Working with Robots as Colleagues: Kenyan Perspectives of Ethical Concerns on Possible Integration of Co-bots in Workplaces

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Introduction

In 2013, a group of US soldiers deployed in Iraq shocked the world by holding an elaborate funeral for a robot, named Boomer, which was destroyed in combat. Grieving over the fallen comrade in arms, the soldiers not only honoured the robot with a 21-gun salute but also with two prestigious medals, the Purple Heart and Bronze Star Medal (Carpenter 2013). The Purple Heart is a decoration awarded in the name of the President to soldiers either killed or wounded in service. The Bronze Star Medal is awarded to soldiers for heroic service in a combat zone. Boomer was considered as male and was recognised "posthumously" for heroic exploits and saving the lives of his comrades in arms (Nyholm and Smids 2020). This funeral and the awards demonstrated unique facts about the type of relationships people can develop with the machines they work closely with. Typically, people can humanise the machines to the extent that they regard them as colleagues and treat them in the same way they would treat their human associates. Similarly,

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they can develop emotional "brotherhood" bonds with the machines in a process that Renzullo (2019) describes as the "anthropomorphisation" of devices. Nijssen et al. (2019, p. 42) explain that "interactions with machines may give rise to emotional attachment and a humanized perception of them to the point where we start considering them deserving of moral care - something that is usually only reserved for other humans".

Boomer's funeral was not the only incident in which human beings have assigned human characteristics to machines. In 2017, workers at the Canadian Broadcasting Corporation feted "retiring" mail robots with a retirement party (Isa 2018). The party, complete with beautiful balloons and a cake, was held to celebrate the tireless, selfless and colourful career of the robots in the corporation having served faithfully for a quarter of a century (Hooker and Kim 2019). During the party, members of staff narrated stories of their experiences with the robots and how they would be missed in the company. Some of the employees expressed the fear that it may be difficult adjusting to the new work experience without the robots. By organising and participating in such a party, the workers demonstrated that human beings have the capacity to develop unique bonds with machines which is akin to relationships colleagues develop with people they work closely with in work spaces. Indeed, staff members narrated how they had become so accustomed to the robots to the extent that they were part and parcel of the workspace just like human colleagues.

Other recent anthropomorphisation cases include the granting of citizenship of a humanoid robot known as Sophia by Saudi Arabia in 2017 (Retto 2017). Sophia who became the first humanoid to be granted citizenship by any country is an advanced robot which is capable of interacting closely with human beings. Sophia is linguistically advanced and capable of expressing feelings such as anger, joy, sadness, amazement, annoyance or fear (Weller 2017; Yu 2020). Importantly, she is able to learn from her interactions with human beings thereby improving her knowledge and experiences. Thus, she is able to fit better in her context by demonstrating familiarity with the culture, emotions and linguistic expressions of the people she interacts with. She is even capable of searching for new information using platforms such as Google. She has an Instagram account with 160 k followers and 500 posts as at October 2021. As a Saudi citizen, Sophia enjoys the rights of a legal person similar to other legal persons, including human beings (Pagallo 2018; Parviainen and Coeckelbergh 2020). In fact, she is the first robot to be appointed

an ambassador by the United Nations where she serves as the United Nations Development Programme's innovation champion. Sophia now has siblings such as Japanese Erica and Chinese Jia Jia (Riaz et al. 2020).

From the foregoing, it is evident that robots are moving closer to human beings, particularly, in workspaces. This will inevitably expose human workers to a different working environment laden with myriad benefits, challenges and concerns thereby raising a number of ethical questions: How should human workers perceive and interact with robots working alongside them? Are these robots supposed to be treated as tools or colleagues by the humans working with them? Can human workers truly trust the robots they work with in the same way they can trust their human colleagues? What factors influence the acceptance of robots as co-workers by human workers? This chapter explores these ethical concerns in the Kenyan context.

Emerging Frontiers for Robots

According to Calo et al. (2016), a robot can simply be perceived as a machine which has some means of sensing the environment or receiving instruction; an algorithm or programme which enables it to decipher the sensed data or instruction; and can take appropriate action based on the sensed instruction. Gates (2007, p. 65) argues that robots and related machines will soon be found in all spheres of human life, including in homes. He explains that "as these devices become increasingly affordable to consumers, they could have just as profound an impact on the way we work, communicate, learn and entertain ourselves as the PC has had over the past 30 years". Kaur et al. (2021) explain that robots are getting more advanced and becoming more helpful in diverse spheres of human life. These trends exemplify an earlier opinion of Gates (2007) who projected that the power and potential of robots in everyday life are bound to increase because the devices have capacity to be networked. Therefore, it is possible to have groups of networked robots which are able to work together to accomplish tasks which may not be performed easily or comfortably by human beings.

Gunkel (2018, p. ix) opines that human beings are currently "in the midst of a robot invasion. The machines are now everywhere doing virtually everything". Iqbal et al. (2017) explain that what was hitherto imagined in science fiction is finally being realised. Indeed, the International Federation for Robotics (IFR) (2015) projected a gradual but

steady increase of robots in nearly all spheres of human life in what was described as "conquering of the world" by the machines. Cookson (2015) also predicted a ubiquitous presence of diverse types of robots. In the service industry, for instance, he envisioned robots entertaining guests, taking care of the elderly, cooking and serving food in restaurants, and milking cows on farms. Sun (2016) stated that several robots were already being used on farms for irrigation, harvesting and processing of crops. Solaiman (2017) reported that there were already 12 million service robots in operation and that this number would grow exponentially in the future. Demianova (2018) predicted an annual 12% growth in the application of robots in diverse sectors of the economy.

Clabaugh and Matarić (2018) explained that new technological advancements have facilitated the development of advanced robots which are able to stretch the limits of human–machine symbiosis to levels that have hitherto not been experienced. Currently, there exist robots for many human endeavours. Pagallo (2013, p. 47) reported that there are artificial agents with the ability to "send bids, accept offers, request quotes, negotiate deals and make contracts". Other latest entrants into the robotics universe include machines which are able to "protect and improve the quality of air, water, and soil; safeguard species biodiversity; and effectively manage natural resources" (Mazzolai et al. 2021); diverse categories of social robots used for educational purposes (Konijn et al. 2020; Xia and LeTendre 2021); automation of diverse forms of industrial processes (Stein and Kaivo-Oja 2020); and those performing assistive roles in homes and medical facilities (Nomura 2017), among other roles.

Many challenges hamper advancement of robotics. According to Gates (2007, p. 60), "the robotics industry faces many of the same challenges that the personal computer business faced 30 years ago. Because of a lack of common standards and platforms, designers usually have to start from scratch when building their machines". Dautenhahn et al. (2005) conducted a study in the United Kingdom to understand the perception of robots among 28 adults. The study found that a large majority of the respondents preferred having a robot as a machine, assistant or servant but not as a companion or friend. Most of the respondents also preferred to assign robots household chores not involving the care of children or animals. Scopelliti et al. (2004) conducted a study which revealed that whereas young people demonstrate an openness towards robots in social set-ups, including in workplaces and homes, the elderly are hesitant and are actually frightened of the prospect.

Cookson (2015) argued that although industrial robots have for many years dominated robotics, the balance has tilted in favour of service robots. These robots are more than just machines. Demianova (2018) explains that many workers fear that the increasing use of robots as an affordable source of efficient labour will render many workers jobless leading to new dynamics in the labour markets globally. Sharkey and Sharkey (2012) argue against the use of robots in a way that totally replaces human beings particularly in situations which require emotional support which robots, being machines, cannot give. They give the example of providing care support to the elderly persons who would feel neglected and isolated if the use of robots extensively reduces their interaction with human beings. Pransky (2001) argues that letting children to interact extensively with robots may lead them to have less interaction with other children and humans thereby leading them to think that human–robot interaction is actually the norm. Fridin (2014) holds the view that exposing young children extensively to robots may lead to poor emotional and social development. This may lead to difficulties in engaging with other humans or being confused about the abilities of humans and robots. Interacting with robots more than human beings may also affect children's moral consciousness. She calls for a balance in the levels of exposure of children to robots and other human beings. Several scholars echo this call (Bertolini and Aiello 2018; de Graaf 2016; Fiske et al. 2019; Haring et al. 2019; Lin et al. 2011; Yulianto 2019).

According to Solaiman (2017), several discourses are ongoing about the personality of robots. One of these is the view that robots should acquire their own legal personality so that they, and not their manufacturers or owners, are held responsible for their own mistakes. Gunkel (2018) poses: Can robots be held responsible for the consequences of the mistakes they make in their line of duty? Do robots, being the machines that they are, expect some level of respect from human beings? Can they be treated with dignity reserved for human beings and other living things? Can robots have any rights?

Contextual Information

Robots have been used in diverse sectors of the economy for decades. The robots, which were largely industrial, worked in controlled spaces not shared with human workers (Fryman and Matthias 2012). Industrial robots supported heavy manufacturing processes. They were intimidating

huge mechanical machines operating autonomously in industrial plants (Dauth et al. 2017; Singh et al. 2013). With technological advancement, new types of robots, called collaborative robots or co-bots, have emerged. As opposed to industrial robots, co-bots are designed and deployed to work closely with human workers in less controlled workspaces (Fast-Berglund et al. 2016; Galin and Mamchenko 2020; Kildal et al. 2018; Simões et al. 2020; Veloso et al. 2015). According to Vojić (2020), co-bots have been largely deployed to perform manual duties such as packing, picking, welding or assembling parts of products. There are also co-bots in the service industry offering user support and customer care. Marvel and Norcross (2017) report that the integration of co-bots in workspaces has been on the increase. For instance, Cohen et al. (2019) projected that the US alone will spend 12 billion dollars on co-bots in 2025, up from 710 million dollars in 2017. It is also estimated that more than 5 million co-bots are already sharing human workspaces globally. It is further estimated that about 400,000 co-bots will be joining the human workspaces yearly in the near future. Malik and Bilberg (2019) opine that co-bot deployment results in the automation of up to 70% of the workload making processes and production to become more efficient and profitable.

Kenya is one of the most technologically advanced countries in sub-Saharan Africa (Kwanya 2021). Its capital, Nairobi, is the technological hub of the East and Central African region earning it the title "Silicon Savannah" (Kwanya et al. 2021). The country is reputed for having one of the best Internet connections in Africa due to the number of undersea cables which land in it (Bramann 2017). Kenya also boasts of the use of the latest technologies in its economy; a dominant presence of multinational ICT companies implying access to latest technologies; a growing population of young people amenable to technological developments; a relatively well-educated population (adult literacy is about 78%); and a history of technological innovation. Indeed, Nairobi is the home of globally-celebrated technological innovations such as mobile money transfer platform, M-pesa, among others (Kwanya 2021).

Kenya's short-term development blueprint is anchored on the "Big 4 Agenda" which is aimed at improving the national economy by enhancing manufacturing, improving food security and nutrition, attaining universal healthcare coverage and providing affordable housing to the citizens (Macharia 2019; Musundi et al. 2021). The Government of Kenya has committed to use emerging innovative technologies to attain the "Big 4

Agenda" targets. It is specifically seeking to mainstream the use of artificial intelligence, machine learning and robotics to achieve its development agenda (Mvurya 2020). Consequently, the government and other stakeholders are already experimenting with co-bots in various sectors of the economy. The latest initiative was the deployment of a medical co-bot, known as Robodoc, to support the country's response to the COVID-19 pandemic. It is expected that the country will experience an influx of co-bots in the next few years (Kwanya 2021).

Literature Review

The category of robots which work and interact closely with human beings is known as collaborative robots or co-bots (Peshkin and Colgate 1999; Kwanya 2021). According to Castillo et al. (2021), co-bots are designed for close physical and functional collaboration with human workers. Colgate et al. (1996) explained that co-bots are robotic devices which perform assigned tasks in collaboration with human workers. They work in close proximity with human beings and share their workload. Their close physical proximity and sharing of work imply that co-bots are constantly in contact with the human beings they work with. Peshkin and Colgate (1999) further explained that co-bots work collaboratively but fairly independently from human intervention. Compared to industrial robots, co-bots are more flexible, adaptable and safe (Fast-Berglund et al. 2016). Table 1 summarises the characteristics of co-bots and compares the same with industrial robots.

According to Yilma et al. (2020), co-bots possess human-like characteristics making them able to collaborate with them on a day-to-day basis. Pazienza et al. (2019) explained that co-bots are specially designed for close and constant interaction with human beings in ordinary workspaces. Cohen et al. (2021) argued that co-bots are critical for the realisation of the 4th Industrial Revolution. Co-bots blur the boundaries between the digital and physical work environments as well as the distinction between human workers and machines. Sladić et al. (2021) also explain that co-bots are designed to collaborate with other robots and humans in performing tasks. Adriaensen et al. (2021) emphasise that while most of the jobs assigned to robots were those which are ergonomically or psychologically challenging for humans to do, co-bots work on the same tasks in the same workspace with human beings. According to Margherita and Braccini (2021), co-bots utilise a human-worker-centric approach in

which the robot does not entirely replace human labour but enriches it. According to Campbell (2021), the greatest benefit of co-bots lies in the fact that they provide an alternative to the use of costly and complex traditional robots. Sony et al. (2021) assert that co-bots will drive the realisation of the fourth industrial revolution by synergising human labour with robotic power. Gjeldum et al. (2021) emphasise that it is the ability of co-bots to directly mingle with and share tasks with humans that make them more versatile in the Industry 4.0 workspaces.

A number of models of interaction between humans and robots in the human workspaces have been identified. The first model of interaction is co-existence. According to Wang et al. (2019), co-existence is a situation where the robot and human share space but perform different tasks. The second model is cooperation. Gjeldum et al. (2021) explain that in cooperation, the robot and the human perform different components of a task but sequentially. The subtasks performed by the robot and the human are mutually independent. The third model is collaboration. According to Vicentini (2020), collaboration involves the robot and human working on the same task at the same time to yield a mutual result. Collaboration brings the robot and human being together to work on the same assignments simultaneously in a relationship that Gupta et al. (2021) describe as mutually-inclusive and contagious. Rossato et al. (2021) explain that collaboration enables organisations to combine the strengths of robots (such as tirelessness, speed and accuracy) with those of the human worker (such as flexibility and dexterity). McQuillen (2021) asserts that when this happens, robots and humans maximise their strengths while also compensating for their individual weaknesses.

Co-bots are now quite common in several sectors of the economy (Fast-Berglund et al. 2016). Many benefits are derived from co-bot deployment in human workspaces. These include precision in job performance (Pazienza et al. 2019; Zhu et al. 2020); improved productivity due to enhanced human–robot collaboration (Gobinath 2021; Sowa et al. 2021); production efficiency due to processing optimisation (Castillo et al. 2021); low production costs (Castillo et al. 2021; Gisginis 2021; Kadir et al. 2018); better quality of products or job outputs (Galin et al. 2020); job enrichment and fulfilment through improved workflows and role distribution (Kadir et al. 2018; Margherita and Braccini 2021); improved capacity to handle complex assignments (Simoes et al. 2019; Zhu et al. 2020); improved safety of human workers when robots take up risky and repetitive duties (Fast-Berglund et al. 2016; Zhu et al. 2020);

quick performance of tedious and sophisticated tasks (Gisginis 2021); as well as improved customisation of goods and services (Kopp et al. 2021).

Many factors have influenced the adoption and use of co-bots. Sladić et al. (2021) identify lack of requisite technical skills to work with robots as one of the factors limiting the deployment of co-bots. Pinto et al. (2021) argue that many human workers, including engineers, do not wholly trust robots and perceive them as being volatile, uncertain, complex and ambiguous. Lambrechts et al. (2021) argue that resistance to change, organisational culture and leadership are among the factors which limit the adoption and use of co-bots. Other factors which hinder widespread adoption and use of co-bots include occupational safety concerns (Kopp et al. 2021). McQuillen (2021) suggests that giving some level of control over the robot to the human coworker enhances the acceptability of the robot by the human. Lambrechts et al. (2021) suggest that reskilling and upskilling human workers to collaborate with co-bots would enhance acceptability and effectiveness of co-bots into their workspaces. Giacometti and Larsson (2017) argued that addressing safety concerns of workers in spaces and tasks shared with robots would also enhance their acceptability and operational gains.

According to Calitz et al. (2017), there is a great opportunity to deploy co-bots in sub-Saharan Africa. Although only a few manufacturing companies and businesses in Africa have deployed co-bots, the machines are acknowledged as having a great potential to drive economic growth of the region. Calitz et al. (2017) also identify the factors contributing to the relative slow adoption of co-bots in sub-Saharan Africa to include perceived high costs of purchase, installation, operation and maintenance; low cost of labour in the region; lack of requisite technical capacity and infrastructure; and lowly educated but highly unionised workforce who fear job losses. According to Chigbu and Nekhwevha (2021), workers in Africa need to acquire new skills to fit the needs of new job tasks which involve collaborating with co-bots. Keet (2021) also suggests that developers of co-bots need to demonstrate cultural awareness when developing co-bots for use in Africa. Dunn (2021) recommends the development and use of policies which facilitate the development of human skills which are relevant for the fourth industrial revolution.

According to Anderson and Anderson (2010), autonomous machines like robots are bound to play a critical role in human life. They further argue that the big question is whether they will do this ethically. Ethical concerns about the widespread use of robots have been on the table for

many years. Indeed, as early as 1941, Isaac Asimov, an American professor, proposed the following three laws of robotics (Asimov 1941):

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm;
2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law; and
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Anderson (2008) argues that the above laws, though a pointer to the need for ethical machines, were unsatisfactory, thereby necessitating the continued dialogue on ethics in robotics. Indeed, Maddahi et al. (2021) explain that robotics has advanced over the years and have outgrown these laws. For example, there are now robots, such as Boomer which was mentioned earlier, used in warfare and are definitely designed to harm enemy human beings.

Maddahi et al. (2021) argue that three main ethical issues arise from the use of co-bots. These include privacy and safety of data either generated or stored by the robot; the impact of robot use on the common good of the society in which they are applied; and the safety of human beings working with the robots or operating in their work environment. Ménissier (2020) explains that the Montreal Declaration for the Responsible Development of Artificial Intelligence aimed to provide a framework for ethical application of artificial intelligence in society. A number of ethical principles can be derived from the declaration. These include respect for autonomy, caution, diversity inclusion, responsibility, democratic participation as well as protection of privacy and intimacy. Maddahi et al. (2021) explain that these principles are human-centric and do not have adequate provisions for advanced robotic machines.

Other ethical dilemmas relate to the possibility and nature of bonding relationships between robots and their human co-workers as well as the socioeconomic effects of widespread automation of tasks (Maddahi et al. 2021). Anderson (2008) wonders whether autonomous machines can have a moral standing. Tolksdorf et al. (2021) explain that in cases where robots are trusted to take care of vulnerable persons, such as children and the elderly, these machines may not be expected to uphold values such as human morals. Therefore, ethical dilemmas arise regarding

the moral safety of the persons under their care. Again, there are also concerns about human beings absconding from their duty of taking care of their offspring and parents. Leaving these fundamental responsibilities to robots alters the social structure of the society and may lead to children growing up with "machine" minds which may affect their capacity to relate well with other human beings when they grow up (de Graaf 2016). Indeed, Anderson et al. (2005) explained that scientists find it difficult to make ethics computable. Robots are disruptive technologies which also stimulate social changes in their environments. If not handled carefully, such changes may have outstanding impact on the humanness of society as we know it today. Tan et al. (2021) point out that these disruptive changes have more serious and long-term social safety implications that can be comprehensively deciphered or anticipated. Liang et al. (2021) explain these ethical dilemmas relating to robots will persist and have consequences on human rights, morals, values, justice and equity.

Anderson (2008) citing the arguments of Asimov (1976) explains that some people hold the view that autonomous machines should have rights to act independently without having to work as slaves for human beings. Chomanski (2021) also advocates for the freedom of artificial persons arguing that they should be treated just like human beings and should not be enslaved or exploited. In this regard, Peeters and Haselager (2021) suggest that robots should be designed with features that enable them to consent to assignments or other forms of interaction with their human operators or co-workers. According to Bennett and Daly (2020), these debates led to discussions on the status of robots as legal persons. These discussions have not been conclusive. Nonetheless, they explain that the rights assigned to a robot may depend on many factors about the robot, including its assumed gender. Nonetheless, other scholars (Kelley et al. 2010; Calverley 2006) hold the view that perhaps it would be better to treat robots in the same way we treat domestic animals or pets. In this case, they would not have exactly the same rights or moral expectations as human beings. The diversity of views on the rights of robots points to the fact that the subject is complex and non-conclusive.

According to Boada et al. (2021), current debates on ethical issues relating to ubiquitous robot use in society are fragmented and conceptually disordered. This limits the perception of ethical risks emanating from integrating robots into the social spheres of human life and the interventions therein. It is also difficult to prescribe a set of ethical principles for machines because ethics is relative. Similarly, ethical dilemmas exist which

make it difficult to prescribe actions in all imaginable decision situations in human life.

Although the sub-Sahara is lagging behind the developed countries on the adoption and use of robots, the situation is changing fast. According to Rapanyane and Sethole (2020), the rise of the use of artificial intelligence and robots in the sub-Sahara is driven by the need to facilitate the fourth industrial revolution in the region. Indeed, Mayer (2018) and Naudé (2017) argued that meaningful industrialisation on the continent will be realised fast by embracing artificial intelligence and robotics in manufacturing. In Kenya, Banga and te Velde (2018) argued that the country can make fast progress in manufacturing by using intelligent systems and equipment. These views echoed positions taken by Kibor and Obwoge (2014), Arunda (2020) and Anitah et al. (2019). Although statistics about the actual level of adoption of robots in Kenya's workspaces are blurry, it can be deduced that this situation will not hold for long. It is just a matter of time before there are a sizable number of robots working alongside human beings in diverse sectors of the economy in Kenya. This will definitely lead to ethical concerns and dilemmas. It is evident from this literature review that Kenyan perspectives to the ongoing debates on ethical issues emerging from the entrance of robots in the job market are lacking. This chapter explores this subject as a means of contributing Kenyan perspectives to this important global debate. The degree to which these salient ethical issues are identified, discussed and addressed will determine the success of robots in Kenyan workspaces.

Methodology of Study

This chapter is founded on a qualitative study conducted to investigate the ethical concerns of Kenyan workers on the integration of co-bots in their workspaces. According to Kahlke (2014), qualitative studies enable researchers to understand issues under investigation from the perspectives of the respondents. Dongre et al. (2010) argued that applying qualitative methods of data collection and analysis helps researchers to explore research issues in-depth and to adequately integrate the opinions of the respondents. This chapter discusses the perceptions and attitudes of Kenyan workers towards collaborative robots in their workspaces. Therefore, it relied heavily on the views of the respondents. A qualitative approach was, therefore, deemed most appropriate to collect data for the study.

Data was collected from 20 purposively selected information scientists in Kenya. According to Malterud et al. (2016), the sample size of populations in qualitative studies depends on the objectives and context of each study. However, they point out that the "information power" or level of expertise of the respondents is critical in determining their number. Thus, the more expert the respondents, the smaller the sample size and vice versa. According to Braun and Clarke (2021), it is possible to reach information saturation with 20–24 interviews. In the study anchoring this chapter, the respondents were experts in information science who were selected through information-oriented purposive sampling. Information scientists were selected because they are likely to encounter robots in non-industrial environments. A sample size of 20 respondents was also deemed as adequate to provide an exhaustive view of the qualitative issues under study. Qualitative data was collected from the selected respondents through telephone interviews. This data collection technique was considered appropriate because of restrictions on physical meetings due to COVID-19 pandemic. A semi-structured interview schedule was used to guide the interviews. The key questions asked included:

1. Are you aware of co-bots?
2. In your opinion, what extent are they deployed in Kenya?
3. Have you encountered a co-bot in your professional work?
4. In your opinion, what are the benefits of co-bots?
5. Are you willing to accept a co-bot as a work colleague? Please, explain your answer.
6. Are you willing to share your workspace with a co-bot? Please, explain your answer.
7. In your opinion, is it ethical to treat a co-bot a colleague in the workplace?
8. If your response to 7 above is yes, what ethical concerns would you have about treating a co-bot as a colleague?
9. How can the concerns identified in 8 above be addressed to enhance acceptability of co-bots in workspaces?

Findings of the Study

The collected data was analysed thematically based on the questions above. The findings of the study are presented here according to the themes. The themes are awareness of collaborative robots, extent of their deployment in Kenya, past experience with co-bots, benefits of integrating

co-bots in human workspaces, willingness to work in close proximity with co-bots, ethical concerns about sharing workspaces with machines such as co-bots, as well as strategies to enhance acceptance of co-bots in human workspaces.

Awareness of Co-bots

All the respondents were aware of the existence of co-bots. When asked to explain what they knew about co-bots, the overall response was that co-bots are robots which have been specially designed and developed to operate in ordinary spaces alongside human beings. Some verbatim responses are as reported hereunder:

> *Co-bots are small robots which interact directly with human beings in ordinary life spaces such as offices, markets and homes.* **R11**
>
> *Co-bots are robotic machines which help human beings to perform normal tasks in homes and offices efficiently.* **R07**
>
> *Cheap, simplified and adaptable robots which are able to operate in normal spaces used by human beings to perform a wide array of tasks to make human life more convenient and comfortable.* **R13**
>
> *A category of robots which can work alone but also together with people and other robots in completing shared job tasks.* **R10**
>
> *Co-bots are advanced human-friendly robots which can operate in normal job locations and can work closely with human beings.* **R3**

It can be deduced from the responses that information workers in Kenya have a good understanding of what co-bots are. They describe co-bots as a category of robots which are designed to work in close physical interactions with human beings and less controlled and human-friendly environments. They also perceive co-bots as representing an advancement in robotics aimed at making robots pleasant and safe to work in close proximity with human beings. This description tallies with the definitions of co-bots found in the reviewed literature (Castillo et al. 2021; Kwanya 2021; Peshkin and Colgate 1999).

These findings demonstrate that people in sub-Saharan Africa are abreast with emerging developments in robotics and associated technologies. Indeed, Calitz et al. (2017) explain that most business enterprises in Africa know about collaborative robots and their potential role in facilitating the realisation of the fourth industrial revolution. Naudé (2017) explained that although the level of awareness of co-bots in Africa is

growing rapidly, more needs to be done to harness their potential. Isa (2018) pointed out that even with relatively cheaper labour, Africa will continue to lag behind developed countries if technologies which provide efficient labour, such as co-bots, are ignored. She emphasises that the advantage associated with cheap labour force in Africa will be eroded incrementally by assistive technologies like collaborative robots. Chinyamurindi and Mey (2017) assert that there is need, therefore, for strategies which will turn the awareness into programmes for adopting co-bots in the workspaces. According to Chigbu and Nekhwevha (2021), Africa will continue being a technological desert if no comprehensive actions are taken to transform technological awareness into reality. Rapanyane and Sethole (2020) assert that assistive technologies are inevitable. The earlier Africa embraces the technologies the better for the continent. In this regard, this level of awareness of co-bots is positive and should be encouraged.

Extent of Deployment of Co-bots in Kenyan Information Workspaces

All the respondents indicated that they were not aware of any co-bot currently deployed in the information workspaces in Kenya. They acknowledged the presence of diverse automation systems in the country but stated that none of these meets the descriptions of co-bots given above. They also stated that there is a limited number of industrial robots in Kenya's manufacturing sector. The findings of the current study concur with Magachi et al. (2017) who investigated the use of industrial robots by listed manufacturing companies in Kenya. They found a low application of industrial robots by the companies. They attributed this low usage to high costs of acquiring and deploying robots as well as inadequate technical skills to operate them. Nganga (2020) also reports low usage of robots in Kenya and attributes this to inadequate skills, infrastructure and policies. Nonetheless, in the wake of health challenges occasioned by the COVID-19 outbreak, Kenya is one of the countries which turned to robots to reduce the spread of the disease. In partnership with the United Nations Development Programme (UNDP) and Japan International Cooperation Agency (JICA), the country's Ministry of Health deployed three robots—*Jasiri*, *Shujaa* and *Tumaini*—at the Jomo Kenyatta International Airport and Kenyatta National Hospital in February 2021. The robots handle high-exposure duties such as temperature screening, automatic disinfection and fumigation, as well as identifying those who are

either standing too close together or not wearing masks. The robots, all given the male gender, also collect other critical health data from high-traffic locations for decision-making and intervention. A number of drones have also been deployed in the country to support telecommunication, security/military, agricultural, health, educational, tourism and customer service operations, among many others (Achieng et al. 2020; Arunda 2020; Banga and te Velde 2018; Forbes et al. 2020; Mvurya 2020; Steer 2017).

It is evident from the findings that the positive level of awareness of co-bots in Kenya is not followed with a commensurate extent of deployment in information workspaces. It is noteworthy, however, that the number and diversity of robots in other workspaces in the country are growing, albeit gradually. It can be concluded, therefore, that it is just a matter of time before more robots enter into Kenya's information workspaces in libraries, mass media institutions, archives, museums, records centres and publishing houses, among others. This situation is not entirely unique to Kenya. In sub-Saharan Africa, only South Africa has co-bots in information workspaces. Ocholla and Ocholla (2020) reported that "Libby", a humanoid robot deployed in the University of Pretoria library in 2019, is the first and only humanoid librarian in sub-Saharan Africa. Libby, originally made in China, is considered as a library employee and offers services alongside other librarians in the institution. They add that although Libby is way ahead of her time, it is a harbinger of more robots to be deployed in information centres in other countries in sub-Saharan Africa. Tella (2020) also argued that the fact that there are few co-bots in information centres in sub-Saharan Africa is by no means a permanent situation. He predicted that robots will soon be part and parcel of sub-Saharan information centres in the near future.

Merits and Demerits of Co-bots in Information Workspaces

Deployment of co-bots in information workspaces can result in several benefits. The respondents explained that the key benefits revolve around helping information workers to perform routine tasks, offering non-stop services, taking up jobs considered unhealthy or risky for human beings, and offering consistent services efficiently. In libraries, for instance, co-bots can shelve books, conduct library orientation for new students, take stock of and label library resources, as well as check-in and check-out information materials (Kwanya et al. 2014). These routine duties take

up a large portion of librarians' time leaving no space for creativity and innovation. By freeing this time, co-bots will enable librarians to spend this valuable time in other roles. In record centres and archives, co-bots can easily work with dusty materials and artefacts which are considered a health hazard for human beings. They can also ensure accurate classification and filing of documents to facilitate prompt searching and retrieval (Kwanya 2021). This will not save the time of the users but also improve their decision-making process ultimately resulting in improved productivity. Co-bots can also be relied on to offer uninterrupted services since they do not have to take leave, fall sick or become moody (Abok and Kwanya 2016). They overcome limitations to consistent services experienced by human workers. This consistency results in steady and superior services throughout the day. In this age where information users seek services on a 24-h, everyday basis, co-bots will aid information centres to expand the reach of their services and reduce barriers to access (Gichora and Kwanya 2015; Nakitare et al. 2020). Some of the verbatim responses are as reported hereunder:

A robot concentrates fully on the job assigned to it since it does not have other responsibilities in life like taking care of sick relatives, attending burials or weddings, dropping or picking children from school. **R07**

Co-bots can perform heavy-duty roles in information centres such as lifting files and artefacts. These tasks would require the effort of many people at a time. In this manner, co-bots will help information centres to cut costs while offering efficient services. **R03**

Robots do not get tired and therefore do not need time off to rejuvenate. As long there is work to be done, they will do it. **R09**

The knowledge held by a co-bot is readily available in the organisation since it is largely explicit. The organisation faces no risk of knowledge loss with staff turnover. In fact, turnover itself is greatly reduced. Co-bots serve faithfully and loyally. They are not looking out for greener pastures. Similarly, they cannot get disgruntled or experience burnout. **R12**

Robots can store and retrieve vast volumes and diversity of data much faster than human beings. This capacity can be used to personalise information services and products to the needs of individual users. This helps to improve the relevance and impact of services. **R10**

Co-bots can keep organisational secrets. They can effectively manage confidential records since they do not gossip or feel the obligation of extending favours. They have no favourites. **R08**

Co-bots can offer transparent and accountable services. They are not corrupt…they cannot take bribes or show impartiality. They can help information centres to overcome challenges associated with negative ethnicity and gender biases which are common in Sub-Saharan Africa workspaces. **R01**

The respondents also explained that despite the many benefits of co-bots, there are also a number of disadvantages of having the machines in information workspaces. Generally, human workers would find co-bots as cold, inflexible and dangerous. Some of the verbatim responses are as hereunder:

What if a co-bot goes berserk while on duty? The consequences would be disastrous. **R11**

Although there are co-bots which can tell stories and share jokes with colleagues, this is quite limited. They have no clue about current affairs. Therefore, their stories and jokes will largely be stuck in time. They can also not tailor their stories or jokes to the mood of the day or personal interests of the colleagues. Working with a co-bot would the most boring part of any worker's life. **R13**

A co-bot does not eat. Therefore, it has not packed lunch to share with a colleague. It lacks the attributes of brotherhood in the workspace. **R04**

Some information materials and artefacts are fragile. It is unimaginable them surviving for posterity with the roughness of robots. **R05**

When faced with unique challenges requiring discretion, co-bots would not be able to reason beyond the programme they have. There are cases, especially in customer services, when workers have to make decisions contrary to the established protocols or policies. The context of the case determines and justifies the decision. **R15**

Robots have no feelings or emotions; they cannot be motivated. They also have no stake in the organisation. They don't care whether the company closes or thrives. They have no capacity to appreciate success or failure. **R17**

Co-bots in Information Workspaces in Kenya

In spite of the demerits discussed above, all the respondents were willing to share their workspaces with co-bots. However, there was divided opinion on whether they would consider such co-bots as colleagues or tools. Those who would consider co-bots as colleagues argued that given that they would share space and tasks, the contribution of the co-bot is much more than that of a tool. They further explained that a tool is

operated but co-bots work independently with minimum human intervention. However, they emphasised that they would remain senior to the co-bot and where needed rather than taking instructions from the co-bot. Therefore, they would remain superior in the workspace and exercise authority over co-bots they work with. Some of the verbatim responses are as reported hereunder:

> *The close proximity in which co-bots and humans work as well as the sharing of tasks qualify them to be considered as colleagues. They can be cataloguing books together. Maybe the human worker enters the metadata while the co-bot attached bar codes and shelves the books. As long as the human is not operating the robot, it is a colleague and not a tool.* **R10**
>
> *The basic perception of a colleague is an entity, human or otherwise, with whom/which one works closely and shares roles or their components. Therefore, co-bots are artificial colleagues.* **R01**
>
> *Co-bots being artificial workers must take instructions from their human colleagues who are far more intelligent than they are. Yes, co-bots can be junior colleagues performing routine, risky and tedious tasks under the guidance of a senior human colleague.* **R09**

Those who would treat co-bots as tools and not colleagues explained that being machines, their contribution to the job roles is limited. They merely extend the performance of human beings. Even where their performance is higher than the human being, they are merely offering support to the human being. They also emphasised that machines such as co-bots can only be colleagues with human workers if they are considered equal. In their opinion, there is no way co-bots will ever equal human beings. Therefore, regardless of their advancement, they will remain tools in the hands of the human workers. Some verbatim responses are hereunder:

> *Any entity which is artificial can be equalled to a living human being. By considering co-bots as colleagues, human beings would be imagining them as their equals. Yes, they may be stronger but can only serve as beasts of burden to their human operators.* **R04**
>
> *Machines make work easier for human beings. Machines have no interest in performing any work. Only human beings are able to attach value to work. Therefore, co-bots cannot appreciate the need for any work. They get no benefits from working. They do whatever they are assigned to do by human beings to make the work easier, convenient or safer for the human being.*

Therefore, they cannot be equals or colleagues with the humans. They are machines, tools, equipment. **R17**

Work is a God-given responsibility of human beings. Co-bots are tools helping humans to work better. They are not colleagues. **R16**

It can be concluded from the foregoing that information workers in Kenya are generally open to receiving co-bots in their workspaces. However, they would like to exercise absolute control over the co-bots either as a master or as a senior colleague.

Ethical Concerns About Considering Co-bots as Colleagues in the Information Workspaces

All the respondents had ethical concerns about considering co-bots in their workspaces as colleagues. One of the concerns, as has already been mentioned, revolved around the concept of work. The issue here is that work is a natural responsibility of humans. By being considered as colleagues, co-bots would be usurping God-given human responsibility which they lack the moral authority to do. In this regard, the respondents emphasised, as explained earlier, that co-bots can only support human beings in doing work. Their role is subordinate. The human being is the owner of work. Regardless of their contribution, co-bots can never be ethically considered as colleagues or equals with humans in matters of work. Besides, Lueg and Twidale (2018) argue that it is not possible to replicate human intellectual abilities in robots. They state that people are now more concerned about developing interfaces for robots than for "mammals who get tired, bored, excited, irritated, intrigued, or distracted, and who even change their minds about what they want to do" (p. 409). The views of the respondents tally with those of Pauliková et al. (2021) that co-bots should only supplement the work of humans and not replace them. Co-bots seek to change the concept of work. Indeed, García-Esteban et al. (2021) explain that the attribute which distinguishes co-bots from the other robots is the fact they can work independently without human intervention and, therefore, do not just complement human labour. They can own work and complete it without human support. Information professions in Kenya, who were the respondents in this study, hold the view that the concept of work and its ownership need to be clarified. This will help to answer the question

on whether co-bots, being machines, can work or not. They can only be considered colleagues if they can work.

Related to the issue above is the concept of the value of the human being. If co-bots can be considered colleagues, is the value attached to them equal to that attached to the human being? Will humans be treated as co-bots and vice versa? Is this not a recipe for chaos in society? With the debates about the rights and personality to ascribe to co-bots, this equality issue is serious. The scholars, such as Chomanski (2021), who advocate for co-bots to be given the same rights and personality humans have, are essentially equating the machines to humans. The rights include the ability to consent to instructions or not (Peeters and Haselager 2021). Bennett and Daly (2020) propose that co-bots should enjoy all the rights given to legal persons. The respondents in this study hold that humans are above co-bots and therefore can never be equated to them whether in the workplace or elsewhere in society. In Kenya, human life is held as sacred. The respondents could not see the conditions under which similar status can be given to machines which are created by other humans. They argued that as opposed to offspring, co-bots are not like the people who create them. They can never grow to become equals with their human creators. In their opinion, it is not possible to share human comradeship in workspaces with co-bots. They underscored the fact that co-bots can, indeed, collaborate with human beings in performing specific roles. However, this does not qualify the robots to be considered as colleagues to the human beings because that is tantamount to equating the artificial with the natural.

Another issue relates to the fear that co-bots will replace humans or at least reduce their role in the workspace. Besides denying humans their God-given right to work, this will deny them opportunity to make a living from working. The big question here is: Would it be ethical to give robots work when many people in Kenya are jobless? Available statistics indicate that about 20% of youth in Kenya are unemployed and the level is likely to increase (Gachari and Korir 2020; Njogu 2015). As explained by Demianova (2018), the fear that robots will replace human beings in some job functions is real. This is partly because robots are bound to be cheaper than human labour. The respondents argue that any initiatives which replaces humans in the workspace with robots or reduces their presence therein give the implication that robots are more important than humans. Besides, denying any human beings work is tantamount to denying them life. Without humans, can there be work for robots?

Therefore, the respondents emphasised, the needs of human beings for opportunities for work should be met before robots can be given work.

The entry of co-bots into information workspaces will result in unintended changes in values, work ethics and moral standards which will have far-reaching consequences on society. For instance, working closely with co-bots will make human workers as cold, emotionally, as the robots. Similarly, it will reduce humans to work mechanically as machines without exhaustively applying their intellectual abilities. Furthermore, humans will develop relationships and bonds with their co-bot colleagues which may isolate them from fellow human beings both in the workspaces and in the society at large. In Kenya, and also in the rest of sub-Saharan Africa, people value social connections and togetherness, possibly more than wealth. The respondents argued that the benefits of robots should not break the social ties which bind communities together. As long as there is potential for this, co-bots will always be viewed with suspicion in Africa. In Africa, "anthropomorphisation" is viewed as immoral and evil. Therefore, deep relationships with devices as the American soldiers did with Boomer are unlikely to develop or be encouraged. Such relations will be perceived as perversion and will attract stigma and disdain.

The other ethical issue relates to trust. Can machines be trusted fully? Can machines make and keep promises? Can machines be confidants? Can robots keep secrets? Can robots advise humans on social or emotional issues? Can robots be role models? Indeed, Pinto et al. (2021) argued that even engineers find it difficult to fully trust robots which they develop. They find them to be volatile and unreliable in some instances. The respondents argued that it is not possible for humans to fully trust co-bots which do not have a sense of loyalty or moral standards. Therefore, co-bots cannot be true colleagues until humans are able to trust them enough to confide in them, seek advice from them, and accept them as role models. The respondents were unable to predict whether these concerns can be addressed through technological advancements alone. There is a need to socialise information professionals differently if they are to accept co-bots as colleagues who are worthy of trust. This will undoubtedly take a lot of time and effort and may not be realised in this generation.

Robots, to a large extent, are culturally dumb. This implies that they lack essential cultural sensitives like etiquette, values and codes of morality. Besides being professional, workspaces are also cultural (Wallace 2021). Although there are advances towards social robots (Jones 2017), it is not

possible to find robots which can fit perfectly in authentic communities like those in Kenya and the rest of sub-Saharan Africa. The respondents explained that most robots have been developed in exotic cultures. So far, no commercial robot is indigenous to Kenya. This means that they are unlikely to accommodate the way of life in Kenyan workspaces. This is exacerbated by the fact that there are limitations on what a robot can learn after development. It will be akin to teaching an old dog new tricks.

Limitations

No co-bots are currently deployed in Kenya's information workspaces. Therefore, the views presented here are not based on the actual presence of co-bots. It is likely that the respondents would consider the issues differently if they were already working in the presence of co-bots. Nonetheless, the opinions are backed up with literature from environments in which co-bots already exist.

Conclusions

From the foregoing, this chapter concludes that Kenyan information workers are willing to welcome co-bots into their spaces but as tools. They are of the view that co-bots do not meet the threshold of brotherhood and, therefore, cannot be considered as colleagues. The respondents explained that many factors influence the acceptability of co-bots into Kenya's information workspaces. These include basic enablers such as skills and infrastructure. However, they argued that there are ethical issues which are more deep and paramount. These include the concept of work as a divine gift to humanity which cannot be shared with machines; the notion that treating co-bots as legal persons equates them to human beings which is viewed as demeaning to humanity; the fear that co-bots will dominate and eventually replace humans in ordinary workspaces thereby denying them not just an opportunity to work but to livelihood; fear of unintended social consequences of "anthropomorphisation" which drive society to oblivion; lack of trust for machines created by limited humans to offer unlimited services and companionship; and discomfort with exotic robots entering professional and indigenous spaces. These ethical concerns need to be addressed comprehensively to enhance the acceptability of co-bots in information workspaces in Kenya. While it is relatively easy to address basic concerns like the need for facilitative skills,

Table 1 *Characteristics of co-bots* Adapted from Cohen et al. (2021)

Characteristic	*Industrial robots*	*Co-bots*
Role	Replacing a worker	Assisting a worker
Human interaction	Commands, programming, assigning locations, movements and gripping	Intelligent interaction: gesture recognition, speech recognition and anticipating operator moves
Camera and computer vision	External camera and external system when they exist	Built-in standard (as part of the co-bot), coupled with artificial intelligence
Workspace	Separate safe workspace for robots and operators usually fenced	Sharing the same workspace. No fencing is necessary
Work envelope	Essential and rigid	Not relevant; flexible and spontaneous
Handling of disruptions and obstruction	Usually needs a full set-up after disruption	Built-in standard to handle disruptions and obstruction; no need to restart
Re-programming	Rare	Frequent
Physical disruptions	Mostly hazardous; set-up required for re-initiation	Safe response to disruptions with easy re-initiation protocol
System self-awareness	Basic failure detection	Real-time monitoring of load on each axis and segment, tactile pressure and axis locations
Agility	Rapid motions	Slow motions
Payload	May be heavy	Not heavy
Acquisition cost	High	Low
Ability to work in dynamic environment, possibly with moving entities	No	Yes

policies and infrastructure, the ethical concerns will take much longer to mediate. It is therefore improbable that information workers in Kenya will unreservedly welcome co-bots into the workspaces in the near future.

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