Millennial perceptions of the 4th industrial revolution in an information technology company

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COMMENTS

The reader is reminded of the following;

- The references, as well as the editorial style, comply with the requirements prescribed by the *Publication Manual* (6th edition) of the American Psychological Association (APA).

- The mini dissertation is submitted in the form of a research article.

I, Lerato P. Morathi, hereby declare that *Millennial perceptions of the 4th Industrial Revolution in an information technology company* is my own work and that the views and opinions expressed in this work are my own and those of the relevant literature references as indicated.

Furthermore, I declare that the contents of this research study will not be submitted for any other qualification at any other tertiary institution.

LERATO P. MORATHI   NOVEMBER 2019

DECLARATION FROM THE LANGUAGE EDITOR

I hereby declare that I was responsible for the language editing of the mini-dissertation entitled 'Millennial perceptions of the 4th Industrial Revolution in an information technology company', submitted by L. P. Morathi (29427266).

Dr Elsabé Diedericks
BA, Hons, HED, Hons, MA, PhD

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SUMMARY

Title: Millennial perceptions of the 4th Industrial Revolution in an information technology company

Keywords: 4th Industrial Revolution, Industry 4.0, millennials, technological revolution, digitisation, workplace.

The 4th Industrial Revolution is in the early stages and impacting every aspect of life. Businesses are realising economies of scales as a result of the technologies introduced by this era; thus, creating uncertainty where existing jobs are concerned as new skills are required. Millennials are the largest generation cohort in the labour market, and they will be required to reconsider their career ambitions in order to remain relevant in this era.

The general objective of this study was to establish millennial perceptions of the 4th Industrial Revolution in an information technology company. A qualitative research design was used, utilising a semi-structured interview approach to obtain data from millennials employed in an information technology company. Participants ($n = 15$) were identified using purposive sampling and were approached, based on the research requirements. Once data had been collected, a content data analysis approach was used to analyse the recorded data.

The results indicated that millennials describe the 4th Industrial Revolution as a phenomenon that has emerged from the 3rd Industrial Revolution. They also associate this era with the introduction of technologies such as artificial intelligence (AI), biotechnology, robotics and automation. They suggest that these technologies are reducing the amount of administrative and physically intensive work. However, as a result of this, they suggest that certain jobs are becoming redundant and new career opportunities are emerging, bringing about a demand for new skills as business demands change. Therefore, millennials suggest that they need to reskill and upskill in order to keep up with and align to the 4th Industrial Revolution. They also suggest that organisations need to support them through establishing people inclusive strategies and provide further support through skills development initiatives that are future focused.

CHAPTER 1

INTRODUCTION, PROBLEM STATEMENT AND OBJECTIVES

The purpose of this chapter is to orientate the reader to the study investigated in this mini dissertation. The main aim of the study is to explore millennial perceptions of the 4th Industrial Revolution in an information technology company. A brief introduction of the study will be provided, followed by a detailed problem statement. A statement of the main research questions, as well as the aims guiding the study will be outlined. This will be followed by the ontological and epistemological positioning, and a discussion of the research methodology guiding the study. Ethical matters related to this study will then be described, and the chapter will then be concluded with an outline of the division chapters of the mini dissertation.

1.   INTRODUCTION

The world is in the early stages of a digital and technological revolution that is impacting every aspect of human existence. Known as the 4th Industrial Revolution, or Industry 4.0, it is changing the way in which people communicate, consume, produce, and work (Daemmrich, 2017), blurring the lines between the physical, digital and biological spheres, and giving way to a deeper integration of technology into society (Kodama, 2018). This is influencing all business disciplines, economies, and even challenging what it means to be human (Schwab, 2018).

At the core of these changes is the objective of driving technological principles and solutions that increase economies of scale (Dombrowski & Wagner, 2014). These drivers motivate organisations to re-evaluate and amend their processes, technologies, organisational behaviours, and even the skills required to gain a competitive advantage and thrive in an environment of continuous change and uncertainty (Aslam, Ilyas, Imran, & Rahman, 2016). This has led to the automation and digitisation of specific functions, bringing about significant organisational changes to current business models across all industries and sectors (Contreras, Garcia, & Diaz, 2017). Thus, posing a threat to existing jobs and the skills required to perform them, as new job functions emerge (Butler-Adam, 2018), making job dislocation prevalent in the process, and increasing the demand for new skills (Hirschi, 2018).

1.1. Problem Statement

It is evident that organisations are already establishing themselves in a digitised environment; however, this is not the case where human capability is concerned (Holmlund, Strandvik, & Lähteenmäki, 2017), particularly in relation to the volatile shift in the nature of work and future skills requirements (Collings & Isichei, 2018). Brynjolfsson and McAfee (2012) concur with this and argue that the biggest challenge the world is facing is that the current skills do not meet the demands of the technological advancements made. Therefore, as the 4th Industrial Revolution progresses, it will increase inequality as labour markets are further disrupted (WEF, 2016). Technologies such as automation and artificial intelligence will substitute a large number of job functions, and the net displacement of workers by machines will exacerbate the gap between return on capital versus return on labour (Xu, David, & Kim, 2018).

Driven by technology, an organisation's most valuable resource will no longer be its large workforce (Taylor, 2016). Instead, it will be its technology and its most talented individuals, with the most relevant skills being retained (Xu et al., 2018). In the long run, this is going to impact developing countries, such as South Africa, where the creation of employment has been providing the world with low cost labour, particularly in areas of mass production and customer services (WEF, 2016). Jobs in such areas are increasingly being replaced by computers and automation, and organisations are seeing greater returns through adopting next generation technologies that can perform the same functions at a faster and cheaper rate than a human can (Ślusarczyk, 2018). Whilst leaders suggest that reforming the basic education system is crucial for this era, it is not possible to weather the current technological advancements by waiting for the next generation to enter the workforce with the relevant set of skills (WEF, 2016). Therefore, the focus needs to be on the generations in the current labour market.

Companies that operate within the IT sector are a key driver of the 4th Industrial Revolution (Kaba & Said, 2014). This is because they provide the infrastructure and innovation that facilitate the transition towards digitisation (Pretorius, Mawela, Strydom, De Villiers, & Johnson, 2015). Millennials form a large part of this sector and have transformed it with their striking characteristics (Robinson, 2017). They are currently at the peak of their careers, transitioning into leadership roles, or entering the job market (Canedo, Graen, Grace, &

Johnson, 2017). Many of them have acquired specific skills and are establishing themselves in various professions (Hirschi, 2018). However, they are faced with the challenge of building and establishing their careers during a time of great technological change and uncertainty (Canedo et al., 2017).

Millennials are under pressure to manage their careers during a period that is undergoing technological changes accompanied by accelerated change, talent shortage, mass unemployment and growing inequalities (WEF, 2016). Further, in a recent study conducted by Deloitte (2018), only a quarter of the leaders surveyed felt that their current workforce had the right skills for the future. This highlights how crucial it is for individuals to think about how they intend re-skilling and up-skilling themselves for current and future needs (Schwab, 2018). This creates a need to establish if this generation understands what the concept of the 4th Industrial Revolution is and what it means for their careers and professional development, as they are increasingly becoming the largest contributors to the new world of work (WEF, 2016). This study therefore sought to understand the perceptions in terms of the 4th Industrial Revolution among millennials working in an information technology company.

1.2.   Literature Review

For the purpose of providing further context to the constructs of the proposed study, a brief literature synthesis was presented below dealing with the 4th Industrial Revolution first and thereafter the millennials.

1.2.1.   The 4th Industrial Revolution

Industrial Revolutions are historical periods of change and disruption in various disciplines that are associated with society and the economy at large (Bonciu, 2017). They are based on the evolution of human knowledge and innovation, changing the values, behaviours, economic activities, and scales of power within various societies (Ślusarczyk, 2018). Industrial Revolutions may also affect the environment, positively or negatively, as they may require specific resources to generate specific outputs (Bonciu, 2017). They may have a positive impact in the form of useful products and services, or a negative impact in the form of waste, pollution, and climate change (Bonciu, 2017). In the context of the current economic climate, Schwab (2018), the founder of the World Economic Forum (WEF), relates the term "revolution" with aspects of industry, science and technology that are abrupt and change radically. Schwab (2018) argues that what differentiates an Industrial Revolution

from mere technological improvements is that it takes place at a larger scale, introducing a new way of performing certain activities.

The 4th Industrial Revolution is a concept that is mainly used in popular science to describe the current era of economic and technological advancements (Roblek et al., 2016). Introduced by the German Federal Government to promote its high-tech strategy, this multi-faceted term is made up of a variety of interdisciplinary concepts such as artificial intelligence, automation, robotics, cyber-physical systems, the internet of things (IoT), the internet of systems (IoS), machine learning and big data, to name a few. These concepts are characterised by three core aspects that uniquely distinguish the 4th Industrial Revolution from the previous ones. Firstly, they enable continuous interaction and exchange of information, not only between humans, but also humans and machines, and machine-to-machine (Roblek, Meško, & Krapež, 2016). Thus, increasing the integration of computation, networking, as well as physical processes (Glistau & Coello, 2018). Secondly, they are disruptive innovations that can create radical change, and allow for organisations to increase operational efficiencies and effectiveness. Lastly, they facilitate the development of machines that possess the ability to behave autonomously through technologies such as artificial intelligence and machine learning (Ślusarczyk, 2018).

Often used as a synonym for the planned 4th Industrial Revolution that brings about major technological potential, the 4th Industrial Revolution is comparable to the developments made in the 1st Industrial Revolution when the field of mechanisation emerged; the 2nd Industrial Revolution with the introduction of electricity; as well as the 3rd Industrial Revolution with the rise of computer services (Oesterreich & Teuteberg, 2016). As with the previous revolutions, the 4th Industrial Revolution is a paradigm shift as far as the pattern of innovation and technology is concerned (Kodama, 2018); therefore, enabling new capabilities for people and machines. Whilst these capabilities are reliant on the infrastructure of the 3rd Industrial Revolution, the 4th Industrial Revolution provides an entirely new way in which technology is embedded into society (Schwab, 2018). Automation and digitisation of certain job functions are enabled, making fundamental changes and technological breakthroughs to the concept of work as we know it (Hirschi, 2018). These elements create a digital value chain for organisations, resulting in an increase in efficiency, flexibility, and delivery times as the landscape becomes increasingly agile (Glistau & Coello, 2018). However, theorists argue

that this may lead to the redundancy of many jobs and the emergence of new occupations and industries (Hirschi, 2018).

1.2.2. Millennials

The study of generations in the workplace has been widely researched over the last few decades (Lyons, Urick, Kuron, & Schweitzer, 2015). Generations are classified using bands of time that include birth years of individuals sharing similar characteristics as shaped by specific events and conditions surrounding their lives (Johnston, 2013). As a guideline, generations are classified using an age range that is based on a common history of events, as well as conditions individuals experience during their formative years that ascertain who they are as a group (Martins & Martins, 2014). Thus, providing further insight into how different generations differ in social context and in the workplace (Heyns & Kerr, 2018). For the purpose of this study, the researcher focused on the millennial group.

With striking characteristics that have intrigued researchers, millennials have transformed the workplace over the years (Alton, 2019). Compared to previous generations, research suggests that they demonstrate contrasting attitudes, values, beliefs and aspirations (Buzza, 2017). Born between 1982 and 2000, they have become the largest population in the workplace and will dominate the work environment for years to come (Buzza, 2018; Heyns & Kerr, 2018). In South Africa, millennials are made up of a group that is old enough to be part of the old regime; however, not old enough to have participated in it. Millennials also constitute a group that was born into the new world order, referred to as the "born free" generation (Martins & Martins, 2014). The South African millennial cohort is characterised by, but not limited to, diversity and integration, participation in work teams, a need to be recognised, access to technology and global influence (Martins & Martins, 2014). They are also opinionated, achievement-orientated, energised and educated. However, it theorised that they lack experience, soft skills, deadline orientation and planning skills that could lead to conflict and frustration with the older generations (Martins & Martins, 2014).

The 4th Industrial Revolution is at its starting point, and to some extent, a large part of the technologies remain in the realm of theory and speculation (Butler-Adam, 2018). However, what is apparent is that digitisation and automation are changing the concept of work. Accordingly, as individuals in this generation progress in their respective occupations, maturing into higher ranks professionally, they will have to look at their careers differently

(Hirschi, 2018). Although this presents a lot of opportunities, it also creates some degree of uncertainty.

1.3.   Research Questions

The major research question is "What are the perceptions of millennials working in an IT company in South Africa regarding the 4th Industrial Revolution?"

The following sub-questions were formulated in the context of the proposed study:
- How do millennials describe the 4th Industrial Revolution?
- What impact does the 4th Industrial Revolution have on millennials professionally?
- What opportunities have the 4th Industrial Revolution presented?
- What challenges have the 4th Industrial Revolution presented?
- What do millennials think is required from them to be aligned to the perceived changes introduced by the 4th Industrial Revolution?

1.4.   Research Objectives

The research objectives were divided into general objectives as well as specific objectives.

1.4.1. General Objective

The general objective of this research was to establish millennial perceptions of the 4th Industrial Revolution in an information technology company.

1.4.2. Specific Objectives

The specific objectives of this research were to:

1. Establish the way in which millennials describe the 4th Industrial Revolution;
2. Understand the impact that the 4th Industrial Revolution has had on millennials;
3. Establish the opportunities that the 4th Industrial Revolution has presented for millennials;
4. Ascertain the challenges that the 4th Industrial Revolution has presented for millennials; and
5. Understand what millennials felt is required from them to be aligned to the perceived changes that the 4th Industrial Revolution has introduced.

1.5. RESEARCH DESIGN

1.5.1. Research Approach

For the purpose of this study, a qualitative research approach was utilised. Qualitative research investigates the subjective opinions, attitudes, beliefs, and reflections of individual experiences in relation to the outer world (Percy, Kostere, & Kostere, 2015). It involves the collection of data through observing or interviewing participants to gain an understanding of their lived experiences and/or perceptions. This brings focus to the social aspects of research, through the lenses of individuals, in the attempt of answering a specific research question (Rutberg & Bouikidis, 2018). The aim of this study was to understand the perceptions of millennials with regard to the 4th Industrial Revolutions. It is through a qualitative lens that the researcher believed that the ideas and hypotheses pertaining to this subject could be drawn or developed as subjects engaged with the phenomenon (Levitt, Motulsky, Wertz, Morrow, & Ponterotto, 2018). Thus, generating rich data from participant interviews in order to answer the research question (Rutberg & Bouikidis, 2018).

1.5.2. Research Philosophy

Philosophical assumptions and considerations guide the principles of the research process. For the purpose of this research, the ontological and epistemological approaches were discussed as follows:

1.5.2.1. Ontology

Ontology is defined as the science of 'what is?', and what constitutes reality (Joslin & Müller, 2016). It is concerned with identifying and understanding the existence, nature and causation of reality, with the focus being on the beliefs that reflect interpretations made by individuals as to what constitutes reality (Cushion & Partington, 2016). The ontological paradigm that was used to guide this research was from a constructivism view. From a social sciences perspective, a constructive paradigm is based on the argument that reality is constructed by individuals as they experience or perceive it (Xyst, 2016). Accordingly, in this case reality is theorised to be subjective, and is based on the engagement that one would have with the construct in question. Thus, the argument is that a researcher can truly understand a certain phenomenon by interacting with the people who experience it (Joslin & Müller, 2016). To understand millennial perceptions of the 4th Industrial Revolution, the researcher engaged with millennials that are employed in an information technology company to establish their experiences and perceptions regarding the phenomenon.

1.5.2.2. Epistemology

Epistemology is concerned with the nature and scope of knowledge, and the way in which it is acquired. Its focus is on the origin, nature, methods, and limits of human knowledge, as well as the distinction between justified belief and opinion (Joslin & Müller, 2016). Epistemology further focuses on the relationship or interaction that exists between reality and the researcher. It examines the relationship between the knower or subject, and the 'would-be' knower, referred to as the researcher (Guyon, Kop, Juhel, & Falissard, 2018). Epistemology from a qualitative perspective therefore attempts to not only understand the world in a set of assumptions, but to also interrogate the beliefs held on a given body of evidence (Cushion & Partington, 2016).

The epistemological paradigm that was used to guide this research was that of interpretivism. An interpretive assumption aims to understand the subjects of interest in their subjective reality. The focus from this view is based on how individuals make sense of various situations as they encounter them (Packard, 2017). As such, the role of the researcher would be to understand, explain and clarify social reality through the eyes of the subjects or participants. This would then drive the formulation of concepts as data is obtained through the interaction (Isaeva, Bachmann, Bristow, & Saunders, 2015). For this study, the researcher gained insight on the research topic through participant experiences and their subjective interpretation, and the interpretation of the researcher.

1.6. Research Approach

In qualitative research, there are various research approaches that can be utilised that are humanistic, interactive and actively involve the subjects being researched (Englander, 2012). The research approach that was proposed for this study is a constructivist and naturalistic paradigm, known as interpretive description (Clark, Spence, & Holt, 2011). Interpretive description is a grounded approach that a researcher can apply to identify themes and patterns that emerge within the context of a phenomenon (Archibald, Caine, Ali, Hartling, & Scott, 2015). Although it is informed by relevant literature within a discipline that informs the research question, an interpretive description inquiry assumes that prior research cannot possibly encompass these multiple realities (Clark, Spence, & Holt, 2011).

The assumption is that multiple realities exist, and knowledge is generated as the researcher and subject interact to shape and co-create an understanding of a phenomenon (Clark, Spence, & Holt, 2011). The approach is therefore inductive, and the researcher would engage with subjects to collect data, establish themes and develop codes in developing theory (Brewer, Harwood, McCann, Crengle, & Worrall, 2014). For this study, the researcher engaged with participants, and recorded new topics and theoretical concepts that occurred as engagement took place in relation to the phenomenon. Themes were coded as the research progressed.

1.7.   Research Method

1.7.1. Literature Review

In phase 1 a complete review regarding the 4th Industrial Revolution and millennials in South Africa was conducted. The sources that were consulted include online business reports, online articles, textbooks, academic journal articles, as well as databases such as Google Scholar and the North-West University online library. Articles used for the study were from studies that were conducted between the year 2014 and the year 2019. Articles older than the timeframe specified were consulted where necessary. The researcher also looked at studies in journals such as *The Journal of Organizational Change Management*, *Computers in Human Behaviour*, *South African Journal of Science*, *Journal of Human Resources*, *Journal of Open Innovation: Technology, Market and Complexity*, *Journal of Management*, and the *Journal of Business Inquiry* amongst others, due to their relevance to this study. Further, the researcher consulted websites such as *Forbes.com, Deloitte* and the *World Economic Forum* due to the extensive and current studies that have been provided by these platforms. Key words used to search for articles relevant to the study are "4th Industrial Revolution", "Industry 4.0", "the future of work", "technology", "automation", "digitisation", "millennials", "future skills", and "skills gap".

1.7.2. Research Setting

The research was conducted at an IT company based in Gauteng, South Africa. Participants were provided with an information sheet and an informed consent form that required their signature prior to collecting data within their natural setting (Creswell & Creswell, 2018). Once consent forms had been signed, the researcher commenced with the data collection process at the information technology company where the participants were employed.

1.7.3. Role of the Researcher

Creswell and Creswell (2018) suggest that it is the researcher's responsibility to ensure entry into a research location. Prior to collecting data, the researcher approached the management of the current organisation where he is employed. The researcher requested a meeting to discuss the intended research study with the relevant stakeholders. He also provided the relevant managers with an approval letter from the scientific and ethics committee, indicating the intention of the study, as well as the data collection process that was employed.

Creswell and Creswell (2018) further indicate that the role of the researcher needs to be clearly defined in a qualitative study. Therefore, it is imperative that the researcher is open about his or her personal perspective and position, as well as how this may impact the study. The researcher is an African male that is classified as a millennial and works for the HR department of the IT company where the study was conducted. In the briefing sessions, he established his role as a researcher, emphasising that the proposed research study is not being conducted in his capacity as an HR professional. The researcher also acknowledged that being familiar with the environment may create some degree of personal bias that could have resulted in him leaning towards concepts that he is familiar with. To mitigate this, Creswell and Creswell (2018) indicate that it is advisable for a researcher to make use of a reflective journal throughout the research process. The researcher of the proposed study kept a reflective journal in which the reactions and feelings of participants towards the research process, assumptions, as well as experiences and thoughts of the researcher were recorded. At a later stage, particularly when interpreting results, these notes were evaluated to establish how personal experiences may have influenced the results (Connelly, 2016).

1.7.4. Data Collection Procedure

1.7.4.1. Procedure

The collection of data for this research study was conducted at an IT company in Gauteng, South Africa. To seek approval to conduct interviews with employees, a letter was sent to the management team of the organisation. Furthermore, facilities were arranged to ensure that the rooms were conducive for interviews. Britten (1995) identifed a number of external factors, such as noise, that could possibly diminish the quality of interviews. With this in mind, the requirement was that the venue be free from disturbances; it also had to be private to reinforce confidentiality (Britten, 1995).

Qu and Dumay (2011) suggest that a brief has to provide participants with an introduction of the research, the purpose of the interview, and the opportunity for participants to ask questions. Prior to commencement, participants were sent an invitation for a face-to-face interview. They were provided with a brief description of the research study, an outline of the interview structure, as well as the time required for the interview. Further, the interviews were conducted in English, using a semi-structured approach to guide the responses. The interviews were held during participants' lunch breaks, and they were scheduled for 45-60 minutes per interview.

1.7.4.2. Data Collection Method

Once permission had been granted by the university's Economics and Management Sciences Research Committee (EMS-REC), data was acquired from participants in the form of face-to-face interviews. An interview approach is a common method of data collection within the qualitative research realm. Although several research positions exist between the continuum end points of structured and unstructured interviews, the researcher made use of a semi-structured interview (Flick, 2018). A semi-structured interview process allowed the researcher to use a script, with some degree of improvisation. As such, open-ended questions were used to allow the researcher to have a degree of flexibility to diverge when further information relating to the topic was required (Creswell & Creswell, 2017). With this study, a semi-structured interview approach enabled the researcher to explore the opinions and perceptions of the respondents in a structured manner with some degree of flexibility.

1.7.4.3. Sampling Method

For this study, a purposive sampling approach was utilised. Purposive sampling provides the researcher with a degree of control in terms of the selection criteria of the sample chosen. As the name suggests, it is concerned with selecting a distinct sample on purpose using several factors or variables (Etikan, Musa, & Alkassim, 2016). This provides the researcher with the power to make decisions in terms of inclusion in the research, as well as exclusion (Flick, 2018). For this study, the researcher sought millennials (born between 1982 and 2000) that had been employed for longer than twelve months in an IT company. A twelve-month period provides participants with enough work exposure and context to the phenomenon. Additional to this, another inclusion criterion was that participants had to be fluent in English. Biographical information of the sample was retrieved to ensure that the sample met the minimum requirements. Such biographical information included age, race, educational

background, and length of employment in an information technology company. The researcher sought to interview a minimum of fifteen ($n = 15$) participants for the study. Interviews continued until the researcher reached data saturation. Data was therefore collected until there was no new information forthcoming from the interviews (Fusch & Ness, 2015).

1.7.4.4. Data Analysis

The nature of the analysis process of qualitative data is that it is not mechanical or technically structured like quantitative data (Connelly, 2016). Instead, it involves extensive notes, voice recordings of the interviews, and the researcher's reflective notes made during the interviews (Sutton & Austin, 2015). To understand the data gained from the semi-structured interviews, the researcher made use of a thematic analysis method. Thematic analysis is an approach that is used to identify, analyse and report patterns in qualitative data (Vaismoradi, Turunen, & Bondas, 2013), allowing the researcher to see and make sense of shared meaning and experiences (Clarke, Braun, & Hayfield, 2015). As a starting point, the researcher listened to the recordings and went through the transcripts. This allowed the researcher to become engrossed into the research data, getting a sense of the information provided (Sutton & Austin, 2015). The researcher then quantified the themes and concepts by grouping them into thematic categories (Flick, 2018). This data was then analysed further to identify subthemes, validate the data, and to filter any themes that were not relevant to this study. The data was then visually organised into tables that are theme based (Crowe, Inder, & Porter, 2015).

1.7.4.5. Note Taking and Voice Recording

It is crucial that the process of data analysis be supported by researcher transcripts and notes, as well as voice recordings. This is because one cannot only depend on written notes due to the possibility of missing key details when taking notes during interviews (Britten, 1995). As such, all interviews were documented through note taking, as well as voice recording. The researcher then went through the notes and voice recordings repeatedly in order to become familiar with the data in such a way that themes could be identified. To ensure that participants were comfortable with the note taking and video recording process, they were made aware of this during the briefing process and permission was obtained prior to interviews being conducted.

1.7.5. Strategies Employed to Ensure Quality Data

To ensure that the data used for this research met the requirements in terms of trustworthiness and quality, the following strategies were undertaken;

1.7.5.1. Credibility

Credibility is concerned with establishing whether the research findings represent plausible data drawn from the information provided by participants. Its focus is on ensuring a degree of consistency between participants' views and the interpretations, as well as arguments made by the researcher (Korstjens & Moser, 2018). A qualitative study is therefore considered credible when its results or findings are recognisable to the individuals who share the experiences. There are several methods that exist for validating research credibility; one that was used for this study is member checking (Hameed et al., 2017). Member checking entails feeding back data, interpretations and conclusions to the groups who had supplied the data. This is to ensure that the researcher's interpretation of the phenomenon is consistent with how participants view it, as well as the way in which they have responded to the research questions (Treharne & Riggs, 2014). The researcher in this study ensured credibility by providing research participants with their interview scripts to validate that what had been recorded was a true reflection of their thoughts, and not those of the researcher. Further, the transcripts were sent to the respective participants to validate that what was transcribed was a true reflection of how the interviews had occurred.

Lastly, the researcher engaged in peer debriefing to further enhance the credibility of the study. Hadi and Closs (2016) suggest that a peer de-briefer must be a skilled qualitative researcher that can objectively interrogate the study, provide different perspectives, and ask meaningful questions that can support the researcher. That being so, the researcher discussed the research methodology, data analysis, and interpretations with colleagues and experts in qualitative research.

1.7.5.2. Transferability

Transferability refers to the extent in which the results of the study can be generalised or transferred to other contexts or settings (Korstjens & Moser, 2018). Unlike other constructs of assessing the quality of data, the nature of transferability is that it is the reader that establishes the extent to which the study is applicable to participants' context (Connelly,

2016). To enable transferability, the researcher provided a detailed description of the research phenomenon, its constructs, as well as its context. This will enable readers to contextualise the research to their own settings, providing researchers with data for future studies within other contexts.

1.7.5.3.   *Dependability*

Dependability refers to the stability of the research data over time and over various settings (Connelly, 2016). Its aim is to establish the extent to which the study is repeatable and consistent with the data collected (Ponelis, 2015). The researcher of this study provided a detailed research report that informed the reader of the research methods used, as well as why these methods were chosen over other methods. Creswell and Creswell (2017) suggest that it is imperative for the researcher to be overt about his or her own past experiences, biases and preconceived ideas that may influence the results of the study. Therefore, the researcher kept an audit trail of research processes, experiences and activities that will be made available to examiners should the need arise.

1.7.5.4.   *Confirmability*

Confirmability is concerned with the degree of confidence that the research findings of the study are based on participants' narrative, and not the potential biases of the researcher (Korstjens & Moser, 2018). Its purpose is to ensure that the research findings are shaped by the participants, as opposed to the researcher (Gunawan, 2015). Methods of confirmability include keeping an audit trail of analysis and methodological memos (Connelly, 2016). The researcher kept records of detailed notes with regard to the decisions and analyses made throughout the research process. These included aspects such as topics that are unique to the study, thoughts around the coding process, and the rationale used to group data. Further, these records included reflections of any ethical issues or dilemmas that may have occurred.

1.7.6. Ethical Considerations

Tracy (2011) argues that one has to consider what is 'wrong' and 'right' in terms of subjects taking part in a specific study, colleagues involved, and those sponsoring the research. For this study, the following ethical aspects were taken into consideration;

1.7.6.1.   Voluntary Participation

Participants in this study were provided the opportunity to choose whether or not to participate in the research process. They were not coerced into participating; voluntary participation was emphasised (Baruch, May, & Yu, 2016). Furthermore, participants were informed that they will be permitted to withdraw from the study at any point in time, and their data will be removed from the findings of the study (Machado & Silva, 2016).

1.7.6.2.   Informed Consent

Participants were provided with sufficient information regarding their participation in the study. This provided participants with the platform to exercise their right to informed consent (Tisherman, 2018). Participants were also provided with a letter of consent, which they were asked to sign. This letter included information that was related to the study and, based on this information, they had the option to sign the informed consent.

1.7.6.3.   Anonymity and Privacy

Gibson, Benson, and Brand (2013) suggest that it is the researcher's responsibility to ensure that he or she does not disclose any identifiable information related to participants, and to protect the identity of participants by adopting processes that are designed to anonymise them. The researcher ensured anonymity by warranting that any information, such as names, email addresses, identity or employee numbers were not used. Creswell and Creswell (2017) also argue that it is the researcher's obligation to protect the privacy of those participating in the research. Numbers were assigned to participants in the research report and transcripts. Further, the researcher refrained from asking any personal questions that could have been used to identify any of the research participants.

1.8.   Expected contributions of the study

1.8.1.   Expected Contribution for the Individual

Based on varying circumstances, millennials are either entering the job market, whilst others are at the peak of their careers. They have acquired specific skills, and as a result of the 4th Industrial Revolution, they may have to reconsider the direction their careers need to take. Theory argues that machine capability is fundamentally transforming the way in which work is performed and, essentially, the expertise required. Therefore, possibly making certain job functions redundant, and creating a demand for a new set of skills (Taylor, 2016), which may create a degree of uncertainty and job insecurity amongst millennials as work transforms.

With this taken into consideration, this research intended to initiate dialogue with millennials to establish their perceptions of the 4th Industrial Revolution, and to establish the resources required for them to transition and integrate into this era. Therefore, possibly assisting millennials in identifying the resources required to be ready for digitisation and establishing the opportunities that are going to be available as they navigate through changes presented by the 4th Industrial Revolution.

1.8.2. Expected Contribution for the Organisation

The WEF has theorised that the talent an organisation has acquired, will be a critical factor in the transition towards the 4th Industrial Revolution (Schwab, 2018). As organisations introduce automation, artificial intelligence, machine learning and predictive analytics, people will be an important component of the transition in terms of the adoption and optimisation of these technologies. As such, they need to be equipped with the ability to optimise technologies and, most importantly, have the desire to engage with them. This research intended creating awareness around the perceptions that millennials have towards the 4th Industrial Revolution. Thus, possibly allowing organisations to engage in initiatives that are relevant to the phenomenon.

1.8.3. Expected Contribution for Literature

The 4th Industrial Revolution is currently one of the most discussed topics amongst practitioners and researchers (Daemmrich, 2017). However, a large piece of the research conducted has focused on trends and technologies that will emerge, as well as the impact that they will have on different industries. Another focus point has also been on predictions made in terms of the redundancy of certain skills and the introduction of new skills. However, not enough research has been conducted to establish the perceptions individuals have about the changes that the 4th Industrial Revolution will present. The proposed study will provide qualitative data that focuses on people's experiences where the 4th Industrial Revolution is concerned. Therefore, providing insight and literature to the perceptions of employees and what is required to help them prepare for the changes that will be introduced.

1.9. Chapter division

The chapters in this mini-dissertation are presented as follows:

Chapter 1: Introduction.

Chapter 2: Research article.

Chapter 3: Conclusions, limitations and recommendations.

1.10. Time frames

Deliverable	Date
Presentation to Scientific Committee	May 2019
Submit ethics application	May 2019
Data Collection	June - July 2019
Data Analysis	August 2019
Writing Chapters 1 & 2	September 2019
Writing Chapter 3	September - November 2019
Submitting mini-dissertation for examination	18 November 2019

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CHAPTER 2

ARTICLE 1

ABSTRACT

Orientation: The 4th Industrial Revolution describes the current economic and technological changes that are transforming the way in which people live and work. It is integrating humans and machines, as well as the physical and cyber aspects through introducing pervasive technologies. Millennials are becoming the largest workforce of this era and, as they progress in their careers, it is imperative to understand their perceptions towards it.

Research purpose: The purpose of this study was to explore millennial perceptions of the 4th Industrial Revolution in an information technology company.

Motivation for the study: Although there are several studies that address the 4th Industrial Revolution, many have focused on defining the phenomenon, as well as predicting its outcome and impact in various contexts. However, there is not enough research that addresses the extent to which millennials perceive the 4th Industrial Revolution and its impact on their career aspirations.

Research design, approach and method: A qualitative research approach was employed in this study, and semi-structured interviews were used to obtain data from fifteen ($n = 15$) millennials working in an information technology company. Thematic analysis was then used to analyse the interview discussions.

Main findings: The results of this study indicate that millennials describe the 4th Industrial Revolution as a new era that has introduced technologies such as artificial intelligence, automation, biotechnology and robotics. They believe that these technologies will be further integrated into their lives, alleviating them of administrative and manually intensive work. They also suggest that this era will make certain jobs redundant; however, it will create new opportunities as it progresses. Millennials believe that they need to transform their skills to align to this era. They further suggest that organisations need to be transparent about their strategies to digitise, supporting them through initiatives that will enable Millennials to reskill.

Practical implications: This study will provide organisations with insight on how to support their millennial workforce in transitioning towards the 4th Industrial Revolution.

Contribution/value add: This study provides insight into millennials' perceptions towards the 4th Industrial Revolution. This will allow researchers, as well as leaders of organisations, to focus on initiatives that support the millennial workforce in focusing on relevancy and readiness for this era.

Keywords: 4th Industrial Revolution, industry 4.0, millennials, technological revolution, digitisation, workplace

The 4th Industrial Revolution is one of the most important societal and economic trends in the world (Hirschi, 2018). This is because it is fundamentally changing the nature of business, work and society at large (Daemmrich, 2017). Thus, bridging the lines between the physical, digital, and biological aspects, resulting in deeper integration of technology into society, and even challenging ideas about it what it means to be human (Kodama, 2018). Whilst these changes hold great promises in terms of opportunities, they also pose major challenges that require organisations, governments, as well as individuals to proactively adapt (Schwab, 2018). From a South African perspective, President Cyril Ramaphosa has been playing a proactive role in strategically creating readiness for the country (Diko, 2019). The president has established the 'presidential commission of the 4th Industrial Revolution', with a mandate to identify opportunities presented by the 4th Industrial Revolution, and to create the necessary policies, strategies and action plans that will position South Africa as a competitive player in the global market (Marwala, 2019). Organisations are also aligning to these requirements as many of them are re-evaluating and adjusting their processes, technologies, and the skills that they require to be competitive in this era (Aslam, Ilyas, Imran, & Rahman, 2016). Thus, transforming labour requirements as automation and digitisation become prevalent within the various business functions (Hirschi, 2018).

It is apparent that technological developments are not only causing a widespread disruption to business models and various policies, but also to labour markets across all industries (Schwab, 2018). Research suggests that jobs are going to be further threatened by redundancies, whilst the creation of new skills grows rapidly as the demand of new jobs emerges (Collings & Isichei, 2018). The greatest challenge the world faces as a result of this is that, as the requirement for new capabilities increases, the current skills will not meet the demands of the technological progress made (Schwab, 2018). It is theorised that this will create further inequality in labour markets as those with the necessary skills gain further access to career opportunities (Butler-Adam, 2018). Technologies such as automation and artificial intelligence (AI) will progress to displace low skilled and entry level work, and the net displacement of workers by machines will exacerbate the gap between return on capital versus return on labour (Xu, David, & Kim, 2018). Those with the most relevant skills will become an organisation's most prized asset, alongside its digital strategy (Xu et al., 2018). Whilst reforming the current education system is critical towards aligning individuals to this era, it is not possible to weather the current demands and wait for the next generation to enter

the labour market (WEF, 2016). Therefore, the focus must be on the current generation - the millennials - that dominates existing labour markets across the various industries.

The IT sector is a key driver of the 4th Industrial Revolution, providing the infrastructure and innovation that facilitate the transition towards digitisation (Robinson, 2017). Millennials form a large part of the workforce employed in this sector, providing it with the necessary skills to drive various functions (Pretorius, Mawela, Strydom, Villiers, & Johnson, 2015). Most of them are at the peak of their careers, in leadership roles, or entering the job market (Canedo, Graen, Grace, & Johnson, 2017). Although they are technologically inclined, like most, they are also under pressure of transforming their careers during a period of rapid change and uncertainty (WEF, 2016). The challenge that they face is that research is polarised between those that anticipate large scales of job dislocation and, in contrast, those that are optimistic and foresee limitless career opportunities (Schwab, 2018). Thus, creating a degree of complexity and making it challenging for millennials to navigate in this era (Butler-Adam, 2018). Therefore, the objective of this study was to establish millennial perceptions of the 4th Industrial Revolution in an information technology company.

The following section reviewed the relevant literature, based on the 4th Industrial Revolution and millennials in South Africa. The research design is then presented, followed by a report on the data gathered. The manuscript is then concluded after a detailed discussion on the main findings, limitations of the study, and recommendations for future research.

Literature Review

4th Industrial Revolution

The term 'Industrial Revolution' is a common phrase that refers to a historical period of major change and industrialisation (Bonciu, 2017). It encompasses moments of transition and disruption in multiple facets that impact the economy and society at large (Schwab, 2018). This is brought on by the evolution of human knowledge and innovation that leads to change in behaviours, values, economic activities, as well as balances of power regionally and globally (Allen, 2015). Schwab (2018), the founder of the World Economic Forum (WEF), describes the term "revolution", whether industrial, scientific or technological, to change that is major and abrupt. What makes it a revolution, as opposed to mere improvements in specific aspects, is the extent to which it radically transforms social and economic activities on a large scale (Schwab, 2018); thus, introducing perspective in terms of how the world is

perceived, as well as new technological capabilities (Allen, 2015). These technologies create the potential to produce more goods and services effectively, equally affecting aspects such as economic performance, health, education, and preservation of nature (Mokyr, 2004).

An Industrial Revolution is a complex phenomenon that cannot be related to a single year and single place due to its incremental nature, and the way in which it expands to different regions at different points in time (Bonciu, 2017). To provide context, authors identify periods that correspond with a specific technological or scientific discovery that has commercial impact (Bonciu, 2017). Industrial Revolutions have gone through four phases of transition, and each one has presented its own specifics (Carvalho, Chaim, Cazarini, & Gerolamo, 2018). Although each one is considered a separate event, as a collective, they can be understood as a series of events that build upon the technologies and innovations of the previous revolutions (Xu, David, & Kim, 2018).

The first one was theorised to have taken place in Britain and spread to Western Europe, the USA, and the rest of the world between 1760 and 1840 (Yao & Lin, 2016). During this period, mechanisation emerged and replaced agriculture as the economic structure of society (Allen, 2009). This was characterised by a complex interplay of changes in society, technology, medicine, education and the economy, in which inventions such as steam power, rail roads and, later in the nineteenth century, internal combustion engines were introduced (Yao & Lin, 2016). This enabled the introduction of manufacturing processes that transformed the economy from one that relied on agriculture and handicraft, to one that was machine-based (Sentryo , 2017). As the adoption of machinery increased, the first factories emerged and the concept of mass production became prevalent (Brooks, 2018).

Mass production yielded a large increase in the total output of goods (Allen, 2009). Operational and manually intensive tasks that were once done by hand, were now being done by machines, and this significantly increased the rate at which goods could be produced. This created many work opportunities within the new factories, and many moved from farms to industrialised cities in search of wage-related jobs (Brooks, 2018). During this period, the principles of 'division of labour' were established (Dietz, 2008). This was based on the ideology that when processes are divided into individual tasks and each employee is assigned one specific task, this will yield greater output than having one employee perform an end-to-end process on his or her own (Batt & Doellgast, 2005). This improved productivity;

however, making work repetitive and mundane (Dietz, 2008). Further, workers were forced to work long hours performing operational tasks for low wages (Batt & Doellgast, 2005). In the years that followed, this fueled the formation of labour movements, unions and laws that protected workers from unfair labour practices (Blinder, 2006). The end of this era came about as a result of a slowdown in macro inventions, and the 2nd Industrial Revolution slowly emerged (Brooks, 2018).

Several events in the 1850s indicated a shift in technology; however, historians date the 2nd Industrial Revolution from 1870 to 1914 (Mokyr, 2004). Whilst the 1st Industrial Revolution introduced the growth of industries such as iron, coal, rail roads and textiles, the 2nd Industrial Revolution was the beginning and expansion of petroleum, steel, nuclear, radio, television, the telephone and electricity (Leonard & Ljungberg, 2010). Electricity fundamentally changed the way in which people lived and worked, as well as the way in which industries operated. Prior to this, candles and gas lamps were used to light up factories and homes, limiting activities to being conducted during the daytime only (Rifkin, 2012). However, as electricity became commercially viable, businesses could operate through the night (Rosenberg, 1998). Over the course of this period, light became independent of the time of day, and brought networks of cables into homes and offices (Rosenberg, 1998), making it easier to add appliances and machinery that run on electrical energy (Mokyr, 2004). This led to more efficient and inexpensive production processes that required less human intervention (Leonard & Ljungberg, 2010). Other developments that were made in this era were transportation, specifically the invention of automobiles and airplanes. This allowed movement of people and culminated the concept of globalisation as travelling became easier across the world (Mokyr, 2004).

As the 2nd Industrial Revolution progressed, the production of goods became increasingly mechanised (Leonard & Ljungberg, 2010). Mass production spread, scientific management was introduced to the workplace, and scientific knowledge was systematically applied to industrial technology (Troxler, 2013). Society became centralised, as well as highly bureaucratic and thus highly efficient (Mokyr, 2004). This was the beginning of automation and firms could produce more goods with a smaller workforce (Xu et al., 2018). Working hours dropped to an all-time low, and eventually job losses became eminent (Voth, 2003). However, as industries produced more goods and competition increased, the concept of work shifted once again (Blinder, 2006). This time towards services-related jobs, which created a

divide between 'blue collar' and 'white collar' workers (Troxler, 2013). The blue-collar worker denotes a worker that performs manual and intensive labour; a white-collar worker is a worker who performs professional, managerial or administrative work (Barley & Kunda, 2001). With education changing the social system at this time, white-collar workers typically had a high school diploma, and many further obtained degrees in specific professions (Blinder, 2006). This gave rise to areas such as accounting, banking, architecture and engineering as professions in the workplace (Barley & Kunda, 2001). The middle class progressed, standards of living improved, and the purchasing power of the worker drastically improved as the world transitioned towards the 3rd Industrial Revolution (Blinder, 2006).

The 3rd Industrial Revolution, also known as the information age, started in 1960 and was marked by the introduction of electronics and information technology (Xu et al., 2018). This era was the beginning of economic developments and the enhancement of productivity through information technology and automation (Blinder, 2006). It was based on rapid technological enhancements in computers and communication that led to a decrease in the cost of searching, creating, transmitting, and processing data as the years progressed (Schwab, 2018). The efficiency of mass production was greatly enhanced by computers as the transition from analogue to digital accelerated (Liu & Grusky, 2013). A key development of this was the discovery of the internet, which enabled networked communication and exchange of information (Rifkin, 2012). Over the years, the internet forced organisations to redefine themselves and the way in which they operate as businesses (Blinder, 2006). Therefore, as with the preceding Industrial Revolutions, the 3rd Industrial Revolution also profoundly changed the way in which society operated and the way in which work was performed, with information technology becoming a critical concept in various aspects (Liu & Grusky, 2013).

Although the 3rd Industrial Revolution was destined to automate a lot of functions, it also created thousands of businesses and, in the same context, millions of jobs (Rifkin, 2012). The development of new technologies and services fostered economic growth and, in turn, new principles to the concept of work (Bonciu, 2017). This changed the concept of traditional and transactional work, to complex work that required some degree of problem solving, experience, and knowledge (Van Dam, 2017). Furthermore, with globalisation at its core, organisations in this era had the ability to move some of their skills capability offshore (Prisecaru, 2016), allowing them to optimise on skills in regions where labour is inexpensive

(Schwab, 2018). As the world became more competitive, organisations had to find various ways of running their businesses in the most efficient manner, and it is through leveraging technologies of this era that they could achieve this (Prisecaru, 2016). In the quest for further efficiencies, the world has pivoted away from this era to one with a fusion of autonomy, artificial intelligence and interoperability, known as the 4th Industrial Revolution (Schwab, 2018).

The 4th Industrial Revolution was introduced by the German Federal Government in 2011, at the Hannover fair, to describe and promote its global value chain and high-tech strategy (Glistau & Coello, 2018). This concept was initially used for the purpose of describing and enabling smart factories in which virtual and physical systems were integrated in such a way that the customisation of products took place with little human intervention (Bonciu, 2017). However, this era is not only about smart and connected machines or systems and has progressed to encompass breakthroughs in a number of areas, such as artificial intelligence (AI), automation, robotics, cyber-physical systems, the internet of things (IoT), the internet of systems (IoS), as well as machine learning (Roblek, Meško, & Krapež, 2016). Technologies of this nature are made up of three core aspects, distinguishing the 4th Industrial Revolution from the previous ones (Ślusarczyk, 2018).

Firstly, the technologies developed in this era enable a continuous interaction and exchange of information, not only between humans, but also humans and machines, and machine-to-machine (Roblek et al., 2016). Therefore, increasing the integration of computers, networks, as well as physical processes (Xu et al., 2018). Secondly, these technologies are disruptive in nature, creating radical change that enables organisations to optimise on the effectiveness and efficiency of innovation (Morrar, Arman, & Mousa, 2017). Lastly, they facilitate the development of machines that have the capability to operate autonomously through concepts of artificial intelligence and machine learning (Prisecaru, 2016).

The 4th Industrial Revolution grew from the 3rd Industrial Revolution; however, it is considered a new era rather than a continuation (Schwab, 2018). This is because, unlike the preceding revolution, it blurs the lines between the physical, digital and biological spheres, and has made way for a deeper integration of technology in society (Xu et al., 2018). Therefore, influencing all business disciplines, economies, consumption patterns, and even challenging what it means to be human (Morrar et al., 2017). At the core of these pervasive

inventions is the objective of optimising on smart innovations that interact with each other in such way that there is an increase in economies of scale and return on investment (Dombrowski & Wagner, 2014). Thus, organisations are encouraged to re-assess their processes, technologies, organisational behaviours, and skills to enable collaboration between humans and machines in such a way that it provides a competitive advantage (Aslam, Ilyas, Imran, & Rahman, 2016). This leads to the digitisation and automation of specific functions and, in the process, the disruption of the labour market with new skills emerging (Morrar et al., 2017). Therefore, as the 4th Industrial Revolution progresses, theorists suggest that machines will become even more productive and augmented into various areas of society, dislocating certain jobs (Schwab, 2018). However, as with previous eras, new industries and skills will emerge (Hirschi, 2018). Millennials are at the forefront of this era, because as a large part of the current workforce, they are the most impacted by the 4th Industrial Revolution (Calk & Patrick, 2017). More so, they will have to immerse themselves further into technology as it will further impact their career decisions.

Millennials

The interest in generations, as well as generational differences, has been widely researched over the last few decades (Lyons, Urick, Kuron, & Schweitzer, 2015). Generations are defined using categories that are based on bands of time and birth years (Johnston, 2013). People born in these birth cohorts are theorised to share similar characteristics that are shaped by similar historical events and conditions experienced during their formative years (Heyns & Kerr, 2018). This includes the way in which they were raised, technologies they were exposed to, and the economy at large (Johnston, 2013). This influences aspects such as values, preferences, expectations and motivation (Lyons et al., 2015); thus, providing insight into how the various generations differ in social context and in the workplace as a result of the different life stages they experience (Heyns & Kerr, 2018). There are several generational groups that have been identified, namely veterans, baby boomers, generation x, and millennials. However, the dates used to group them differ from one author to the next (Martins & Martins, 2014). Heyns and Kerr (2018) suggest that South Africa has its own unique historical events, compared to western countries, and this has caused a degree of fragmentation. Therefore, the social and political context, for South Africa in particular, needs to be considered when categorising generations (Brown, 2017). For the purpose of this study, South African millennials were classified to be born between 1982 and 2000 (Martins & Martins, 2014).

Millennials in South Africa comprise a group that is old enough to be a part of the old regime, but not old enough to have participated in it (Martins & Martins, 2014). On the other hand, it consists of individuals, known as born-frees, born into the new world order (Martins & Martins, 2014). Millennials have grown up in a period that is racially and culturally integrated, as well as connected to the rest of the world (Geradine-Brown, 2017). The different cultures and races in this generation have more in common and are more diverse than their counterparts (Smith & Clark, 2010). Further, they are considered to be the most confident of the generations as they were raised by child-focused parents whose focus was on building their children's self-esteem and dedicating their time to raising them (Chou, 2012; Martins & Martins, 2014). Compared to the other generations, millennials demonstrate contrasting attitudes, values, beliefs and aspirations (Chou, 2012). Firstly, they are educated and technologically well informed, and generally rely on technologies such as smart devices to communicate and perform tasks (Gibson & Sodeman, 2014). They are family centric and prioritise their work-life balance compared to the older generations (Hershatter & Epstein, 2010). They are described as ambitious, achievement-orientated and have a desire for meaningful work and recognition (Nolan, 2015). On the other hand, researchers suggest that they tend to lack experience, soft skills, deadline orientation and the ability to plan, which could lead to conflict and frustration with the older generations (Martins & Martins, 2014).

Millennials make up the largest and the fastest growing segment of the current workforce (Calk & Patrick, 2017). They bring new attitudes, technologies and ideas to the work environment that leaders need to consider (Buzza, 2017). They seek a management approach and organisational culture that are significantly different from the other generational cohorts (Chou, 2012). They also have high expectations of their employers and are not afraid to question authority (Kuron, Lyons, Schweitzer, & Ng, 2015). Millennials are immersed in a culture of hyper feedback due to social media and, as a result, they seek quicker feedback from their managers and peers (Rodney & Wakeham, 2016). When compared to other generational cohorts, they are more likely to change jobs regularly and are less likely to stay in a single company throughout their careers (Buzza, 2017). This is because they move with the view of progressing their careers and exposing themselves further (Kuron et al., 2015). However, they are willing to exert effort where performance is concerned and have a strong personal commitment towards making a contribution (Calk & Patrick, 2017).

Millennials are 'digital natives' and dominate the information technology environment (Au-Yong-Oliveira, Gonçalves, Martins, & Branco, 2018). They are immersed in technology and this has shaped the way in which they interact, as well as their career choices (Au-Yong-Oliveira et al., 2018). As the 4th Industrial Revolution progresses, this is going to be critical as companies in the IT sector progress to offer further growth opportunities that impact all the other sectors. However, in as much as it impacts other sectors, skills in this domain will undergo the same changes.

The world has pivoted away from the 3rd Industrial Revolution and the 4th Industrial Revolution is in its early days (Schwab, 2018). Although many advancements have been made, a big part of the concepts and technologies discussed are still in the realm of theory and speculation, causing uncertainty (Butler-Adam, 2018). Nonetheless, what remains consistently apparent is the transformation of jobs and the introduction of new ways of work (Bonciu, 2017). Technology in this era is set to cause widespread disruption to labour markets, with major changes in the skills sets required to thrive in the new landscape (Glistau & Coello, 2018). As millennials increasingly dominate the market, specifically the IT sector, they will have to think of how to strategically position their careers in an environment that is dominated by robots that can function autonomously and machines that can learn and unlearn things. This research, therefore, aims to explore the perceptions of millennials working in an IT company towards the 4th Industrial Revolution.

Research Objectives
The research objectives of this study were divided into general and specific objectives.

General Objective
The general objective of this research was to establish the perceptions about the 4th Industrial Revolution by millennials employed in an information technology company.

Specific Objectives
The specific objectives of this research were to:
1. Establish the way in which millennials describe the 4th Industrial Revolution;
2. Understand the impact that the 4th Industrial Revolution has had on millennials;
3. Establish the opportunities that the 4th Industrial Revolution has presented for millennials;

4. Establish the challenges that the 4th Industrial Revolution has presented for millennials; and

5. Understand what millennials think is required from them to be aligned to the perceived changes that the 4th Industrial Revolution has introduced.

Research Design

Research Approach

A qualitative research approach was utilised for this study. This involved the collection of data through observing or interviewing participants to gain an understanding of their lived experiences and/or perceptions. This brought about a focus on the research phenomenon through the lens of the individual in terms of answering the research question (Rutberg & Bouikidis, 2018). The focus of this study was to understand the perceptions of millennials working in an IT company about the 4th Industrial Revolution. It was through a qualitative lens that the researcher believed that ideas and hypotheses related to the subject could be drawn or developed as subjects engaged with the phenomenon (Levitt, Motulsky, Wertz, Morrow, & Ponterotto, 2018). Thus, rich data was generated from participant interviews in terms of answering the research question (Rutberg & Bouikidis, 2018).

Research Strategy

The research strategy that was followed in this study is of a constructivist and naturalistic paradigm, known as interpretive description (Clark, Spence, & Holt, 2011). Interpretive description is a grounded approach that a researcher can apply to identify themes and patterns that emerge within the context of a phenomenon (Archibald, Caine, Ali, Hartling, & Scott, 2015). The approach is inductive in nature; therefore, the researcher engaged with subjects to collect data, establish themes and develop themes (Brewer, Harwood, McCann, Crengle, & Worrall, 2014).

Research Method

Literature Review

In phase 1 the researcher conducted a complete review of the 4th Industrial Revolution and millennials in South Africa. The sources consulted included, but were not limited to, online business reports, online articles, textbooks, academic journal articles, as well as databases such as Google Scholar and the North-West University online library. The articles that the

researcher used for this research were from studies that have been conducted between the years 2014 and 2019. Articles older than the timeframe specified were consulted in various aspects. The researcher made use of studies in journals such as *The Journal of Organizational Change Management*, *Computers in Human Behaviour*, *South African Journal of Science*, *Journal of Human Resources*, *Journal of Open Innovation: Technology, Market and Complexity*, *Journal of Management*, and the *Journal of Business Inquiry* amongst others, due to their relevance to this study. Further, the researcher consulted websites such as *Forbes.com, Deloitte* and the *World Economic Forum* due to the extensive studies that have been conducted by these sources. Key words used to search for articles for this study were "4th Industrial Revolution", "industry 4.0", "the future of work", "technology", "automation", "digitisation", "millennials", "future skills", and "skills gap".

Research Setting

The research was conducted at an IT company based in Gauteng, South Africa. Participants were provided an overview of the study, as well as an informed consent form that required their signatures prior to collecting data within their natural setting (Creswell & Creswell, 2018). Once the consent forms had been signed, the researcher proceeded with the data collection process at the organisation where the participants were employed.

Role of the Researcher

Creswell and Creswell (2018) suggest that it is the researcher's duty to ensure participants gain the necessary entry into the identified research location. Prior to collecting data, the researcher communicated with the management of the current organisation. The researcher then requested a meeting to discuss the intended research study with the relevant stakeholders. He also provided the respective managers with a letter from the scientific and ethics committee, indicating the objective of the study and the data collection process.

Creswell and Creswell (2018) further indicate that the role of the researcher must be defined in a qualitative study. Therefore, it is imperative that the researcher is open about his or her position and standpoint and its possible impact on the study. The researcher is an African male, classified as a millennial and works for the HR department of the relevant IT company. In the briefing sessions, he established his role as a researcher, stressing that the research study was not being conducted in his capacity as an HR business partner of the organisation. The researcher also acknowledged that being immersed in the organisation may create some

degree of personal bias that may result in him leaning towards concepts that he is familiar with. To mitigate this, Creswell and Creswell (2018) suggest that it is advisable that a researcher makes use of a reflective journal throughout the research process. The researcher kept a reflective journal where records of things such as the reactions and feelings of participants towards the research process were kept, as well as experiences and thoughts of the researcher. At a later stage of the study, particularly when interpreting results, these notes were incorporated to establish how personal experiences may have influenced the results (Connelly, 2016).

Sampling Method

This study utilised a purposive sampling approach, providing the researcher with a degree of control regarding the selection criteria of the sample selected (Etikan, Musa, & Alkassim, 2016). This provided the researcher with the ability to make decisions as to inclusion and exclusion of participants (Flick, 2018). For this study, the researcher sought millennials (born between 1982 and 2000) that have been employed for longer than twelve months in an IT company. A twelve-month period provided participants with the necessary work exposure and context to the phenomenon. Also, another inclusion criterion was fluency in English. Biographical information of the sample was captured to ensure that the sample met the minimum requirements. Such biographical information included age, race, education, type of employment, and length of employment. The researcher sought to interview a minimum of fifteen ($n = 15$) participants for the study.

Table 1

Characteristics of Research Participants (n=15)

Participant	Gender	Age Range	Race	Tenure	Occupation
Participant 1	Female	31 - 37 years	Coloured	7 years +	Project manager
Participant 2	Female	25 - 30 years	African	4 - 6 years	Training specialist
Participant 3	Male	31 - 37 years	Coloured	7 years +	Training specialist
Participant 4	Female	19 - 24 years	African	1 - 3 years	Product manager
Participant 5	Male	25 - 30 years	Indian	4 - 6 years	Product manager
Participant 6	Female	19 - 24 years	White	1 - 3 years	Network engineer
Participant 7	Male	31 - 37 years	White	7 years +	Network engineer
Participant 8	Male	31 - 37 years	African	1 - 3 years	Project manager
Participant 9	Male	31 - 37 years	African	7 years +	Operations manager
Participant 10	Male	25 - 30 years	African	4 - 6 years	Product manager
Participant 11	Male	31 - 37 years	African	4 - 6 years	Installations engineer
Participant 12	Female	31 - 37 years	African	7 years +	Risk Analyst
Participant 13	Female	31 - 37 years	Indian	7 years +	Project manager
Participant 14	Male	25 - 30 years	African	7 years +	Security engineer
Participant 15	Male	31 - 37 years	African	7 years +	Security engineer

Table 1 indicates that there were 15 participants in this research study. In terms of gender, the sample was divided into 60% male and 40% female. Most of the population group was between ages 31-37 years as 60% of the group was represented by this category. This was followed by participants aged 25-30 years (27%), and participants aged 19-24 years (13%). In terms of race, the participant group comprised 60% Africans, 13.3% Coloureds, 13.3% Indians, and 13.3% Whites. Lastly, the tenure presented by the participants was 7+ years (53.3%), 4-6 years (26.7%), and 1-3 years (20%).

Data Collection Method

Once permission had been granted by the university's Economics and Management Sciences Research Committee (EMS-REC), data was gathered from participants in the form of face-to-face interviews. A semi-structured interview process was followed, enabling the researcher to use a script, with the flexibility to improvise where required (Flick, 2018). It also allowed the researcher to explore the opinions and perceptions of the respondents in a structured manner with the ability to probe further. To achieve this, open-ended questions were used to allow

the researcher a degree of flexibility to diverge when further information relating to the topic was required (Creswell & Creswell, 2017).

The qualitative interviews comprised the following interview questions;

1. What is your understanding of the 4th Industrial Revolution?
2. What impact has the 4th Industrial Revolution had on you professionally?
3. What opportunities have been presented to you as a result of the 4th Industrial Revolution?
4. What challenges have you experienced as a result of the 4th Industrial Revolution?
5. What do you think is required from you to be aligned to the perceived changes that the 4th Industrial Revolution has introduced? (Or the changes that will be presented in future?)

Note taking and voice recording

All the interviews conducted were audio recorded, and the researcher made use of field notes as the sessions progressed. Prior to this, participants were informed that the interviews will be recorded and noted. The recorded data was then transcribed verbatim and all transcripts, including field notes, were then prepared for the analysis phase of the research process. All the data that had been obtained during the research study was stored on the researcher's laptop and encrypted with a password. Only the researcher and his supervisor had access to the data set. Finally, all the data gathered, including audio recordings, transcripts and field notes were destroyed once they had been utilised for the intended purpose.

Data Analysis

The analysis process of qualitative data is not mechanical or technically structured as in quantitative data (Connelly, 2016). Instead, it consists of extensive notes, voice recordings of the interviews, and the researcher's reflective notes made during the interviews (Sutton & Austin, 2015). To understand the data gained from the semi-structured interviews, the researcher made use of thematic analysis. Thematic analysis is a method that enables one to identify, analyse and report patterns in qualitative data (Vaismoradi, Turunen, & Bondas, 2013). From this process, the researcher could establish trends and patterns regarding words or terms used, meaning, and their relationship to the phenomenon (Stemler, 2015). The researcher spent time listening to the recordings and read through the transcripts. This enabled the researcher to become personally engrossed in the research data, getting a sense of

the information provided (Sutton & Austin, 2015). The researcher then quantified the data using categorising phrases, sentences and paragraphs (Flick, 2018). This data was then analysed further to identify subthemes, validate the data, and to filter any themes that may have not been relevant to the current study. The data was then visually organised into tables that are theme-based (Crowe, Inder, & Porter, 2015).

Strategies Employed to Ensure Quality Data

To ensure that the data used for this research meets the requirements in terms of trustworthiness and quality, the following strategies were undertaken:

Credibility

Credibility is concerned with ensuring that there is a degree of consistency between participants' views and the interpretations, as well as arguments made by the researcher (Korstjens & Moser, 2018). The researcher ensured credibility in this study through member checking, by providing research participants with their interview transcripts to validate that what had been recorded was a true reflection of their thoughts and not those of the researcher. Lastly, the researcher engaged in peer debriefing to further enhance the credibility of the study.

Transferability

Transferability refers to the extent in which the results of the study can be generalised or transferred to other contexts or settings (Korstjens & Moser, 2018). To enable transferability, the researcher provided a detailed description of the research phenomenon, its constructs, and its context. This will allow readers to contextualise the research to their own settings, providing researchers with data for future studies in other contexts.

Dependability

Dependability refers to the stability of the research data over time and over various settings of the study (Connelly, 2016). Its aim is to establish the extent to which the study is repeatable and consistent with the data collected (Ponelis, 2015). The researcher provided a detailed research report that informed the reader of the research methods utilised, as well as why these methods were chosen above other methods. The researcher also kept an audit trail of research processes, experiences and activities that will be made available to examiners should the need arise.

Confirmability

Confirmability is concerned with the degree of confidence with which the research findings of the study are based on participants' narrative, and not the potential biases of the researcher (Korstjens & Moser, 2018). Its purpose is to ensure that the research findings are shaped by participants, as opposed to the researcher (Gunawan, 2015). The researcher kept records of detailed notes regarding the decisions and analyses made throughout the research process. These included aspects such as topics that are unique to the study, thoughts around the coding process, and the rationale used to group data. Further, reflections of any ethical issues or dilemmas that may have occurred were included.

Reporting

A qualitative writing style was used when reporting on the findings of this research study. The results were presented in the form of a descriptive essay. The questions addressed during the semi-structured interviews served as guidelines for establishing the main themes from the participants' responses. Subthemes were identified and explained further using participant responses.

Ethical Considerations

Ethical approval for this research study was obtained from the North-West University's Economic and Management Sciences Research Committee (EMS-REC) and the researcher was provided with an ethics number (NWU-00748-19-A4). Critical ethical aspects taken into consideration were obtaining informed consent and ensuring that participants were not coerced into taking part in the research, as the process was voluntary. The researcher further ensured that all data collected was managed confidentially; no identifying information was used. All participants were provided with a document containing the details of the research study, including ethical aspects. This letter included information related to the study, and based on the information provided, participants could sign the letter based on informed consent. Prior to signing the document and conducting the interviews, participants were given the opportunity to ask questions about the study. They were also informed that they could withdraw from the process at any point, and their information would be excluded from the final findings.

Results

The findings of this study are categorised into five sections, based on the research objectives. Firstly, an overview of the way in which millennials described the 4th Industrial Revolution is presented. Secondly, themes relating to the impact the 4th Industrial Revolution has had on millennials are reported. Thirdly, opportunities are highlighted that millennials have been presented with as a result of the 4th Industrial Revolution. Fourthly, challenges that millennials have encountered as a result of the 4th Industrial Revolution are revealed. Lastly, millennials convey their thoughts on what needs to be in place in order to align to the 4th Industrial Revolution. The findings are indicated as follows and will be depicted in Table 2. The reader should note that participant responses have been recorded verbatim and have not been subjected to language editing.

The way in which millennials describe the 4th Industrial Revolution

Theme 1: The introduction of new technologies

Eight participants described the 4th Industrial Revolution as a change and transition in technology. They associated this era with the introduction of new technological concepts, such as artificial intelligence, automation, biotechnology and robotics. This is illustrated in the words of participant 10 who stated that: *"The 4th Industrial Revolution as I understand means AI and robotics. So, things are becoming a lot more autonomous"* (Participant 10, male), while another participant mentioned that: *"We have now moved to an age where artificial intelligence is not only a possibility, but its real and its here"* (Participant 2, female).

Theme 2: A shift from the 3rd Industrial Revolution to the 4th Industrial Revolution

Four participants described this era as a transition from the 3rd Industrial Revolution to the 4th Industrial Revolution. They suggested that the 3rd Industrial Revolution was based on the principles of computerisation, whilst the 4th Industrial Revolution is focused on the digitisation of existing technologies. Participant 2 stated the following argument: *"My understanding of the 4th Industrial Revolution is that we have moved on from the 3rd of which focused more on technologies such as computers, to now a digital age"* (Participant 2, female). Participant 11 further elaborated on this by saying: *"...it is a shift and adaptation of new technologies, and a new way of how we do things..."* (Participant 11, male).

Theme 3: Access to more information

Four participants associated this era with the increase in and ease of access to information, stating that they associate it with the ability to acquire knowledge as and when they require it. Participant 2 said: *"...is certainly around the ability to act and having information at my fingertips which gives me a competitive edge in comparison to the individual that don't necessarily have access to it"* (Participant 2, female). Another participant further said: *"...so the 4th Industrial Revolution for me is about providing access to information and making things more reachable"* (Participant 7, male).

Theme 4: A change in jobs and skills required

Four participants described the 4th Industrial Revolution as a change in jobs and skills required as a result of technology. Participant 3 demonstrated this by saying that: *"It is going to be a massive change to the way in which we work and the types of jobs that we have…"* (Participant 3, male). Participant 2, along with another participant, further argued that this era has introduced a new set of skills and will continue to make more jobs redundant: *"This period can be detrimental, particularly to traditional jobs as they exist now…"* (Participant 2, female). Another participant echoed this statement by saying: *"Jobs are going to change, and this is going to make way for new type of skills"* (Participant 14, male).

Theme 5: The integration of machines and computers into work

One participant elaborated on how this era has enabled the integration of technology into work in such a way that humans are working a lot closer with robots than before. Participant 4 reflected on this theme as follows: *"I saw a clip and they were showing a robot conducting surgery. So, we are going to have to work closely with robots"* (Participant 4, female).

Theme 6: Relieves humans of tasks that are physically and administratively intense

Eight participants discussed this era in relation to how it is relieving humans of tasks that are physically and administratively intense. Participant 5 elaborated on this by saying: *"...monotonous tasks that we are used to doing can be done in a more efficient way now"* (Participant 5, male). Participant 11 concurred with this by saying: *"Things you can see being done away with is the jobs or functions that are manually intensive and repetitive"* (Participant 11, male).

Theme 7: Redundancy of jobs

Two participants associated this era with the redundancy of jobs and suggested that as this era progresses, jobs are going to be lost. Participant 8 expressed his concern by saying: *"It's scary, because we are going to struggle in terms of finding job opportunities. Particularly, low level or entry level type of jobs that a computer can do"* (Participant 8, male). Participant 12 also mentioned that: *"It is replacing people with technology where it's possible to get things done faster and efficiently"* (Participant 12, female).

Theme 8: The creation of efficiencies

One participant described this era in relation to the efficiencies that it presents, saying: *"I think the concept behind the 4th Industrial Revolution is to make things more efficient and to, in a way, grow the potential of human beings"* (Participant 15, male).

The impact of the 4th Industrial Revolution on millennials

Theme 1: The automation of certain functions

Four participants suggested that the impact of the 4th Industrial Revolution is that certain functions are now automated. These participants mentioned that parts of their work that they used to do are now automated and being run on intelligent computer systems. Participant 12 supported this view by saying: *"Certain parts of my job are now being done by a computer. I was introduced to automation and I loved it. It made things easier for me"* (Participant 12, female). This was further supported by Participant 1 who mentioned: *"Changes that have taken place in terms of how the organisation is automating our systems and process"* (Participant 1, female).

Theme 2: The introduction of tools that make work more efficient

Three participants have seen the introduction of intelligent systems and tools in their work and this has made them more efficient. Participant 5 mentioned how his job has evolved by saying that: *"...my job now involves the use of AI, data analytics and data orchestration. Now my function as a traditional engineer has changed"* (Participant 5, male).

Theme 3: A reduction in administrative work

Four participants suggest that new technologies have reduced mundane and administrative work; they can now create value in other aspects. A participant elaborated on this by saying that: *"I believe that some parts of what I currently do are no longer going to be valid.*

Specifically, the admin function with the advancement of these online and cloud-based tools" (Participant 3, male). Participant 8 provided further evidence by saying: *"...business has decided to combine the service delivery and service management function because technology has taken care of the administrative or operational function"* (Participant 8, male).

Theme 4: Increased access to information

For five participants, the impact is that they can now source information a lot easier than they would have before. They can also use various sources and platforms to acquire the skills and knowledge they need. This was supported by Participant 2's statement: *"I have greater access to information, and so I learn a lot more than I would have before. There is a lot more content available to me"* (Participant 2, female). Another participant further stated that: *"I can acquire skills a lot easier than before"* (Participant 11, male).

Theme 5: The transformation of skills

Three participants suggested that the impact of this era is in terms of the transformation of skills, as the demand for a new set of skills increases with time. Participant 3 elaborated: *"I can already see that I am required to have a multitude of skills. So, I can no longer rely on one type of skill"* (Participant 3, male), with participant 10 attributing his ability to acquire new skills to working in an information technology company by saying: *"Working for an IT company gives me an advantage to some extent. So, I have the advantage of acquiring new skills earlier than most"* (Participant 10, male).

Theme 6: The redundancy of jobs

Two participants mentioned that the impact of this era for them is the redundancy of certain jobs, and the introduction of new job functions. Both participants went through a period where their roles were made redundant and Participant 6 said: *"When I started my career, I was in sales operations and a few months later my role was made redundant. I then transitioned into digital marketing"* (Participant 6, female).

Theme 7: Very little impact

Four participants have seen very little impact by the 4th Industrial Revolution. From these participants, two suggested that this is due to the nature of their work: *"I would say little impact because in the area that I am in a lot of people engagement is still required"*

(Participant 1, female). Participant 2 agreed with this perspective: *"It hasn't had a direct impact on me, I think that I have been protected from it simply because of the line of work that I am in. However, I do believe that it soon will"* (Participant 2, female).

Opportunities available to millennials in the 4th Industrial Revolution
Theme 1: Focus driven

Three participants believe that the opportunity that the 4th Industrial Revolution provides is focus. These participants believe that this era will reduce the amount of time spent on unnecessary tasks, providing focus to aspects that create value. Participant 1 discussed this further by saying: *"It will make me a better and competent practitioner within my current role, because it will allow me to focus on the things that I should focus on"* (Participant 1, female). Participant 8 also said: *"Clients want more interaction, so I think technology will allow me to free up time to focus on that. Because that is what my role should be after all"* (Participant 8, male).

Theme 2: Access to information

Two participants feel that they now have greater access to information and they can acquire this information through various mediums. Participant 2 elaborated: *"I'm a researcher by nature, so collecting information is my thing, and the ability to collect it at a faster and more effective rate is quite appealing to me. And I think that technology will provide that"* (Participant 2, female), while Participant 4 mentioned the different mediums that they have access to: *"I can now find videos on YouTube to learn coding; you can literally study your life from YouTube, and I feel like with 4IR it will enable people who can't go to university get the skills required for them to get upskilled"* (Participant 4, female).

Theme 3: The opportunity for career growth

Four participants indicated that the 4th Industrial Revolution has presented them with career growth and the opportunity to redefine their skills. Participant 3 mentioned that: *"I could transition into a role that is fit for the future of the organisation"* (Participant 3, male). Participant 15 concurred: *"It has allowed me to redefine my career and to start thinking of the future skills that I need to acquire"* (Participant 15, male).

Theme 4: The opportunity to optimise on intelligent tools and systems

Four participants argued that this era has provided them with the opportunity of making use of intelligent tools and systems. Participant 6 contextualised this to her role and said: *"I think the tools that are available to us are also going to help us become better at digital marketing"* (Participant 6, female). Participant 11 also mentioned that: *"The systems and tools that we interact with will no longer require a lot of human intervention"* (Participant 11, male).

Challenges that millennials have experienced as a result of the 4th Industrial Revolution

Theme 1: The redundancy of jobs

Although they have not been directly impacted, six participants suggested that the challenge the 4th Industrial Revolution is going to present is an increase in the redundancy of jobs. Therefore, they feel that they are a lot more replaceable now; more than they would have in the preceding era. Participant 2 highlighted this as a concern: *"I think as it relates to my work specifically, it's more around a potential threat of being replaced by a robot or AI. I'm a lot more replaceable than I was before"* (Participant 2, female). Participant 13 further stated that: *"I am scared that my job could be redundant. Particularly with the skills that I have"* (Participant 13, female).

Theme 2: The challenge in identifying the necessary skills

Four participants suggested that the 4th Industrial Revolution has increased the amount of information that they have access to. However, they find it difficult to identify the skills and information relevant to them due to the exponential growth of information. This was supported by Participant 10: *"We have so much access to so much information, so I would say the biggest challenge is navigating through all this data and establishing what is relevant to you"* (Participant 10, male). Participant 6 further mentioned that: *"There is a lot of noise at the moment, and a lot of information being thrown at us. So, it is very difficult to understand what risks we should be taking now"* (Participant 6, female).

Theme 3: Inequality between people

One participant felt that this era is going to create further inequality as those that have access are going to benefit further. Participant 4 elaborated on this by saying: *"It is going to create inequality where the city of Johannesburg for example is talking about having smart cities, but nobody is talking about having smart townships"* (Participant 4, female).

Theme 4: No challenges

Three participants feel that they have not experienced any challenges. One participant even further elaborated on this: *"I don't think it will pose any challenge, I think it's going to create more opportunities if anything, particularly within the company that I work in"* (Participant 14, male). Another participant elaborated on this by saying: *"Not really, not if you define a challenge as a change in thinking. I think that 4IR will require a change in thinking"* (Participant 5, male).

Ways in which millennials can align to the 4th Industrial Revolution

Theme 1: Skills development and relevance

Thirteen participants believe that they need to educate themselves about this phenomenon and transform their skills to remain relevant in this era. Participant 5 mentioned that: *"One has to ensure that they have the relevant skills. But not just relevancy for now. One must start thinking about the future as well"* (Participant 5, male). Participants 7 and 8 agreed with this view: *"I think people need to have the right skills and stay on top of what is happening"* (Participant 7, male); and *"The first thought that comes to me is study and coupled with studying you need to be exposed"* (Participant 8, male).

Theme 2: A change in mind set

Two participants suggest that the 4th Industrial Revolution will require a change in mind set where people no longer think of work in the traditional concept. This was elaborated on by Participant 2 who mentioned that: *"It's more a change of mind set. From being solution driven and having a growth mind set. So often at times we look at problems, but that's as far as we actually go"* (Participant 2, female). Participant 9 supported this: *"I think what people need to do is start thinking about things in a different way. They need to get away from thinking that they are going to have a job for life or be employed by someone"* (Participant 9, male).

Theme 3: Develop entrepreneurial skills

Two other participants suggested that individuals will need entrepreneurial skills and start thinking about how they can create value in society, whilst getting compensated for it. Participant 2 mentioned that: *"We definitely need to be more entrepreneurial, because I don't see the regular 9 to 5 job lasting"* (Participant 2, female). Participant 9 elaborated by saying:

"…and start thinking about how I as an individual create value in society and how do I get compensated for it" (Participant 9, male).

Ways in which organisations can support millennials in this era

Millennials were further asked if they thought there was anything organisations could do to support them in aligning to the 4th Industrial Revolution. The following themes occurred when they elaborated on this aspect.

Theme 1: Enabling employees to be more self-sufficient

Two participants suggested that organisations need to empower employees to be more self-sufficient and autonomous. This was elaborated on by Participant 2 who mentioned that: *"If companies ought to do anything, then they need to help employees or empower employees to be a lot more self-sufficient"* (Participant 2, female), while another participant approached this aspect from a knowledge-perspective saying that: *"Content needs to be digitised to allow for people to consume up to date information as and when required"* (Participant 11, male).

Theme 2: Leaders need to have a clear understanding of future roles

Four participants argued that organisations need to have a clear understanding of how the 4th Industrial Revolution impacts the way in which they operate, and the effect that this has on the various job roles. Participant 9 said: *"…and once they have figured out what the strategy is around AI and 4IR in general, then they need to identify the new roles that are going to be required, and make sure that they make appropriate training available to help people transform their skills to start the transition into the new era"* (Participant 9, male). Participant 15 echoed this and said that: *"So, to help individuals they need to start thinking about what the new roles are going to look like and start redesigning jobs"* (Participant 15, male).

Theme 3: Transparency from leaders

Two participants feel that leaders of organisations need to be more transparent about their strategic imperatives where the 4th Industrial Revolution is concerned, and how this impacts their employees. Participant 4 elaborated on this by saying: *"If AI and robotics is where the organisation is going, then that is what the company must communicate to its people so that they understand. Transparency has to be created so that people know how to adjust and make career decisions accordingly"* (Participant 5, male).

Theme 4: Leaders need to develop employees

Four participants suggested that organisations need to establish a culture of learning and develop their employees on an ongoing basis. Participants expanded on this by saying: *"Companies need to create a culture of lifelong learning. So, they need to make it easier accessible for employees to acquire skills"* (Participant 5, male). Participant 13 said: *"Organisations should look at the skills that they currently have and enhance the skills of the people you have in the organisation. Rather than outsourcing"* (Participant 13, female).

Theme 5: Future-orientated leaders

Two other participants felt that leaders need to be future orientated in order to better equip employees for the changes to come. Participant 6 expressed her view by saying: *"We need to have leaders that are future thinking. If there is a change coming and want to adopt a specific type of technology, then they should be feeding employees information that will make you ready for what is to come"* (Participant 6, female).

To deliver the findings in a table, the themes have been classified based on the research questions utilised to gather data. Although there are overlaps to some degree, subthemes have also been identified to group the themes from the interviews.

Table 2

Themes of the Research Study

Themes	Subthemes	Response
Describing the 4th Industrial Revolution	Introduction of new technologies	"With the 4th Industrial Revolution, we speak of technology in terms of AI and automation. I would also say it's the introduction of intelligent computing where computers can now make decision and gather data to understand patterns" (Participant 1, female). "We have now moved to an age where artificial intelligence is not only a possibility, but its real and its here" (Participant 2, female). "Things that weren't automated are now being automated, having robots at Mac Donald's taking your order, and also having robots assisting you at a mall if you go shopping" (Participant 4, female). "I do know that it means to change. In terms of the revolution of the digital world. Companies are moving towards AI and automation in terms of making people's experiences better" (Participant 6, female). "It is changing the way in which we live our lives through computers and functionalities such as AI. So, a

		lot of automation is coming in" (Participant 7, male). "So 4IR talks to the machine age if I can call it that. It talks to the world of automation. So, it speaks to the reliance of machines to help create value for society" (Participant 9, male). "The 4th Industrial Revolution as I understand means AI and robotics. So, things are becoming a lot more autonomous" (Participant 10, male). "It's around biotechnology, automation, and AI. From what I understand personally, it is related to the way we use technology and create a better world using it" (Participant 14, female).
	A shift from the 3rd to the 4th Industrial Revolution	"We have moved on from the 3rd of which focused more on technologies such as computers, to now a digital age" (Participant 2, female). "My understanding of it is the fact that it is a new phase in the way that things are done compared to the 3rd Industrial Revolution" (Participant 3, male). "It is the next economic era in the sense that humans have gone through multiple phases from an economic perspective. There's been a couple of factors that have created a shift" (Participant 8, male). "It is a shift and adaptation of new technologies, and a new way of how we do things" (Participant 11, male).
	Access to information	"For me it is certainly around the ability to act and having information at my fingertips which gives me a competitive edge in comparison to the individual that don't necessarily have access to it" (Participant 2, female). "The 4th Industrial Revolution is providing access and making things more reachable" (Participant 7, male). "The concept of knowledge workers is going to be something that is going to be pervasive" (Participant 9, male). "Some of the stuff that I learned back then are no longer relevant and you are seeing new types of skills emerge" (Participant 11, male).
	A change in jobs and skills required	"It can be detrimental, particularly to traditional jobs as they exist now, and can create redundancies" (Participant 2, female). "It is going to be a massive change to the way in which we work and the types of jobs that we have" (Participant 3, male). "The types of skills that we need in order to advance, or at least to survive are going to change" (Participant 3, male). "New jobs will be introduced. So, there's more opportunities for coders and programmers" (Participant 12, female). "Jobs are going to change, and this is going to make way

for new type of skills" (Participant 14, male).

	Integrating machines and computers into work	"I saw a clip where a robot was conducting surgery. And if you think about public hospital and how they are so overloaded with people where doctors and nurses don't have the capacity. So, we are going to have to work closely with robots" (Participant 4, female).
	Relieve humans of tasks that are physically or administratively intense	"Going down the automation route means getting rid of mundane and administrative tasks" (Participant 4, female). "…I wouldn't say it starts to make people redundant, but monotonous tasks that we are used to doing can be done in a more efficient way now" (Participant 5, male). "It is enabling human beings to do more through technology. It's freeing up time for us to do literally anything we want. We just need to educate ourselves" (Participant 8, male). "Less human intervention will be required in some respects" (Participant 10, male). "Things you can see being done away with is the functions that are manually intensive and repetitive. Computers can do these far better…" (Participant 11, male). "So basically, it is about finding ways to automate things that would normally require a person to perform" (Participant 12, female).
	Redundancy of jobs	"It's scary, because we are going to struggle in terms of finding job opportunities. Particularly, low level or entry level type of jobs that a computer can do. These jobs are falling away" (Participant 8, male). "It is replacing people with technology where possible to get things done faster and efficiently" (Participant 12, female).
	The creation of efficiencies	"I think the concept behind the 4IR is to make things more efficient and to, in a way, grow the potential of human beings" (Participant 15, male).
The impact of the 4th Industrial Revolution	Certain functions being automated	"Changes that have taken place in terms of how the organisation is automating our systems and process" (Participant 1, female). "Certain parts of my job are now being done by a computer. I was introduced to automation and I loved it. It made things easier for me" (Participant 12, female). "We used to see slow transitions and then all of a sudden you are seeing far faster transition towards automation and doing things yourself" (Participant 13, male). "I have seen a strong integration of automation into what I do" (Participant 15, male).
	Very little impact	"I would say little impact because in the area that I am in a lot of people engagement is still required" (Participant 1, female). "It hasn't had a direct impact on me, I think that I have

been protected from it simply because of the line of work that I am in. However, I do believe that it soon will" (Participant 2, female).

"It has not had a great impact yet" (Participant 4, female).

"I am fortunate that it has not had a negative impact on me" (Participant 14, male).

	A reduction in mundane and administrative tasks	"We used to use a lot of spreadsheets, and it was a very manual process. Now at a company level we can input data and get results from that. And get a better picture of what is happening on the ground. And that's all run on an application" (Participant 2, female). "I believe that some parts of what I currently do are no longer going to be valid. Specifically, the admin function with the advancement of these online and cloud-based tools" (Participant 3, male). "The tools that I now use to perform my job have changed" (Participant 4, female). "If we look at my current role, it used to be split into two different functions. However, business has decided to combine the service delivery and service management function because technology has taken care of the administrative or operational function" (Participant 8, male).
	Introduction of tools that make work more efficient	"The tools that I now use to perform my job have changed" (Participant 4, female). "My job now involves the use of AI, data analytics and data orchestration. Now my function as a traditional engineer has changed" (Participant 5, male). "I have been in my current company for 12 years now; we have recently adopted some new technologies and retiring the old ones" (Participant 7, male).
	Increased access to information	"I have greater access to information, and so I learn a lot more than I would have before. There is a lot more content available to me" (Participant 2, female). "It is becoming easier to get stuff that has always been out of reach. Or difficult to get hold of. So, the 4th Industrial Revolution is providing access and making things more reachable" (Participant 7, male). "The concept of knowledge workers is going to be something that is going to be pervasive" (Participant 9, male). "Some of the stuff that I learned back then is no longer relevant and you are seeing new types of skills emerge. Also, I can acquire skills a lot easier than before" (Participant 11, male). "Working for an IT company puts me in a better position when it comes to understanding and grasping technological concepts and information" (Participant, 14, male).
	Transformation	"I can already see that I am required to have a multitude

of skills		of skills. So, I can no longer rely on one type of skill" (Participant 3, male). "Working for an IT company gives me an advantage to some extent. So, I have the advantage of acquiring new skills earlier than most" (Participant 10, male). "Firstly, the skills that I am required to learn have changed. So, I have had to acquire new skills" (Participant 11, male).
	Job redundancy	"When I started my career, I was in sales operations and a few months later my role was made redundant. I then transitioned into digital marketing" (Participant 6, female). "My previous role was at risk; however, I do think the 4th Industrial Revolution introduces a lot of exciting opportunities" (Participant 9, male).
Opportunities presented by the 4th Industrial Revolution	Provides focus	"It will make me a better and competent practitioner within my current role, because it will allow me to focus on the things that I should focus on" (Participant 1, female). "A big part of product management is about understanding user behaviour and user patterns in terms of how they find value in the products that they use. A lot of this information is found in data, which means it would have to be analysed and patterns would need to be found. So, the tech that the 4IR has introduced will further aid the product function" (Participant 5, male). "Clients want more interaction, so I think technology will allow me to free up time to focus on that. Because that is what my role should be after all" (Participant 8, male).
	Access to information	"I'm a researcher by nature, so collecting information is my thing, and the ability to collect it at a faster and more effective rate is quite appealing to me. And I think that technology will provide that" (Participant 2, female). "I can now find videos on YouTube to learn coding; you can literally study your life from YouTube, and I feel like with 4IR it will enable people who can't go to university get the skills required for them to get upskilled" (Participant 4, female).
	Career growth opportunities	"The fact that I am quite agile, and because of my agility it has allowed me a lot more from a career growth perspective. So, I could transition into a role that is fit for the future of the organisation" (Participant 3, male). "From a skills perspective, we can now sell skills to different parts of the world" (Participant 9, male). "It has allowed me to relook my career. At age 32, I have recently gone back to school" (Participant 10, male). "With me being in the risk department, and with technology increasing risk in a lot of aspects, my job is going to become even more relevant" (Participant 12, female).

		"It has allowed me to redefine my career and to start thinking of the future skills that I need to acquire" (Participant 15, male).
	Better systems and tools	"I think the tools that are available to us are also going to help us become better at digital marketing" (Participant 6, female). "I think my job will change eventually, where there is less field work and we can access devices remotely" (Participant 7, male). "The systems and tools that we interact with, we no longer require a lot of human intervention" (Participant 11, male). "People buy from people, so the introduction of AI systems will allow me to focus on my role. Which is driving sales" (Participant 14, male).
Challenges presented by the 4th Industrial Revolution	Job redundancy	"I do think there will be redundancies in some respects because of technology" (Participant 1, female). "I think as it relates to my work specifically, it's more around a potential threat of being replaced by a robot or AI. I'm a lot more replaceable than I was before" (Participant 2, female). "The potential of increased unemployment, so as manufacturing companies introduce machinery, what happens to the 500 people that need to be retrenched?" (Participant 4, female). "I think there will be redundancies. I think that less of us will be required in certain functions" (Participant 8, male). "I don't think that my job will be redundant at this point, I do, however, think that if people do menial tasks or repetitive tasks, then those tasks will eventually be outsourced to a machine (Participant 9, male). "So, what I am seeing is departments scaling down in terms of the labour force. So fewer people doing the current tasks that still require human beings" (Participant 11, male). "I am scared that my job could be redundant. Particularly with the skills that I have" (Participant 13, female).
	Identifying the knowledge and skills required	"There is just so much information out there that it sometimes becomes quite difficult to identify what one needs to be upskilled in" (Participant 3, male). "There is a lot of noise at the moment, and a lot of information being thrown at us. So, it is very difficult to understand what risks we should be taking now" (Participant 6, female). "We have so much access to so much information, so I would say the biggest challenge is navigating through all this data and establishing what is relevant to you" (Participant 10, male). "Trying to constantly stay abreast with all the skills

		changing is quite a challenge" (Participant 15, male).
	Inequality between people	"It is going to create inequality where the city of Johannesburg, for example, is talking about having smart cities, but nobody is talking about having smart townships" (Participant 4, female).
	No challenges	"Not really, not if you define a challenge as a change in thinking. I think that 4IR will require a change in thinking" (Participant 5, male). "I don't see any career-related challenges. I think I will have to learn new laws, deal with new governance challenges" (Participant 12, female). "I don't think it will pose any challenge, I think it's going to create more opportunities if anything, particularly within the company that I work in" (Participant 14, male).
Aligning to the 4th Industrial Revolution	Skills development and relevance	"Equip people with the right level of skill for what is going to be required in that 4th Industrial Revolution" (Participant 1, female). "They need to build skills. The skills that I think are super important are good communication skills, high EQ, some computer-based skills - programming being one of them" (Participant 3, male). "Knowledge, understanding and research. People need to educate themselves further about the 4th Industrial Revolution" (Participant 4, female). "One has to ensure that they have the relevant skills. But not just relevancy for now. One must start thinking about the future as well" (Participant 5, male). "But if I educate myself and I actually understand what's going to be happening and why it's going to be happening, then I can be prepared for it" (Participant 6, female). "I think people need to have the right skills and stay on top of what is happening" (Participant 7, male). "The first thought that comes to me is study and coupled with studying you need to be exposed" (Participant 8, male). "They have to evolve their skill sets. So, they need to be well versed in their industries and how technology impacts them" (Participant 10, male). "I would say learning, adapting, embracing new technologies… That's the only way that one is going to survive" (Participant 11, male). "Individuals need to understand what the future holds for their respective careers and upskill themselves accordingly" (Participant 12, female). "Skill set is a big focus in terms of whether you are relevant or not. So, one needs to focus on skills that are in high demand" (Participant 13, female). "I would advise people to study, and to study something

		that is digitally based. Also understanding what digitisation means as well as where it is going" (Participant 14, male). "To establish what the trends are and how they are going to impact their career. And redefine their skills accordingly" (Participant 15, male).
	Change in mind set	"It's more a change of mind set. From being solution driven and having a growth mind set. So often at times we look at problems, but that's as far as we actually go" (Participant 2, female). "I think what people need to do is start thinking about things in a different way. They need to get away from thinking that they are going to have a job for life or be employed by someone" (Participant 9, male).
	Entrepreneurial skills	"We definitely need to be more entrepreneurial, because I don't see the regular 9 to 5 job lasting" (Participant 2, female). "And start thinking about how I, as an individual, create value in society and how do I get compensated for it" (Participant 9, male).
How organisations need to support employees	Enable employees to be self-sufficient	"If companies ought to do anything, then they need to help employees or empower employees to be a lot more self-sufficient. They need to teach them to be more entrepreneurial and to actually ready themselves for the possibility of their jobs not existing anymore" (Participant 2, female). "Content needs to be digitised to allow for people to consume up to date information as and when required" (Participant 11, male).
	Clear understanding of future roles	"They need to have a very clear understanding of what various jobs and roles require - particularly ones that they are planning for" (Participant 3, male). "Leaders need to take employees on journey from the onset by sharing knowledge and helping employees with the skills to anticipate what is to come" (Participant 4, female). "And once they have figured out what the strategy is around AI and 4IR, in general, then they need to identify the new roles that are going the be required, and make sure that they make appropriate training available to help people transform their skills to start the transition into the new era" (Participant 9, male). "So, to help individuals, they need to start thinking about what the new roles are going to look like and start redesigning jobs" (Participant 15, male).
	Transparency	"Leaders need to be transparent about the changes that the 4IR will present and how these are part of the long-term business strategy" (Participant 4, female). "If AI and robotics is where the organisation is going then that is what the company must communicate to its

		people so that they understand. Transparency has to be created so that people know how to adjust and make career decisions accordingly" (Participant 5, male).
	Develop employees	"Companies need to create a culture of lifelong learning. So, they need to make it easier accessible for employees to acquire skills" (Participant 5, male). "I would say that businesses need to drive their employees into specialisation. Once people acquire and specialise in specific skills, then they become subject matter experts in a specific area" (Participant 8, male). "As a business, we need to develop content and a mechanism that speaks to millennials" (Participant 10, male). "Organisations should look at the skills that they currently have and enhance the skills of the people you have in the organisation. Rather than outsourcing" (Participant 13, female).
	Future-orientated leaders	"We need to have leaders that are future thinking. If there is a change coming and want to adopt a specific type of technology, then they should be feeding employees information that will make you ready for what is to come" (Participant 6, female). "Motivate employees and create performance objectives that are aligned to the technologies introduced, as well as for the future" (Participant 7, male).

Discussion

The general objective of this study was to explore millennial perceptions of the 4th Industrial Revolution in an information technology company. The findings are discussed and linked to the specific objectives of this study.

The *first objective* was to establish the way in which millennials describe the 4th Industrial Revolution. The way in which a fair number of participants in this study described the 4th Industrial Revolution is consistent with Schwab's (2018) view that argues that the 4th Industrial Revolution came about as a result of the foundation laid by the 3rd Industrial Revolution, and that it is a new era rather than a continuation due to its pervasive nature. The commonality that this era shares with the preceding one is the invention of transformative technologies that change society on a fundamental and economic scale (Bartodziej, 2017). However, a key differentiator is that, unlike the 3rd Industrial Revolution, the 4th Industrial Revolution is reshaping human existence through technologies that are merging the physical, digital and biological spheres, fostering a closer relationship between humans and machines (Finley-Moise, 2019).

A significant number of participants described this era using technologies such as artificial intelligence (AI), robotics, biotechnology and automation, with an emphasis on how these capabilities enable computers to gather large amounts of data, collect data patterns, and make decisions autonomously. Mahmood and Hussin (2018) agree with this view and suggests that technologies of this nature have simplified the way in which certain functions are performed through autonomous and intelligent computing, allowing machines to learn from historical data to identify patterns, as well as optimise on algorithms to produce desired results (Khan, 2018). Roblek et al. (2016) suggest that it is these concepts and capabilities that make this era unique, as they bring humans and machines closer. A small number of participants agreed with this perspective and discussed the nature of the 4th Industrial Revolution in relation to how machines and computers are now going to be further integrated into work compared to before. Thus, increasing the integration of technologies into business processes as machines become self-sustaining and interconnected (Weinberger, 2018), enabling organisations to optimise on innovations that interact with humans and increase efficiencies in various aspects of the business (Dombrowski & Wagner, 2014).

A fair number of participants referred to the 4th Industrial Revolution as an era that encompasses technologies that relieve humans of monotonous, administrative and mundane tasks. This is because repetitive, and administrative functions can be automated and digitised so that humans can create value in another aspect of work (Morrar et al., 2017). For a small number of these millennials, this era entails a change in jobs and skills, more so the redundancy of jobs that currently exist. However, for a significant number of these participants, it is perceived that this era will increase career opportunities made available to them. The 4th Industrial Revolution is still in its early stages and researchers have contrasting views where work is concerned (Bonciu, 2017). Schwab (2018) suggests that literature in this regard is diluted between the optimists who foresee limitless career opportunities and the pessimists who anticipate a mass dislocation of jobs. The optimistic prediction suggests that the coming few years will see millions of new jobs being created (Butler-Adam, 2018); whilst the pessimistic view suggests that technology will dislocate more jobs than it will create (Butler-Adam, 2018). Research conducted by McKinsey predicts a dislocation of 800 million jobs across 42 countries (Menon, 2019). However, what remains consistent across the various views is that this era is going to transform the skills and labour market, as all industries fundamentally evolve and embrace new technologies (Schwab, 2018).

The *second objective* of this study was to determine how the 4th Industrial Revolution has impacted millennials. A small number of millennials have seen a significant change in the tools and systems they use to perform work. Research indicates that 85% of organisations intend to adopt a big data strategy, whilst 58% anticipate that they will optimise on technologies such as artificial intelligence, as well as augmented and virtual reality (Schwab, 2018). Therefore, the number of hours that systems and machines will work is likely to increase, compared to the number of hours that will be worked by humans in the coming years (Schwab, 2018). This is consistent with the view of some of the participants that mentioned that systems and processes in their jobs are now automated, allowing them to reduce the levels of mundane and administrative activities that they are required to routinely perform. Buzza (2017) agrees that this new generation of automated systems is gradually reducing the amount of operational and administrative work that is performed, enabling individuals to re-think their careers and create value in other aspects (Carvalho et al., 2018). While this is the direction that most organisations are taking, Weinberger (2018) argues that these technologies are still in their infancy and heavily dependent on human oversight.

Therefore, it will take years before companies realise the true value of autonomous and self-optimising systems (Weinberger, 2018).

A significant number of participants in the study also indicated that the 4th Industrial Revolution has increased their access to information and knowledge. As this era progresses, millennials are required to continuously acquire new skills as new job roles emerge (Singh, Sarkar, & Bahl, 2018). A significant number of the millennials interviewed suggest that this era has made this possible and has provided them with the opportunity to acquire new skills through different sources and platforms. The 4th Industrial Revolution is powered by exponential amounts of data, as well as intertwined chains of networks that create large amounts of information (Paprocki, 2019); therefore, providing millennials with access to various sources of knowledge and expertise (Hirschi, 2018). One participant even suggested that working for an IT company has given them an advantage, because organisations of this nature introduce and adopt technological advancements earlier than most organisations. In a study conducted by Deloitte (2017), it was found that the 4th Industrial Revolution is increasingly demanding more knowledge and experience within the technical domains. Therefore, the demand for digital skills and expertise in big data and analytics, which reside in the information technology industry, are going to increase (Petrillo, Felice, Cioffi, & Zomparelli, 2018).

A small number of participants described the impact of this era as negative due to their roles being made redundant. Senvar & Akkartal (2018) suggest that the 4th Industrial Revolution is impacting every aspect of work, making jobs that are vulnerable to automation redundant. In contrast, a fair number of participants had a different perspective in this regard and indicated that the 4th Industrial Revolution has had very little impact on their work, and this is due to the amount of human interaction that is involved in what they do. Davis (2016) argues that although we are in the early stages of the 4th Industrial Revolution, exposure to this era is not evenly distributed. Therefore, for some people, the impact of the technologies introduced has not been felt as yet (Schwab, 2018). However, from this group of participants that have not been impacted, one did mention that although they have not felt the change, they do foresee a significant impact as digitisation becomes prevalent.

The *third objective* of this study was to establish the types of opportunities that millennials have been presented with as a result of the 4th Industrial Revolution. The introduction of this

era has promised significant social and economic opportunities for the world at large (Manda & Ben Dhaou, 2019). Organisations are becoming 'smarter' and more efficient through the systems and tools they employ (Morrar et al., 2017). For a few of the participants' interviewed, this has allowed them to make use of systems and tools that create efficiency in the work they need to perform. Bonciu (2017) further suggests that as the 4th Industrial Revolution progresses, there are going to be significant advancements in technologies such as AI, robotics and IoT (Bonciu, 2017). For a small number of participants, this is going to allow them to create focus, and time for aspects of work that they are hired to do. Therefore, allowing them to create value in engaging with others, whilst technology takes care of aspects such as analysing data and creating patterns from it. This is because digital technologies introduced by the 4th Industrial Revolution are intended to relieve humans from automatable tasks, enabling them to focus on more complex business issues (Daemmrich, 2017). It is anticipated that this kind of focus will be achieved through enduring human skills such as creativity, emotional intelligence and supervision, coupled with technical capabilities and competencies that will support the technologies introduced (Deloitte, 2018).

For a small number of participants, the 4th Industrial Revolution has provided them with access to acquiring information at a faster and more efficient rate. They can also acquire skills through various channels, and consume information through platforms such as YouTube, as opposed to the traditional classroom approach. Penprase (2018) argues that 4th Industrial Revolution is in motion and as it progresses, it is going to require accelerated skilling and re-skilling, as the access to online and tech-enhanced learning material increases. Concepts such as micro-learning where individuals can acquire small chunks of information in a short space of time through mediums such as short videos, gamification and podcasts are increasingly becoming prevalent (Harve, 2019). Therefore, to optimise these platforms, millennials will need to shift their mindsets from acquiring specific credentials, to pursuing skills and capabilities that will enable lifelong learning (Hattingh, 2018).

A significant number of participants mentioned that they are now presented with a lot more career opportunities as organisations re-define the skills that they need. The digitisation and automation of work is fundamentally changing the nature of work (Hirschi, 2018). It is retiring certain occupations and introducing new jobs and principles where work is concerned (Bonciu, 2017). Smart machines and AI enabled systems are going to be further integrated, and millennials will need to understand where their skills fit in the value chain as technology

becomes further augmented into work (Selamat, Alias, Hikmi, Puteh, & Tapsi, 2017). One participant further argued that technology has created the opportunity for one to sell one's skills to anyone in the world, and location is no longer a barrier. This view is consistent with Hattingh (2018) who argued that the nature of work will result in significant changes where work will no longer be defined by working for one employer and location will no longer be a barrier. Therefore, millennials have to shift their mind sets to adapt to an environment where work is flexible, short-term and based on demand (Hattingh, 2018). One other participant felt that his role has already been aligned to the 4th Industrial Revolution, and if anything, it is going to become even more relevant and critical than before.

The *fourth objective* was to establish the kind of challenges that millennials have experienced as a result of the 4th Industrial Revolution. Although they have not been presently impacted, a large number of the participants think that it is highly likely that their jobs will be made redundant in the foreseeable future. From these participants, a small number further argued that organisations are scaling down and their teams are going to become smaller as new technologies are adopted. Two participants went as far as saying that they fear they will not have work as a result of robots and AI taking over. As mentioned previously, researchers are on extreme ends where work is concerned. Whilst some indicate that many of the existing job roles are going to be made redundant, others anticipate an increase in the creation of new types of jobs (Hirschi, 2018). Therefore, there is not a clear consensus as to whether this era will create more job opportunities versus the number of jobs it will make redundant. However, what is consistent across both views is that human capability is not going to be completely obsolete; instead, the concept of work is going to transform and in effect so will the prerequisites of employment (Gwata, 2019).

Another challenge that was identified was the ability to identify the skills required for the future. As organisations transition towards digitisation, some of the challenges that they will experience will include skills mismatch and the redundancy of skills due to the changing nature of work (Manda & Ben Dhaou, 2019). A fair number of millennials argued that although technology has allowed them greater access to information, there is so much information that one needs to navigate through, that it has become challenging to identify the skills relevant to them. New knowledge is created at an exponential rate and contributing towards the 'half-life' of knowledge and skills (Hattingh, 2018). Therefore, in as much as new knowledge and information can be made instantly available, it can now become obsolete

at an equally rapid pace (Hirschi, 2018), making it highly likely for millennials to be overwhelmed by the information overload and challenging to sift through what is relevant to them (Hattingh, 2018).

One participant felt that the 4th Industrial Revolution is creating further inequalities, and that privileged individuals are going to benefit even further; whilst disadvantaged people who do not have access to technology might not reap the benefits this era provides. Xu et al. (2018) agree that this era is yielding further inequality, as it displaces entry level or operational work, creating more opportunities for those with scarce skills. Von Reiche (2019) concurs and suggests that digitisation is the reason for inequality, also the segregation between lower skilled workers, and those that are skilled and considered to be benefactors of the 4th Industrial Revolution. A small number of the participants had a contrasting view and felt that this era has not created any challenges; instead, they feel it ultimately requires new skills and a new way of thinking to remain relevant. As such, they are anticipating more opportunities presented than challenges.

The *final objective* of this study was to establish what millennials think is required to align themselves to the 4th Industrial Revolution. From the participants interviewed, a large number suggested that the best way to align themselves to the 4th Industrial Revolution was to expose themselves further to the phenomenon. They felt that it is imperative to understand what it means and how their career paths fit into it. It was further elaborated that they would need to create relevancy for now, as well as relevancy for the future. Therefore, they need to redefine their skills on an ongoing basis as the concept of work evolves. This is because the acceleration of innovation and the disruption of pervasive technologies is going to require a different approach to thinking (Hattingh, 2018). Two participants agreed with this notion and mentioned that the 4th Industrial Revolution requires a change in mind set. These participants reckoned that this era would require a growth mind set where people move away from thinking that they will have the same job for life. Accordingly, Hagel, Schwartz, and Bersin (2017) suggest that individuals need to be constantly thinking of how they can reinvent and redefine the skills they have.

One participant argued that millennials must focus on skills that are 'digitally' focused, as these are highly sought after. Hattingh (2018) agrees in this regard and suggests that it is not just technology that improves efficiency, but it is also the technical competence behind the

technology that is critical in ensuring that it performs as it should. A small number of participants also mentioned that millennials need to acquire entrepreneurial skills and start thinking of their skills as a 'business', as they will be required to sell their skills to the market whilst creating value in society and getting compensated for it. Gwata (2019) agrees that employees need to be more entrepreneurial as they will be expected to play an even more active role in this era. Hattingh (2018) supports this and suggests that entrepreneurial skills will be essential for the 4th Industrial Revolution; employees will be required to add value through innovation and actively seeking improvements in their work environments.

Participants were further probed and asked what they think organisations can do to support them in creating readiness and alignment to the 4th Industrial Revolution. A small number of participants argued that there is a need for leaders to be open and transparent about their long-term business strategies and how the 4th Industrial Revolution impacts these strategies. They felt that this would allow them to start thinking about their careers differently. Schwab (2018) has a contrasting view in this context and suggests that the digital revolution requires leaders that are 'more human', emotionally intelligent, and able to model and champion co-operative working. This is because leaders of this nature will coach rather than command; they are more likely to be driven by empathy and not their own ambitions (Hattingh, 2018). Two participants postulated that there is a need for future-orientated leaders. These participants suggested that when leaders are thinking about the future, they can start preparing people for change and empower them with the necessary resources. Artley (2018) is in agreement that leaders need to understand and consider the skills that are most favourable for their organisations' future state, and develop people accordingly.

A fair number of participants also suggested that it is imperative that when organisations are contemplating introducing new technologies, they need to have a 'people inclusive' strategy that encourages self-sufficiency. This way they can be proactive in planning for the future as some of their skills become redundant. Gwata (2019) agrees with this standpoint and suggests that in a world where employment is challenged by the digitisation of the workplace, self-sufficiency will play a critical role in enabling people to establish their careers in such a way that they are augmented and not threatened by technology. A small number of particpants further stated that as organisations redesign their structures, they need to have a clear understanding of what skills are going to be required. Similarly, Schwab (2018) suggests that it is critical for organisations to take an active approach in supporting their existing workforce

in upskilling and reskilling. Therefore, organisations need to focus on investing in an agile workforce that has future skills to realise the extent to which technology can be optimized whilst mitigating the risks of high levels of redundancies (Davis, 2016).

Millennials also suggest that organisations need to create a culture of lifelong learning, particularly around niche skills, by making learning more accessible through various mediums. The 4th Industrial Revolution has made skills development seamless and accessible through mediums such as Edx, Coursea, podcasts and YouTube videos (Schwab, 2018). Although one needs to have in-depth knowledge of a specific field, Gwata (2019) argues that individuals need to have enough knowledge in fields outside their own specialisation. These skills should be complementary and enable millennials to enrich their existing skills in their fields of expertise (Gwata, 2019). Therefore, in as much as millennials need to acquire core skills and expertise, they also need to be multi-faceted in other areas to become all rounded and relevant.

Practical Implications

This research study aimed to explore millennial perceptions of the 4th Industrial Revolution in an information technology company. The data collected in this research study can assist companies in understanding and establishing what millennials require to transition in the 4th Industrial Revolution. Thus, providing insight into what millennials think of the phenomenon and investing in interventions that can support them through the transition, particularly around transforming skills and creating readiness through various mediums.

Conclusion

The objective of this study was to establish millennial perceptions of the 4th Industrial Revolution in an information technology company.

Based on literature, the 4th Industrial Revolution is a concept used to describe the current economic and technological era (Roblek et al., 2016). In this study, it was found that millennials describe the 4th Industrial Revolution as a new era that stems from the 3rd Industrial Revolution. They further associated this era with the introduction of new technologies such as artificial intelligence, automation, biotechnology and robotics. Millennials suggest that these technologies are going to be further integrated into their lives in such a way that they are going to be relieved of administrative and manually intensive

tasks. Although there is minimal impact currently, millennials anticipate that as this era progresses, it is going to introduce new tools and systems, resulting in the automation of certain job functions. Millennials argue that this is going to lead to the redundancy and transformation of current skills.

To cope with this and still remain relevant, millennials believe that they need to change their mind sets and educate themselves about the 4th Industrial Revolution and its impact on their long-term career aspirations. They also believe that they need to align to this period by acquiring skills and reskilling more frequently than before, due to the accelerated rate of change. They further suggest that they need to be more entrepreneurial and start thinking of how they can create value in society, whilst getting compensated for it.

Another aspect that was focused on in this study was the contribution that organisations can make in supporting millennials to align to the 4th Industrial Revolution. Millennials believe that organisations need to be clear and transparent about their strategic ambitions, and how the 4th Industrial Revolution will influence the various job roles in their businesses. Millennials also suggest that organisations need to drive a culture of learning, empowering employees to be self-sufficient. This way they will continue to evolve their skills and proactively manage their career progression. Marr (2019) suggests that business leaders will need to expand their thinking away from traditional concepts, to being future-orientated. Furthermore, they need to rethink their strategies and business models in such a way that they consider the impact of the 4th Industrial Revolution on various aspects of business, particularly their workforce (Marr, 2019).

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CHAPTER 3

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

The purpose of this chapter is to draw conclusions from literature and to present the empirical results based on the research objectives. Furthermore, attention is drawn to the limitations related to the study and the recommendations made by the researcher for individuals, organisations and future research.

3.1. CONCLUSIONS FROM LITERATURE AND EMPIRICAL RESULTS

The aim of this study was to explore millennial perceptions of the 4th Industrial Revolution in an information technology company. The world is at the cusp of the 4th Industrial Revolution, and what makes this era unique is that it is challenging the ideology of what it means to be human (Marr, 2018). Although extensive research has been conducted around this phenomenon, a large amount of it has focused on defining what this era is, addressing the technologies that it has introduced, as well as its impact on economies, organisations, and changes in the labour market. However, minimal focus has been given to individuals' perceptions in relation to their beliefs, and the way in which they think this era impacts them.

A qualitative approach was employed to establish millennial perceptions of the 4th Industrial Revolution in an information technology company. Fifteen participants were identified using purposive sampling, and data was gathered following a semi-structured interview approach. Once data had been collected, themes were then identified, based on the specific objectives of the study. Subthemes were then associated with the respective themes; and redundant codes were deleted from the findings. Following this, codes were grouped into categories and themes addressing the specific research questions.

The *first objective* of this study was to establish the way in which millennials describe the 4th Industrial Revolution. Rouse (2017) agrees that although the 4th Industrial Revolution is developed on the foundation of the 3rd Industrial Revolution, it is a new era rather than an extension of the preceding Industrial Revolution. This is because the technologies introduced in this period are disruptive in nature and fundamentally changing human existence as it is currently known (Hirschi, 2018). It was further found that a significant number of millennials

described this era in relation to technologies such as biotechnology, robotics and automation. The 4th Industrial Revolution has brought about the development of various technologies, with artificial intelligence, robotics, cognitive computing, biotechnology and automation being a few of them (Leitao, et al., 2016). This study indicated that millennials feel that it is these technologies that have enabled them to be more efficient. Further, it was found that millennials think that these technologies will be integrated into their lives in such a way that operational and mundane activities are going to be reduced. Coldwell (2019) agrees that these technologies are becoming further embedded into society and transforming organisational systems, management principles, as well as employee qualitative and quantitative workloads. As technology takes care of monotonous tasks that they would typically engage in, employees are now allowed to create value in other ways (Morrar, Arman, & Mousa, 2017).

The findings of this study also indicated that millennials associate this era with a change in jobs and skills. They further indicated that as this era progresses, it is going to present new career opportunities that require a new set of skills. However, for one participant, the 4th Industrial Revolution is indicative of the job redundancies to come. With previous Industrial Revolution, it could be asserted that technology would create more jobs than it would displace (Skilton & Hovsepian, 2018). However, what makes the 4th Industrial Revolution complex is the extent to which machines can perform various functions autonomously, as well as learn from the data it works with - better than humans would (Ślusarczyk, 2018). Therefore, the likelihood of certain jobs being replaced by machines becomes a possibility, making way for new concepts of work (Pîrvu & Zamfirescu, 2017).

The *second objective* of this study was to establish the impact that the 4th Industrial Revolution has had on millennials. It was found that a significant number of participants in this study associated the impact of this era with a significant reduction in operational and administrative duties as a result of automated systems and processes. The automation of operational functions of work has eradicated tedious aspects of work across many business functions, allowing humans to focus on meaningful tasks that create value (Sohimi et al., 2019). Millennials also indicated that this era has given them access to various platforms where knowledge and skills can be acquired. The 4th Industrial Revolution has created an exponential scale of interconnections and exabytes of information (Skilton & Hovsepian, 2018); therefore, creating a new level of on-demand computing power that enables

individuals to acquire knowledge at any point and on any given device (Skilton & Hovsepian, 2018).

Although the 4th Industrial Revolution is bringing about significant productivity gains for society, it is also displacing many jobs as it progresses (Chan, 2019). In this study it was confirmed that two participants were impacted by job redundancies. This is because technologies driven by this era have taken over certain functions; new human capabilities and competencies, which provide a comparative advantage, are being developed (Acemoglu & Restrepo, 2019). Accordingly, these participants had the opportunity to transition into roles that are digital in nature and aligned to the requirements of this era. For a few participants, it was found that the 4th Industrial Revolution has had very little impact on their roles; they suggest that this is because their roles require extensive human interaction. This confirmed Dixon and Jordan's (2018) argument that human-focused competencies such as creativity, problem solving, people management and critical thinking are going to be critical in a world where machines can perform operational functions.

The *third objective* entailed establishing the types of opportunities that millennials have been presented with as a result of the 4th Industrial Revolution. It was found that millennials can now use intelligent tools and systems that enable them to create efficiencies. Thus, allowing them to focus on more complex business issues that computers cannot perform (Daemmrich, 2017). It was also identified that the 4th Industrial Revolution has introduced tech-enhanced platforms that create ease and access to information (Penprase, 2018). As such, millennials felt that they can now acquire skills and consume knowledge through various platforms.

Considering the number of billions of devices that are interconnected, this era has given rise to unprecedented processing power, storage capabilities, as well as greater access to knowledge (Botha, 2019). Therefore, providing millennials with the opportunity to acquire the skills that they need (Hirschi, 2018). As organisations redesign and introduce new concepts of work, it was also found that a significant number of the millennials interviewed feel that they will be presented with more career opportunities and various ways of offering their skills as a service, as opposed to the traditional concepts of a '9 to 5' job. Marr (2018) concurs with this view and anticipates that the 4th Industrial Revolution will introduce new skills; therefore, the long-established concept of clocking in to work at nine and leaving work at five will cease to exist as it gets replaced by agile work environments (Marr, 2018).

The *fourth objective* of the study was to understand the kind of challenges that millennials experience as a result of the 4th Industrial Revolution. Although it was found that most millennials have experienced minimal impact where job redundancies are concerned, they anticipate that their jobs will be impacted as organisations progress to adopt digital tools and systems. They argued that this is going to make certain jobs redundant, while some jobs and skills evolve, as suggested by Butler-Adam (2018). However, there is no clear consensus as some researchers anticipate an increase in opportunities, while some expect to see more jobs become redundant (Hirschi, 2018).

Although millennials now have access to more information and knowledge, this study found that millennials regard this as a challenge to some extent. Millennials feel that it has become challenging to navigate and sift through large amounts of information, and to establish what is relevant. It becomes difficult to establish what knowledge and skills one should be focusing on due to the levels of data made available to them. Although a key milestone of this era is the democratisation of information and knowledge, this study identified that it can be challenging to navigate through the amounts of information (Davis & O'Halloran, 2018). Therefore, to acquire the right knowledge, millennials need to establish key areas that will be relevant to them, prior to embarking on specific learning paths (Moloko, 2019).

One participant indicated that another challenge is the inequality that this era has created. They argued that the skilled workforce now has better access to increased opportunities than those that are underprivileged, as entry level work becomes further redundant. Von Reiche (2019) agreed that technology has disrupted the labour market and that the beneficiaries of these developments will be those that are going to provide the relevant intellectual and physical capital. Lastly, it was found that a small number of participants felt that this era has not created any challenges for them; instead they see it as an opportunity to acquire new skills and optimise the opportunities made available to them.

The *final objective* was to establish what millennials think is required to align themselves to the 4th Industrial Revolution. Millennials suggested they need to change their mind sets and educate themselves about the 4th Industrial Revolution and its impact on their long-term career aspirations. Cooper (2019) agrees that while a change in skillset is imperative in this era, a growth mind set is just as important in driving agility as individuals reskill and upskill. It was also found that millennials need clarity in terms of the phenomenon and its impact on them. Thus, they feel that it is crucial for them to get a clear understanding of the 4th

Industrial Revolution and its impact on the concept of work (Schwab, 2018). This way they can align to this period and acquire the appropriate skills. Millennials also indicated that, as the concept of work evolves, they will need to be more entrepreneurial. Gwata (2019) agrees that entrepreneurial skills will provide individuals with the competency to identify opportunities that create value, establishing careers that are augmented and not threatened by technology.

Another aspect that was focused on in this regard was the contribution that organisations can make in supporting millennials to align to the 4th Industrial Revolution. It was found that millennials believe that organisations need to be clear and transparent about their strategic ambitions, and how the 4th Industrial Revolution will influence their business objectives and various job roles. Millennials also suggested that organisations need to drive a culture of learning and empower employees to be self-sufficient. This way they will continue to evolve their skills and proactively manage their career progression; therefore, ensuring that they have the necessary skills to support the new technologies employed (Ryder, 2018). Marr (2019) suggests that business leaders need to expand their thinking away from traditional concepts and gear their human capital towards digitisation. Lastly, millennials suggested that leaders need to rethink their strategies and business models in such a way that they proactively consider the impact of the 4th Industrial Revolution on various aspects of business, particularly their workforce (Marr, 2019). This way they can engage in meaningful conversations with employees as they create readiness for the future.

3.2. LIMITATIONS OF THIS STUDY

Limitations were taken into consideration in this study. Creswell and Creswell (2018) argue that qualitative research is generally subjective in nature. Whilst the researcher endeavoured to be objective and minimise bias from the study, participants' responses to the questions were subject to the researcher's interpretation. The research study is based on a pool of participants that work in the same organisation, limiting the findings to one environment. With this consideration in mind, the transferability of the findings may be limited to a similar context. Furthermore, the researcher is employed in the same organisation at which the research had been conducted. Although he clarified his role as a researcher, being a colleague to the participants may have possibly impacted some of the responses. Due to the focus of this study being on millennials that work in an information technology, they may be more

informed and exposed to the phenomenon than millennials working in other industries. Lastly, the themes established were based on the specific objectives of the study, limiting the ability to explore other themes that could have potentially emerged.

3.3. RECOMMENDATIONS

Recommendations based on the findings of this study will be presented in this section. First, recommendations for the individual, followed by the organisation, and lastly future research.

3.3.1. Recommendations for the Individual

Machine capability has fundamentally changed work as it is known and, ultimately, the skills that are required (Taylor, 2016). Research indicates that this has already started making certain jobs redundant and, long term, it is theorised that more jobs will be lost as a result of technology (Butler-Adam, 2018). However, new skills and jobs will emerge and introduce new types of capabilities where humans are concerned (Schwab, 2018). Based on the findings of this study, it is suggested that millennials need to educate themselves further on the 4th Industrial Revolution. They need to establish how it impacts their careers, as well as their skills respectively. This way they can make informed career choices that will enable them to remain relevant in this progressive era.

3.3.2. Recommendations for the Organisation

Organisations are reorganising and repositioning themselves in the effort of optimising on economies of scale that the 4th Industrial Revolution has presented (Holmlund, Strandvik, & Lähteenmäki, 2017). As organisations endeavour to introduce digitised technologies, people will be an important component of the transition (Schwab, 2018). As such, this study suggests that as leaders consider the 4th Industrial Revolution in their strategies, they need to position the skills that they require and develop their workforce accordingly, as opposed to seeking talent externally in a market where digital skills are potentially scarce (Canedo et al., 2017). Organisations need to also create awareness around this phenomenon and support their workforce in understanding the value that it brings, and the way in which they can align to it to remain relevant. Therefore, they need to engage with employees around the future skills required and how they will support the organisation in a digital age.

3.3.3. Recommendations for Future Research

The 4th Industrial Revolution is one of the most discussed topics as it impacts every aspect of society (Daemmrich, 2017). However, a large amount of the research has focused on the impact of this era at a macro level from an economic, policy and labour perspective. Instead, very little research exists that addresses the perceptions towards the phenomenon. It is anticipated that the results of this study will contribute to this aspect of research and it is recommended that similar research be conducted in various contexts and industries. Further, it is suggested that research focusing on other generational cohorts be conducted to establish similarities and differences between the various generations. This will provide insight and further literature into how various generations, working in different industries, perceive and are impacted by this era.

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