capacity to accelerates the societal and economic growth. Even though the 4IR has brought profound change in the economy, increased productivity as well as creativity, innovation, it also raises concern that automation of work and the potential loss of jobs are central concerns about 4IR, in particular, the male dominated sectors such as manufacturing, construction and mining due to machine substitution. Different stakeholder groups such as employees, entities and government need to embrace and adapt to the new era by re-skilling and upskilling through training and development programmes. They need to strategise on how they can manipulate these transformative technologies for positive results. It can be concluded that for the emerging economies to fully adopt 4IR era technologies, there is a need to elucidate the role of leadership in this contemporary environment. Governments, businesses, and individuals need to adapt to this era by embracing lifelong learning, upskilling, and finding ways to leverage these transformative technologies for positive outcomes.

Emerging economies in Fourth industrial revolution era

In emerging economies, there is little to be said about the adoption of 4IR technologies, though early engagement with the concept by businesses and governments may see this develop (Sutherland, 2020). The societal and economical changes vary from industry to industry across the globe, leading to varied responses towards 4IR technologies, exclusively developed in other continents. From literature analysis, it is revealed by scholars that government bodies through their leadership fail to sync with new technology prevalent in 4IR era. Furthermore, they lack competency and capacity to manage investments, accompanied by the delays in the administration and political processes needed to address the challenges of providing the necessary legal, institutional and policy frameworks. According to Sutherland (2020:236) “emerging economies have almost exclusively been takers of advanced technologies and of related policies, often with limited adaption to national requirements”. The adoption of 4IR technologies is heavily dependent on the availability of skills through human capital, infrastructure as well as intellectual capital. Countries like South Africa and Rwanda have been proactive in adopting and integrating 4IR technologies into their industries. This is because, their government bodies have an understanding of the potential benefits related to these technologies and the need to be at par with the developed economies.

This study focused on the emerging economies, main reason being their potential for leapfrogging. There are also high chances of these economies catching up with developed economies, what is needed is the capacity to bypass the traditional stages of development, as the advanced economies successfully did that. According to Schwab (2016) by leveraging these advanced technologies, emerging economies can improve their industrial capacities and competitiveness in a shorter period. In addition, adoption of 4IR technologies allow emerging economies to improve their infrastructure. This can be done through taking advantage of mobile and digital technologies and they can cater for the less privileged areas such as healthcare as well as the education sector. This enhances financial services provision and to widen digital financial inclusion, as well as poverty alleviation with an aim to achieve the UN 17 SDGs by 2030 within these economies.

From literature analysis, emerging economies are largely dependent on agriculture, manufacturing and/or mining. Adoption of new advanced technologies such as AI, IoTs, Big data, robotics and automation allow diversification, tapping in new industries as well as enhancing societal and economic growth and creation of employment. In addition, 4IR technologies augments integration into the global supply chains. Through employment of block chain technologies and IoTs, emerging economies can resolve constraints of high cost, financial literacy, access difficulties linked to geographical access, and the inadequacy of financial services and products (Schuetz & Venkatesh, 2020). According to Mpofu-Sebele (2023) blockchain has a great likelihood of contributing to the UN Sustainable Development Agenda and the achievement of the SDGs especially in reducing poverty, hunger, and inequalities among other economic, social, and environmental challenges in emerging economies. Considering the above, it is noteworthy to acknowledge problems encountered by emerging economies in adopting the aforementioned technologies. These include failure to secure sufficient capital, poor digital infrastructure, skills shortages as well as red tape.

In summary, emerging economies are increasingly embracing fourth industrial technologies to leverage leapfrogging opportunities, overcome infrastructural limitations, diversify their economies, and integrate into global supply chains. While challenges exist, the potential benefits of such adoption are significant, paving the way for sustainable growth and development. Having offered a fair background of 4IR era, emerging economies in 4IR technologies, the following section aim to explore the leadership skills and practices that are beneficial for leading various industries in the 4IR era.

Leadership skills for the Fourth industrial revolution era.

According to Twin (2020) “leadership is defined as the capability of management to fix and accomplish challenging aims, make efficient decision making when required, overtake the rivalry and influence followers to achieve at the utmost level they can”. Leadership plays a crucial role in the adoption of the fourth industrial revolution era technologies. Since the adoption of the 4IR technologies by other emerging countries such as South Africa, a more holistic approach to leadership should be considered and implemented fully. According to Gray (2016) 4IR era have birthed among other technologies, artificial intelligence, robotics, big data analytics, block chain as well as

automation. These technologies require full adoption by specific industries. According to Uys and Webber-Youngman (2019) successful implementation of the technologies requires a very different kind of a leader. This means that leadership will have to change and adapt to a new skills-set to be successful in the 4IR era. The necessary skills include emotional intelligence, change management, diversity management, critical thinking, being focused, quick and constant learning, technologically advanced as well as workforce flexibility and well-being and so on. These skills are necessary because industries such as mining, construction, etc require an emerging class of creative and sophisticated solution-seekers who incorporate the additional talents listed. The efficacy of this transformation will be determined by the calibre of the leaders who will be at the forefront with an entirely novel perspective along with corresponding competencies. (Uys &Webber-Youngman, 2019). Gray's (2016) article presents 10 leadership skills needed to thrive in 4IR era as follows: complex problem-solving, critical thinking, creativity, people management, coordinating with others (group work activities), emotional intelligence, judgement and decision-making, service orientation as well as negotiating and cognitive flexibility.

Based on the findings of Gray (2016); Naidoo and Potokri (2020); Sutherland (2020), researchers established that leaders should consider emotional intelligence as a leadership skill. This implies that machines are incapable of comprehending the qualities that make every human unique. They are unable to simply take the place of a person's capacity for emotional, empathic, and moral connection with other people. Given that they are mindful of themselves and have good interpersonal skills, leaders with high EQ are in high demand in the 4IR era. In addition, Gray (2016)'s article revealed that potential leaders need to be kept up with new improvements and they should be aware that these new developments will occur quickly in many different areas. To see the changes as chances for improvement and evolution, they must arm themselves with adaptability abilities.

It also follows that, being a leader, there is a need for diversity management. This means that being culturally intelligent is crucial. Acknowledging the differences in social structure, experiences, their sexual orientation, and ethnicities is a must in today's varied labour force, which is always changing in the workplace. The ability to comprehend, accommodate, and control an array of workers will lead to improvements

in ways employees interact with one another as they function collectively. According to Schwab (2016) leadership that is adept at thinking critically and analytically will be equipped to address complicated issues and come up with novel solutions. These abilities will enable leadership to guide the connection between human beings and technological advances required to increase the efficiency of labour. On the other hand, Gray (2016) and Naidoo and Potokri (2020) adduce the need for 21st century leaders to be focused, quick and continuously learning. This entails that someone in leadership who recognizes that there is an abundance of additional abilities to be acquired daily and develops themselves frequently will be an asset to any company.

In addition to that, leadership that is tech adept is going to leap out above everyone. Not only relating to the technical abilities of encoding and comprehending concepts like robotics, the internet of things, data, intelligent machines, etc., but also to leadership's capacity for discussion and decision-making regarding the fundamentals of technological advances, their willingness to adopt it, and their capacity for helping prepare the company for the years to come. Lastly, it is important to note that different shifts in labour and workplace requirements will occur. Leaders need to be more adaptable. Particularly in the digital age, adaptability with the employees and a commitment to their mental health are essential.

Challenges faced by leadership in the Fourth industrial revolution era.

Schwab (2017) demands that managers and staff "in tandem build an era that is beneficial for everyone by placing humanity first, developing them, and constantly reiterating that all of these cutting-edge innovations are primarily instruments developed specifically for humans." Nevertheless, leadership is obligated to pioneer innovations and support others as they evolve and adjust to changing times, whether it be through interpersonal relationships or learning and instruction. Deloitte’s annual Millennial Survey report (2023) disclosed that firm officials had genuinely professed a desire to make the world a better place. According to the poll, CEOs placed societal effect above economic success and consumer or staff satisfaction when assessing their organization's economic performance. In today's markets, which are shifting quickly, it was also made clear that top management was finding it difficult to create successful plans. Many leaders struggle to comprehend all the innovative technologically driven prospects when confronted with an ever-growing array of

emerging technologies, and in some instances may lack an overall strategic plan to direct their endeavours. Additional literature study reveals that businesses lack comprehensive procedures for making decisions and that organizational silos restrict their capacity to create and exchange expertise to put innovative strategies into practice.

However, rather than undertaking hazardous decisions to spark chaos, executives still put a greater focus on employing modern technology to defend what they believe. The difficulties involve getting overly concerned with immediate outcomes, not completely comprehending the fourth industrial revolution innovations, and having an abundance of technological options. The competence problem is also growing more obvious. Leadership has become more conscious of the size of the knowledge divide and the depressing reality that the present educational landscape will not be able to handle the task. Organizational leaders must work to develop current staff members rather than focus on recruiting new ones. However, Deloitte's annual Millennial Survey (2023) reveals that opinions about who should be in charge of training certain talents are different among leadership and new employees. The following figure presents a summary of challenges faced by the 4IR era leadership.

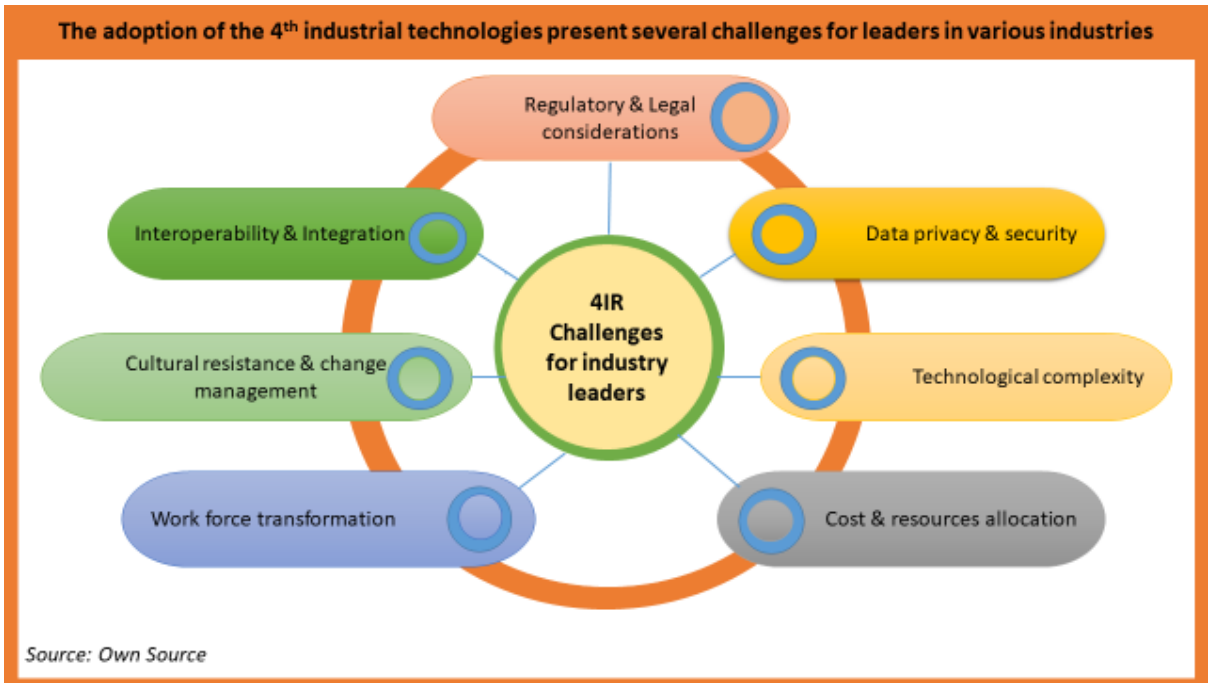

Figure 1: Challenges faced by leadership.

According to Schwab (2017) fourth industrial technologies, such as artificial intelligence, robotics, and automation, are often highly complex and require a deep understanding to implement effectively. Leaders may lack the technical expertise necessary to navigate and make informed decisions in this rapidly evolving landscape. This is followed by the assertion that integration of new technologies often necessitates significant changes in the workforce. As a result, leaders must navigate the challenges of upskilling their employees, addressing potential job displacement, and managing the overall transition to new roles and responsibilities.

In addition to that, there is an issue of cost and resource allocation. Adopting fourth industrial technologies can require substantial financial investments. Leaders must carefully allocate resources to acquire the necessary technology, upgrade existing infrastructure, and train employees. Balancing these investments while ensuring optimal return on investment can be a significant challenge. It also follows that Fourth industrial technologies heavily rely on vast amounts of data for analysis and decision-making. Therefore, leaders must address concerns related to data privacy, cybersecurity, and ethical use of personal information. Safeguarding data while leveraging its potential can be a complex task.

According to Uys &Webber-Youngman (2019) the adoption of new technologies often encounters resistance from employees and stakeholders who may be resistant to change. It is necessary that leaders navigate cultural barriers, address fears and concerns, and effectively communicate the benefits and rationale behind their technological initiatives. On the other hand, Gray (2016) asserts that integrating fourth industrial technologies into existing systems and infrastructure can be challenging. This implied that leadership need to ensure compatibility and seamless integration with legacy systems, often requiring strategic planning and collaboration with different departments. Also, the adoption of new technologies is accompanied by regulatory frameworks that can vary across industries and regions. It is imperative that leaders stay informed about evolving policies, navigate compliance requirements, and proactively address legal challenges posed by the adoption of the fourth industrial technologies.

Considering the challenges outlined above, it can be deduced that leadership in emerging economies face the formidable task of understanding, implementing, and

leveraging fourth industrial technologies within the unique context of their organisations. Overcoming these challenges requires a combination of technical expertise, strategic vision, effective change management, and a commitment to continuous learning and adaptation.

Supporting and developing 4IR era leadership

Kelly (2019); Naidoo and Potokri (2020) adduce an aspect of paradigm shift in the era of digitalisation influenced by the 4IR technologies and its necessity across different continents. These scholars further point out the need for leaders to shift from "decision making to sense-making" (Kelly, 2019:124). This implies that using facts as basis for economic decision making will not suffice in 4IR era, there is a need to adopt a holistic approach and take note of both the contextual and situational settings. In addition, Kelly's (2019:129) article articulate that it is necessary for leadership to shift their mindset from "charismatic authority to swarm intelligence". The effective leadership uses collaborative networks where main decisions are handled by using collective intelligence rather than a single leader's influence. It also follows that fourth industrial leadership should shift from "analogue to digital mindset". Learning new technological skills is essential for digital transformation, but is not enough (Kelly, 2019). Developing a digital mindset takes work, however it is worth the effort. According to Naidoo and Potokri (2020) leadership who have a digital mindset are better able to set their organisations up for success and to build a resilient workforce. This implies that digital mindset leaders are proactive and are well-positioned to take advantage of new business.

Following the above discussion, Larson, Miller and Ribble (2010) identified five elements that will improve and enhance digital leadership. The scholars cite that leaders of both knowledge and digital economies must have vision to keep abreast of technology within the industry. Naidoo and Potokri (2020) support the idea of owning a vision and they add that, through clear vision, leaders promote innovativeness and creativity. Larson et al. (2010) further state that leaders should understand the learning culture of the digital age, and this can be achieved through evaluating how the 4IR technologies promote an enabling environment. In addition to that, it is necessary for leadership to establish the effects of new technologies in the long-run, and this is done to sustain "systemic improvement". In conclusion, the scholars outline the need of

developing a universal framework for “excellent professional practice” as well as promoting digital citizenship across industries. Considering the above, for leaders to adopt new technologies, it should be a personal choice and their understanding of new technologies benefits as well as their impact on organisation’s financial performance and value creation. Then, a proposal to support and develop emerging economies leadership will enhance their personal learning networks which will have impact on their professional development. The following section of the study presents the research methodology utilised to explore the roles of leadership in adopting the 41R era technologies.

Methodology

A semi-systematic review method was adopted in this paper. According to Synder (2019:335) “the semi-systematic or narrative review approach is designed for topics that have been conceptualized differently and studied by various groups of researchers within diverse disciplines and that hinder a full systematic review process”. By the adoption of this review, this study seeks to identify and understand all potentially relevant research traditions that have implications for the role of leadership in Fourth industrial revolution and to synthesise these using meta-narratives. This enabled the researchers in understanding complex areas, such as the implications of leadership in 4IR technologies such as big data, robotics as well as artificial intelligence among others. This study focused on emerging economies. This is because the adoption of Fourth industrial technologies in some emerging economies is still not visible across the globe (Sutherland, 2020). Some emerging countries such as South Africa, Brazil, Russia, India and China have been actively adopting and integrating these technologies into their industries. Lee, Maleba and Primi (2020) adduced that these countries have embraced 4IR due to potential benefits arising from new technologies as well as aiming to be at par with the developed economies. The literature findings were analysed using the thematic analysis, which is guided by the writings of Braun and Clarke (2006). Thematic analysis using semi-systematic review allows the identification of key themes, which are then synthesised prior to thematic network presentation.

Results

The findings of this study were based and guided by the following studies: Demski (2012); Cote (2017); Kay (2019); Naidoo and Potokri (2020); Sutherland (2020); Salina, Noordina, Rajadura, and Othman (2021). The emergence of 4IR era features, requires leadership to be proactive, adapt and adjust to the current trends of the Fourth Industrial revolution. If leadership roles remain unknown with certainty, then it shows that leaders are ill-prepared to adopt the new digital technologies. From literature analysis, it was revealed that the role of leadership in the adoption of fourth industrial technologies is crucial and multifaceted. Leadership plays a significant role in driving and facilitating the successful integration of these emerging technologies within an organization or industry. Figure 2 below show the summary of key aspects of leadership roles.

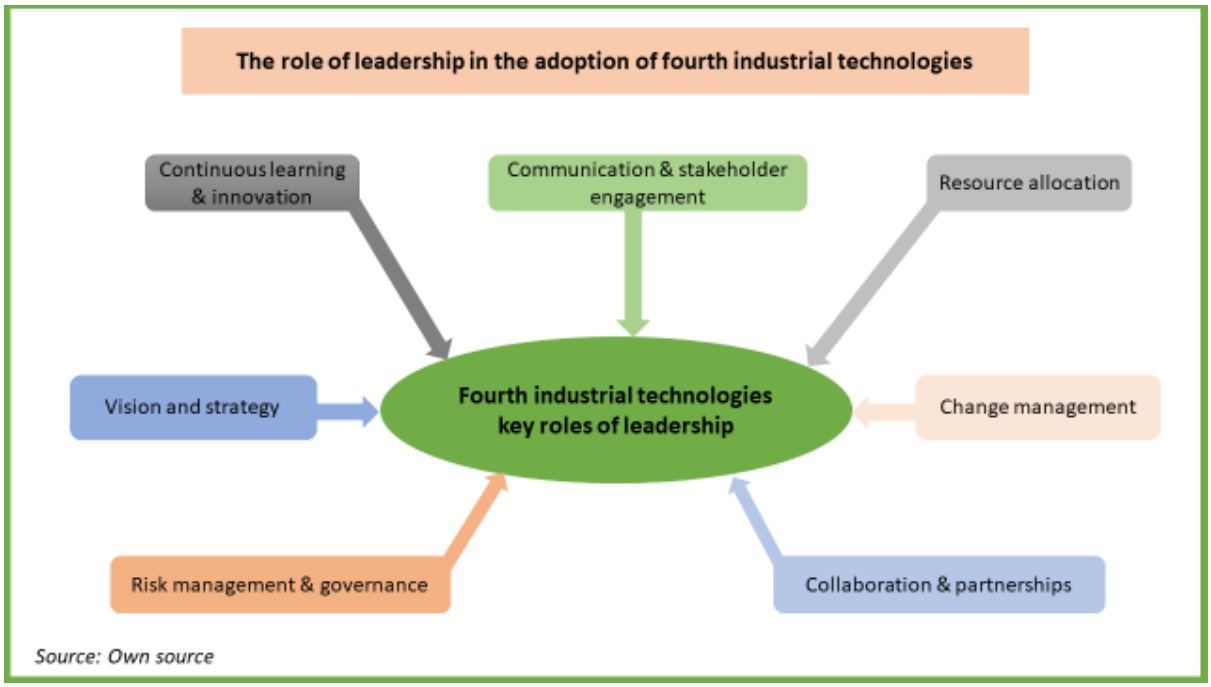

Figure 2: Roles of leadership in the Fourth Industrial era

Vision and Strategy

From literature analysis, it was revealed that organisational strategic objective embedded in a vision is an important pedal the leadership can utilise. The crucial role of effective leadership is to work towards the organisational vision, clearly outline strategies as well as aligning organisation strategic purpose with individual goals. This

can only be achieved if the leaders have clear vision and understand the impact of 4IR era technologies on the value creation and financial performance of an organisation.

Change Management

The adoption of fourth industrial technologies often requires significant changes in processes, workflows, and organizational culture. Leaders need to effectively manage this change by fostering a positive and adaptable mindset among employees, providing necessary training and resources, and addressing any resistance or challenges that may arise.

Resource Allocation

Leaders play a crucial role in allocating the necessary resources, including budget, personnel, and time, to support the adoption of these technologies. They prioritize investments in infrastructure, research, and development, as well as hire or train skilled professionals to work with these technologies.

Collaboration and Partnerships

Fourth industrial technologies often involve collaboration with external entities, such as technology vendors, research institutions, or industry peers. Leaders facilitate partnerships, alliances, and knowledge sharing to leverage the expertise and resources of others in accelerating the adoption and implementation of these technologies.

Risk Management and Governance

Leaders understand and assess the risks associated with adopting fourth industrial technologies, including cybersecurity, data privacy, and ethical implications. They establish robust governance frameworks and policies to mitigate these risks, ensuring compliance with relevant regulations and standards.

Communication and Stakeholder Engagement

Effective leaders communicate the benefits, potential challenges, and progress of fourth industrial technology adoption to various stakeholders, including employees, customers, investors, and regulatory bodies. They foster trust, actively engage

stakeholders, address concerns, and ensure transparency throughout the adoption process.

Continuous Learning and Innovation

Leadership in the adoption of fourth industrial technologies requires a commitment to continuous learning and innovation. Leaders stay updated on the latest technological advancements, industry trends, and best practices. They encourage a culture of experimentation, learning from failures, and adapting strategies to embrace new opportunities that arise from these technologies.

Conclusion

The aim of the study was to explore the role of leadership in the adoption of the Fourth industrial revolution era technologies. With the rapidly changing technological landscape and emerging 4IR technologies, a visionary approach to leadership is essential. This is because leadership plays a crucial role in driving the successful adoption of fourth industrial technologies. They provide a clear vision, facilitate change, allocate resources, foster collaboration, manage risks, engage stakeholders, and foster a culture of innovation. Their effective leadership sets the foundation for organizations and industries to leverage the transformative potential of these technologies. They strategise using practical measures to bring the vision to life and leading their workforce towards that goal. This study recommends development of personal learning networks (PLNs). PLNs are an essential tool to enhance 4IR leadership skills through connection and collaboration with fellow industry leadership.

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