COULD DIGITAL UBUNTU BE THE SOUTH AFRICAN VERSION OF INDUSTRY 4.0?

M. Mangaroo-Pillay[1], M. Roopa[1]* & W. Maisiri[1]

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Contact details
* Corresponding author
meelan.roopa@nwu.ac.za

Author affiliations
1 School of Industrial Engineering, North-West University, South Africa

ORCID® identifiers
M. Mangaroo-Pillay
https://orcid.org/0000-0002-7825-7864

M. Roopa
https://orcid.org/0000-0002-3852-2192

W. Maisiri
https://orcid.org/0000-0002-4892-2675

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ABSTRACT

Advanced technologies are satisfying the demands of individuals and of industry. But what about employees? Various organisations have begun to explore adopting new technologies and increasing employee buy-in. 'Digital Ubuntu' is a newly coined term that describes collaborating with each other to solve a problem digitally. This discussion paper aims to explore the use and unpack the implications of using the term "Digital Ubuntu" around the adoption of advanced technology in South Africa. This paper concludes that Digital Ubuntu could significantly impact employee buy-in, the adoption of advanced technology, and policymaking. This study offers direction for further exploration of Digital Ubuntu.

OPSOMMING

Gevorderde tegnologieë voldoen aan die eise van individue en van die industrie. Maar wat van werknemers? Verskeie organisasies het begin om nuwe tegnologieë aan te neem en werknemers se inkoop te verhoog. 'Digitale Ubuntu' is 'n nuutgemaakte term wat die samewerking met mekaar beskryf om 'n probleem digitaal op te los. Hierdie besprekingsartikel het ten doel om die gebruik te ondersoek en die implikasies van die gebruik van die term 'Digitale Ubuntu' in die aanvaarding van gevorderde tegnologie in Suid-Afrika te verken. Hierdie artikel kom tot die gevolgtrekking dat Digitale Ubuntu 'n beduidende impak op werknemersinkoop, die aanvaarding van gevorderde tegnologie en beleidmaking kan hê. Hierdie studie bied rigting vir verdere verkenning van Digitale Ubuntu.

1. INTRODUCTION

As the Fourth Industrial Revolution (4IR) unfolds, the world continues to move deeper and deeper into this technologically inclined era. Technology is becoming increasingly more a part of our daily lives and of operational processes in industry. Subsequently, technology is satisfying more of the demands of individuals and of industry. But how does this affect people? In a recent study, Kinzel [1] explained that humans need to make sure that they are adequately skilled to address the emerging needs of 4IR. Furthermore, it is imperative to emphasise growing human non-technical skills [1].

Human factor engineering (HFE) provides a bridge to addressing Kinzel's [1] concerns. Essentially, HFE aims to make technology work for people [2]. Moreover, HFE improves human interactions with systems by enhancing processes' safety, performance and satisfaction [2]. There are several domains in HFE [2]:

- **Engineering psychology** – The human mind as it relates to design
- **Ergonomics** – Factors related to physical work and designing for it
- **Human computer integration** – User experiences and software
- **Macro-ergonomics** – The design of teams and organisations
- **Cognitive engineering** – Management of systems, aided by decision aids and automation
- **Human systems integration** – People's interactions with all systems

In South Africa, the implementation and impact of advanced technologies come with their own set of challenges [3]. Some individuals view advanced technologies negatively, claiming that they adversely influence work and people's interactions. However, there are significant opportunities to mitigate these feelings about and attitudes towards advanced technology adoption. Organisations could get better buy-in from their employees by balancing advanced technologies adoption and social sustainability [4, 5]. Human computer integration, cognitive engineering, and human systems integration could aid organisations in finding the balance when adopting new technology.

Various organisations have begun to explore and approach the balance of adopting new technologies and employee buy-in. A notable example is that of Jendamark, a local South African automation company, which approached this balancing act with a concept they termed 'Digital Ubuntu' [6]. Digital Ubuntu is the idea of people collaborating to solve a problem digitally. It requires thinking in an ecosystem way to resolve issues and, as South Africans, Ubuntu equips people to think and behave in a collaborative and communal way [6].

Ubuntu is the ancient African concept of "Humanness" or what it means to be human [7]. It is best expressed in the isiZulu aphorism "Umuntu ngumuntu ngabantu", which translates as "I am a person through other people" [7]. While Ubuntu is said to predate most African knowledge [7, 8, 9, 10, 11], the philosophy has only been documented since the 1990s.

Ubuntu is based on eight core values: compassion, forgiveness, responsibility, honesty, self-control, caring, love, and perseverance [12].

2. PURPOSE

Significant challenges and concerns are observed in relation to advanced technology adoption in developing countries. Therefore, this study aimed to explore the use and unpack the implications of using the term "Digital Ubuntu" around the adoption of advanced technology in South Africa.

3. INSIGHTS FROM THE LITERATURE

3.1. Ubuntu

While Ubuntu has existed for centuries, it has only been formally documented in the literature since the 1990s [12]. Before this, the teaching of this philosophy was passed down verbally from one generation to the next, forming the foundations of leadership and hope for South Africans [12]. Although South Africa is a melting pot of diversity, Ubuntu is a phenomenon that unites all [7]. Over the years, Ubuntu has had various famous ambassadors, such as Nelson Mandela, Richard Branson, Bill Clinton, and Desmond Tutu [13].

Once Ubuntu was formally documented, it began to transcend into the management sphere, leading to the development of the Ubuntu management philosophy [8]. However, the Ubuntu management philosophy is still in its infancy. Its teaching incorporates the core values of traditional Ubuntu into the management practices of the 21st century. Msila [14] has explained the management principles in five sections, as shown in Table 1.

Table 1: Ubuntu management principles (adapted from Msila [14] and from Mangaroo-Pillay *et al*. [15])

Section	Principles	Description
I – People-centredness	1 – People-centred work culture – community, solidarity, commitment	By placing an emphasis on all employees, it promotes a feeling of responsibility to elevate the organisational culture. When employees are happy, it boosts team commitment to achieve organisational goals.
	2 – Empowering people – team leadership and shared responsibility	Once all employees share leadership traits, it is easier to achieve the organisation's goals. Employees use their skills to develop the organisation, as responsibility is continually shared by all.

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Table 1: Ubuntu management principles (adapted from Msila [14] and from Mangaroo-Pillay *et al*. [15]) (cont.)

Section	Principles	Description
	3 – Transformational leadership – inspire, motivate, influence, support	It reinforces trust and respect in an organisation, as fellow employees treat leaders with honour, allowing the leaders to bring about valuable changes in the organisation.
	4 – Mentoring – supportive environment	To strengthen people-centeredness in an organisation, Ubuntu recommends mentoring. This helps to develop employees such that they can grow the organisation.
	5 – Shared vision – goal directed	People-centred companies are efficacious because their employees try to achieve one vision, based on common ground, with the company's interest at heart.
II – Permeable walls	6 – Openness and honesty – supporting relationships and communication	Clear communication, supported by openness and honesty, is critical to achieving coordination in an organisation. This requires the full participation of everyone in the organisation.
III – Partisanship	7 – Loyalty to the organisation	Loyalty must be built through strong organisational values. This is achieved by cultivating and promoting collegiality while reinforcing commitment in an organisation. Organisations should perform the African tradition of 'sharing a calabash', by providing employees with the platform to share their ideas to build the organisation.
IV – Progeny	8 – Collective decision-making	Ubuntu uses consensus among employees in arriving at decisions in an organisation, based on the need for a 'village to survive'. Ergo, all employees need to participate in decision-making.
	9 – Sharing power and teamwork	Power-sharing in an organisation creates a sense of equality among employees. It fosters the importance of solidarity, responsibility, and effective teamwork.
V – Productivity	10 – Continuous employee support and development	Continuously develop employees and provide them with constant support while magnifying the brand and goals.
	11 – An effective team is a team with the right tools	To magnify production, effectiveness, and efficiency in an organisation, employees should access the correct tools and the equipment that is needed.
	12 – Strong organisational value	Effective organisations will shape and strengthen the positive values that lead to solid employee commitment.
	13 – Rewarding employees for application of the 'right culture'	Encourage employees by introducing a reward system, thus illustrating the benefits of the organisational culture to employees.

3.2. The Fourth Industrial Revolution

The term 'industrial revolution' arose from the description of "the process of change from an agrarian and handicraft economy to one dominated by industry and machine manufacturing" [16], referred to as the First Industrial Revolution. Since then, the literature has referred to the successive universal paradigms shifts as the Second Industrial Revolution (a period of rapid industrialisation, automation, and standardisation) and the Third Industrial Revolution (a period of digitisation, computing, and digital technologies) [17].

Currently we are in the Fourth Industrial Revolution, which is significantly driven by Industry 4.0 (I4.0) [18, 19, 20], a manufacturing industry initiative coined as Germany's high-tech strategy. Although the terms I4.0 and 4IR are used interchangeably in the literature [21] and among various professionals, it is important

to note their differences, since these could have significant implications for other elements of sustainability, such as social sustainability. In its original form, I4.0 focuses on cyber-physical systems, and manufacturing is at its heart [22, 23]. In contrast, 4IR extends cyber-physical systems' scope by incorporating biological systems [24]. Therefore, we have regarded I4.0 as a subset of 4IR (Figure 1).

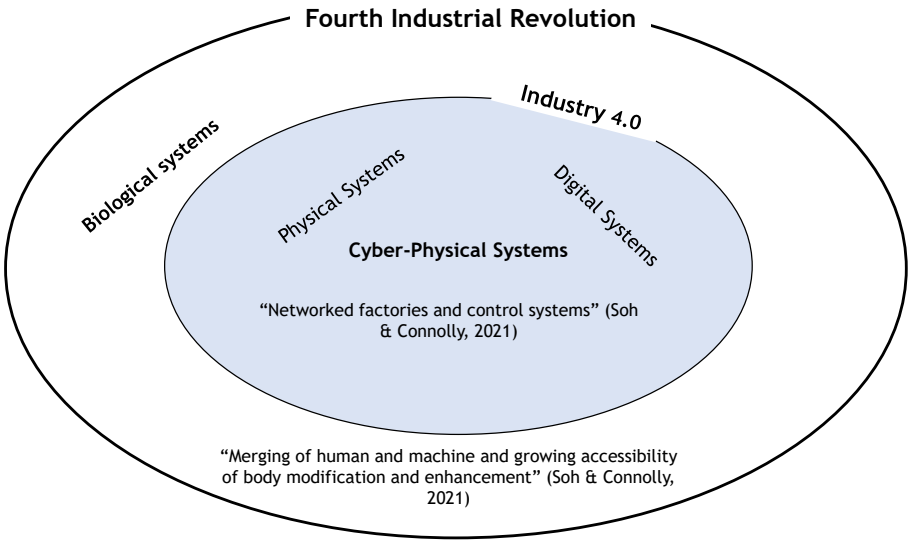

Figure 1: Relationship between 4IR and I4.0 (adapted from Maisiri [17])

Digitalisation is at the core of both I4.0 and the 4IR. The term refers to the "use of technologies and data to improve and transform the business processes" [25]. Digitalisation has significant potential to drive a sustainable society if the collaboration of various stakeholders such as industry, civil society, trade unions, and politics is fostered [26]. The objective should be to balance the trade-off between the benefits and risks of digital technologies. Thus, digital transformation should involve interaction and interdependency between technological innovation, economic drivers, societal and ecological impacts, and regulatory efforts [26].

3.3. Human-technology disconnect

Human civilisations have continuously adapted and improved their ways of living in order to benefit the collective well-being of their communities and societies. As societies shifted from foraging in decentralised locations to people valuing collective well-being in centralised communities, these societal developments led to interactions with the environment and the establishment of languages, belief systems, and cultures. Much of this progression is owed to an innate understanding of progress, sustained by mechanisms, artefacts, and established norms [27]. The more progressive advances in societies have been a result of technology.

As explained by Targowski [28], the role of technology in civilisations cannot be ignored. Society and technology promote each other's development. As technologies benefit and uplift society, society continues to interact with and improve the design of current technologies. This synergetic relationship ensures that technology builds stability and creates economic gain but, in turn, re-establishes the value and relevance of technology's advancement and innovation. Mumford [29] conducted a cultural analysis that integrated technology, the natural and urban environments, and the individual and the surrounding community. The analyses demonstrated that the inventions of language and social organisation enhanced the use of tools and the conquest of nature.

In response to these human needs that became reliant on technology, the relationship between technology and society has coincided thanks to the mutual benefits that each dimension can provide. To establish harmony between these dimensions, socio-technical systems theory tries to establish and harness the joint optimisation of each domain [30]. Figure 2 shows the technical and social gap between the independent social and technical dimensions that has led to the creation of a hybrid socio-technical domain.

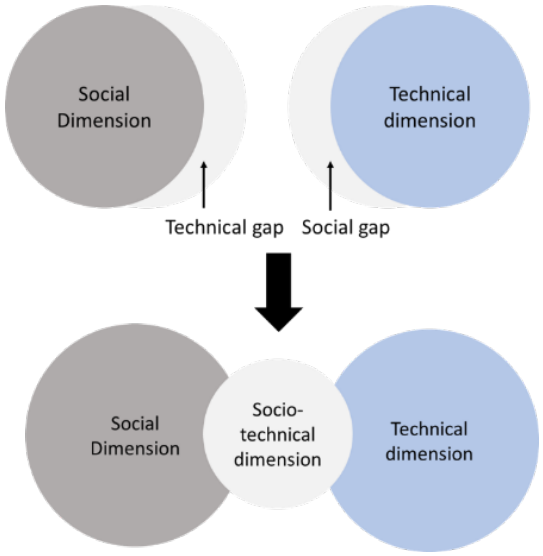

Figure 2: Socio-technical gap (adapted from Whitworth [31])

As shown in Figure 2, the shift in societal and technological needs has resulted in a socio-technical dimension that tries to establish harmony between these two domains. Although it is simplified in its representation, the relationship between people, processes, and technologies is indeed complex and non-linear [32].

A means of conceptualising the core components that drive civilisations and establish economic growth is also represented by the organisational efforts that reap value in surrounding environments. The makeup of such organisations, composed of individuals with diversified beliefs and cultures, will ultimately shape the company's culture. As society has developed, our reliance on technology has become even greater. According to Davis *et al*. [33], the socio-technical framework for organisational systems comprises six interrelated elements, visualised in Figure 3.

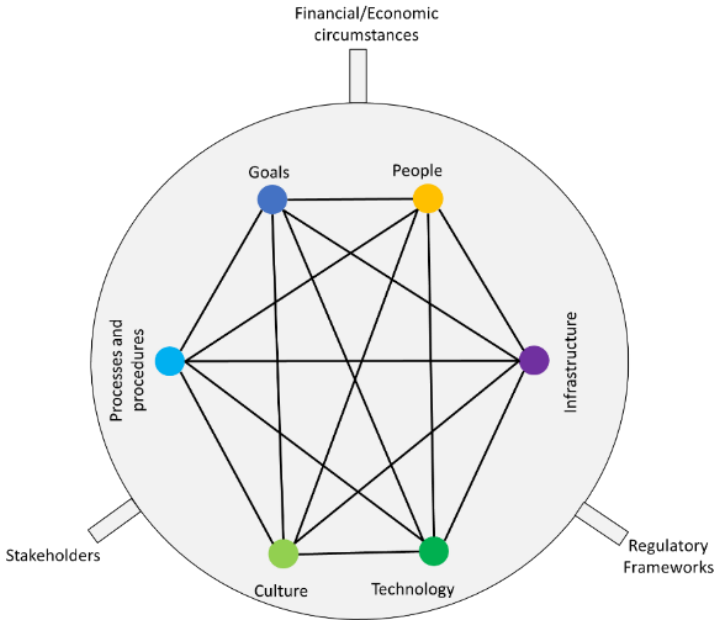

Figure 3: Embedded socio-technical system (adapted from Davis *et al*. [33])

It is also crucial that such a system is tailored to the external system in which it functions. For this reason, the influence of regulatory frameworks, stakeholders, and economic circumstances establishes the strength and reliance of each component. This framework enables one to analyse the linkages and relationships between social and technical aspects.

While the human-technology disconnect remains a prevalent issue, research in this field has sought to understand this challenge better and to solve it. For South Africa, Digital Ubuntu presents itself as a novel approach that correctly balances the adoption of advanced technology.

4. BALANCING THE ADOPTION OF NEW TECHNOLOGY

Four factors, among others, can be considered to achieve social sustainability [26]: equivalent living conditions, sovereignty, active participation in the digitalisation process, and social and cultural identification with the transformation. Ren *et al*. [26] pointed out the possible danger that technological advancement might erode cultural practices through propagating attitudes, beliefs, and worldviews that are biased towards one culture.

Human capital is the critical determinant of long-term sustainability. The literature has pointed out that human capital contributes significantly to the dimensions of sustainability. A sustainable future can be ensured through the development of human capabilities and abilities in manipulating technologies [34]. Technology adoption must not focus on replacing humans but on enhancing the development of human capabilities [34].

Human capital aspects range from human capabilities (productive resources such as skills and tools); social or organisational resources (governance, commerce, production, and education); mental-intellectual resources (such as ideas, knowledge, science, technology, and information); and cultural and psychological resources (such as values, customs, ways of life, character formation, personality development, and individuality) [34]. Moreover, Šlaus and Jacobs [34] argue that aspects such as technological advancements have the potential to eclipse the role of human capital as an essential determinant of the economic system. However, the literature focuses on the role of humans as the primary driver of sustainable economies.

Industry 4.0 principles and objectives can undermine employees' social sustainability. Sustainable work environments should promote employees' well-being and job satisfaction [35]. Papetti and Pandolfi [35] pointed out that workplace social sustainability encompasses "workers' rights, preventive occupational health and safety, human-centred design of work, worker empowerment, individual and collective learning, employee participation and work-life balance". Thus, the adoption of Industry 4.0 advanced technologies and principles should be human-centric to achieve social sustainability in workplaces.

Organisations lack "holistic and proactive approaches" [35] in balancing the adoption of I4.0 and industrial social sustainability. The nature of I4.0 technologies and principles is to enhance manufacturing performance and drive competitiveness. Therefore, thoughtful trade-offs between productivity and employee well-being become significant to attaining social sustainability in workplaces. This trade-off includes eliminating or reducing the potential of replacing people with advanced technologies, especially in environments with high unemployment.

Digital literacy can ensure that various technologies are used to achieve balanced societal development. For example, gadgets such as tablets and cell phones should be used for creativity and innovation; otherwise, society might turn into a social media society.

The term 'sustainability' derives from the Latin word sustenere, a contribution to sustainable development that ensures concurrent social, economic, and environmental benefits [36]. For many years, society, the economy, and the environment were seen as independent facets that were distinct and non-mutual. This view was later adapted to include overlapping relationships, shown in a Venn diagram. More recently it has been refined by using a representation of the economy embedded in society, which in turn functions in a defined environment. Figure 4 illustrates the evolution of our understanding of the relationships between the economy, society, and the environment.

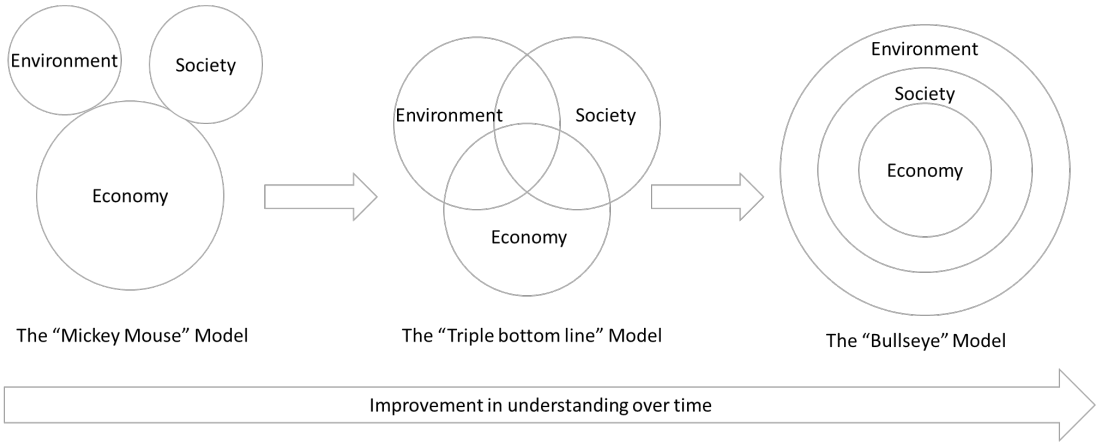

Figure 4: Evolution of economy, society, and environment (adapted from Darwish [37])

Any new technology or engineering feat must enable economic growth while simultaneously ensuring that irreplaceable resources are not depleted or destroyed [38]. With the technologies spurred on by 4IR, Society 5.0 tries to remedy social problems by re-orientating how solutions could serve as the interface between people and technologies. Society 5.0 configures a human-centred society with high levels of integration with the physical environment and cyberspace [39].

Industry 4.0, derived from the high-tech strategy of the German manufacturing industry [25], is widely used globally, and has been successfully deployed in developing countries [40]. However, one critique of I4.0 is its implications for workforces and the worsening of social sustainability. In evaluating three high-tech Italian automotive factories, Cirillio *et al.* [41] discovered that I4.0 adoption influenced the intricate relationships between the adoption of technology, worker skills, lowered power relations in organisations, knowledge regimes, and the space of the intervention authority. It was found that employee autonomy was reduced while forms of management control increased. This had further ramifications for organisational performance, employment patterns, and decision-making authority.

Other countries have prioritised and modified their use of 4IR technology. In Japan, 4IR adoption has seen an increased focus on the application of robotics. According to Japan's New Robot Strategy, released in 2015, the Japanese government aims to accelerate the development of artificial intelligence and robotics technology. This venture is intended to ensure a gradual automation across all sectors and economic growth for the country [42].

In 2015 China decided to roll out an action plan to boost its economy across various sectors with a mixed integration of IoT, cloud computing, and big data in a human-centric model that drives innovation [43]. This data ecosystem is geared to explore China's societal and economic conditions in order to pair the internet with the manufacturing, finance, commerce, transportation, healthcare, and education sectors.

It is evident that in various parts of the world the use of 4IR technology and digitalisation is an act of customised technology adoption according to a country's or region's specific needs. South Africa, much like other African countries, is faced with high unemployment and inequality, both of which mean that technology adoption must be approached with caution. As previously discussed, various factors need to be considered and balanced for social sustainability when adopting new technology. One way of customising 4IR adoption in South Africa would be to recognise the phenomenon of Ubuntu and how Digital Ubuntu can redefine this transformation.

5. POSSIBILE IMPLICATIONS OF DIGITAL UBUNTU

Digital Ubuntu has untapped potential to drive the sustainable adoption of advanced technologies. This approach could promote collective well-being in an organisation and sustainable economic gain while acting as a bridge in introducing 4IR technologies to employees and improving buy-in.

However, recent studies [44, 45] have found several difficulties in and barriers to Industry 4.0 adoption in organisations, such as:

- Limited understanding of ethics and safety
- Lack of reference architecture and standards
- Government policy and regulation
- Cyber-security and privacy
- Inefficient IT applications
- Skills deficit in labour market
- Reluctance from supply chain partners
- Unavailability of adequate broadband infrastructure
- Legal and contractual ambiguity
- Trade restrictions
- Coordination problems across different units or departments
- Unwillingness of top management
- No competence in adopting new business models
- Lack of digital strategy
- Employees' resistance to change
- Absence of adequate management systems
- Inferiority of existing data
- Lack of clarity on Industry 4.0's benefits
- Data integration challenges
- Cost of implementation
- Lack of resources to invest
- Workers' resistance
- Lack of perseverance
- Lack of cooperation with suppliers
- Challenges in finding qualified personnel
- Delays in the transformation process
- Lack of an advanced education system for training personnel
- Lack of readiness for innovation
- Lack of information communication technology (ICT) adoption

These challenges and barriers were explicitly identified for I4.0 technologies. For the purposes of this study, these challenges and barriers were generalised to all 4IR technologies and future technological advancements.

South Africa is faced with unique barriers to adopting advanced technologies, such as resistance to technology, a lack of awareness, and cultural constructs [44]. Significant stakeholders such as labour unions are concerned about the potential of shading off low-skilled and semi-skilled jobs. The replacement of these skills would contribute significantly to the country's unemployment burden and impede the achievement of social sustainability. Digital Ubuntu principles could provide guidelines that challenge the status quo and enable employers to innovate in their technology adoption and promote the preservation of jobs while advancing in the adoption of technology.

Various countries have innovation strategies that drive the 4IR, such as I4.0 in Germany, Advanced Manufacturing in the United States of America, and Internet Plus in China. In response to the South African National Development Plan's goals of fighting poverty, inequality, and unemployment, Digital Ubuntu could be South Africa's version of innovation strategy that addresses the country contextual challenges.

Digital Ubuntu is at the forefront of leading the more successful adoption of advanced technology in South Africa. One concern with 4IR technology is the need for relevant management principles that complement workforces. Digital Ubuntu management principles could be derived from the existing Ubuntu management principles. Besides being able to better manage the implementation of 4IR technology in South Africa, they would facilitate new strategic methods that organisations could use to become more competitive.

Furthermore, the 4IR skills development and training could be inspired by the Ubuntu philosophies by using the term Digital Ubuntu. With one of the core reasons for technology failing being problems with upskilling and training employees in organisations, Digital Ubuntu could also overcome legacy and technology-work insecurities.

When considering the challenges mentioned earlier and the barriers to 4IR technology adoption, Ubuntu management philosophy offers an outlook to mitigate these challenges and barriers, as shown in Table 2.

Table 2: Ubuntu management principles to mitigate the barriers to and challenges of 4IR technology adoption

Ubuntu management principles	**Industry 4.0 adoption challenges and barriers to be mitigated**
1- People-centred work culture – community, solidarity, commitment	Unwillingness of top management Employees' resistance to change Workers' resistance Delays in transformation process
2 – Empowering people – team leadership and shared responsibility	Limited understanding of ethics and safety Employees' resistance to change Lack of clarity about Industry 4.0 benefits Workers' resistance Challenges in finding qualified personnel
3 – Transformational leadership – inspire, motivate, influence, support	Unwillingness of top management Employees' resistance to change Workers' resistance Challenges in finding qualified personnel Delays in transformation process Lack of an advanced education system for training personnel
4 – Mentoring – supportive environment	Unwillingness of top management Workers' resistance Challenges in finding qualified personnel
5 – Shared vision – goal-directed	Coordination problems across different units or departments Unwillingness of top management Lack of clarity about Industry 4.0 benefits
6 – Openness and honesty – supporting relationships and communication	Coordination problems across different units or departments Lack of clarity about Industry 4.0 benefits Workers' resistance
7 – Loyalty to the organisation	Workers' resistance
8 – Collective decision-making	No competence in adopting new business models Workers' resistance
9 – Sharing power and teamwork	No competence in adopting new business models Workers' resistance
10 – Continuous employee support and development	Cyber-security and privacy Skills deficit in labour market Workers' resistance Lack of an advanced education system for training personnel

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Table 2: Ubuntu management principles to mitigate the barriers to and challenges of 4IR technology adoption (cont.)

Ubuntu management principles	Industry 4.0 adoption challenges and barriers to be mitigated
11 – An effective team is a team with the right tools	Lack of reference architecture and standards Inefficient IT applications Unavailability of adequate broadband infrastructure Absence of adequate management systems Inferiority of existing data Data integration challenge Cost of implementation Lack of resources to invest Lack of perseverance Lack of cooperation with suppliers Lack of an advanced education system for training personnel Lack of readiness for innovation Lack of information communication technology (ICT) adoption
12 – Strong organisational value	Lack of digital strategy Workers' resistance Unwillingness of top management
13 – Rewarding employees for application of the 'right culture'	No competence in adopting new business models Workers' resistance Lack of an advanced education system for training personnel

It is often said that change is the only constant. Moreover, it is also common for people to be resistant to change. While Industry 4.0 offers South Africa a fountain of opportunities for growth and development, local employees might also be resistant to the changes it brings about. Using an inherently South African philosophy, Ubuntu, to introduce employees to Industry 4.0 technologies could create a bridge of understanding, thereby removing some of the resistance to change and increasing the chances of employee buy-in.

When better buy-in has been established with employees, an organisation should be able to adopt Industry 4.0 technologies with less resistance and more understanding from its employees. In turn, this would allow it to upskill its employees and to mitigate several of the challenges and barriers, as previously discussed. As a result, employees would have better job security, based on their new skills and understanding. Overall, this would result in substantial societal gains and boost the South African economy in alignment with the South African government's National Developmental Plan for strategic growth and development

6. DISCUSSIONS AND CONCLUSION

Since Ubuntu is inherently indigenous African knowledge, and is well-known to the South African public, Digital Ubuntu would create a bridge to introducing new technologies to the South African workforce. Other African countries could use and customise this approach to fit their respective interpretations of Ubuntu, thereby creating customised initiatives for their countries that increase employee buy-in and improve 4IR technology adoption.

Above and beyond the promising future that Digital Ubuntu might have, its implications for policymaking are worth mentioning. Considering the governance structures that emerged in various countries prior to public sector implementation of 4IR technology adoption, the concept of Digital Ubuntu could inspire policymaking. Furthermore, Digital Ubuntu could serve as the blueprint for the government structures that would be needed to ensure mass adoption of the I4.0 technology that would sustain local communities. Following the establishment of the Presidential Commission on the Fourth Industrial Revolution (PC4IR) by South African President Cyril Ramaphosa in 2019, a core recommendation would be that policies and legislation be appropriately reviewed and amended [46]. Another recommendation would be to invest in human capital. Digital Ubuntu presents itself as a way of inspiring the way forward in line with the PC4IR's suggestions.

Developed countries have tailored their technological adoption roadmaps and crafted unique digital stories to solve their specific country challenges. This paper could inspire African developing countries to support their domestic technological developments and innovations. Thus, moving toward sustainable technological advancements and bridging the digital divide between countries.

Could Digital Ubuntu be the South African version of Industry 4.0?

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