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# Training and skills development in the wake of the Fourth Industrial Revolution: Evidence from Botswana borehole drilling companies

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**Orientation:** Organisations are hesitant to implement new technologies that are beneficial to the organisation to achieve their goals more effectively and efficiently.

**Research purpose:** The study's major aim was to investigate the best practices of training and skills development in the wake of the Fourth Industrial Revolution (4IR) using a case study of Botswana borehole drilling companies.

**Motivation for the study:** Training and skills development in the wake of the 4IR has received little investigation in Botswana and hence this study looked for the best practices in training and skills development in the aftermath of the 4IR and its impact on Botswana's borehole drilling companies.

**Research approach/design and method:** A quantitative descriptive research design was adopted for this study. A probability sample consisting of 100 participants from a population of 300 workers of Botswana borehole drilling companies was studied. Data were gathered using questionnaires and analysed using Statistical Package for the Social Sciences (SPSS).

**Main findings:** The study findings showed that training and skills development play an important role in equipping employees with new skills, especially in this modern day of technological advancement for an organisation to have a competitive advantage.

**Practical/managerial implications:** There is a need in organisations to unlearn old technologies and practices and relearn new ones to successfully adapt to the realities of disruptions from technological advancement.

**Contribution/value-add:** The study recommended that businesses in the borehole drilling sector should embark on training and skills development if their workers are to keep abreast with the relevant technology in the industry.

**Keywords:** Fourth Industrial Revolution; training and development; 21st century skills; Botswana borehole drilling companies; technological advancement.

## Introduction

The Industrial Revolution (IR) has one common thing in history, namely societal transformation because of the invention of new technology (Schwab, 2017). Furthermore, the IR has profoundly impacted the nature of work and 21st century skills, employee requirements and workforce preparedness (Anshari & Hamdan, 2022; Sakhapov & Absalyamova 2018). It has been evident that new jobs have emerged, but technology has subsequently made some of the jobs to undergo drastic changes or even perish (Autor, 2015; Frey & Osborne 2017). The First IR used water and steam power to transform manual labour into machine labour. This resulted in the emergence of a slew of new occupations and the transformation of the manufacturing sector (Sousa & Rocha, 2019; Yun & Lee, 2019). The Second IR, on the other hand, was marked by yet another great leap forward in innovation. The introduction of electricity, design, aeroplanes, avionics, the synthetic industry and mechanical engineering resulted in the rapid development of cutting-edge firms because of mass manufacturing, assembly lines and electrical power (Ranzatti et al., 2017).

According to Ranzatti et al. (2017), the above inventions aroused people's curiosity about science and engineering, thereby increasing the demand for qualified individuals in these fields. Electronics and computers were introduced during the Third IR, resulting in novel computerised operations (Yun & Lee, 2019). The need for qualified workers became even more urgent during

the Third IR, resulting in the rapid internationalisation of scholarly research via digital technology, as well as increased demand for training experts (Ogutu et al., 2014).

Since the beginning of the Fourth Industrial Revolution (4IR or Industry 4.0), there has been debate and discussion on this complicated phenomenon that can best be described as a combination of technology that blurs the barriers between man and machine (Schwab 2016). According to Frank et al. (2019), as the 4IR progresses, it has a complex picture that becomes even more perplexing. The only picture at this point is that digital skills will become increasingly vital in the workplace. The necessity for new abilities or talents becomes more obvious at the start of each succeeding IR.

Organisations in Botswana have notably continued to use unskilled workers for quite some time. The advent of the 4IR will result in some workers becoming redundant because of them not fitting the demands of technological advancement at the workplace. Therefore, this study sought to determine whether good training and development practices increase productivity.

The empowerment of people is at the heart of the 4IR. Allocating resources for workplace learning is the minimum requirement with updated technology to enable corporate training and assure a return on investment (ROI). Global companies must also address the skills shortages in their businesses. Workforce readiness, soft skills, technical skills and entrepreneurship are some of the most in-demand abilities in the 21st century (Frank et al., 2019). Employees should be encouraged to develop an entrepreneurial mindset by their employers. Instead of simply working for Chief Executive Officers (CEOs), today's employees should be able to take ownership of their jobs.

Transformative technologies are disturbing the traditional way of conducting business and will have a substantial influence on employment ranging from job creation to job displacement and from heightened labour productivity to widening skills gaps. It is noted in many organisations that there are mismatches between skills and job execution. With the wake of the 4IR in Botswana, most of the borehole drilling organisations are going to experience challenges as the equipment they use will be in full automation; hence, employee training will be a necessity.

The objective of the study is to determine the best practices of training and skills development in the wake of the 4IR and not to find out whether training and development practices increase organisational productivity.

## Research objectives

- To identify how technology affects training and skills development at Botswana borehole drilling companies.
- To examine the relationship between training and skills development and the 4IR at Botswana borehole drilling companies.
- To identify the benefits and challenges brought by technology in training and skills development at Botswana borehole drilling companies.

## Literature review

### The Fourth Industrial Revolution

The 4IR is defined by Prisecaru (2016) as a combination of improvements in simulating intelligence, automation and other technologies such as the 'Internet of Things', 3D printing, genetic engineering, quantum computing and others. The Inclusive Growth Forum describes the 4IR as the advent of 'cyber-physical systems' linking new competencies with people and machines. These competencies are dependent on the technologies and infrastructure of the Third Industrial Revolution. The 4IR signifies completely new methods in which technology becomes implanted within societies and even in human bodies.

The literature on the impact of 4IR on jobs has undergone a reversal from a pessimistic to a more optimistic outlook. Although several studies initially predicted that new technologies would eliminate a significant number of jobs, more recent estimates indicate the risk has been overstated (Ra et al., 2019). Three major findings by more recent studies offer reasons for optimism. Firstly, new research suggests that automation is more likely to replace tasks and activities within an occupation rather than eliminate jobs in their entirety. Secondly, rising salaries are likely to counteract job displacement that is caused by automation that is especially true in emerging countries (Acemoglu & Restrepo, 2018). Thirdly, technology adoption may not be economically feasible, thus displacement because of automation may not be immediate (Ra et al., 2019).

According to Frey and Osborne (2017), over 47% of total employment in the United States (US) will be automated in the next decade or two. The World Bank (2016) contends that 78% of occupations in emerging Asia might be automated. Frey and Osborne (2017) offered a similar gloomy picture. Their estimates show that the share of occupations that face the danger of automation ranges from 57% in Organisation for Economic Co-operation and Development (OECD) countries to 85% in Ethiopia. Recent studies that have improved the approach to looking at the influence of automation on tasks and activities within jobs have found reduced effects. For example, using a task-based approach, Arntz et al. (2016) evaluated the impact of automation on jobs in the US and established that just 9% of the jobs were at risk of automation, which was far less pessimistic than the Frey and Osborne (2013) prediction of 47%.

### Training and development

According to Mathis et al. (2015), training is the process taken for workers to acquire capabilities to be equipped for performing the jobs, while development refers to the initiatives and efforts applied to improve employees' ability to handle a variety of assignments and to cultivate capabilities beyond those required by the current job. Training is mostly short-term with a concrete goal; it focuses more on the role as it aims at a specific job or requirement and revolves around

present or immediate worker needs. Development, on the other hand, is more long term, focuses on the person or employee more, is more conceptual as it focuses on the overall progression of employees and is oriented towards the future (Masadeh 2012).

### Technology

Furthermore, some studies suggested that rising incomes raise the demand for products and services that serve as a countervailing force to technology-induced job losses. Technological innovation can enhance productivity and lower production costs resulting in lower prices and hence more discretionary income. Rising earnings because of increased productivity that emanates from technology adoption might raise demand in other industries. This spillover aids in the creation of jobs in other industries. In their research on how technology affected performance in South African firms, Autor and Salomons (2017) discovered that productivity increases owing to labour-saving technology can diminish employment in one area while helping to generate employment in other sectors and industries. Bessen (2017) demonstrated that while computer use decreased manufacturing jobs in South Africa between 2004 and 2017, it was associated with employment growth in non-manufacturing industries.

Although current research reveals that technology does not eliminate jobs in the aggregate, it is evident that employees will confront a transition as jobs fall in industries where technology is adopted but expand in other industries because of spillover effects (Autor & Salomons, 2017). According to a McKinsey Global analysis from 2017, up to 375 million people worldwide may need to switch to new occupations. This will necessitate workers to learn new skills regularly (Manyika et al., 2017).

The literature's second major finding is that technology will alter the nature of work. Non-routine and cognitive jobs are more likely to be created as they require higher-order cognitive and soft skills that are less susceptible to automation (Ra, 2018). According to a report by Price Waterhouse Coopers (2016), developing technologies will enable more occupations in the services sector that are more difficult to automate. According to the Asian Development Bank (2018), the demand for employment demanding no-routine cognitive activities has expanded at a quicker rate than the demand for professions that require regular and manual tasks.

According to a study of four rising Asian economies, employment in jobs that require non-routine cognitive skills grew 2.6 times faster than the total employment during the last decade (Khatiwada, 2020). Researchers and managers are two examples of non-routine cognitive professions. Automation is more likely to replace routine physical jobs such as assembly line workers and routine cognitive tasks such as data gathering than non-routine cognitive tasks (Keister & Lewandowski, 2017). Khatiwada and Veloso (2019) concur that highly skilled jobs account for 62% of new job titles in India (2004–2015) compared to 82% in Vietnam (1998–2008), 80% in Malaysia (1998–2008) and 61% in the Philippines (1990–2012).

According to Frey and Osborne (2017), the danger of automation is greater in low-wage and low-skilled jobs. As a result, appropriate preparation of the current and future workforce to shift to high-skilled employment is critical. Technological breakthroughs have enabled new ways of learning during the last decade; educational technology has been introduced at many stages of schooling around the world (Johnson, 2016). The provision of equipment and access to information and communication technology, scripted lesson plans to facilitate teaching and the use of adaptive learning software that supports individualised learning are all examples of technology-based techniques in education. Pure online courses and mixed approaches in which online courses are paired with face-to-face instruction have become more popular in higher education and training.

Furthermore, in recent years, a new breed of online courses that are known as massive open online courses (MOOCs) has proliferated. While the research on the impact of technology on educational results is inconsistent, it appears that education technologies function best when they improve pupils' ways of learning. For example, in the People's Republic of China, a game-based computer-assisted learning program that was developed to improve language learning outcomes has been related to increases in mathematics achievements (Lai et al., 2012). Adaptive learning in particular shows promise. To facilitate tailored learning, such systems employ power artificial intelligence to model learners' cognitive processes and pace content accordingly. Assessments, a mathematics homework platform that is used in the US, provide pupils with guidance based on their performance on specific problems (Roschelle et al., 2016).

The notion of adaptive learning technology is founded on the idea of teaching students abilities that have been shown to improve learning (Banerjee & Duflo, 2014). On the one hand, educational technology has tended to operate best when it supports good teaching and learning methods. Providing access to technology, on the other hand, does not improve learning (Autor & Salomons, 2017). It is critical to shift the educational and training systems' focus from what students learn to how they learn to improve learnability and technology utilisation. It is now necessary to adopt innovative approaches that focus on how students acquire digital skills using technology-driven learning. The adoption of inquiry-based and holistic learning methodologies is becoming more popular (Campos-Vazquez, 2017). Finland's education system adopted phenomenon-based learning in 2016 in which students investigate a phenomenon through an interdisciplinary lens and apply the material that is learned to the Industry 4.0 revolution (Spiller, 2017). Using technology in education and training, neuroscience research has produced significant evidence on how pleasurable experience can drive motivation, curiosity and higher cognitive functioning (Liu et al., 2017). There is also some evidence that a positive experience with technology in the classroom can

improve the brain's plasticity or ability to adapt to new information (Nelson 2017).

#### Training and skills development and the Fourth Industrial Revolution

The 4IR is all about empowering people; this comes on the premise that change in technology results in a change sought for employee skills (Cirillo, 2017). With advanced technology to aid corporate training and ensure a ROI, allocating resources for workplace learning is the minimum requirement (Park, 2016). Organisations must address the skills gaps in their industries so that their operations are sustainable. The 4IR came with the need for some of the most in-demand skills that are crucial for workforce readiness, namely soft skills, digital and computer skills, technical skills and entrepreneurship (Rotatori et al., 2021).

### Problem definition

Employee performance determines the growth of every firm, and talented personnel who are well-equipped with the latest technology are critical for constant and true success (Lorsch et al., 2002; Mihalcea, 2017). With non-existing expertise, organisations will continue using predictable techniques. If the skill is not available, corporations are hesitant to implement new technologies that are beneficial to the organisation to achieve their goals more effectively and efficiently (Elnaga & Imran, 2013). There is a requirement for human resource development with attention to emerging technologies (Mahapatro 2022). The downscaling of the drilling business in Botswana is a consequence of the ineffectiveness of the market. The Botswana drilling industry faces challenges that make it less competitive internationally. The 4IR has received little investigation in Botswana; hence, this study looked for the best practices in training and skills development in the aftermath of the Fourth IR and its impact on Botswana's borehole drilling companies.

## Research design

### Research approach and research design

This study used a descriptive research design and adopted a quantitative approach. The descriptive research design was adopted for this study because of its strength in accurately as well as systematically describing a situation, population or phenomenon. This research design was used because it helped the researchers to understand the best practices of training and skill development in the wake of the 4IR case of Botswana borehole drilling companies.

### Target population and sampling design

The target population was made of 300 employees, and a sample of 100 employees was used from two Botswana borehole drilling companies adopting simple random sampling.

### Measuring instrument

Semi-structured questionnaires were used as the data collection instrument. Questionnaires were appropriate for this study as they enable the gathering of first-hand information from a larger audience, in the form of a survey. Questionnaires are highly practical and can be carried out by any number of people, and results can be quickly quantified as well.

### Data collection procedure

Permission to administer questionnaires was sought through an introduction letter and signed consent forms. Once the questionnaire was given, the respondent filled it in and the researchers collected them directly, thereby giving them an opportunity to seek clarity.

### Data analysis

Statistical Package for the Social Sciences was used to analyse the data. Pearson's Correlation Matrix was carried out to establish the significance of the relationships of the variables namely how technology affects training and skill development and the relationship between training and skills development during the Fourth Industrial Revolution.

### Validity and reliability of the data collection tool

To ensure the validity and reliability of the data collection tool, research experts were given questionnaires to go through them and evaluate whether the questions effectively capture the topic under investigation. Moreover, a pilot test survey was done on a subset of the population. The whole idea was to remove ambiguous and vague questions that may lead to vague answers. Pilot testing of the instrument, therefore, gave an idea of how the respondents would interpret, understand and react to the questions. Feedback from pilot testing was used to refine the questions that may cause ambiguity and lead to misinterpretations.

### Ethical considerations

The researcher guaranteed the privacy and confidentiality of participants by advising the participants not to provide their names on the questionnaires and assuring them that the study is for academic purposes. In addition, informed consent was another important research ethic considered as the respondents had to sign consent forms denoting their voluntary participation and freedom to withdraw from the study. Study was approved by Botswana Open University Ethics Clearance Committee. Ethical clearance number: 201904373969

## Results

This section presents and analyses the results of the data gathered from workers of the borehole drilling companies. The presentation of the results addresses the research questions of the study.

### Effect of technology on training and skill development

The findings in Table 1 show the mean values of the responses to each of the scale items. The uppermost mean

value produced from the results shows that technology affects training and development with the ($m$ = 4.8600) which is approximately 5 on the statement that employees should be up to date with changes in technology, followed by the larger ($m$ = 4.3000) on the statement that training and skill development on technology improve on employee efficiency that is also approximately to 5. The range of the mean of the statement was from ($m$ = 3.7400 to $m$ = 4.8600), which reveals that the bigger number were supporting that technology affects skill and development. This indicated that change in technology will force employees to improve their skills to remain relevant and up to date with technology.

The Kaiser–Meyer–Olkin (KMO) test used in the data analysis is a statistical measure to determine how suited data is for factor analysis. The test measures sampling adequacy for each variable in the model and the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. The higher the proportion, the higher the KMO value, and the more suited the data is for factor analysis. The results presented in Table 1 indicated that all the scale items are valid as confirmed by the factor loadings and the KMO values. All the factors that were considered important in the analysis of the effect of technology on training and skill development accounted for 68.66%. The effect of technology on training and skill development amounted to a KMO measure of sampling adequacy of 0.533, and this is above the threshold of 0.5 for acceptable validity. The factor loadings were found to be statistically important at the 1% level, which is within the acceptable cut-off point of 0.5. The factor loadings ranged from 0.531 to 0.938, which is above 0.5. This confirms adequate convergent validity. Therefore, the results imply that the changes in technology also lead to changes in skill development and the need to train employees so that they adapt.

Table 2 shows the correlation between the explanatory variables of the effect of technology on skill development

**TABLE 1:** How technology affects training and skill development.

| Technology effects | KMO | Bartlett test | Mean | SD | AVE | Factor metrics |
|---|---|---|---|---|---|---|
| **Statements** | 0.533 | 66.850 | - | - | 68.66 | - |
| Employees should be up to date with changes in technology | - | - | 4.8600 | 4.90726 | - | 0.699 |
| Technology makes it a requirement that employees should constantly be trained with new skills | - | - | 3.8700 | 0.83672 | - | 0.912 |
| Training and skill development in technology improves employee efficiency | - | - | 4.3000 | 0.61134 | - | 0.938 |
| New technology leads to new training and skill development | - | - | 3.7400 | 1.29973 | - | 0.531 |
| Investment in new technology without proper training and skill development does not yield the required results | - | - | 4.1200 | 0.64008 | - | 0.757 |

KMO, Kaiser–Meyer–Olkin; AVE, average variance extracted; SD, standard deviation.

**TABLE 2:** Correlations of the effect of technology on skill development and training.

| Effect of technology | Employees should be up to date with changes in technology | Technology makes it a requirement that employees should constantly be trained with new skills | Training and skill development in technology improves employee efficiency | New technology leads to new training and skill development | Investment in new technology without proper training and skill development does not yield the required results |
|---|---|---|---|---|---|
| **Employees should be up to date with changes in technology.** | | | | | |
| Pearson Correlation | 1 | 0.029 | 0.174 | 0.069 | 0.181 |
| Sig. (2-tailed)** | - | 0.774 | 0.083 | 0.497 | 0.071 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Technology makes it a requirement that employees should constantly be trained with new skills.** | | | | | |
| Pearson Correlation | -0.029 | 1 | -0.436 | -0.329 | 0.293 |
| Sig. (2-tailed)** | 0.774 | - | 0.000 | 0.001 | 0.003 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Training and skill development in technology improves employee efficiency.** | | | | | |
| Pearson Correlation | -0.174 | -0.436 | 1 | 0.379 | 0.062 |
| Sig. (2-tailed)** | 0.083 | 0.000 | - | 0.000 | 0.540 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **New technology leads to new training and skill development.** | | | | | |
| Pearson Correlation | 0.069 | -0.329 | 0.379 | 1 | -0.266 |
| Sig. (2-tailed)** | 0.497 | 0.001 | 0.000 | - | 0.008 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Investment in new technology without proper training and skill development does not yield the required results.** | | | | | |
| Pearson Correlation | 0.181 | 0.293 | 0.062 | -0.266 | 1 |
| Sig. (2-tailed)** | 0.071 | 0.003 | 0.540 | 0.008 | - |
| *N* | 100 | 100 | 100 | 100 | 100 |

**Correlation is significant at the 0.01 level (2-tailed).

and training in borehole drilling companies. Pearson's Correlation Matrix was carried out to establish the significance of the relationships of the variables. Table 2 shows the correlation of the effects of technology on training and skill development using five variables and the correlation was found to be statistically significant at the 0.01 level (2-tailed).

The results summarise the relationship between the effect of technology and training and the skill development statement. The results showed that the relation between the statement that employees should be up to date with changes in technology and investment in new technology without proper training and skill development does not yield the required results is ($r$ = 0.181, $p$ < 0.01), the relationship between the statement that technology makes it a requirement that employees should constantly be trained with new skills and training and skill development on technology improves on employee efficiency ($r$ = 0.293, $p$ < 0.01). These results show that there is a positive relationship between the independent variables (statements from the questionnaire), which means that technology change has an impact on skill development and training in the borehole drilling industry.

## The relationship between training and skills development with the Fourth Industrial Revolution

The results in Table 3 illustrate the mean and standard deviation values of each scale item. The range of mean values ranges (from $m$ = 3.8200 to $m$ = 4.2500). The values of the mean are approximately 5, which indicated that there is a strong relationship between training and skill development and 4IR. The uppermost value from the results was on the statement that employees should be trained according to the technology employed by the company ($m$ = 4.2500) and the lowest is on the statement that changes in technology lead to changes in skills ($m$ = 3.8200). The standard deviation values (SD) range from (SD = 0.53889 to SD = 0.90319). The high positive value of standard deviation means that the data was evenly distributed indicating there is a strong relationship between training and skill development and the 4IR.

Table 3 is showing the results of the factor loading and KMO confirming that all the scale items are valid. The average of all factors is 67.00% accounting that all factors were considered valid in the analysis of the relationship between training and skill development and the 4IR. The relationship between training and skill development and the Fourth Industrial Revolution amounted to a KMO measure of sampling adequacy of 0.586, which is above the threshold of 0.5 for acceptable validity. Similarly, the factor loadings were ranging from 0.560 to 0.690, which is above 0.5 and is confirming adequate convergent validity. Therefore, this result has proved that there is a strong positive relationship between training and skill development and the 4IR.

Table 4 shows the correlation between the explanatory variables of the relationship between training and skills development during the 4IR. Pearson's Correlation Matrix was carried out to establish the significance of the relationships of the explanatory variables. Table 4 is showing the correlation between training and skills development with the 4IR and the results are found to be statistically significant at the 0.01 level (two-tailed).

The correlation between the statement that changes in technology lead to changes in skills and technology brings efficiency and effectiveness to workplaces ($r$ = -0.272, $p$ > 0.01). On the same hand the correlation between the statement that technology leads to improvement in training and skill development ($r$ = 0.101, $p$ > 0.01) and employees should be trained according to the technology employed by the company ($r$ = 0.462, $p$ > 0.05). The results show a positive but weak association between the explanatory variables, which therefore results indicated a weak relationship between training and skill development with the 4IR.

## The benefits and challenges brought by technology in training and skill development

This subsection presents the results of the benefits and challenges brought by technology in training and skill development. The validity and reliability of the constructs were tested using the Kaiser-Meyer-Olkin (KMO), Bartlett's Test of Sphericity (BTS), and the Average Variance Extracted (AVE). The individual scale items were rated using the mean and the standard deviation.

The results in Table 5 show the nine-factor loading of the explanatory variables on the benefits and challenges brought by technology in training and skill development. The KMO is 0.534, which is higher than the acceptable limit

**TABLE 3:** The relationship between training and skills development with the Fourth Industrial Revolution.

| Relationship between the variables | KMO | Bartlett test | Mean | SD | AVE | Factor metrics |
|---|---|---|---|---|---|---|
| **Statements** | 0.586 | 186.721 | - | - | 67.00 | - |
| Changes in technology lead to changes in skills | - | - | 3.8200 | 0.90319 | - | 0.607 |
| Technology leads to improvement in training and skill development | - | - | 4.1700 | 0.58698 | - | 0.690 |
| Employees should be trained according to the technology employed by the company | - | - | 4.2500 | 0.55732 | - | 0.688 |
| Management at our company emphasises on training and development of employees when introducing new technology | - | - | 4.1800 | 0.62571 | - | 0.560 |
| Technology brings efficiency and effectiveness to workplaces | - | - | 4.0500 | 0.53889 | - | 0.588 |

KMO, Kaiser–Meyer–Olkin; AVE, average variance extracted; SD, standard deviation.

**TABLE 4:** Correlations between training and skills development with the Fourth Industrial Revolution.

| Correlations between variables | Changes in technology lead to changes in skills | Technology leads to improvement in training and skill development | Employees should be trained according to the technology employed by the company | Management at our company emphasises on training and development of employees when introducing new technology | Technology brings efficiency and effectiveness to workplaces |
|---|---|---|---|---|---|
| **Changes in technology lead to changes in skills** | | | | | |
| Pearson Correlation | 1 | 0.668 | 0.151 | 0.398 | -0.272 |
| Sig. (two-tailed)** | - | 0 | 0.135 | 0.000 | 0.006 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Technology leads to improvement in training and skill development** | | | | | |
| Pearson Correlation | 0.668 | 1 | 0.486 | 0.081 | 0.101 |
| Sig. (two-tailed)** | 0.000 | - | 0.000 | 0.424 | 0.319 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Employees should be trained according to the technology employed by the company** | | | | | |
| Pearson Correlation | 0.151 | 0.486 | 1 | -0.449 | 0.462 |
| Sig. (two-tailed)** | 0.135 | 0.000 | - | 0.000 | 0.000 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Management at our company emphasises on training and development of employees when introducing new technology** | | | | | |
| Pearson Correlation | 0.398 | 0.081 | -0.449 | 1 | -0.446 |
| Sig. (two-tailed)** | 0.000 | 0.424 | 0.000 | - | 0.000 |
| *N* | 100 | 100 | 100 | 100 | 100.000 |
| **Technology brings efficiency and effectiveness to workplaces** | | | | | |
| Pearson Correlation | -0.272 | 0.101 | 0.462 | -0.446 | 1 |
| Sig. (two-tailed)** | 0.006 | 0.319 | 0.000 | 0.000 | - |
| *N* | 100 | 100 | 100 | 100 | 100 |

**Correlation is significant at the 0.01 level (two-tailed).

**TABLE 5:** The benefits and challenges brought by technology in training and skill development.

| Benefits and challenges of technology | KMO | Bartlett test | Mean | SD | AVE | Factor metrics |
|---|---|---|---|---|---|---|
| **Statements** | 0.534 | 365.868 | - | - | 60.67 | - |
| Technological changes make other employees redundant. | - | - | 3.8000 | 1.14592 | - | 0.889 |
| Effective use of technology needs the necessary infrastructure. | - | - | 4.1300 | 0.73382 | - | 0.888 |
| Most organisations cannot comprehend new technology. | - | - | 4.0600 | 0.87409 | - | 0.658 |
| The level of economic growth can also be affected by the level of technological implementation. | - | - | 3.3200 | 1.44166 | - | 0.697 |
| Introduction of new technology if not properly implemented and managed can bring dire consequences. | - | - | 3.7500 | 1.32097 | - | 0.768 |

KMO, Kaiser–Meyer–Olkin; AVE, average variance extracted; SD, standard deviation.

of 0.5. The benefits and challenges brought by technology in training and skill development statement account for an average of 60.67%. The factor loading ranges from 0.658 to 0.889. As per the factor metrics, technological changes that make other employees redundant can be singled out as the dominant response with the highest factor loading of 0.889. These results indicated that the instrument is valid to measure the benefits and challenges brought by technology in training and skill development. The standard deviation shows the range from (SD = 0.73382 to SD = 1.44166). The positive values indicate that the responses are valid to measure the benefits and challenges brought by technology to training and skill development.

Table 6 is presenting the correlation between the variable statements of the benefits and challenges brought by technology in training and skill development. Pearson's Correlation Matrix was carried out to establish the significance of the relationships between the variables. Table 6 is showing the correlation of the benefits and challenges brought by technology in training and skill development and the results are found to be statistically significant at the 0.01 level (two-tailed).

The results in Table 6 illustrate a strong association between employees becoming redundant as a result of technological advancement. The statement that technological changes make other employees redundant ($r = 0.734$, $p < 0.05$) indicated there is a strong relationship that technological changes can lead to redundancy in other employees. The study results on the statements that effective use of technology needs necessary infrastructure ($r = 0.569$, $p < 0.05$), most organisations cannot comprehend new technology ($r = 0.022$, $p < 0.01$), the introduction of new technology, if not properly implemented and managed, can bring dire consequences ($r = 0.734$, $p < 0.05$) indicate a strong association on the challenges brought by changes in technology.

## Discussion

The study noted that there was a high knowledge level on questions concerning opportunities and challenges

**TABLE 6:** Correlation of the benefits and challenges brought by technology in training and skill development.

| Correlation of benefits and challenges | Technological changes make other employees redundant | Effective use of technology needs the necessary infrastructure | Most organisations cannot comprehend new technology | The level of economic growth can also be affected by the level of technological implementation | The introduction of new technology if not properly implemented and managed can bring dire consequences |
|---|---|---|---|---|---|
| **Technological changes make other employees redundant** | | | | | |
| Pearson correlation | 1 | -0.569 | 0.022 | 0.669 | 0.734 |
| Sig. (two-tailed)** | - | 0.000 | 0.827 | 0.000 | 0.000 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Effective use of technology needs necessary infrastructure** | | | | | |
| Pearson correlation | 0.569 | 1 | 0.611 | 0.383 | 0.336 |
| Sig. (two-tailed)** | 0.000 | - | 0.000 | 0.000 | 0.001 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Most organisations cannot comprehend new technology** | | | | | |
| Pearson correlation | 0.022 | -0.611 | 1 | -0.248 | 0.083 |
| Sig. (two-tailed)** | 0.827 | 0.000 | - | 0.013 | 0.411 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **The level of economic growth can also be affected by the level of technological implementation** | | | | | |
| Pearson correlation | 0.669 | -0.383 | -0.248 | 1 | 0.838 |
| Sig. (2-tailed)** | 0.000 | 0.000 | 0.013 | - | 0.000 |
| *N* | 100 | 100 | 100 | 100 | 100 |
| **Introduction of new technology if not properly implemented and managed can bring dire consequences** | | | | | |
| Pearson correlation | 0.734 | 0.336 | 0.083 | -0.838 | 1 |
| Sig. (two-tailed)** | 0.000 | 0.001 | 0.411 | 0.000 | - |
| *N* | 100 | 100 | 100 | 100 | 100 |

**Correlation is significant at the 0.01 level (two-tailed).

presented by 4IR in borehole drilling industry. However, this does not translate to the fact that the skills risk posed by new technology is low, but it is dependent on whether the employees have been equipped with the necessary skills (Lukowski et al., 2021; Ra et al., 2019). On the other hand, respondents had the lowest knowledge levels in questions on whether or more challenges are posed as compared to benefits when it comes to introducing the 4IR in the borehole drilling sector.

Proper training and development play an important role in curbing skill lagging in the borehole drilling sector. Several enactments have set some guidelines for businesses in different sectors to ensure that proper training and skills development is conducted at the workplace. It is pathetic to note that from the study only 30% indicated that they do not seem to know if there is any relationship existing between training and skills development with the 4IR concerning the borehole drilling industry. This result strikes a similarity with what was reported by Jenpanich (2015) on a like research carried out in Thailand in which the employees indicated that they were not sure if the training they received was going to aid them in carrying out their duties. However, training and skills program practices do not entirely result in the employees being able to use new technology. Training programs should be appropriate to the needs and requirements of the job and the employees, and a proper training needs assessment should be conducted to promote training effectiveness.

Employees trained in technology and skills seemed to have a better understanding of how to use current technology in carrying out their tasks than their untrained fellows. It was also determined by statistical analyses that there is a significant relationship between training and skills development and the 4IR in the borehole drilling sector ($p < 0.05$). These results support earlier work by (Cuprasitrut et al., 2011; Rahman et al., 2012) on similar research done in Asia. Statistical analyses revealed a significant association between training and skills development and implementation of the 4IR ($p < 0.05$).

A mere 7% of the respondents seem to strongly disagree with the statement that technological advances make other employees redundant. According to Ra et al. (2019), some new technologies would mean that new employment is going to be created or it is still the same job title that is going to be in a different form. In the study a large portion of respondents (67%) maintained that they agree with the statement that the introduction of 4IR has adversely affected employees by making them redundant; this seems to be concurring with the writing of Dachs (2018) on the impacts of technology on the labour market where it was established that the introduction of technology is going to result in more people being laid off as a result of the introduction of new technology.

The findings from the study also show the correlation between the explanatory variables of the effect of technology on skill development and training in borehole drilling companies. The findings support the same notion raised by Cirillo (2017) in prior studies. Pearson's Correlation Matrix was carried out to establish the significance of the relationships of the variables. The study established that the effect of technology on training and skill development using five variables was that there is a correlation found to be statistically significant at the 0.01 level (two-tailed).

The results summarise the relationship between the effect of technology and training and the skill development statement. The results showed that the relation between the statement that employees should be up to date with changes in technology and investment in new technology without proper training and skill development does not yield the required results ($r = 0.181, p < 0.01$); the relationship between the statement that technology makes it a requirement that employees should constantly be trained with new skills, and training and skill development on technology improves on employee efficiency ($r = 0.293$, $p < 0.01$). These results show that there is a positive relationship between the independent variables (statements from the questionnaire), which means that technology change has an impact on skill development and training in the borehole drilling industry.

In the study, it was established that the correlation between the explanatory variable of the relationship between training and skill development and the 4IR exists. The study findings denote that there is a weak correlation between the statement that changes in technology lead to changes in skills that is relative to technology, brings efficiency and effectiveness to workplaces ($r = -0.272$, $p > 0.01$). Similarly, there is a weak correlation between the statements that technology leads to improvement in training and skill development ($r = 0.101, p > 0.01$) and that employees should be trained according to the technology employed by the company ($r = 0.462$, $p > 0.05$). The results show a positive but weak association between the explanatory variables, which therefore indicates a weak relationship between training and skill development during 4IR.

### Practical implications

The findings of this study can be valuable to operations managers and human resource managers as they are champions of the organisation's core resources such as human skills that must be matched to the appropriate job tasks. Botswana as a developing country requires awareness of how employees in the borehole drilling industry utilise skills in relation to new technology to improve their work ethics and decision-making. The study will also be used by government institutions to track human resource strategic plans across Botswana's workforce to comprehend both the positive and negative implications of the 4IR.

### Limitations

Although the results of this research confirmed that technological change has an impact on skills development and training, it is difficult to generalise these results due to some methodological limitations. This is because, firstly, the study was conducted for Botswana borehole drilling companies. Secondly, the quantitative research design used to collect the data may have resulted in getting slightly fewer insights into the perceptions, thoughts, and motivations of the study participants.

### Recommendations

To promote the uptake of the 4IR, the study recommends that businesses in the borehole drilling sector should formulate new approaches and measures to strengthen inclusion and social protection in the context of 4IR. It is critical to ensure that the country's journey towards 4IR includes providing opportunities to the underprivileged. Support for three types of workers is needed: entry-level workers, workers at risk of job displacement and workers needing up-skilling. Modern delivery mechanisms, including digital platforms with industry-recognised credentials, can reach the underprivileged in remote locations and could analyse variations in access to critical skills by age, gender, geography and economic background. This could then inform the targeted training programs, which could be developed in conjunction with the private sector. For example, Microsoft has established several targeted programs that address the relative disadvantages faced by at-risk youth, women, long-term unemployed individuals and people with disabilities.

As a requirement of the rapidly changing technology, businesses in the Botswana borehole drilling sector should always avail training and skills development if their staff to keep abreast with new technology. Further studies should focus on how new technology can be incorporated into the operations of the Botswana borehole drilling industry. Moreso, the study recommends conducting more studies in other institutions, especially in the public sector to improve service delivery.

## Conclusion

The research attempted to achieve the three objectives of the study and an investigation of the best practices of training and skills development in the wake of the 4IR was carried out. Skill development is a complex discourse and involves a unique process to come out with a complete employee who would be identified as a finished product of the same process. Following what respondents revealed, training and skill development should be a recurring process where employees are continuously being equipped with new skills.

It emerged from the study that training and skills development play an important role in acquainting employees with new skills, especially in this modern day of technological advancement. The Computer-Aided Manufacturing (CAM) method has dominated most workplaces that have computers. Technology is now found everywhere.

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### Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

### Authors' contributions

O.K.S. conceptualised the idea and did the data collection and analysis. E.Z. did the writing of the manuscript.

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### Data availability

The data that support the findings of this study are available on request from the author, O.K.S.

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