



An exploratory study into the connection between Industry 4.0 and workplace diversity

by

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An exploratory study into the connection between Industry 4.0 and workplace diversity

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

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ABSTRACT

The Fourth Industrial Revolution has disrupted our traditional world of work through the introduction of advanced technology. The way in which workplace diversity in the form of age, gender, and education of people affect their ability to function in the Fourth Industrial Revolution era is largely unknown. The study aimed to explore the impact of Industry 4.0 on the workplace diversity traits of age, gender, and education in the South African workplace. An interpretivist study using a qualitative methodology was undertaken. Nineteen in-depth semi-structured interviews and observations were conducted online and face-to-face at three organisations in the Gauteng province. The results of the study showed that technology has removed mundane and repetitive tasks to simplify work and improve time of task completion in the workplace; however, the integration of robots into the workplace has raised concerns of increased job losses. The study further indicated that robots will not take over jobs completely but will require the workforce to be enhanced, thus calling for reskilling and upskilling of existing and future employees. Job roles will continue to change as technology is updated. The older generations are resistant to technological changes, but they should not be alienated because of their vast knowledge and experience. The younger generations embrace diversity, are flexible, innovative, and competitive. These characteristics allow for managers to utilise their strengths to drive the organisational goals and vision. Gender was not a determining factor as to which gender adapts better to technology. However, more males occupy senior positions in the three sample organisations as opposed to females, which points to gender inequality at higher levels in the sample organisations. A formal qualification is a good foundation to have; however, self-education through informal learning avenues can assist willing individuals to upskill themselves through online resources. There needs to be collaboration between the industry and universities to ensure better employability and training of graduates to convert theoretical knowledge into practical skills in order to solve real-world problems in the modern workplace.

This study contributed to filling a gap in the literature by combining the Fourth Industrial Revolution with workplace diversity, focusing on the specific diversity traits of age, gender, and education. The findings were used to make recommendations to industry, government and theory. Industries who have employed Industry 4.0

technologies, can utilise this study to benchmark with other organisations to gain knowledge from different perspectives and to share their knowledge to manage their employees better. Government needs to encourage innovation, allow for investment into education and training around Industry 4.0, and update policies and other requirements as technology changes. The study will facilitate an understanding of how resources can be used to optimise the impact of the Fourth Industrial Revolution on major organisations as well as the impact thereof on employees in the workplace. It is recommended that the organisations focus on the internal resources and utilise their resources better by means of the resource-based view.

Keywords: Fourth Industrial Revolution, workplace diversity, diversity traits, age, gender, education, technology

ABSTRAK

Die Vierde Industriële Revolusie het ons tradisionele wêreld van werk ontwig deur die bekendstelling van gevorderde tegnologie. Die manier waarop werkplekdiversiteit in die vorm van mense se ouderdom, geslag en opvoeding hulle vermoë beïnvloed om in die era van die Vierde Industriële Revolusie te funksioneer, is grootliks onbekend. Die studie het ten doel gehad om die impak van Industrie 4.0 op die werkplekdiversiteitseienskappe van ouderdom, geslag en opvoeding in die Suid-Afrikaanse werkplek te verken. 'n Interpretivistiese studie is met behulp van 'n kwalitatiewe metodologie onderneem. Negentien diepgaande semi-gestruktureerde onderhoude en waarnemings is aanlyn en van aangesig tot aangesig gevoer by drie organisasies in die Gautengprovinsie. Die resultate van die studie het getoon dat tegnologie alledaagse en herhalende take verwyder het om werk te vereenvoudig en tyd van taakvoltooiing in die werkplek te verbeter; die integrasie van robotte in die werkplek het egter kommer oor verhoogde werkverliese laat ontstaan. Die studie het verder aangedui dat robotte nie werk heeltemal gaan oorneem nie, maar gaan vereis dat die arbeidsmag verbeter word, wat dus 'n beroep doen op heropleiding en vaardigheidsverbetering van bestaande en toekomstige werknemers. Werkrolle gaan aanhoudend verander soos tegnologie verbeter. Die ouer generasies bied weerstand teen tegnologiese veranderinge, maar hulle moet nie vanweë hulle uitgebreide kennis en ervaring vervreem word nie. Die jonger generasies aanvaar diversiteit, en hulle is buigsaam, innoverend en mededingend. Hierdie eienskappe laat bestuurders toe om hulle sterkpunte te gebruik om die organisasiedoelwitte en -visie te bevorder. Geslag was nie 'n bepalende faktor van watter geslag beter by tegnologie aanpas nie. Meer mans beklee egter senior posisies in die drie steekproeforganisasies in teenstelling met vroue, wat dui op geslagsongelykheid op hoër vlakke in die steekproeforganisasies. 'n Formele kwalifikasie is 'n goeie grondslag om te hê; selfopvoeding deur informele leerweë kan egter gewillige individue help om hulle vaardighede deur middel van aanlyn hulpbronne te verbeter. Daar moet samewerking wees tussen die bedryf en universiteite om beter indiensneembaarheid en opleiding van gegradueerdes te verseker om teoretiese kennis in praktiese vaardighede om te skakel en sodoende werklike probleme in die moderne werkplek op te los.

Hierdie studie vul 'n gaping in die literatuur deur die Vierde Industriële Revolusie met werkplekdiversiteit te kombineer, met die fokus op die spesifieke diversiteitseienskappe van ouderdom, geslag en opvoeding. Die bevindinge is gebruik om aanbevelings vir die bedryf, regering en teorie te maak. Bedrywe wat Industrie 4.0-tegnologieë gebruik, kan hierdie studie gebruik om saam met ander organisasies normbepaling te doen om verskillende perspektiewe te verkry en om hulle kennis te deel om hulle werknemers beter te bestuur. Die regering moet innovasie aanmoedig, voorsiening maak vir belegging in onderwys en opleiding rondom Industrie 4.0, en beleide en ander vereistes bywerk soos tegnologie verander. Die studie fasiliteer 'n begrip van hoe om hulpbronne in te span om die impak van die Vierde Industriële Revolusie op groot organisasies asook werknemers in die werkplek te optimaliseer. Daar word aanbeveel dat organisasies moet fokus op interne hulpbronne en dit beter benut deur middel van die hulpbrongebaseerde siening.

Sleutelwoorde: Vierde Industriële Revolusie, werkplekdiversiteit, diversiteitseienskappe, ouderdom, opvoeding, tegnologie

ISISHWANKATHELO

Inguqukazi Yesine Yezorhwebo iyiphazamisile indlela ebekufudulwa kusetyenzwa ngayo ngenxa yokungenisa ubuchwepheshe obukwizinga eliphezulu. Ifuthe leyantlukwano ekusebenzeni kwabantu ngokuphathelene nobudala, isini, nemfundo yabantu alaziwa gokubanzi kweli xesha leNguqukazi Yesine Yezorhwebo. Esi sifundo sasijolise ekuphandeni ngefuthe leNguqukazi Yesine Yezorhwebo kwiimpawu zeyantlukwano emsebenzini ngokumalunga nobudala, isini nemfundo kwiindawo zemisebenzi eMzantsi Afrika. Uphando lwalandela indlela yophando ngokutolika imeko nangokuzathuza. Iindliwano ndlebe ezilishumi elinethoba ezingaqingqwanga ngqongqo kunye neengqwalasela zaqhutywa ngeintanethi nangeendibano zobuso ngobuso kumaqumrhu amathathu kwiphondo laseGauteng. Iziphumo zesifundo sophando zabonisa ukuba ubuchwepheshe buyisusile imisetyenzana edikayo nephindaphindayo ukuze umsebenzi ube lula, kuphuculwe ixesha lokugqiba ekumele kwenziwe emsebenzini. Noxa kunjalo, ukufakwa kweerobothi emsebenzini kudale inkxalabo yokuba kungakhula ukulahlekelwa yimisebenzi. Isifundo sibuye sabonisa ukuba iirobothi azizukuyithatha ngokupheleleyo imisebenzi, into efunekayo kukuxhobisa abasebenzi abakhoyo nabaseza kuqeshwa ngezakhono ezitsha. Iindima zomsebenzi ziza kuthi gqolo zitshintsha njengokuba ubuchwepheshe buhambela phambili. Abantu abadala abazithakazeleli iinguqu zobuchwepheshe, kodwa oko akuthethi kuthi mabakheswe ngoba banolwazi namava abanzi. Abantu abatsha bona bayamkela lula iyantlukwano, bayithambeke inguqu, ba nodla ekuqaleni izinto kwaye bayathanda ukukhuphisana. Ezi mpawu zivumela ukuba abaphathi basebenzise amandla abo ekuqhubeleni phambili iinjongo neembono zequmrhu. Isini asibanga luphawu oluphandwayo kuba asidlali ndima ingako kubuchwepheshe. Kwafumaniseka ukuba maninzi amadoda ngaphezu kwabafazi kwizikhundla eziphezulu kula maqumrhu mathathu kwakuphandwa kuwo, nto leyo ibonakalisa ukungalingani ngokwesini. Imfundo esesikweni sisiseko esomeleleyo, kodwa ukuzifundela umsebenzi kumaqonga angekho sesikweni kunakho ukumnceda umntu ofuna ukunyusa umgangatho wakhe njengokufunda kwimithombo yolwazi efunaneka kwi-intanethi. Kudingeka intsebenziswano phakathi kwamashishini neeyunivesithi ukuze kuqinisekiswa ukuqeshwa okungcono nokuqeqeshwa kwabafundi abaphumeleleyo ekuthini baguqule ulwazi olusezincwadini lube lolunokusetyenziswa ngeenjongo

zokusombulula iingxaki ezikhoyo kwiindawo zemisebenzi zale mihla.

Esi sifundo sifake igxalaba ekuvaleni isikhewu kuluncwadi ngokudibanisa Inguqukazi Yesine Yezorhwebo kunye neyantlukwano emsebenzini, kugxininiswa kwiimpawu zeyantlukwano ezibubudala, isini nemfundo. Okufunyanisiweyo kwasetyenziselwa ukufaka iingcebiso kumaqumrhu ezoshishino, kurhulumente nakubaqulunqi beengcingane. Amaqumrhu asebenzisa ubuchwepheshe ekuthiwa bob*Industry 4.0*, angasisebenzisa esi sifundo ekuzithelekiseni namanye amaqumrhu ngenjongo yokufumana ulwazi oluvellelwe kwiinkalo ngeenkalo kunye nokwabelana ngolwazi ngenjongo yokuphucula indlela yokulawula abasebenzi. Urhulumente udinga ukukhuthaza umdla wokuziqalela, atyale imali emfundweni nakuqeqesho malinga ne*Industry 4.0*, kwaye aphucule imigaqo nkqubo nezinye iimfuno njengokuba ubuchwepheshe buguquguquka. Esi sifundo siza kuququzelela ukuqonda ukuba imithombo inokusetyenziswa njani ekomelezeni ifuthe leNguqukazi Yesine Yezorhwebo kumaqumrhu amakhulu nakubasebenzi. Kucetyiswa ukuba amaqumrhu aqwalasele imithombo yangaphakathi, ayisebenzise ngcono loo mithombo ngokuyibona ngenkalo yokuqonda esekelwe kwimithombo.

Amagama aphambili: Inguqukazi Yesine Yezorhwebo, iyantlukwano emsebenzini, iimpawu zeyantlukwano, ubudala, isini, imfundo, ubuchwepheshe.

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LIST OF ACRONYMS

Artificial Intelligence	AI
Bavarian Engine Works Company	BMW
Enterprise Resource Planning	ERP
Executive Committee	EXCO
Fourth Industrial Revolution	Industry 4.0 / 4IR
Corona Virus Disease 2019	COVID-19
Cyber-Physical Systems	CPS
Information and Communication Technology	ICT
Internet of Things	IoT
Information Technology	IT
Microsoft Teams	MS Teams
Radio Frequency Identification	RFID
South Africa	SA
Science Technology Engineering and Mathematics	STEM
Three Dimensional	3D
Technical and Vocational Education and Training	TVET
University of South Africa	UNISA
United States of America	USA / US

CHAPTER 1: INTRODUCTION TO THE STUDY

1.1 INTRODUCTION

Technology has transformed the way in which the world functions and improvements continue to occur daily. Technology brought friends, families, and acquaintances closer through internet connectivity and online interaction. It enabled organisations to conduct business faster and more efficiently, as businesses can connect across geographical or generational differences using technology as the interface for the connection (Liddle, Pitcher, Montague, Hanratty, Standing, and Scharf, 2020). Technology is derived from the Greek word *Tekhnologia*. It is the utilisation of a body of knowledge or science with regard to production in the form of engineering and design of industrial systems (Murphie and Potts, 2017). Technology is understood as the driving force of globalisation (Naz and Ahmad, 2018). It has led to the continuous aspiration to improve the lives of humankind in society, resulting in four industrial revolutions to date (Vyas, 2018). Chapter 1 presents the blueprint for this study and provides the motivation for conducting this particular study. Figure 1.1 illustrates the layout of Chapter 1.

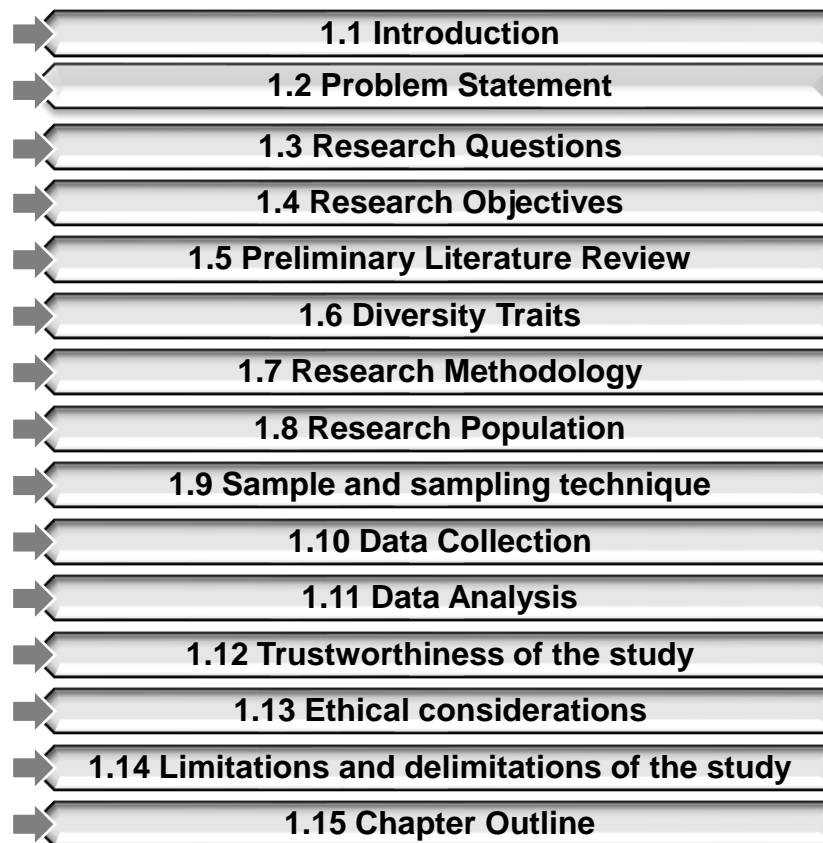


Figure 1.1 Schematic diagram of Chapter 1
Source: Authors own compilation (2020)

The First Industrial Revolution (1700 onwards), brought about by water and steam power, evolved into mechanical work (Baygin, Yetis, Karakose, and Akin, 2016). The discovery of coal led to the invention of the steam engine, which led to railroads, transforming how people commute. In addition, steam engines allowed people to travel faster. This meant that people could meet in person to conduct face-to-face meetings frequently, as opposed to by means of the postal system to communicate decisions and requests. Countries were able to develop, increase and diversify their economies, thereby cultivating better living standards, new skills, increased urbanisation, which lead to the creation of the modern, global economy (Kayembe and Nel, 2019; Block, 2018).

The Second Industrial Revolution (1870–1914 onwards) saw the development of steel, chemical, electricity, and petroleum (Agarwal and Agarwal, 2017). The invention of electricity was a fundamental expansion which made it possible for many industries to operate and develop their businesses (Kayembe and Nel, 2019). The invention of electricity allowed for the introduction of lighting, heating, cooling, locomotion for

transportation and mechanical power (Crawford, 2019). Petroleum was used to produce transportation fuels, fuel oils for heating, and for generating electricity in homes, workplaces, and cities (The United States (US) Energy Information Administration, 2022). The invention of the first automobile placed people on the road with modes of transport such as cars, buses, and trucks. This allowed people to travel long distances in comfort and convenience.

These great inventions allowed the Third Industrial Revolution (from 1969 onwards) to take place and the advancements in technology took the world to a more urbane level. The Third Industrial Revolution presented a new type of energy, called nuclear energy. The revolution allowed for technological innovations but not at the same rate as the present-day (Kayembe and Nel, 2019). The invention of new technologies, such as electronic computers, automation and autonomous energy (Yang, Yu, Ma, Zhang, and Wang, 2021), gave way for the world to welcome the Fourth Industrial Revolution (2011 to date), also known as Industry 4.0. Figure 1.2 summarises the revolutions that have been mentioned and indicates the main developments associated with each of the revolutions.

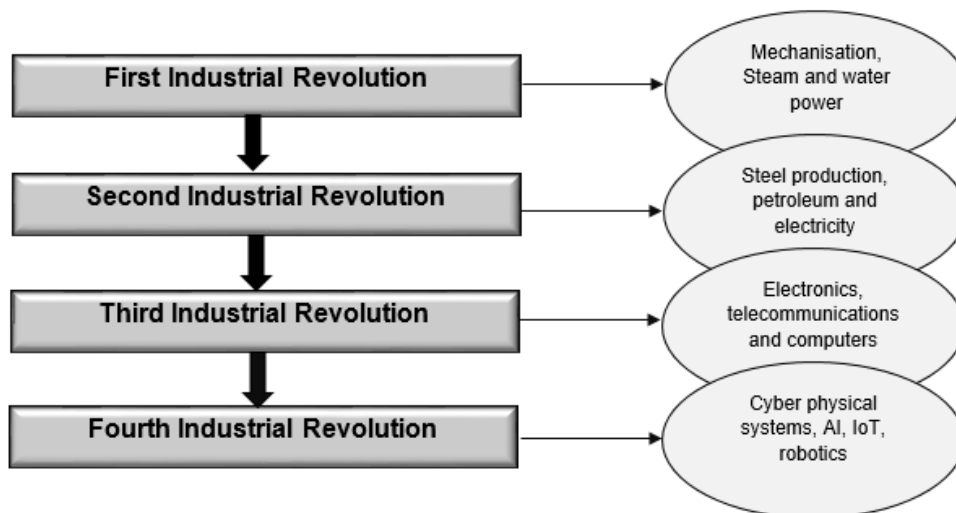


Figure 1.2 The industrial revolutions
Source: Authors own compilation (2019)

The phenomenon of Industry 4.0 was first introduced in Germany in 2011. Industry 4.0, the Fourth Industrial Revolution and 4IR all refer to the same thing and will be used interchangeably throughout the study. The formation of the early industrialised countries was shaped by the advancement towards the fourth stage of industrialisation, widely known as 'Industry 4.0' (Stock and Seliger, 2016). Industry 4.0

is the advent of cyber-physical systems (CPS), involving the arrangement of hardware, software, and people to execute tasks (Baldassari and Roux, 2017). Cyber-physical systems are used to monitor and control the physical world (Humayed, Lin, Li, and Luo, 2017). Bassi (2017) interpreted Industry 4.0 as the extensive use of the internet to create new products, functions, and features as a source of information. Industry 4.0 influenced the manufacturing sector by involving smart factories, smart services, and smart products (Almada-Lobo, 2015). The goal of Industry 4.0 is to increase productivity and attain mass production while using innovative technology (Demir, Döven, and Sezan, 2019). Industry 4.0 is fuelled by technologies such as cognitive computing, CPS, IoT, cloud computing, 3D printing, cybersecurity and big data, to refer to just a few.

Figure 1.3 indicates some of the technologies related to Industry 4.0. These are the building blocks of Industry 4.0. These technologies are the widespread terminologies that are being used to describe what the Fourth Industrial Revolution entails.

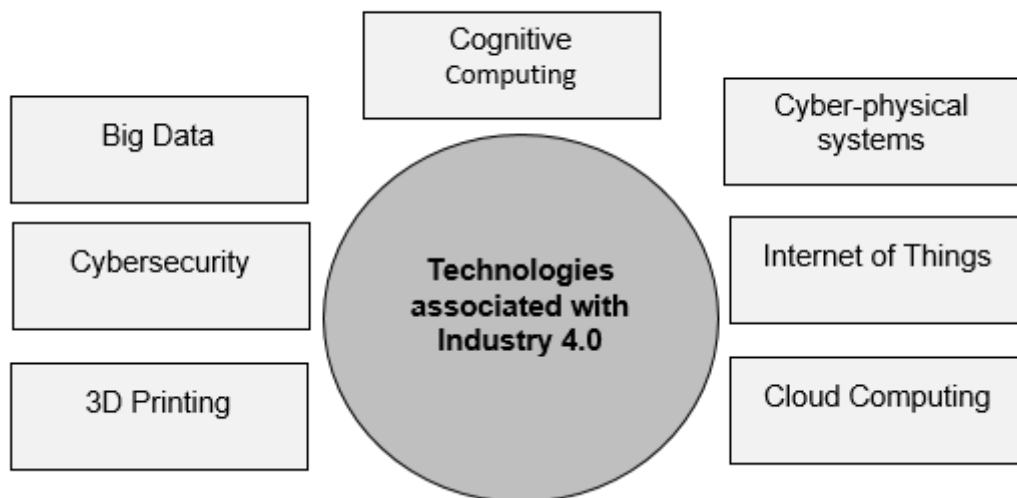


Figure 1.3 Technologies associated with Industry 4.0
Source: Adopted from Saturno, Pertel, Deschamps, and Loures (2017)

Figure 1.3 illustrates some of the technologies associated with Industry 4.0 which are used in daily operational processes. South Africa’s research and innovation system is characterised by robust institutions. The fairly low level of interaction among the innovation systems and key contributors continues to hinder South Africa’s capability to fully deploy 4IR technologies (Jegede, 2021). Better management of South Africa’s

internal and external resources can help the country to build further capacity to catapult and become a global contributor to the Fourth Industrial Revolution (Jegede, 2021). Table 1.1 provides definitions for some of the technologies associated with Industry 4.0. These definitions enabled the study to provide an understanding regarding some of the key terminologies when referring to Industry 4.0. The researcher is aware that there are many other technologies that exist. However, this study will focus on the aforementioned technologies of Industry 4.0. The other aspects will not be elaborated upon.

Table 1.1 Definitions of technologies associated with Industry 4.0

TECHNOLOGIES ASSOCIATED WITH INDUSTRY 4.0	DEFINITION	AUTHORS
Cognitive computing	Form of artificial intelligence depends on machine learning and other data-analysis technologies to grasp and draw patterns from volumes of contrasting data.	Patel, Michelini, Snell, Balu, Hoyle, Parker, Hayward, Eberhard, Salazar, McNeillie and Xu (2018)
Cyber-physical systems (CPS)	Enables smart applications and services to operate accurately and in real-time.	Yaacoub, Salman, Noura, Kaaniche, Chehab and Malli (2020)
Internet of Things (IoT)	Platforms convey varied information and deliver a common language to the devices and applications to communicate with one another.	Verma (2018)
Cloud computing	Data processing and storage can be conducted proficiently on large frames of computing and storage systems available via the Internet.	Marinescu (2017)
3D Printing	Deposition of material in a layer-upon-layer manner to gradually construct a solid model.	Vaz and Kumar (2021)
Cybersecurity	Ensures that devices are sustained in a protected environment for users to access.	Lu and Da Xu (2018)
Big Data	A platform to create data collected from the user's digital communication devices e.g. smartphones.	Huda, Maselena, Atmotiyoso, Siregar, Ahmad, Jasmi and Muhamad (2018)

Source: Authors own compilation (2022)

According to Roblek, Meško, and Krapež (2016), the era of the Fourth Industrial Revolution is characterised by automation through the use of electronics and information technologies (for example, Mercedes-Benz uses co-bots on their factory floor) and digitisation (for example, CPS). Schreiber (2016) stated that Industry 4.0 is the digitisation of the manufacturing sector and the optimisation of smart, flexible supply-chains, factories, and distribution models. Furthermore, with automation,

machines capture and transfer data via machine-to-machine communications and to human operators (Schreiber, 2016), allowing the physical and digital worlds to converge.

Trener, Chng, Wang, Suhaila, Lim, Lu, and Oh (2021) mention that the fast advancement of digital technologies is profoundly changing the nature of work and organisations. Therefore, there will be a need to recruit talent with the necessary skills to thrive in an automated workplace (Anshari, 2020). With the change in the workplace, which is due to technology, there is a concern that there will be job losses and employment opportunities (Anshari, 2020). Effective prioritisation and policy innovation allow for transformative benefits and the creation of new types of jobs, leading to technological advancements. This transforms how work is done while also creating new job opportunities and new skills.

It is necessary that people develop skills to align with the advancements of machines in order to function under specified working conditions (Zhong, Xu, Klotz and Newman, 2017). Machines are there to support people to carry out their daily tasks more effectively. Automation necessitates people to develop their skills and capabilities. This is because information and knowledge with regard to future job requirements are crucial in the prediction of which skills will be in demand (Josten and Lordan, 2022). Thus, achieving educational qualifications, improving skills, and amplifying creativity as well as high-level cognitive capabilities will allow an employee to maintain an edge and enhance their skills (Manyika, Lund, Chui, Bughin, Woetzel, Batra, Ko and Sanghvi, 2017).

Zhou, Liu, and Zhou (2015) pointed out that the purpose of Industry 4.0 is to form a workable production model of distinct digital products and services with real-time communications between people, commodities, and devices. According to Pillay, Ori, and Merkofer (2017), the traditional manufacturing industry is in disarray and needs to move towards reorganising themselves in order to remain competitive. However, technology has both a positive and negative influence on people, the workplace and the country. For example, the influence of technology on the future employment of people is accompanied by a growth in skills shortages in the labour market. Therefore, reskilling and upskilling employees are critical challenges that organisations and governments face (Trener *et al.*, 2021).

In the modern workplace there has been a visible increase in the use and accessibility of technology which has created a change in how people conduct their work (Holland and Bardoel, 2016). A diverse workforce allows an organisation to benefit from the richness of ideas and talents (Barak, 2016). Employees are required to understand how workplaces are changing and what their role is in bringing about change. A lack of skills such as problem solving, attention to detail, critical thinking, and writing proficiency (Dishman, 2016) are rated as some of the challenges created by evolving technologies (PricewaterhouseCoopers, 2016).

Workplace diversity has expanded globally and is characterised by a mix of gender, ethnicity, lifestyle, and functional backgrounds, commonly referred to as diversity (Jaiswal and Dyaram, 2018). Workplace diversity is more than identifiable human characteristics (e.g. race, gender). Johnston and Packer (1987) gave rise to the topic of diversity in their publication entitled *Workforce 2000*. Thomas (1992) described diversity as the inclusion of everyone and not only inclusion as defined by race or gender. According to Inegbedion, Sunday, Asaleye, Lawal, and Adebaniji (2020), workplace diversity ranges from ethnic to linguistic, national, economic, organisational, and cultural diversity. Tamunomiebi and John-Eke (2020) point out other characteristics of diversity such as ethnicity, age, culture, nationality, religion, and gender. According to Greene and Kirton (2016), diversity is a descriptor of the workforce and a theoretical paradigm highlighting demographic differences (age, race gender).

In a global study entitled *2018 Deloitte Millennial Survey*, a global sample of Millennials was approached (Deloitte Touche Tohmatsu (Firm), 2018). They were invited to provide their perspectives with regard to diversity traits that need to be addressed in the wider society and the workplace. Millennials (also known as Generation Y) are people born between 1980 and 1994. The feedback indicated that age, gender, and educational background were the traits of choice. The surveyed participants provided feedback on the diversity trait that was of most concern. The results indicated that 42% indicated educational background, 39% indicated age and 34% indicated gender as the traits of choice indicating that these diversity traits are of global concern in the workplace. But how do these traits affect the modern workplace, or do they have no impact? The researcher was aware that there are many definitions of diversity and

diversity traits, the author's definitions, as outlined above, are acknowledged. For this study, the researcher defined diversity as the variations among individuals with regard to their age, gender and education. Rock and Grant (2017) pointed out that interacting with people who are different might challenge the human brain to overcome its closed-minded ways of thinking and strengthen a person's mental competence.

There is always a demand for skilled workers. However, skills shortages prevail. Employability depends on the individual and their willingness (or lack of thereof) to improve their capabilities during formal education and after (Nikunen, 2021). There is a shortage of qualified employees, which creates a talent gap of 74% in the United States as opposed to the talent gap of 78% in South Africa (Manpower Group, 2022, p.8). Brown, Gosling, Sethi, Sheppard, Stubbings, Sviokla, Williams, Zarubina, and Fisher (2017) found that there is a notable skills shortage of professionals in the field of Science, Technology, Engineering and Mathematics (STEM). However, organisations need to assess which skills are required to strengthen and deepen expertise and which skills to disinvest in (Nandini, 2017).

Education is seen as the building block towards employment (Hlobo, Moloj and Mhlanga, 2021). Education can help to alleviate the challenge of job losses by upskilling employees who are at risk in of being replaced by automated technologies that are used in the workplace (Moore, 2018). Education refers to acquiring knowledge, developing skills, understanding cognitive abilities and relating concepts in order to have a comprehensive understanding of the world (Bartlett and Burton, 2016). An educational qualification is essential and provides an important justification for schooling (Biesta, 2020). Training on the other hand is gaining the knowledge and skills productively, effectively, and profitably for a specific task (Heathfield, 2018). Technology used in education can help students prepare for lifelong learning (Haleem, Javaid, Qadri and Suman, 2022). An educational qualification required for entry to particular types jobs or for further study, advance a person's skills and knowledge in specific areas and a good foundation to build upon. It prepares people for citizenship and to make a contribution to society (Leech, 2022). In contrast, training allows employees to obtain new skills, improve existing ones, increase productivity, complete work tasks better, and become better leaders (Chopra, 2022). For this study, when the

researcher refers to education, the reference will be inclusive of training and other informal types of learning.

Gender is a social construct relating to the ways in which characteristics and behaviours are deemed masculine or feminine (Anderson, 2016). Noland, Moran, and Kotschwar (2016) argued that women do not participate in the global economy at the same level as men do. Krivkovich, Robinson, Starikova, Valentino, and Yee (2017) found that fewer women as opposed to men are employed at entry level, despite women representing the majority of college graduates. As a result, industry gender gaps continue to emanate throughout the world. From an age perspective, Shook and Knickrehm (2017) believed that Millennials make up most of the present-day workplace, but Millennials desire flexibility and autonomy to function at their optimal level in the workplace. The *2018 Deloitte's Millennial Survey* indicated that the global sample of 46% of Baby Boomers and 43% of Generation X have fewer opportunities to progress in their careers as opposed to the Millennials (Deloitte Touche Tohmatsu (Firm), 2018 p.16.).

Diverse people interact daily in the workplace; therefore, organisations need to cater for diverse employees. A diversified workforce allows for generating innovative ideas and increased profits which can be particularly beneficial (Gould, 2017). Everyone possesses their own beliefs, opinions, assumptions, generalisations, and experiences. These differences are the foundational strength behind diversity (Biro, 2017). As Baby Boomers progress towards retirement, Generation X managers need to discover ways to motivate and manage this talent pool of mature employees (Reh, 2019). The different generational cohorts perceive the world differently but learning from one another can help employees engage with one another and be productive. It is, therefore, compulsory for organisations to put measures in place to optimise this learning and knowledge-transfer process. The modern digital organisation must function as teams, concentrate on empowerment, and allow open communication channels and inclusive working styles (Bourke, Garr, and Wong, 2017).

Several organisations are focused on immediate concerns (electricity and labour), rather than investing in education, training, innovation as well as research and development (Bezuidenhout, 2015). The biggest challenges faced in South Africa are that citizens struggle to have accessible, adequate, and reliable internet connectivity

as a result of high data costs and infrastructure among other issues (Lephaka, 2021). Interventions to resolve these issues will encourage the wider adoption of Industry 4.0 within the country. The deployment of Industry 4.0 applications focusses on producing greater process integration and automation, resulting in enhanced efficiency and effectiveness (Sauter, Bode, and Kittelberger, 2016).

1.2 PROBLEM STATEMENT

Despite the high degree of automation, people are needed to manage the automation in Industry 4.0 (Gabriel and Pessl, 2016). Industry 4.0 focuses on technology, whereas workplace diversity looks at the human factor among all the technology. The interaction between the diversity traits of age, gender, and education and Industry 4.0 technologies is not clear from literature. There needs to be an understanding of: whether the impact of technology on the different generational cohorts is a factor to consider or; whether a person's gender affects how they respond to Industry 4.0 technologies and; whether different types of education affects one's response and ability to cope with the era of Industry 4.0.

The impact that new technology has on people's jobs and working lives must be considered. This is because it will increase further because the role of technology will become even greater in the modern work environment (Houghton and Baczor, 2020). Developments in technology have not only altered the jobs available to us but have also transformed the nature of work and how work is performed (Johnson, Dey, Nguyen, Groth, Joyce, Tan, Glozier, and Harvey, 2020). Therefore, understanding the impact of technology on the modern workplace is essential. People need to acquire new digital skills, while others may need to change career paths and improve their skills in order to adapt to the new job market (Gerald, Fernandes, Sakurada, Rasmussen, Bennyson, Pellegrini and Leitao, 2021).

There has been an ample amount of research conducted regarding Industry 4.0 and workplace diversity respectively. However, there has been no research with regard to the impact of Industry 4.0 on workplace diversity and specifically diversity traits such as age, gender, and education. The problem statement of this study is: How workplace diversity in the form of the age, gender, and education of people affects the ability to function in the era of the Fourth Industrial Revolution, is largely unknown.

1.3 RESEARCH QUESTIONS

Given the gap that has been identified in literature, the research questions were formulated as follows:

The primary research question of this study is:

How has the Fourth Industrial Revolution impacted the diversity traits of age, gender and education in the South African workplace?

The secondary research questions are:

- How do Industry 4.0 technologies affect the modern workplace?
- How do age, gender, and education currently find application in an automated and technological workplace?

1.4 RESEARCH OBJECTIVES

The **primary objective** of this study is to explore the impact of Industry 4.0 on the workplace diversity traits such as age, gender, and education in the South African workplace.

The **secondary research objectives** of the study were:

- to explore how Industry 4.0 technologies affect the modern workplace;
- to explore how age, gender and education currently find application in an automated and technological workplace.

1.5 PRELIMINARY LITERATURE REVIEW

1.5.1 The Fourth Industrial Revolution (Industry 4.0 / 4IR)

The technological environment is growing, and the innovations being created are exciting, impactful and dynamic in the workplace (Burlacu, 2017). The term Industry 4.0 was made famous at the Hannover Fair in 2011 in Germany (Pfeiffer, 2016). Industry 4.0 has been reported and acknowledged all over the world in places such as the Asia-Pacific region, America, Europe, the Middle East and Africa

(PricewaterhouseCoopers, 2016). However, in Africa, the current implementation and impact of Industry 4.0 remains low, as the biggest challenges are connectivity and accessibility (Pillay *et al.*, 2017). Trends and new catchphrases such as digitisation, the Internet of Things (IoT), and cyber-physical systems (CPS) have become more and more pertinent in workplaces all over the world (Hofmann and Rüsçh, 2017). In the United States, Europe and China Industry 4.0 is referred to as the internet of everything, smart manufacturing, smart factory, or smart industry (Dopico, Gomez, De La Fuente, García, Rosillo and Puche, 2016).

Industry 4.0 is the advent of cyber-physical systems involving the collaboration of hardware, software and people to execute tasks (Baldassari and Roux, 2017). Industry 4.0 enables a smart factory within modular-structured smart factories where cyber-physical systems (CPS) observe physical processes (Calitz, Poisat and Cullen, 2017). In addition, Industry 4.0 is the vision of intelligently automated factories in which workers, products and customers are connected (Karre, Hammer, Kleindienst and Ramsauer, 2017). Organisations, therefore, need to adjust to latest technologies to remain competitive (Pillay *et al.*, 2017). Industry 4.0 has presented both advantages and disadvantages to employees and organisations. According to Hofmann and Rüsçh (2017) the opportunities accompanied by Industry 4.0 include extremely flexible mass production as well as the occurrence of new services and business models. As with every revolution there have been advantages as well as disadvantages. Table 1.2 indicates specific advantages and disadvantages of Industry 4.0.

Table 1.2 Advantages and Disadvantages of Industry 4.0

Advantages	Disadvantages
Elimination of human dependency	Recruitment and development of the new talents
Effective use of human resources and materials	Financial costs of initial investments in technology
Improved productivity through optimisation and automation	Continuous learning and on-the-job training
Remote maintenance and work	Collaboration and Information technology modernisation
Higher quality products , due to real-time monitoring	Cybersecurity and infrastructure gaps

Source: Kumar and Kumar (2020)

Table 1.2 indicates that, even though there are advantages such as individual elimination of human dependency, the effective use of human resources and

materials, maintenance and work can be conducted remotely, there is improved productivity and higher quality products are produced. Although there may be advantages, there are disadvantages of Industry 4.0. Such as recruitment and development of people, the unforeseen financial costs of the initial investment of the technology, continuous training and learning, the collaboration between people and robots and there could be unforeseen issues such as cybersecurity and infrastructure gaps. However, COVID-19 has taught us that sometimes working remotely is not suited to everyone. There will be always a need for employees to be upskilled and trained with regard to any new programmes or systems and this could be costly.

Industry 4.0 can alter the flow of production and modify communication between humans and machines. It can also influence and change the interaction among producers, customers and suppliers (Suleiman, Shaikholla, Dikhanbayeva, Shehab and Turkyilmaz, 2022). The automotive industry has been transformed by the digital age, triggering a momentous shift in the way in which car manufacturers and service providers are distributing goods and services to the market. This, in turn, is impacted by a higher consumer demand (Llopis-Albert, Rubio and Valero, 2021). Leading car manufacturers such as Bavarian Engine Works Company (BMW) and Mercedes-Benz incorporate Industry 4.0 technologies in the design and production of their vehicles (BMW Group, 2023; Mercedes-Benz Group, 2023).

Wajcman (2017) mentioned that machines are automated workers and are no longer viewed as tools. This is supported by the advantages mentioned in Table 1.2. The phenomenon is known as automation, which is the application of technology that allows machines to complete tasks with minimal human intervention. The objective is to release people from performing mundane monotonous tasks that machines can perform more effectively and efficiently (Heller and Savargaonkar, 2021). Organisations that are productively deploying Industry 4.0 place emphasis on business value not technology. They mobilise and train their workforce with regard to the new technologies and processes, and they are moving towards an integrated information technology (IT) infrastructure and automated technology (Systems, Applications and Products in Data Processing, 2021).

1.5.2 Diversity in the workplace

According to Özbilgin and Syed (2015), workplace diversity is the demographic and job-related differences among people within the organisational workforce. The influence that diversity has on organisations can no longer be ignored (Kundu and Mor, 2017). Irrespective of a person's identity or background, all individuals are permitted to develop their skills and talents to their full potential (Hislop, Coombs, Taneva and Barnard, 2017). Diversity in the workplace is vital for a business to be successful, as the world continues to advance (Lauri, 2020). Diverse perspectives encourage creativity and effective problem solving (Fitzpatrick, 2018). It is imperative to have an inclusive workplace where all stakeholders and employees feel capable to participate and realise their true potential (Hislop *et al.*, 2017).

According to Dyson (2017), organisations that recruit a diverse workforce employ qualified candidates with a specified skills set. A diverse workforce is a fundamental factor in the contemporary business landscape. Organisations should pursue and embrace diversity to ensure a competitive advantage (Dickson, 2020). The *Deloitte Millennial Survey of 2018* indicated that a sample of Millennials was questioned on what aspects of diversity needed to be addressed by the wider society, businesses in general and their employers. The study showed diversity issues identified were religion, social background, ethnicity, disability, gender, age and educational background (Deloitte Touche Tohmatsu (Firm), 2018). The three focal diversity traits that Millennials felt needed to be addressed were age, gender and educational background (Deloitte Touche Tohmatsu (Firm), 2018). The responses of the participants made the researcher question as to why individuals felt that these are the areas of diversity that needed attention.

1.6 DIVERSITY TRAITS

The three identified diversity traits of age, gender and education will now be explored further.

1.6.1 Age

Age is the time that has passed since birth (International Institute for Applied System Analysis, 2016). An age-diverse workforce warrants a diverse array of experiences,

ideas and problem-solving approaches that diverse co-workers can benefit from (Duval, 2017). The workplace comprises of a workforce with varied generations of employees (Calk and Patrick, 2017). These generations include Baby Boomers (born in 1946-1964), Generation X (born in 1965-1978), Generation Y/ Millennials (born in 1980-1994) and Generation Z (born in 1997-2012).

It is noticeable that older employees continue with their work commitments beyond the statutory retirement age (Sewdas, De Wind, Van der Zwaan, Van de Borg, Steenbeek, Van de Beek and Boot, 2017). Increased longevity combined with a decreasing birth rate has led governments everywhere to look for ways to motivate people to work for longer and postpone retirement (Ní Léime, Ogg, Rašticová, Street, Krekula, Bédiová and Madero-Cabib, 2020). Doyle (2017) explained that people are living longer and that some of the older generations are not in the best financial position to retire. Also, older generations are still supporting their millennial children. The digital age has created innovative ways to work and add value. However, new skills are crucial and are forcing organisations to closely examine their workforce capabilities (Brown *et al.*, 2017). Different generations bring their individuality to the workplace and younger employees know more about technology, as opposed to some older employees who prospered when technology was less important (Braga, 2016).

Demands for the reskilling of the workforce have prepared the labour markets to cope with the technologies of the Fourth Industrial Revolution (World Economic Forum, 2017). According to the *Workforce of the future report, the competing forces shaping 2030*, automation is replacing human tasks and jobs (Brown, Gosling, Sethi, Sheppard, Stubbings, Sviokla, Williams, Zarubina and Fisher, 2017). It is also modifying the skills that an organisation is looking for in individuals. Therefore, acquiring new skills can lengthen an individual's career. Individuals are encouraged to embrace Industry 4.0 technologies, rather than shunning away from the technological changes that are evident (Morgan, 2016).

1.6.2 Gender

Gender categorises individual traits according to the societal classifications of male and female (Kimmel and Gordon, 2018). However, today, people may identify themselves as male, female, non- binary or neither. The Fourth Industrial Revolution

may affect female and male employees in different ways (World Economic Forum, 2017). Despite a women's experience and educational qualifications, gender-based stereotypes about men and women limit the entry of women into the industry (Bosch, 2021). Gender within the technological environment is a continuous challenge and women must endlessly prove their capabilities and strengths (Sidler, 2017). Furthermore, salary inequality has been prominent in many other countries such as the United States, Japan and Denmark (Kliff, 2018).

The discrepancy in salary earnings between men and women could be due to differences in education, experience and occupation (Ortiz-Ospina and Tzvetkova 2017). In high-paying sectors such as technology women are under-represented in the field and are compensated 20% less than men (Connley, 2018). In South Africa for example, the labour markets lean towards being more promising towards men than to women and men earn a larger salary as opposed to women regardless of race (Statistics South Africa, 2018). Ortiz-Ospina and Tzvetkova (2017), found that there has been an increase of women in the workforce. However, men tend to participate in the labour market more regularly at a higher frequency than women.

1.6.3 Education

Education is a human right that has been entrenched in the South African Constitution. Similarly being educated may open doors in the battle against poverty and inequality. It can be perceived that education is the answer to market demands and job creation (Bjerre, 2017). As mentioned before in Section 1.1, education refers to educational qualifications as well as the skills, knowledge or experience that one acquires (through training) for the purposes of this study. Education can be used to close the gaps that are potentially created by the era of Industry 4.0.

The combination of the education system and the labour market can provide people with appropriate job opportunities (Hunt, 2016). However, as the technological world advances, educational qualifications are at risk of being obsolete before completion (Samuels, 2016). Existing qualifications and experience need to align with the requirements of Industry 4.0 in order to bring about continuous development within the workplace (Schröder, 2016).

1.7 RESEARCH METHODOLOGY

The research design is the blueprint for the collection, measurement and analysis of the data; its motive is to answer research questions (Sekaran and Bougie, 2016). The current research follows a qualitative methodological approach to explore the impact of Industry 4.0 on the workplace diversity traits of age, gender and education in the South African workplace. Qualitative research uses existing literature, research and theory to connect with the current research topic (Mason, 2017). The researcher aspires to the fact that the use of a qualitative design can provide meaning and expectations as to how to improve the embracement the Fourth Industrial Revolution. The interpretivist paradigm was employed by the researcher to retrieve a detailed response from participants, thereby uncovering the assumed meaning as attributed by the participants (O'Neil and Koekemoer, 2016). The interpretivist paradigm permitted the participants to provide the researcher with their meanings and interpretations on the specific research topic (Mason, 2017).

1.8 RESEARCH POPULATION

Ary, Jacobs, Irvine and Walker (2018) defined a population as a larger group to which the researcher aspires to generalise. It comprises of all members of a defined class of people, events or objects. The target population for this study was three organisations that are using Industry 4.0 technologies. These were organisations who are aware of Industry 4.0 technologies and are located within the Gauteng Province. The participants included senior/middle managers who were able to advise to what extent Industry 4.0 was embraced in their workplace. It also included the lower-level staff within the organisations who provided an employee perspective of how Industry 4.0 affected the workplace environments.

1.9 SAMPLE AND SAMPLING TECHNIQUE

Sampling enabled the researcher to study a subset of the population of interest and use analytical methods, which allowed the researcher to make differentiations about the population (Patten and Newhart, 2017). For this study, a non-probability, purposive sampling method was applied. As the researcher focused on participants with specific characteristics who were capable to contribute to the related research (Etikan, Musa

and Alkassim, 2016). Creswell (2014) mentioned, qualitative research allows the researcher to select participants purposefully in order to guide the researcher in understanding the problem and the research questions.

The organisations included in this study were from different industries. The first organisation offers training workshops to address skills gaps within organisations, the second organisation was from the automotive industry and finally, the third organisation specialise in freight logistics. The researcher initially aimed to interview eighteen employees. However, nineteen employees in total formed part of the data collection process. The participants were chosen as per the three diversity traits (age, gender and education) that have been identified to form part of this study. The organisations were identified using the snowballing method. The organisations that the researcher chose acknowledged Industry 4.0, the technologies associated with the era and awareness around what the revolution entails. The requirements were that the participants were between the age group of 18-65 years, had to be male, female or any gender they personally identify with and from different educational backgrounds.

1.10 DATA COLLECTION

The data were collected from the original sources for specific purposes of the study (Sekaran and Bougie, 2016). The data for this study comprised both primary and secondary sources of data. The secondary data were compiled by means of a desktop literature review from annual reports, journal articles, conference papers, internet sources and textbooks. Permission to conduct the study was requested and obtained from the organisations as well as the participants who individually signed consent forms to be interviewed {Addendum C}.

Face-to-face and virtual semi-structured interviews were conducted with the sample of nineteen employees that have been identified to participate in the study. The researcher employed the method of observation during the interviews and notes were taken accordingly. The interviews took place at the participants place of work and via virtual platforms. The researcher formulated a range of questions based on the purpose and objectives of the study. The interview questions {Addendum D} were open-ended to encourage participants to express their thoughts regarding the research topic. It thereby allowed the interviewer to gain valuable qualitative insights

into the study context (Wildemulth, 2016). The interview questions were made available to each participant beforehand to allow the participants to prepare for the interview.

Audio recording was used, and the researcher took notes during the interviews. The interviewer had a set of guiding questions to keep the interview schedule on track (Wilson, 2016). All the participants answered the same questions as per the interview schedule to provide their own interpretation of the questions. Each question was read aloud to the participant, and it was repeated where necessary to ensure that the participant understood the question.

1.11 DATA ANALYSIS

The interviews were recorded, and the audio recording was thereafter transcribed verbatim to ensure that all the participants responses were recorded accurately. The behaviour and reactions of the participants were equally significant as their verbal words. This was noted down in the form of observational notes conducted physically at one organisation and virtually at the remaining two organisations. The qualitative content-analysis method was used to analyse the transcripts (Graneheim, Lindgren and Lundman, 2017) in order to interpret the responses from the participants, specifically with regard to common terminologies, characteristics or sentences. Content analysis allowed the researcher to identify common themes, phrases or responses. The data analysis was done manually by the researcher. The commonalities in the data echoed the story communicated by the participants. It forms the foundation of the recommendations of the study. Triangulation was therefore achieved by means of the following data sources: desktop literature, interviews and observations.

The researcher read over the transcripts several times, where after significant and relevant information were underlined. Codes were allocated to the underlined sections. The codes were clustered together to form themes and sub-themes. The member-checking process assisted to increase the trustworthiness of the study. Whereby the transcript and coded documents were sent to all the participants to ensure that the correct interpretation was captured. The various themes were compared to each other, and findings were identified for the study.

1.12 TRUSTWORTHINESS OF THE STUDY

The trustworthiness is an integral part of the research study. To ensure trustworthiness the researcher ensured that the data were collected in an appropriate and accurate manner to avoid any difficulties when analysing the data. Trustworthiness of qualitative analysis is one of the facets that determine the quality of analysis (Mandal, 2018). The researcher avoided bias by maintaining a neutral stance during data collection and interpretation of the data. The procedures used to establish credibility include prolonged engagement with participants, persistent observation, member checking and reflective journaling (Connelly, 2016). The researcher acknowledged that credibility is an important factor as the research findings need to be plausible and trustworthy (Stenfors, Kajamaa and Bennett, 2020). The researcher checked and rechecked the data. The purpose was to ensure that the essence of the study was captured. A further purpose was to confirm that the findings that were supported by the data in the form of written notes and audio recordings.

Dependability is the solidity of the outcome from the study. Dependability involves participant evaluations of the findings, interpretations and recommendations of the study, such that all are reinforced by the data collected from the participants of this particular research study (Moser and Korstjens, 2018). In this study, dependability was achieved through making sure that the data collected from all the participants occurred in a uniform manner. The purpose was to aid the researcher in obtaining rich data to interpret and from which to make recommendations and conclusions. Furthermore, this research document will be sent to an editor for a professional technical editing {Addendum E} to be conducted on the document in order to further ensure the trustworthiness of the document.

1.13 ETHICAL CONSIDERATIONS

Ethical clearance were guided by the UNISA research ethics policy and it was obtained from the university before proceeding with the planned research {Addendum A}. An official letter from the researcher with a request to conduct the study in the respective organisations was formally addressed to the management of the chosen organisations and the human resources departments {Addendum B}. The contents of the study was

fully disclosed. The organisations were requested to consent that the researcher could interact with their employees. The written and signed consent of all participants of the study was obtained. The participants were informed that their participation was voluntary and that they could withdraw from the study when they felt fit to do so {Addendum C}. The researcher is obliged to safeguard the information from unauthorised access, disclosure, modification, loss or theft (UNISA's Policy on Research Ethics, 2016) for a period of five years. As a result of the COVID-19 pandemic, the researcher had to ensure that the data were collected virtually. Therefore, the researcher opted to use Microsoft Teams (MS Teams), a preferred platform of communication within university. The researcher ensured confidentiality by using password-protected computers, hard drives, universal serial bus and documents. Once the data were collected, the researcher ensured that the data were kept in password-protected computers, documents and any other form storage to prevent any unauthorised individuals from accessing the information.

Anonymity of the participants was ensured by allocating pseudonyms to each participant to safeguard them from any form of discrimination, prejudice, or penalisation. Therefore, the researcher retained all information about the participants by ensuring that it remains unknown to others (Sage Publications, 2018). Bias is the deviation from the truth in the data collection, data analysis, interpretation and publication which can cause fabricated conclusions (Simundic, 2013). The researcher further prevented herself from being emotionally or cognitively bias by permitting the participants to express their opinions. The researcher did not comment or influence the participants in any way or form. The researcher removed her beliefs and predetermined notions regarding the study matter. She allowed the participants to share their own perspectives regarding the subject matter.

1.14 LIMITATIONS AND DELIMITATIONS OF THE STUDY

The researcher acknowledges that there are many other organisations as well as diversity traits that could have been used in this study. However, only the mentioned aspects such as the various types of organisations and the diversity traits of age, gender and education were considered for this study due to time and cost constraints. The limiting factor of the study would be that the study was conducted at organisations located in the Gauteng province of South Africa. There are only three diversity traits

which have been chosen by the researcher to complete the study and these are age, gender and education. The sample of the study initially consisted of eighteen participants. However, the researcher interviewed nineteen participants. The study may therefore not be transferable to the larger population. Furthermore, the COVID-19 pandemic required the researcher to adjust the originally planned face-to-face interview method. Interviews took longer to secure and the observation process during the interviews for triangulation had to occur remotely as well.

1.15 CHAPTER OUTLINE

This study has been arranged into chapters as follows:

Chapter 1

This chapter introduced the study by providing an overview of the research. It states the problem statement, research question, research objectives and the research methodology. In addition, ethical considerations and aspects regarding trustworthiness of the study are also explained.

Chapter 2

This chapter focused on: literature related to Industry 4.0 technologies; the types of technologies and; the influence that the introduction of these technologies had on the workplace and the adoption of Industry 4.0 in developed countries as well as in South Africa. Finally, consideration was given to the skills required in order to perform in the Industry 4.0 era.

Chapter 3

This chapter focused on defining diversity in the workplace and understanding the importance of diversity. Furthermore, diversity management as well as the opportunities and challenges of diversity are explained. Finally, the chapter provides an in-depth discussion of the three diversity traits chosen for this study.

Chapter 4

In this chapter, the qualitative research methodology is explained in terms of the population, sample, data collection and data analysis methods.

Chapter 5

In this chapter, a presentation of the data is provided according to the themes that emerged from the collected data during data analysis.

Chapter 6

This chapter provides a detailed discussion of the interpretation of the data. Furthermore, the chapter identifies the findings and the implications of the data collected for this study.

Chapter 7

In this chapter, the conclusions and recommendations as well as suggestions for future exploration stemming from the current research processes are provided, centred on the most important findings of the research.

CHAPTER 2: INDUSTRY 4.0 IN THE MODERN WORKPLACE

2.1 INTRODUCTION

In this chapter, the researcher discusses what Industry 4.0 entails and the impact that it may have on the workplace. Industry 4.0 allows for faster computers, smarter machines, smaller sensors, affordable data, transmission enabling machines and smart products to communicate (Vaidya, Ambad and Bhosle, 2018). The literature review centres on the fundamental ideologies. Furthermore, it defines the essential concepts that relate to Industry 4.0. It does so by indicating how previous work is linked to this revolution and how a study will fit in with the work published on the specified topic (Ang, 2014). Finally, it aims to synthesise knowledge relating to the research question (Machi and McEvoy, 2016). This particular study focused on Industry 4.0 and the impact it may have on chosen diversity traits (age, gender and education) in the modern workplace. This chapter provides a detailed literature review of Industry 4.0 in the modern workplace. Figure 2.1 illustrates the layout of this chapter.

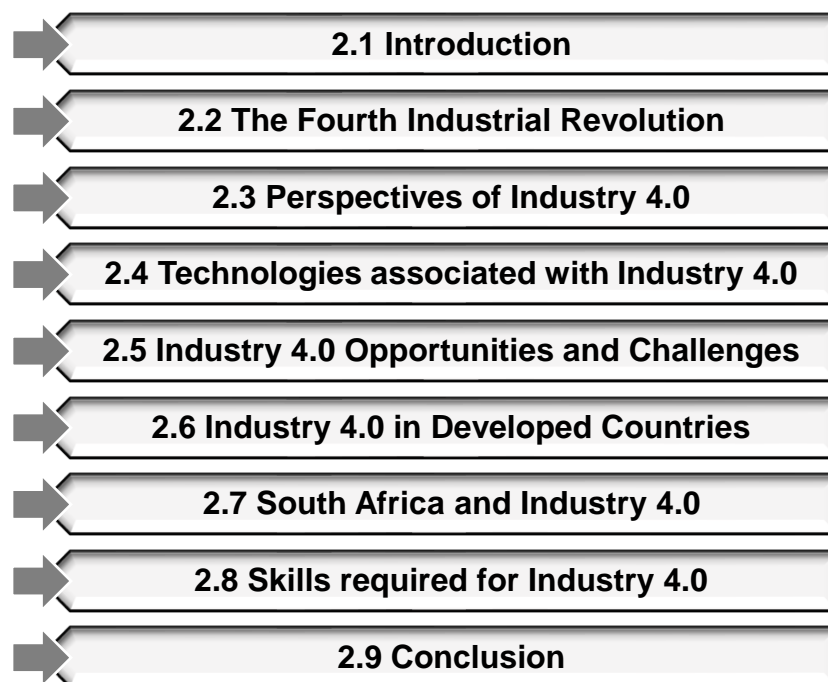


Figure 2.1 Schematic diagram of Chapter 2
Source: Authors own compilation (2020)

2.2 THE FOURTH INDUSTRIAL REVOLUTION (INDUSTRY 4.0 / 4IR)

Technology is at the forefront of daily lives. As technology advances, it will alter the way people perform everyday tasks. As time lapses, old practices and the way humans previously carried out daily tasks change. Industrialisation has allowed for a significant transformation since its commencement in the eighteenth century (Badri, Boudreau-Trudel and Souissi, 2018).

The phenomenon of Industry 4.0 was introduced in Germany in 2011 (Kagermann, Lukas and Wahlster, 2011). The prominent propositions of Industry 4.0 were published in a high-tech strategic plan, where Industry 4.0 was referred to as the strategic inventiveness of Germany (Kagermann *et al.*, 2011). Technology has played a role in the evolvement of humans and has entered many facets of our daily lives. Technology has also paved the way for how human beings think, feel, touch, and communicate. Therefore, technology affects our behaviour. Innovative technological inventions have been designed to make our lives easier and it structures a future where people and technology can live in harmony. As the years have passed, it is curious to note how people have evolved and learned to adapt to changes. Such as societal changes, and to environmental, infrastructural and technological changes. To understand how people, the workplace, the environment and the world have transformed, it is important to have knowledge of how technology has evolved and why it matters.

In the earlier days, animals were domesticated and used for transportation, or as a source of food and farming (Tourrand, Srairi and Hubert, 2015). For instance, pigs were grown to be slaughtered for food and cattle were used to graze the land, produce milk and be a source of food. Animals such as horses were used to plough the land, but horses were unable to work for lengthy amounts of time and needed to rest frequently. Also, they needed to be fed to build strength before beginning work again. Today, sophisticated farming equipment can complete the work on the land with faster response times and therefore less effort is required from farmers. Technology has assisted to transform farming equipment through providing it with intelligence, which makes the growing and harvesting of crops much easier. Hand tools that farmers first used, such as hand shovels, rakes and hoes, have been automated and can attach to larger machinery to improve efficiency and operations (Banks, 2021). Innovative farming equipment have permitted farmers to connect their farms to the internet for

meticulous agriculture and enhanced efforts towards sustainability (Banks, 2021). The advancements in technology have given farmers the upper hand with better medication for the animals and access to transport. Resources have allowed for improved production of food which has aided in accommodating rising population numbers. This has led to cities being developed and land being used for properties.

Three other revolutions preceded the Fourth Industrial Revolution. The three revolutions have shaped how the world is functioning and it created the world we live in presently. The First Industrial Revolution gave us the steam engine. The Second Industrial Revolution allowed for mass production and new-fangled industries such as steel, electricity, oil and the use of the internal combustion engine. The Third Industrial Revolution, also known as the digital revolution, introduced personal computers, the internet and semi-conductors. The Fourth Industrial Revolution has allowed for limitless possibilities by allowing people to be connected by means of devices. It has also elevated process power, storage capacity and the acquisition of knowledge (Schwab, 2017). Technology has merged with the human factor, and it influences everyday life in a multitude of ways. Technologies has advanced day by day and there are continuous breakthroughs to improve the world in which we live. Figure 2.2 highlights the sequence of when the industrial revolutions have taken place, as well as the century of occurrence and important advancements in the mentioned industrial revolutions. It is a summary of what was discussed in this paragraph.

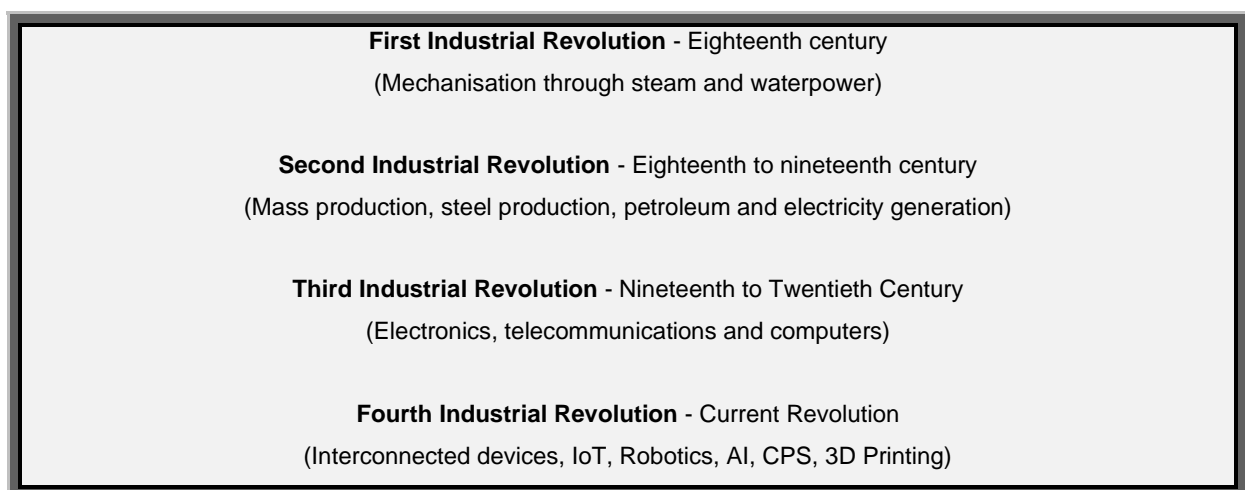


Figure 2.2 The industrial revolutions and the major advancements
Source: Authors own compilation (2019)

Industry 4.0 has transformed digital machines by adding intelligence and redefining the way they communicate and carry out particular tasks (Muhuri, Shukla and Abraham, 2019). This has led to improved response times, allowing work to be completed on time or even ahead of time and tasks to be executed without errors. The Fourth Industrial Revolution meshes the virtual and the physical world by merging workers, intelligent machines, smart products, production processes and systems (Pereira and Romero, 2017). Götz and Jankowska (2017) outlined some expectations with regard to Industry 4.0. These include modern ways of balancing the customisation of mass production; relieving resource scarcity; enhancing energy effectiveness; permitting urban production and; cushioning against repercussions of demographic change. Finally, in advanced countries, Industry 4.0 allows an organisation to have a competitive advantage. Other authors such as Savić (2018), focus on the potential impact that Industry 4.0 has on people and the organisation. Figure 2.3 illustrates the potential impact that Savić (2018) identified.

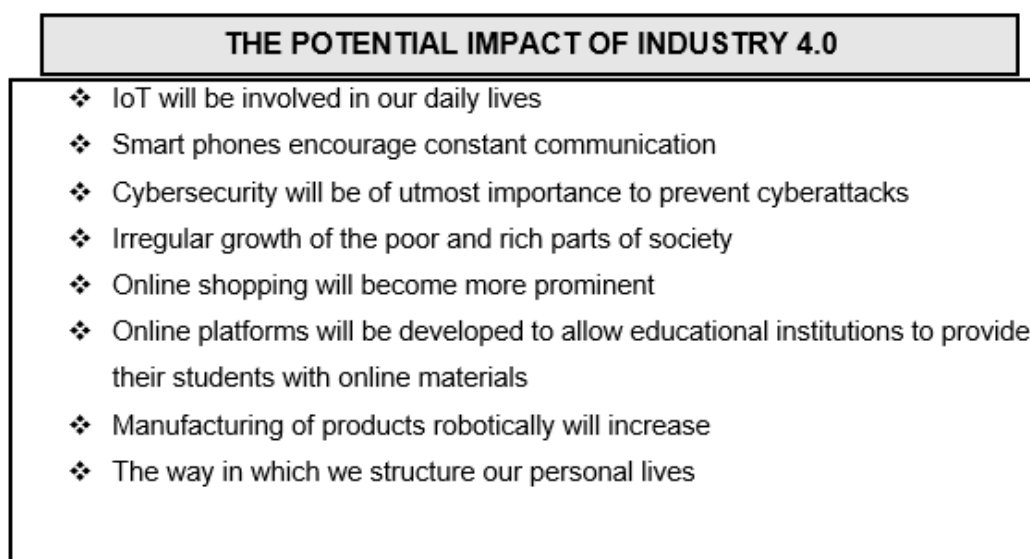


Figure 2.3 The potential impact of Industry 4.0
Source: Adopted from Savić (2018)

Figure 2.3 depicts the potential impact of the Fourth Industrial Revolution. These impacts will guide daily activities, although there are several opinions, thoughts, ideas and viewpoints as to what the Fourth Industrial Revolution is really about. Academics and organisations have popularised Industry 4.0 as a field of research (Pereira and Romero, 2017).

Different authors have defined Industry 4.0 and gave it a reference as to what they believe Industry 4.0 involves. Saxena (2014) believed that humans have moved towards globalisation and the world has become a global village. Work tasks are requiring greater decision-making, real-time control, improved performance and quality of organisational processes (Hitpass and Astudillo, 2019). This will lead to a comprehensible trend concerning the latest business processes and e-commerce (Hitpass and Astudillo, 2019). Thus, embracing technological advances allows work environments to become innovative (Pereira and Romero, 2017).

Industry 4.0 takes manufacturing to another level, where advances in communication with machines enable machines to re-examine themselves and self-correct in the functions they perform (Muhuri *et al.*, 2019). Steiner (2019) agrees that Industry 4.0 connects the parts of machines via cohesive data chains and operations. However, linked intelligent systems synchronise production, machines, equipment, people and products to be in communication with one another, allowing for the creation of intelligent robots (Gubán and Kovács, 2017). In doing so, Industry 4.0 is transforming production and how work is being performed (Stăncioiu, 2017). Industry 4.0 allows for the integration of people, products and machinery, executing tasks swiftly, introducing products faster and expanding resource effectiveness through digitisation (Stăncioiu, 2017). Industry 4.0 allows for the real-time connection of physical and digital systems, enabling technologies to alter how work tasks are accomplished (Olsen and Tomlin, 2020).

There are disparate technologies linked to Industry 4.0. It which allows for the emergence of cyber physical systems (CPS) in the organisation comprising hardware, software and people to fulfil tasks (Baldassari and Roux, 2017). Information technology (IT) in Industry 4.0 comprises of cyber-physical systems (CPS), cloud computing, the Internet of Things (IoT), 3D printing, big data, cognitive computing and cybersecurity. The Fourth Industrial Revolution affects lives, identities and the way in which society is governed. It does so by allowing for the acquisition of new knowledge and skills as well as the reconstruction of existing processes and methods (Savić, 2018). Industry 4.0 processes create contemporary market-generated value for the end customer (Celaschi, 2017).

2.3 PERSPECTIVES OF INDUSTRY 4.0

Scholars have used diverse perspectives to define the Industry 4.0 phenomenon. Names synonymous with the digital age are the Fourth Industrial Revolution, Industry 4.0 or the industrial internet which are used interchangeably (Lee, Yun, Pyka, Won, Kodama, Schiuma, Park, Jeon, Park, Jung, Yan, 2018). Lasi, Fettke, Kemper, Feld and Hoffman (2014) believed that Industry 4.0 consists of information technology which is the driving force within the manufacturing industry. The use of manufacturing-implementation systems is influenced by the Fourth Industrial Revolution (Almada-Lobo, 2015). As a result, by reaching the objective of Industry 4.0, an advanced level of operational efficiency, productivity and automation is achieved (Thames and Schaefer 2016). Sung (2018) looked at how Industry 4.0 is being incorporated in Korea and how organisations introduced Industry 4.0 into their strategic plans to attain a competitive edge over other organisations. Kamble, Gunasekaran and Gawankar (2018) grasped Industry 4.0 from a technical perspective. They believe Industry 4.0 to be paradigm of connected physical devices such as radio frequency identification (RFID), sensors, actuators, and the internet network. Industry 4.0 was founded on the merging of information, communication, and industrial technologies. It is predominantly dependent on building cyber-physical systems to acquire a digital and intelligent workplace by promoting digital awareness (Zhou, Liu and Zhou, 2015). Industry 4.0 technologies, therefore, permit connected computers, equipment, applications and individuals to communicate through interconnected networks. It provides producers with timely insights into processes (Javaid, Haleem, Singh and Suman, 2021).

The driving force of Industry 4.0 is to build a flexible production model of personalised, digital products and services, with real-time interconnections between people, products and devices throughout the production process (Zhou, Liu and Zhou, 2015). The academic, government, and industry sectors acknowledge the presence of Industry 4.0 as it builds upon the previous industrial revolutions. Furthermore, these new technologies allow the physical, digital and biological worlds to fuse. The benefits of connecting through communication networks and smart mobile devices offer ease of access to data and information by using high-speed internet and limitless storage (Savić, 2018).

The enhancement of economic growth and competitiveness as well as revolutionised capabilities improve working environments. This is achieved by allowing for creativity and resource efficiency as well as finding a balance between work and private life (Kagermann, Wahlster and Helbig, 2013). This innovative reality has raised excitement and curiosity. According to Stăncioiu (2017, p.1), one-third of organisations consider digitisation to be a high priority, and the level is anticipated to increase on average from 33% to 72% in the next five years. The aim is to increase production, thereby increasing flexibility and resource efficiency (Stăncioiu, 2017). Exploring the relationship between computer designs, the Fourth Industrial Revolution and the technological forces associated with the Fourth Industrial Revolution (García Ferrari, 2017) will assist the organisation to function optimally (Fettermann, Cavalcante, Almeida and Tortorella, 2018). There are several terms associated with Industry 4.0 such as automation, artificial intelligence, digitisation and digitalisation. These terms are synonymous with Industry 4.0 and are briefly defined below.

Automation: Automation refers to technology which permits machines to complete tasks with minimal human intervention (Heller and Savargaonkar, 2021). In essence, automation utilises technology to perform tasks with reduced assistance from humans. Automation is more widespread in industries such as retail and logistics, supply chain and logistics, healthcare, and customer service (Jha, 2020). It creates an autonomous system which require little, if any, human involvement and therefore it reduces the risk of human error (Sarter, Woods and Billings, 1997). Automation is done with the aid of digital electronic devices, compelled by improvements in artificial intelligence (Parschau and Hauge, 2020).

Artificial intelligence (AI): Around the world robots are present in sectors such as healthcare, academia, manufacturing, mining and government offices. Information technology (IT) forms part of Industry 4.0 and relates to terms such as cyber-physical systems (CPS), cloud computing and the IoT. Artificial Intelligence (AI) refers to any machine displaying traits associated with the human mind, be it knowledge or problem solving (Frankenfield, 2019). Algorithms aim to accelerate the exposure to data and the interaction between humans and machines (Jarrahi, 2018). Machines are incapable of thinking logically and do not possess the ability of human intuition (Jarrahi, 2018). Algorithms are used by humans to assist machines or robots in

minimising the need for human abilities. However, machines and robots lack skills such as decision-making and cognitive thinking (Jarrahi, 2018). The field of AI strives to answer a simple question: can a machine match a human's level of intelligence?

Digitisation: Digitisation refers to taking analogue information and encoding it into zeros and ones so that computers can store, process, and transfer such information (Bloomberg, 2018). An example is converting typewritten or handwritten text into digital form. Should you wish to scan a photo or a document into bits or bytes, you are digitising that object (Prause, 2020). In essence, digitisation is transforming something into digital format for your intended use.

Digitalisation: Digitalisation allows for the application of digital technologies which creates change in business-to-business activities and the business market (Ritter and Pedersen, 2020). Digitalisation relies on digitisation to improve and convert processes to be more resourceful, productive and profitable (Bogush, 2021). By leveraging technology current business models are transformed. Also, value is created by improving existing processes and business models to increase revenue and decrease costs (Bogush, 2021). An example is using computers to do online banking and shopping or using a digital device as a phone or even an e-reader to read books (Oentoro, 2022).

Data collection and storage have evolved, and tools are used to collect multitudes of data through sensors and connected devices. The developments in technology are reflected in the increased availability of computing power, required for advanced data analysis, machine learning and neural networks (Khyatin, 2016). Industry 4.0 is made up of different technologies to modify isolated and optimised production into extensively unified, automated, and simple work processes and patterns (Vaidya, Ambad and Bhosle, 2018). This means that the production, integration, and acceptance of Industry 4.0 technologies will play a part in making life simpler, leading to improved efficiency. The technologies will aid in driving Industry 4.0 forward. The researcher believes these technologies of Industry 4.0 will give the study a basis on which all individuals will need to be accustomed to in the coming years.

2.4 TECHNOLOGIES ASSOCIATED WITH INDUSTRY 4.0

The application of technology creates better decision-making; innovative opportunities for upskilling, reskilling, and cross-functional collaboration; improved talent attraction and retention, employee satisfaction and attaining a competitive advantage (Gregolinska, Khanam, Lefort and Parthasarathy, 2022). There are several interpretations of the core technologies related to Industry 4.0. The researcher is aware that there are many technologies linked to Industry 4.0. However, the researcher has chosen to expand on some of technologies associated with Industry 4.0, namely cyber-physical systems, the Internet of Things, cloud computing, 3D printing, cybersecurity, big data and cognitive computing. The researcher will expand on some of the technologies and provide explanations as to how one technology may relate to another. Industry 4.0 has led the way for new technologies and technological terms. Table 1.1 highlights some of the technologies associated with Industry 4.0. Figure 2.4 represents a summary of the technologies associated with Industry 4.0 that the researcher explains further.

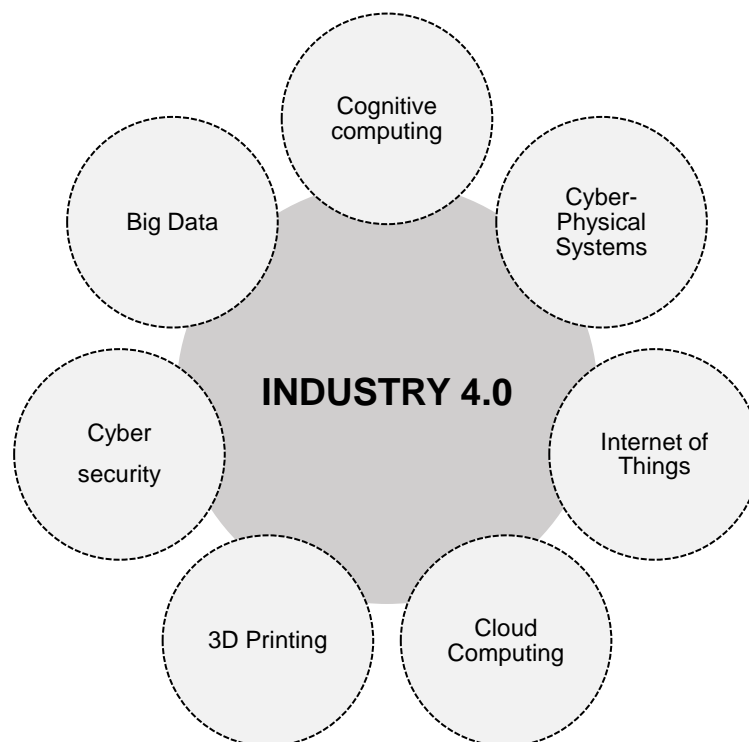


Figure 2.4 Technologies associated with Industry 4.0
Source: Authors own compilation (2019)

There are other technologies. However, due to the length of the study the researcher has chosen not to explain all technologies associated with Industry 4.0 and rather

contrast how they are related to one another. The researcher will provide a discussion on each of the technologies illustrated in figure 2.4.

2.4.1 Cyber Physical Systems (CPS) and the Internet of things (IoT)

Cyber-physical systems (CPS) are systems that permits the physical, digital and biological worlds to combine. Al-Ali, Gupta and Nabulsi (2018) mentioned that the significant features of Industry 4.0 relate to the conversion of mass, semi-customised and variant product manufacturing. Cyber-physical systems have brought about physical and biological systems examined or controlled by an embedded computational core (Bartocci, Deshmukh, Donzè, Fainekos, Maler, Ničkovič and Sankaranarayanan, 2018). Furthermore, CPS consists of collaborative computational structures that are tightly cooperating with physical components through sensors and actuators (a component of a machine). CPS are systems which allow for the communication between these components and humans over the Internet of Things, a network infrastructure permitting the synergy of these devices (Ratasich, Khalid, Geissler, Grosu, Shafique and Bartocci, 2019). Cyber-physical systems are expected to revolutionise the approach in which organisations execute daily functions (Colombo, Karnouskos, Kaynak, Shi and Yin, 2017). The collaborative relationship between a human and robot has grown, and humans will continue to physically program a robot in order to complete predetermined daily functions (Ansari, Erol and Sihni, 2018).

Cyber-physical systems were employed through the combination of embedded systems, physical environments, smart objects, and people, all bound by a communication infrastructure. Examples of CPS are smart transportation systems, smart factories, smart buildings, smart homes and smart vehicles (Ochoa, Fortino and Di Fatta, 2017). Embedded systems signify the intelligence and knowledge of numerous products which vary from aeronautics to the spatial industry (Aït-Kadi, Simeu-Abazi and Arous, 2018). CPS may include complex systems and support Industry 4.0 in being the most talked about and progressive revolution, in other words, CPS are at the heart of Industry 4.0 (Al-Ali *et al.*, 2018).

Today, people turn to the internet for different reasons; be it personal or work related. Examples are sending emails, online banking, messaging, telephone calls and watching videos. Cyber-physical systems are connected via the internet and

recognised as the Internet of Things (IoT). The Internet of Things connects people, objects and sensors. Worldwide, the advances in technology allow people to acquire information in a matter of nanoseconds. In the years to come, it is inevitable that the internet will grow to a vast network of networked objects (Mehta, Sahni and Khanna, 2018). The Internet of Things (IoT) is a platform where everyday devices become smarter, daily processing becomes easier and everyday communication turns out to be educational (Ray, 2018). The aim of the IoT is to employ smart technologies by connecting smart technological objects at any time to achieve anything at any place (Mehta *et al.*, 2018). The Internet of Things provides for the combination of the physical and digital worlds by means of networked sensors, machine learning and big data, resulting in improved operational efficiency (Wong and Kim, 2017). The purpose of the IoT is to exchange and update information to achieve optimum performance of the overall system (Saha, Mandal and Sinha, 2017).

The author Kevin Ashton (2009) promoted IoT by using Radio Frequency Identification (RFID); this is a precondition of the IoT to identify objects or products that are to be tagged for inventory in order to guarantee recording accuracy (Ashton, 2009). The vision and application of the IoT have since evolved and things such as cloud computing, wireless networking, sensors and embedded systems are fundamental technologies of the Fourth Industrial Revolution. It permits the IoT to be one of the central technological drivers of Industry 4.0. Bridging the gap amidst the virtual and physical world, the IoT enables co-operation, addressability, communication, identification, actuation, sensing, embedded information-processing localisation and user interfaces. This supports the IoT to push Industry 4.0 forward (Bisio, Garibotto, Grattarola, Lavagetto and Sciarrone, 2018).

The IoT strives to enrich the quality of human life and aims to promote healthcare, transportation, automation and emergency responses. The IoT enables a device to hear, see, listen and communicate at the same time, just as a human would do. The internet will consist of a network of computers encompassing many smart devices and embedded systems (Rathore, Ahmad, Paul and Rho, 2016). Devices connected in the IoT will be used efficiently and economically (Gubán and Kovács, 2017).

2.4.1.1 The Internet of Things and Cyber Physical Systems

The definitions of IoT and CPS are similar; both refer to digital competence as well as the network and computational capability of physical devices and systems (Greer, Burns, Wollman and Griffor, 2019). Examples vary from autonomous intelligent vehicles to sophisticated manufacturing systems; be it in agriculture, smart cities or the energy sector. Cyber-physical systems originated from a system engineering and control perspective. IoT emerged from a networking and information technology perspective, thereby envisioning the collision of the digital domain into the physical world (Greer *et al.*, 2019). These technologies both converge as prominent technologies for Industry 4.0; their basic goal is to merge the physical and the cyber worlds.

2.4.2 Cybersecurity

In life, feeling secure and being protected is an essential need. The need to be safe in the cyber world is similarly essential. Over the years, cybersecurity was seen as protecting people and organisations from hackers, loss of information and viruses. However, in the past few years, as technology has progressed, the level of protection against cyberattacks has changed completely. Such attacks include those on government, internet espionage, financial crimes and even the cloning of documents, bankcards, and a person's credentials. Criminals are becoming smarter and committing crimes over the internet is becoming more prevalent. Devices that are not secured properly over the Internet of Things create opportunities for cyber criminals to attack and have access to the IoT network.

A threat to cybersecurity involves the illegal access to information and the occurrence of cyberattacks resulting in the disruption of service availability (Lu and Da Xu, 2018). Therefore, cybersecurity and the IoT infrastructure necessitate confidentiality, being auto immune and reliable in order to safeguard and develop the cyber world (Lu and Da Xu, 2018). However, there has been an increased number of cybersecurity breaches that have emerged and there is a need to strengthen cyber resilience.

The Fourth Industrial Revolution has many technologies attached to it and these technologies require the internet to complete daily tasks. Therefore, cybersecurity is of utmost importance and a top priority. This is because personal details must be kept

confidential as we make use of online banking, online purchasing and any platform where a person's personal details need to be protected. There has been an increased intensity in cyberattacks, concerning financial crime, industrial espionage and targeting of governments and critical infrastructure (Young, 2018). Information aimed at detouring cyberattacks are among the main issues brought about by the extensive use of networks (de Gusmão, Silva, Poletto, e Silva and Costa 2018). A cyberattack is an attack launched over the internet on one or more computers for instance through malware, phishing and denial-of-service attack (Joshi, 2020).

In the IoT, there are security risks such as the security of devices, privacy and data protection, application risk, cloud computing and the insecure transmission of data (Young, 2018). With the advancement of technology there are bound to be new vulnerabilities such as cyber threats, which have become a permanent threat to society (Oosthoek and Doerr, 2021). In doing so, organisations, government, as well as the industry should invest in cybersecurity measures. For instance, 3D printers vary in many ways. However, they share similar features that make them vulnerable to cyberattacks (Nachreiner, 2018). The file for 3D printing has a native encryption. Cyberattacks can occur as 3D printers require an internet connection and are open sourced, resulting in a host of security issues, ranging from digital to physical (Nachreiner, 2018).

It is essential to boost the cybersecurity of Industry 4.0. The gap in cybersecurity jobs worldwide raises concerns as to how higher education institutions will provide diverse skills sets and prepare students for the world of work (Sobel, Parrish and Raj, 2019). These authors further mention that cybersecurity may be a technologically advanced academic discipline, which needs more attention in order to explore the content and restrictions of cybersecurity.

2.4.3 Cloud Computing

Cloud computing is a new computing paradigm that provides scalable, on-demand and vitalised resources for users. A user can access a shared pod of computing resources, which is provided. It requires minimal management efforts from users, e.g. backup and recovery of data on Facebook, Twitter, Myspace and LinkedIn (Ghahramani, Zhou and Hon, 2017). Cloud computing allows for information to be accessed via the cloud. It

allows a person to be in remote locations, but still have access to the required data, stored files on network servers and personal files all via the internet (Frankenfield, 2019). Cloud computing can be considered as another utility like electricity, water or gas, which every household in many countries around the world use (Marinescu, 2017). Diverse employees working towards a shared objective allow for varied contributions concerning their outlooks, strengths, roles and understanding. This can be communicated willingly and regularly; it also permits the different views to be migrated onto the cloud platform sanctioning a higher succession rate (Kilgore, 2018).

The progression of cloud computing is dependent on the future of the internet and the essence of cloud-based services is to store data that may only be accessed via the internet. However, this allows people to be vulnerable to cyberattacks (Gubán and Kovács, 2017). Cloud computing provides people with the ease of accessing information from anywhere using any device. Jadhav and Patankar (2018) identified cloud computing characteristics as: being an on-demand self-service; having a broad network of access; bringing together resources by measuring services and the ability to access the cloud from various types of cloud facilities, irrespective of the user's location. Table 2.1 indicates the types of cloud facilities which include the private cloud, hybrid cloud, public cloud and community cloud.

Table 2.1 Types of clouds

TYPES OF CLOUD	DEFINITION
Private cloud	Services are hosted in house infrastructure and supplied via the intranet. Local administrators write their own security policies for users' access
Hybrid Cloud	Consist of two or more private and public clouds
Public Cloud	Designed for the general public, runs over the internet. Allows people to utilise this technology via cloud service providers
Community Cloud	A combination of public, private or hybrid cloud, organisations tend to utilise this type of cloud for security reasons

Source: Adopted from Jadhav and Patankar (2018)

Either one or more of the clouds mentioned in Table 2.1 are used daily; some of the cloud services include Amazon, Google App Engine, Apple iCloud and Microsoft Office Online. For instance, the hybrid cloud consists of two or more private or public clouds. The private cloud allows users to gain access to content in the cloud such as security policies. The public cloud is designed for the public and allows random people to use the technology via cloud service providers. The community cloud combines either the public, private or the hybrid cloud. In our daily lives we use various types of clouds assist people to store information.

2.4.3.1 The Internet of Things and Cloud Computing

The IoT and the cloud computing relationship permits smart devices, mobile devices and sensors to communicate. Cloud computing plays a role in the IoT, where the IoT is a source of data (Verma, 2018). The cloud is an enabler of IoT that solves data-driven needs of the organisation and provides agile platform to improve significant IoT applications for better data devices over the internet (Bittok, 2021). Thus, the combination of IoT and cloud computing may bring a paradigm shift in multi-networking and open services platforms (Bittok, 2021).

2.4.4 Big Data

Big data are substantial amounts of data (both structured and unstructured) that give organisations the ability to capture and attempt to analyse data (Storey and Song, 2017). Big data serve as a platform for generating data collected from the user's communication by using digital devices such as tablets, smart phones and laptops (Huda *et al.*, 2018). For example, doctors in healthcare can view a patient's entire collection of medical records and historical details at any given time when the patient has a medical issue. In education, open distance learning universities, course content and information of the university are available online. This data are stored on an online platform and makes it easier to access. Big data relate to dealing with a massive scale of data, while cloud computing deals with the infrastructure (Verma, 2018).

Big data analytics requires tools to be in place for grasping vast volumes of data sets to pinpoint trends to distinguish patterns and gather findings (Zhong, Xu, Chen and Huang, 2017). Big data analytics is a skill needed to process large amounts of data, including to capture, transfer, store, analyse, visualise, secure and keep data private

(Xu and Duan, 2019). Obtaining new skills are essential, some of the skills required for the workplace are critical thinking, problem solving, emotional intelligence, creativity, and people management (Jezard, 2018). Big data signifies large amounts of data that are unmanageable by means of traditional software or internet-based platforms. This is because it surpasses the traditionally used amount of storage, processing, and analytical power (Dash, Shakyawar, Sharma and Kaushik, 2019).

The collection storage, transport, maintenance, and analysis of this data necessitate a lot of work (Gubán and Kovács, 2017). However, the simplification offered by big data management and cloud computing enables data to be converted into intelligence for decision-making. In essence, big data focuses on finding patterns and common sense in a vast amount of data so that people can make sense of the data. The link between big data and cloud computing is that large amounts of data are produced and cloud computing assists with the storage and management of the data (Verma, 2018). With the Internet of Things, the relationship to big data is that it can assist each other to facilitate the interaction between humans, devices, and machines. Organisations are required to rebalance their workforce, concentrating on the partnership between humans and technology and employing human skills such as empathy, creativity, ethics, and digital skills in an organisation (World Economic Forum, 2018).

2.4.5 3D Printing

Printing is no longer the mundane task of producing what you create digitally onto paper (Jadhav and Patankar, 2018). 3D printing converts digital designs into physical goods by layering thin slices of a material in an additive process (Rindfleisch, O' Hern, and Sachdev, 2017). The term 3D printing was first used in the mid-1990s to describe a specific additive manufacturing process (Schniederjans, 2017). 3D printing permits the production of customised parts from metals, ceramics, and polymers without the need for moulds or matching conventional formative and subtractive fabrication (Ligon, Liska, Stampfl, Gurr and Mülhaupt, 2017). 3D printing involves the procedure for constructing three-dimensional objects in solid form to being transformed from a digital model into a product. 3D printing is used in medicine, aerospace, civil engineering and industrial manufacturing (Nachreiner, 2018).

The cost of purchasing a 3D printer and printing an item using the 3D printer is high (Rindfleisch *et al.*, 2017). This hampers the rapid adoption of 3D printing by consumers for various uses and applications (Schniederjans, 2017). The printable materials include hard and soft plastic, carbon firewood and metal (Rindfleisch *et al.*, 2017). In South Africa, 3D technology was used to print middle-ear bones and the surgery of implantation was performed successfully (Mediclinic, 2019). This shows that 3D printing has allowed for leaps in medicine and will present many future opportunities for advancement in many fields.

2.4.6 Cognitive Computing

Humans are searching for ways to create robots to perform tasks just as humans do. Cognitive computing overlaps with artificial intelligence and includes similar underlying applications, including virtual reality, neural networks, robotics and expert systems (Rouse, 2018). Cognitive computing supports the decision-making processes, whereas artificial intelligence is based on systems and machines that improve decisions on a human's behalf (Gupta, Kar, Baabdullah and Al-Khowaiter, 2018). Cognitive computing systems uses computerised models to replicate the human cognition process in order to unearth solutions in complex situations where the answers may be obscure and uncertain. Cognitive computing builds a new class of systems that learn from experience and gain insights to unlock the value of big data (Haldorai, Ramu and Chow, 2019). It creates self-learning systems, which use data mining, pattern recognition and natural language processing to emulate the way a human brain functions (Haldorai, Ramu and Chow, 2019).

The developments in technology are trying to mimic how a human behaves, thinks and feels, incorporating these characteristics into forthcoming technological designs. Artificial intelligence and cognitive computing incorporate similarities such as learning algorithms. Cognitive computing does not make decisions but rather provides added information which permit humans to make suitable decisions, unlike AI which makes decisions on its own, minimising the role of humans (Barbaro, 2022). Future transformations in technology must be managed well to enhance work, create jobs and enrich the quality of life, without creating bigger skills gaps (Jezard, 2018). Employers require employees with innovative skills to retain a competitive edge. Also, employers have a responsibility to develop their workforce's productivity. Employers

and employees experience rapidly declining opportunities in a range of job roles that were previously considered to be safe. They will now need to consider how to create secure career opportunities (Jezard, 2018).

The above-mentioned technologies are the important drivers of Industry 4.0 and aid in the success of the Fourth Industrial Revolution. These technologies are interdependent and, in some way, or other related to one another. Industry 4.0 uses technologies to enable change and embrace new possibilities. The next section discusses Industry 4.0 opportunities and challenges to provide an understanding of the advantages and disadvantages that are associated with the Fourth Industrial Revolution.

2.5 INDUSTRY 4.0 CHALLENGES AND OPPORTUNITIES

With digital transformation and rising interconnectivity, new challenges are occurring in organisations (Pereira and Romero, 2017). People have hopeful expectations for the future of Industry 4.0. Among other things, the medical and life sciences are being discussed as key areas of this revolution, as compared to the previous industrial revolutions (Yoon, 2017). The concern around unemployment due to modernised technologies taking over mundane job tasks is undeniably an imminent problem that has the potential to create pronounced inequalities (Peters, 2017).

However, there are numerous advantages arising from smart and innovative technologies in the workplace such as: new ways to balance customisation with mass production; alleviating resource scarcity; improving energy efficiency; enabling urban production; cushioning the consequences of demographics of the population; and an ageing society (Götz and Jankowska, 2017). Infrastructure, information technology facilities and technologies are fundamental in the implementation of Industry 4.0 theories (Luthra and Mangla, 2018). Industry 4.0 involves the transition of current business models into a modern industry where more advanced business models are used. Industry 4.0 has revolutionised the workplace. However, along with this change are challenges and opportunities. Luthra and Mangla (2018) identified several challenges of Industry 4.0 in their study. Figure 2.5 illustrates to some of these challenges.

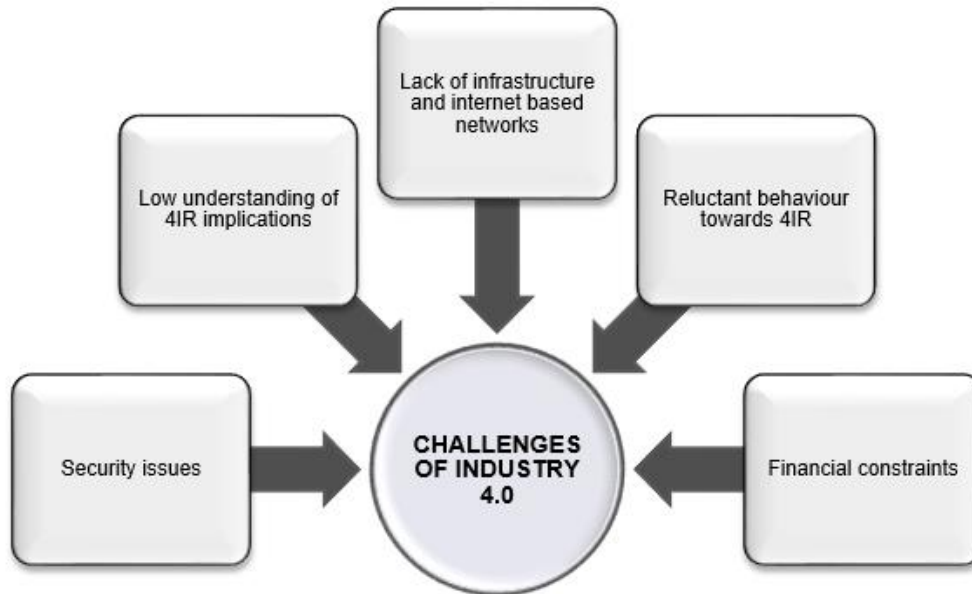


Figure 2.5 Challenges of Industry 4.0
Source: Adopted from Luthra and Mangla (2018)

Figure 2.5 identifies the challenges of Industry 4.0 in terms of a minimal understanding of what Industry 4.0 truly entails as researchers and practitioners are still exploring this phenomenon. Security issues such as digital protection are vital as organisations need to secure their products, productions, customers and employees. Security protects organisations from being exposed to vulnerabilities. Financial constraints may arise due to acquiring newer and more expensive technologies, ensuring that systems are up to date and that regular maintenance of systems takes place. This increases costs and organisations need to ensure that they have sufficient funds in place. There are possibly people who are resistant to the change that Industry 4.0 may bring. Therefore, plans need to be put into place to ensure that there is a smooth transition into incorporating newer technologies within organisations. Infrastructure, information technology facilities and technologies are fundamental in the implementation of Industry 4.0 (Luthra and Mangla, 2018).

The three previous industrial revolutions paved the way for new opportunities and types of employment. By acknowledging the potential challenges of Industry 4.0, an organisation can strive to improve itself and learn to adapt to the rapid changes. Almada-Lobo (2015) identified the opportunities of Industry 4.0. The author has presented the findings in Figure 2.6, indicating the opportunities of Industry 4.0.

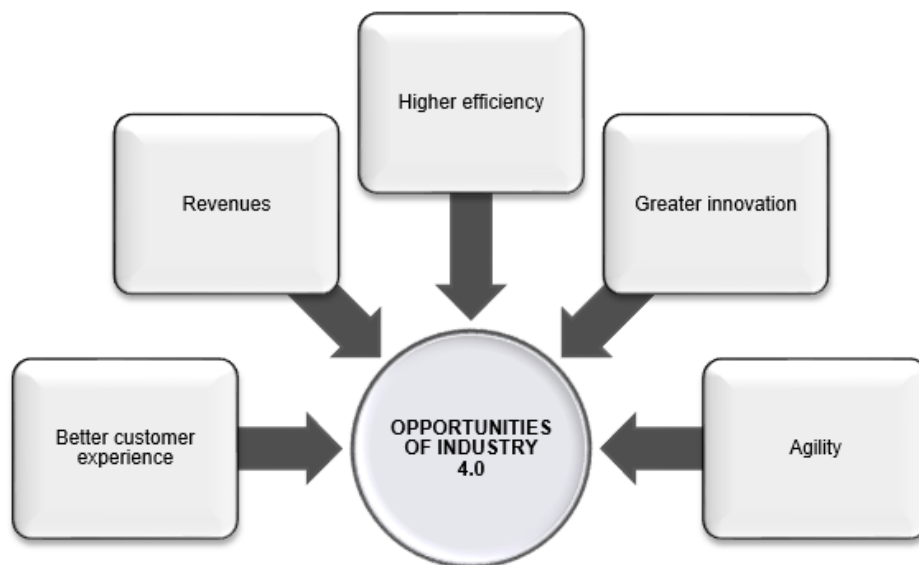


Figure 2.6 Opportunities of Industry 4.0
Source: Adopted from Almada-Lobo (2015)

Figure 2.6 describes that with higher efficiency in terms of automation, tasks will be completed quicker and with fewer errors. The customisation of products speeds up the production process. With innovative products constantly being introduced, ongoing experimentation leads to new products being created at a faster rate. Customers will have a better experience as products are customised according to their specifications. With better quality, lower costs, and a wider customer range, Industry 4.0 allows organisations to be at the forefront and to be the preferred choice for serving larger markets. Industry 4.0 is not regarded as a new phenomenon. However, the adoption of it has been slow. This is due to different factors such as unskilled people, lack of the required infrastructure, and monetary issues. The researcher will now look at Industry 4.0 in developed countries and in South Africa.

2.6 INDUSTRY 4.0 IN DEVELOPED COUNTRIES

Developed countries are at the forefront of Industry 4.0. These countries aspire to increase labour productivity, propose higher production costs and disentangle the issue of ageing populations by embracing Industry 4.0 technologies. By adopting Industry 4.0 technologies combined with the lower costs of production, emerging countries can progress in the value chain and decipher societal issues (United Nations Industrial Development Organisation, 2017). A study was conducted by Ślusarczyk (2018, p.17) with regard to the readiness of individuals for Industry 4.0. The results

showed that 90% of the surveyed participants from the United States (US) and Germany agreed that Industry 4.0 is an opportunity and not a threat. However, the study showed that in Japan people were not as enthusiastic as the Germans and Americans, but they do classify Industry 4.0 as being a positive. The results from the three countries are summarised in figure 2.7.

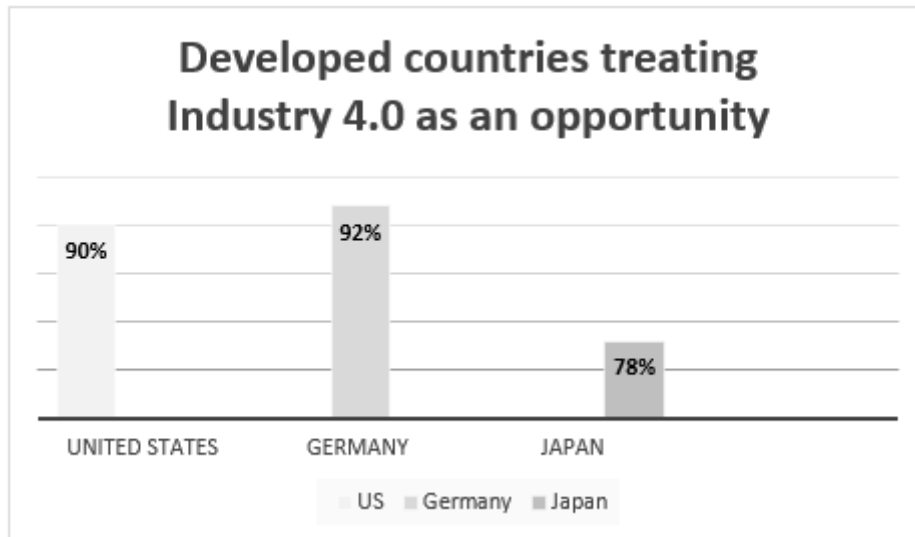


Figure 2.7 Developed countries treating Industry 4.0 as an opportunity
Source: Adopted from Ślusarczyk (2018)

Authors such as Petrillo, Felice, Cioffi, and Zomparelli (2018) identified steps that can potentially be followed to incorporate Industry 4.0 in the workplace. This can be done by creating awareness of how important innovation really is and by training people at the management level of organisations about these innovations. Through awareness creation, communities and organisations are preparing people globally to be more accepting of the fact that our world is changing, and that change is unavoidable. However, the concept is comparatively innovative in developing economies, and it needs an in-depth understanding and practical application from the side of business (Hofmann and Rüsçh, 2017). The term revolution refers to the ability to meet present challenges, as well as future challenges (Drath and Horch, 2014). Petrillo *et al.* (2018) outlined potential challenges that are facing developed and developing countries in Table 2.2.

Table 2.2 Challenges of Industry 4.0 faced in developed versus developing countries

CHALLENGES FOR DEVELOPING COUNTRIES	CHALLENGES FOR DEVELOPED COUNTRIES
Training employees with specific skills in managing digital jobs	Experimentation and learning to give way for companies to strengthen their business
Scalability, there are few companies that have implemented Industry 4.0 leading systems	Data explosion, to send information quicker and increase the data volume
Need for funding, to start planning at the national or regional level for the implementation of 4IR systems	Transformation of the workforce, integrating the system operators with new skills that enable it to manage work digitally with the help of CPS

Source: Petrillo, Felice, Cioffi and Zomparelli, 2018

2.7 SOUTH AFRICA AND INDUSTRY 4.0

Industry 4.0 is an unavoidable phenomenon. Many sectors in South Africa (SA) are not prepared for the transformation and are unable to stay competitive (Maasz and Darwish, 2018). Industry 4.0 creates unpredictability regarding the capacity and capabilities necessary for organisations and sectors to adapt (Erol, Jäger, Hold, Ott and Sihn, 2016). Globally, the automotive and manufacturing industries have accelerated the adoption of Industry 4.0 technologies (Vaidya, Ambad and Bholsa, 2018). However, there is a lack of successful technology adoption in the mining sector. This is mainly due to a lack of internet connectivity, and communication technology as well as an inaccessibility to these technologies on site (Pillay *et al.*, 2017). Industry 4.0 organisations digitise physical assets and integrate them into digital ecosystems throughout the value chain. These organisations also increase their productivity through the integration of digital systems with the analysis and networking of all data systems (Badri, Boudreau-Trudel and Souissi, 2018). The essence of Industry 4.0 lies in using modern and modular structures for factories where CPS creates a virtual world. In this virtual world decentralised decisions are made, and physical processes are controlled (Savić, 2018).

In the Deloitte survey entitled *‘The Fourth Industrial Revolution is here, are South African executives ready?’* executives from nineteen countries were surveyed (Deloitte, 2018). One hundred of these were from South Africa. The study compared South African executives to those from other countries in assessing if executives are ready to embrace Industry 4.0 technologies in the workplace. The data indicated that

South African (SA) executives are uncertain that their respective organisations are ready to harness the changes that Industry 4.0 brings to the workplace. Also, only 4% of SA executives as opposed to only 14% of global executives were confident that they were able to cope. Additionally, only 2% of SA executives and 33% of global executives were certain that they can act as representatives in this time of technological change. The results of the survey also indicated that these executives were of the opinion that Industry 4.0 might bring about social upheavals and an increased income inequality (Deloitte, 2018). South Africa will need to keep up with the development of the world if it wants to be seen as a global competitor.

2.8 SKILLS REQUIRED FOR INDUSTRY 4.0

Automation is our future. The ways in which we deal with, accept, and embrace the new technological world will allow us to work towards the change that is required. Manyika *et al.* (2017) reported on how Industry 4.0 would affect jobs and the possible new skills that will be required. The report indicated an increased demand for millions of jobs by the year 2030 in the face of an ageing society. In this way there will be a realisation of energy efficiencies, climate challenges will be met, and goods and services will be produced for the expanding societies.

In the workplace, the need for skilled, digitally abled workers will increase as the need for manual work will decrease. With the economy predicted to grow over the coming years, the new developments in technology will increase productivity. This will lead to the creation of different types of jobs. According to Manyika *et al.* (2017), as the years have progressed, the expansion of digital and innovative technologies, as well as their implementation, have urged organisations around the world to continuously monitor developments and embrace modernisation and automation to remain competitive. Organisations and government need to look at the created opportunities, which will lead to job creation. However, the creation of jobs may stem from current occupations and thereafter, as new technology changes work, the creation of jobs that currently do not yet exist (Manyika *et al.*, 2017).

As machines become more intelligent and able to perform mundane tasks, the work previously performed will become redundant (Moalusi, 2019). Managing workplace transformation enables effective employees through reskilling, shifting the traditional

concept of work and financial security (Portalatin, 2019). Jezard (2018) mentioned that there are skills necessary for Industry 4.0 that include the basic cognitive, physical, social higher cognitive, emotional, and technological skills required to function in the workplace. Physical and manual skills encompass tasks that could be performed by relatively unskilled labour, such as drivers and assembly line workers. While machines will not entirely replace humans in the workforce, there are particular jobs and tasks that will become redundant. Workplace diversity will be further discussed in the next chapter.

2.9 CONCLUSION

The chapter presented a detailed literature review of Industry 4.0 in the modern workplace. The chapter provided the various industrial revolutions and the potential impact of Industry 4.0 along with the various perspectives of Industry 4.0. Furthermore, a few technologies associated with Industry 4.0 were introduced and discussed to provide a contrast and understanding of the technology as well as the interdependent relationship that the technologies have with one another. The chapter indicated the challenges and opportunities of the Fourth Industrial Revolution. The chapter also explored how Industry 4.0 is perceived in developed countries and South Africa is ready for Industry 4.0 technologies to be implemented in the workplace. There is a general lack of skills that are required for using Industry 4.0 technology. The next chapter will provide a detailed discussion on workplace diversity and the chosen diversity traits (age, gender, and education) for this study.

CHAPTER 3: WORKPLACE DIVERSITY

3.1 INTRODUCTION

This chapter unpacks the definition of diversity and the importance of understanding diversity, diversity management, the opportunities and challenges of diversity as well as diversity traits. It begins by looking at what diversity entails within the context of the workplace. It examines the work of different researchers and authors with regard to diversity and the relationship between diversity and individuals. An understanding of aspects that influence diversity will be discussed. Then the literature will look at the value and importance of understanding and managing diversity, particularly the chosen diversity traits that had been identified for this study namely age, gender, and education. Figure 3.1 illustrates the outline of Chapter 3.

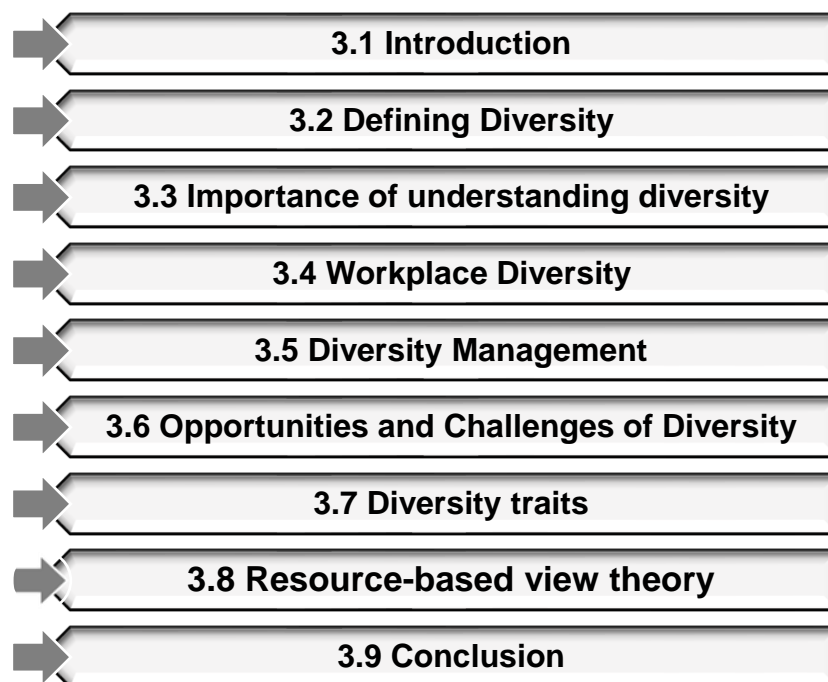


Figure 3.1 Schematic diagram of Chapter 3
Source: Authors own compilation (2020)

3.2 DEFINING DIVERSITY

In general, diversity refers to the combination of people from different cultures, religions, and ethnic groups emanating from birth. It also refers to secondary characteristics such as religious associations, occupation, educational background, and marital status (Jones, 1999). Jones (1999) identified diversity as physical and non-

physical characteristics that differentiate us all from each other. This is consistent with Roberson (2019) who agreed that diversity encompasses characteristics that people are born with and other characteristics that are acquired through human development.

Hudson (2014) viewed diversity as appreciating and recognising characteristics that make people unique. Mazibuko and Govender (2017) perceived diversity in a different light. These authors mentioned that diversity is not about comparing attributes. Rather that, the appreciation of these differences can contribute to the achievement of organisational and team objectives. Diversity comprises aspects that differentiate people from another. Such differences are frequently found in race and ethnicity as well as socioeconomic, geographic, and academic/professional backgrounds (Inegbedion *et al.*, 2020). Cletus, Mahmood, Umar and Ibrahim (2018) stated that by taking advantage of these differences in the workplace, diversity can help the organisation to achieve success. Hogg and Rinella (2018) adopted a different viewpoint on diversity whereby perceptions, feelings, behaviour and the adaptation to an organisational culture will allow an individual to fit in and have a sense of belonging. However, Byrd (2018) proclaimed that diversity is socially constructed and dissimilarities among people within the work environment is perceived as a strategy that may generate an organisation's competitive advantage.

Organisations are embracing the concept of an inclusive workplace, comprising organisational commitment, work retention, job satisfaction and effectiveness of completing tasks (Goswami and Kishor, 2018). This allows for people from different backgrounds to interact with one another. For the context of this study, diversity will be referred to as the variations among individuals in relation to their age, gender and education, realising that all individuals have their own distinctive characteristics.

3.3 THE IMPORTANCE OF UNDERSTANDING DIVERSITY

According to Cletus *et al.* (2018), diverse populations across the world have been transformed by geopolitical, environmental, socioeconomic, and technological influences. Organisations rely on diversity to facilitate change in the workplace to capitalise and maximise productivity (Green, López, Wysocki, and Kepner, 2002) through a vast range of talents (Shemla and Wegge, 2019). This may result in various opinions regarding situations that may occur in the workplace. Tariq (2021) believes

that having a diverse workforce can benefit an organisation to see things from multiple ways of thinking and perspectives, thus allowing organisations to serve a diverse client base.

Diversity exposes a larger talent pool by having diversity in leadership, workstyles and backgrounds (Tariq, 2021). Policies and procedures must govern the actions of people to ensure fair treatment of all individuals. Furthermore, diversity management promotes effective communication and mutual respect in an organisation in order to enhance its reputation and provide the potential for the staff to be promoted (Ubaid, 2018). A diverse organisation allows for diverse opinions and healthy discussions that generate different inputs and ideas, ultimately giving rise to a more productive business and working environment (Ubaid, 2018).

3.4 WORKPLACE DIVERSITY

The world is interconnected. Diversity is shaped by globalisation and inventive technologies that structure our present society (Eswaran, 2019). The term diversity has received widespread attention since the 1990s (Roberson, 2019). Researchers and practitioners have been ambitious in attempting to clarify the impact that diversity may have on the workplace and developing strategies to manage diversity. The workplace has changed during the past few decades. Changes range from: doing manual filing to using electronic filing; from using big desktop computers to using book size computers, and from writing letters that needed to be posted via post offices to sending emails that the receiver receives in seconds. The present-day workplace is globally focused, digital and more diverse (Chernyak-Hai and Rabenu, 2018). Employers must manage dissimilar age groups in the workplace, people with varying education and non-educational backgrounds and people from under-represented groups. Therefore, organisations need to structure themselves in a way that improves cohesion and interconnectedness among people to promote teamwork (Mazibuko and Govender, 2017).

Cletus *et al.* (2018) agreed that organisations will need to adjust their policies and strategies to successfully attract future talent. Johnston and Packer (1987) mentioned that organisations need to encourage work growth. In order to retain the dynamism of the ageing workforce, more women and people of colour need to be included in the

workplace. There is a possibility that automation may pose a threat to people's jobs and therefore future education needs to shift towards Science, Technology, Engineering and Mathematics (STEM) to build the skills of the future (Annunziata and Bourgeois, 2018). For instance, women's representation in science has increased during the past few years (Kang and Kaplan, 2019). Industry 4.0 necessitates research, innovative solutions implemented in the economy, the monitoring of the practical effects of such implementations and the identification of possible solutions to new problems that may occur (Grzybowska and Łupicka, 2017).

3.5 DIVERSITY MANAGEMENT

The expansion of new technologies prompts improvements in the quality of life of people and the well-being of societies (Grzybowska and Łupicka, 2017). People from different backgrounds, experiences and ethnicities are getting connected and driving innovation forward (Eswaran, 2019). Society encompasses diversity by enjoying delicacies from various parts of the world; dressing styles are influenced by cultures, the learning of different languages and respecting other religions. Managing and encouraging diversity is important to ensure that people from diverse backgrounds interact with one another, while sharing their views, opinions and knowledge (Georgiadou, Gonzalez-Perez and Olivas-Luján, 2019).

In the workplace and society, there are rules and regulations that need to be followed. Policies and procedures are in place to ensure fair treatment. By managing diversity, people and organisations can function at optimal levels. Cox (1994) mentioned that managing diversity requires a plan of action and a maximisation of the capabilities of employees to accomplish the organisation's objectives. Georgiadou *et al.* (2019) explain that diversity management initiatives customarily attempted to address inclusion in order to safeguard equality and allow organisations to align business strategies with its culture and vision. Abaker, Al-Titi and Al-Nasr (2018) recognised that managing diversity involves the consideration of diverse employee needs, attitudes and values in deploying diverse skills and talents to attain a competitive advantage for the organisation.

Seminal authors Cox and Blake (1991) also mentioned that diversity would create a competitive advantage. They mention important components for transforming a

traditional organisation into a multicultural one. Joubert (2017) commented that managing diversity enriches an organisation's competitiveness through teamwork and communication. Cox and Blake (1991) also mentioned other traits to remain competitive such as leadership, training, research, analysis, change of culture and human resources in the workplace. Creating a more inclusive culture, empowering people, expanding the network of people and aiming for customer satisfaction.

Madera, Dawson and Neal (2018) believed that diversity management is centred on an effective human resource policy that is focused on increasing and maintaining diversity at all levels of the organisation. However, Risberg and Gottlieb (2019) mention that some people understand diversity management as equal opportunities irrespective of their background. Furthermore, employee diversity is perceived as a resource to accelerate an organisations performance. It allows for diversity management practices in the workplace to guide an organisation to triumph (Madera *et al.*, 2018). The behaviour and mind set of leaders echo throughout the organisation as they are the stewards of an organisations culture, and they will set an example for the organisation (Ely and Thomas, 2020). When developing diverse teams, management must ensure that diverse individuals work together coherently to achieve the set objectives and avoid conflicts. Values are also important, and every employee should embody the values that form part of the organisational culture.

3.6 OPPORTUNITIES AND CHALLENGES OF DIVERSITY

As our global economy changes, people no longer live and work alone, everyone forms part of the global economy (Green *et al.*, 2002). Diversity incorporates differences that may bring about new opportunities. Figure 3.2 was adapted from Cletus *et al.* (2018), indicating possible opportunities brought about by diversity.



Figure 3.2 Opportunities of diversity
Source: Adopted from Cletus *et al.* (2018)

In relation to Figure 3.2, individuals must possess critical-thinking and problem-solving skills. Employee growth and development as well as the incorporation of diverse employees unify the strengths within an organisation which embodies diversity in the organisation. It also promotes corporate attractiveness and positive relationships in the organisation's supply network. Finally, different people bring different thought processes to the workplace, thereby fostering innovation. All individuals bring their own individual strengths to the workplace and an organisation should aim to inspire their employees to execute tasks to the best of their ability (Clarke, 2018). Bearing in mind that these opportunities exist, there are also challenges that diversity has attached to it. Figure 3.3 indicates some challenges of diversity.

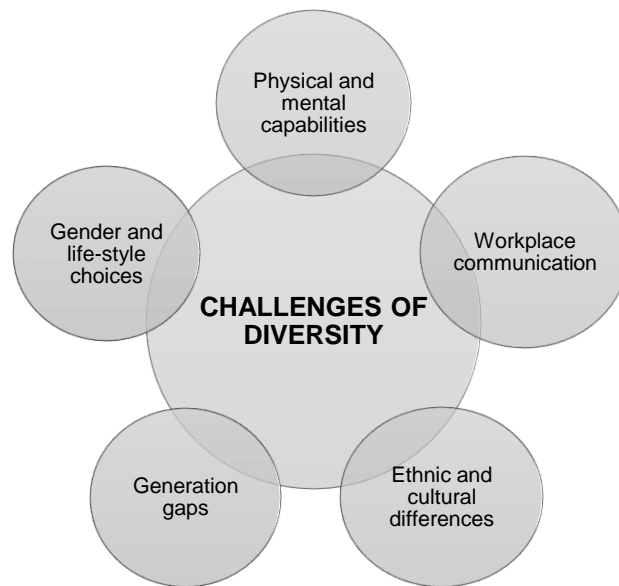


Figure 3.3 Challenges of diversity
Source: Adopted from Cletus *et al.* (2018)

Diversity brings with it some challenges as mentioned in Figure 3.3. People may still encounter forms of discrimination due to their personal choices. Behaviours and attitudes of employees may affect decision-making (Hunt, Prince, Dixon-Fyle and Yee, 2018). Ethnic and cultural differences may include language, race, gender and religion. Having different beliefs and opinions may result in aggression, discrimination or a lack of respect in the workplace. People with disabilities may be viewed negatively in terms of a person’s ability to perform certain tasks (Cletus *et al.*, 2018). Generation gaps in the workplace can pose potential conflicts of interest and divergent opinions can lead to a breakdown in communication within the workplace. The opportunities and challenges of diversity in the workplace need to be prudently managed. The next section will introduce and explain the chosen diversity traits for this study.

3.7 DIVERSITY TRAITS

Werner-Washburne (2018) distinguished that diversity encompasses the age, gender, ethnicity, education, race, skills and backgrounds of people. By appreciating different abilities and accepting varied perspectives, value is extracted from diversity (Byrd, 2018). When asked to describe oneself, terms such as caring, male, female, being fun and seen as a complainer or a procrastinator are traits that may be highlighted.

According to Cherry (2022), a trait is an objectively constant characteristic that causes individuals to behave in certain ways.

Diversity includes the differences between individuals. As discussed in section 3.2, diversity recognises that all individuals are unique, and it is necessary to embrace these differences. For this study, diversity traits are the characteristics that a person possesses. The researcher acknowledges that there are different traits; however, for this particular study the three chosen to be elaborated on further are age, gender and education. The three chosen diversity traits for this study are reflected in Figure 3.4.

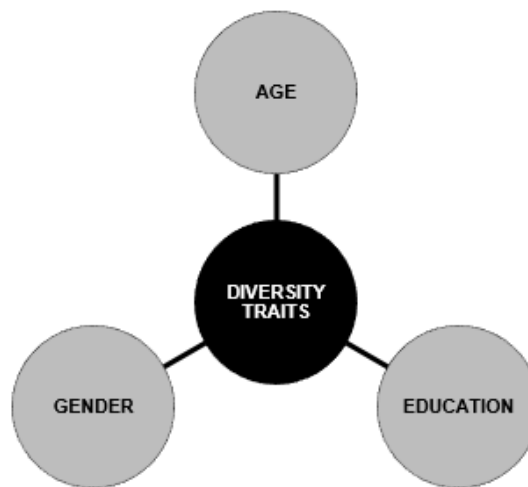


Figure 3.4. Diversity traits
Source: Author (2019)

These mentioned diversity traits will be summarised further for the reader in order to gain an understanding of each of them.

3.7.1. Age

The topic of age can be sensitive for some employees. Age diversity reveals the differences between workforce groups within an organisation based of different characteristics (Bashir, Hameed, Bari and Ullah, 2021). The workforce has become progressively age diverse, as a result in a wider range of younger and older people working together (Bellotti, Zaniboni, Balducci, Menghini, Cadiz and Toderi, 2022). Age is the measurement of time since the birth of a person (Hughes and Touron, 2021). There are different generational cohorts that exist namely, Baby Boomers, Generation X, Generation Y and Generation Z.

The topic of generational differences in the workplace has always been a topic of interest (Lyons, Urick, Kuron and Schweitzer, 2015). Reiser, Van Vreede and Petty, (2019) mention that people from different generations are influenced by shared experiences that may have transpired at momentous points in their lives. There is an assumption that people of similar ages would have experienced the same influences that shaped their outlook in a similar way (Schewe, Meredith and Noble, 2000).

The fluctuations in population growth and the ageing workforce bring the challenge of different perspectives, which amplify the requirement for organisations to productively manage workplace diversity (Roberson, 2019). In an organisation there are bound to be different generational cohorts that co-exist. The discussion going forward centres around the different generational cohorts and how they are impacted by modern technology in the workplace. The generational cohorts under discussion are Baby boomers, Generation X, Generation Y and Generation Z.

3.7.1.1. Generational Cohorts

In the workplace, there are different age groups that work together. The workplace is a place where most of our time is spent. Workplace generational differences are evident, as different generations intermingle while they carry out their tasks (Cucina, Byle, Martin, Peyton and Gast, 2018; Noble and Schewe, 2003). Cohorts are groups of people born during similar periods and they journey through life together (Schewe, Debevec, Madden, Diamond, Parment and Murphy, 2013). They experience similar external events together (Schewe and Noble, 2000, Duh and Struwig 2015; Jones, Murray and Tapp, 2018). Jackson, Stoel and Brantley (2011) mentioned that each generational cohort has certain values and priorities that persist during their lifetimes.

Generational cohorts with their own experiences may provide a way to understand how different people interact with differing lifestyles and the ageing process may possibly shape a person's interpretations of the world (Dimock, 2019). This affects employees, as the older and younger generations have differences in terms of beliefs and opinions (Dimock, 2019). The modern workforce is multi-generational, and this impacts organisational outcomes due to differences in views, opinions and beliefs (Jones *et al.*, 2018). Therefore, it is imperative to pay attention to the change in the workplace and to understand how generational influences influence the operations of

the organisation (Rosa and Hastings, 2018). Table 3.1 outlines the timelines for each generational cohort.

Table 3.1 Timelines for generational cohorts

TIMELINES FOR GENERATIONAL COHORTS	
Baby Boomers	Born between 1946-1964
Generation X	Born between 1965-1978
Generation Y/ Millennials	Born Between 1980-1994
Generation Z	Born Between 1997-2012

Source: Author (2019)

Table 3.1 explains the year spans in which the different generations were born. With reference to Table 3.1, the researcher will now discuss each generation and explain what each generation entails.

3.7.1.1.1. Baby Boomers

Individuals who were born between the year of 1946 and 1964 are referred to as Baby Boomers. Baby Boomers are considered to be the prevalent generational cohort to have shaped higher education in developed economies during the past few decades (Altman, Baruch, Zoghbi Manrique-de-Lara and Viera Armas, 2020). According to Reiser *et al.* (2019), these individuals pursue their goals tenaciously and are willing to sacrifice relationships. Baby Boomers influence society to be idealistic, driven and make personal sacrifices for financial attainment (Lee, Kippenbrock and Emory, 2019). Callanan and Greenhaus (2008) found that Baby Boomers are talented, experienced and educated. They occupy leadership and senior management positions, play significant roles and act as resources. For this reason, Baby Boomers are assets to an organisation as their experience in the workplace can be vital in driving the organisation forward. However, Waters and Seal (2019) have a different view in that they mention that Baby Boomers lack values and that they may be disconnected regarding understanding the newer generations. Nevertheless, organisations and

universities need to acknowledge the changes within each generation and the population at large (Waters and Seal, 2019).

Even though life expectancy has increased, Baby Boomers face the option to choose between retiring and not retiring, depending on their individual situations. However, in the study conducted by Altman *et al.* (2020), it was found that due to financial commitments and family situations, Baby Boomers may possibly choose to continue working past retirement age, be it full-time or part-time. Altman *et al.* (2020) asked Baby Boomers what they will miss when they retire. The feedback ranged from mental stimulation, collaborating with others, mentoring younger generations and educating future professionals (Altman *et al.*, 2020). Baby Boomers seem to be interested to continue working should they have the capacity to do so.

According to Hayes, Parks, McNeilly and Johnson (2018), Baby Boomers are loyal, hardworking team players who remain individualistic, ambitious, achievement-oriented and competitive. Netzer (2019) commented there are not enough of the younger generations who are entering trades to replace the aging Baby Boomers who are leaving the workforce. Therefore, these job roles that are not filled need to be filled by the next generation of workers (Netzer, 2019). Baby Boomers have acquired much knowledge which they can transfer to employees who would take over their job roles once they retire. In essence, Baby Boomers have helped to shape societies and there is an expectation from society that they will continue to pass down their knowledge to the newer generations.

3.7.1.1.2 Generation X

This group is the connection between Millennials and Baby Boomers. These individuals were born between the year 1965 and 1978. Generation X or Gen Xers, as they are also known by, is the post-Baby-Boom generation who grew up during the computer revolution and they learnt to expect and thrive with change. According to Bova and Kroth (2001), job-hopping is a familiar method for career advancement for Gen Xers and money is the main motivator.

In the opinion of Fish (2018), Generation X is crucial to the workplace as they possess a wealth of proficiencies. Fish (2018) further mentioned that Generation X tends to be cooperative. Furthermore, they possess old-style leadership skills and a work ethic

that organisations require in order to obtain a competitive advantage. Generation X work to attain their own goals as well as to accomplish organisational goals (Weerarathne, Walpola, Piyasiri, Jayamal, Wijenayaka and Pathirana, 2022). Generation X employees believe in themselves and prefer being independent and do not wish to be supervised (Weerarathne *et al.*, 2022). Their characteristics are maintained by hard work, openness, respect for diversity, curiosity, practicality and respect for hierarchy (Bencsik, Horváth-Csikós and Juhász, 2016). However, these individuals believe a work-life balance is paramount (Lee, Kippenbrock and Emory, 2019).

3.7.1.1.3 Generation Y / Millennials

Generation Y are also referred to as Millennials. These individuals were born between the year 1980 and 1994. Millennials are ever eager to express their opinions and they are always willing to take advantage of training opportunities that their organisation may provide (Rosa and Hastings, 2018). Generational cohorts such as Baby Boomers are almost fully retired, and Generation X is slowly retiring from the workforce. Therefore, it is essential to give priority to the recruitment and retention of Millennials (Arora and Dhole, 2019). As employers recruit the younger generations in the workplace, they may find opportunities that could build a competitive advantage for the organisation (Stewart, Oliver, Cravens and Oishi, 2017).

Millennials have distinctive differences when compared to previous generations due to their unique relationship with technology (Hershatler and Epstein, 2010). Millennials seem to have different perspectives with regard to the performance of tasks, communication, diversity, technology and relationships in the workplace. These perspectives aid in increasing organisational performance and productivity (Myers and Sadaghiani, 2010). Millennials grew up in a technological world. Millennials seek technologically enhanced ways to conduct business (Arora and Dhole, 2019). Gong, Ramkisson, Greenwood and Hoyte (2018) pointed out that Millennials support innovation. Organisations need to recognise Millennials as an important resource that plays a crucial role in the organisation. Planning approaches to involve and retain Millennials will enhance productivity (Arora and Dhole, 2019). Therefore, organisations need to ensure that they accommodate innovation and, in doing so, take advantage of the technological competence of Millennials.

3.7.1.1.4 Generation Z

Generation Z's are usually called Gen Z. This generation consists of the youngest of the age groups who are currently entering or who have entered the workplace. This generation has never experienced the world without the internet (Chillakuri, 2020). They are always online, and they are comfortable in the online environment, whereas any other form of physical interaction or socialisation is not the norm for them (Bencsik, *et al.*, 2016). Gen Z's prefer to communicate via text messaging, instant messaging, and their mobile phones (Nicholas, 2020). Within the workplace, Gen Z's question the conventional ways of conducting work tasks and they aim to work smart (Chillakuri and Mahanandia, 2018). Being tech-savvy, Gen Z gravitates towards work that can be automated to reduce human errors and guarantee the quality of work produced (Chillakuri, 2020). This cohort prefers self-learning, being self-directed and learning independently, while leveraging technology (Chillakuri, 2020).

Generation Z possesses different talents, are action-oriented, follow trends and use the media and the internet for information (Arokiasamy and Balaraman, 2019). Millennials are hungry for a career that challenges them, is interesting, is satisfying and provides a good salary (Arokiasamy and Balaraman, 2019). As Baby Boomers and Generation X move toward retirement, preparing Millennials to take over vacant job positions in the workplace can raise concerns. These concerns include whether they are prepared, sufficiently experienced or qualified enough to take on a new role (Porter, Gerhardt, Fields and Bugenhagen, 2019). Millennials are always on the lookout for a different job or to move across departments in organisations (Gong *et al.*, 2018). Nevertheless, organisations seek to amend their present roles to meet new demands (Gong *et al.*, 2018).

Gen Z are the new entrants, and they will need to rely on and learn from the older generations, although they can provide improvements by using technology. Gen Z may value autonomy, flexibility and a work-life balance, yet they are keen to continue learning (Chillakuri, 2020). Table 3.2 illustrates the generational behavioural characteristics of the different age groups and sums up what each generation represents in terms of their views, relationships, aims, IT and values.

Table 3.2 Generational behavioural characteristics of different age groups

	BABY BOOMERS	GENERATION X	GENERATION Y	GENERATION Z
VIEW	Mutual integrated thinking	Self-centered and medium term	Egotistical/short term	No sense of commitment, be happy with what you have and live for the present
RELATIONSHIP	First and foremost, personal	Personal and virtual networks	Principally virtual network	Virtual and superficial
AIM	Solid existence	Multi-environment, secured position	Competes for leader position	Live for the present
INFORMATION TECHNOLOGY	Based on self-instruct and imperfect	Use with confidence	Part of everyday life	Intuitive
VALUES	Patience, soft skills, respect for traditions and hard work	Hard work, openness, respect for diversity curiosity, practicality	Flexibility, mobility, broad but superficial knowledge, success orientation, creativity, freedom of information takes priority	Live for the present, rapid reaction to everything, initiator, brave, rapid information access, and content search

Source: Adopted from Bencsik and Machova (2016)

Table 3.2 provides the different characteristics that each generation possesses such as their view of the world, how they see relationships, their aims, views on information technology and the values they possess. Each generation is different. They have different views and feelings towards many things in life, nevertheless each person needs to be respected and valued. Acknowledging that organisational environments are multidimensional and heterogeneous is crucial to manage the different age groups (Ingusci, 2018). In this way, a cohesive synergy can extract the best from each cohort's strengths and abilities. The alterations in politics, technology, music, cultures, historical events and economies generally define differentiations between each generation (Ohmer, Barclay and Merkel, 2018). Arora and Dhole (2019) point out that organisations need to understand generational differences. They need to learn to develop succession planning to replace the ageing workplace. The next diversity trait,

gender will be discussed further to understand how gender contributes towards the nature of diversity.

3.7.2. Gender

Over the past twenty-five years there has been a number of developments with regards to sexual and gender identities (Monro, 2020). A person's gender is how they identify internally and how they express this externally using clothing, appearances and behaviours (Zambon, 2020). Gender is socially created characteristics of women and men such as roles, standards and relationships between men and women (World Health Organisation, 2023).

There are individuals who identify themselves as a gender that society does not see them as and this creates friction in society. This has caused gender to be a sensitive subject as there are different perceptions and meanings attached to the concept. Sex and gender are used interchangeably. Even though genetic factors naturally define a person's sex, gender refers to how a person identifies themselves on the inside (Zambon, 2020). As commonly known, a person with male-typical external genitalia identifies themselves as boys or men, whereas a person with external female typical genitalia will usually identify themselves as girls or women (Hines, 2020). Sex is the development and changes of a person's body during their lifespan. This is dependent on various factors such as sex chromosomes, reproductive organs and hormones (Kumar and Allarakha, 2021; Zambon 2020).

Additionally, only an individual can determine what gender they identify with (Zambon, 2020). Some people identify as man or woman, others may identify as neither, both or somewhere in-between (Zambon, 2020). There are different types of genders that people may identify with such as: cisgender, agender, gender fluid, transgender, genderqueer, intersex, and gender nonconforming. There are many labels to describe gender and the terminology may differ. However, a person will personally identify with whichever gender they deem correct in terms of the way they feel about themselves (Vijlbrief, Saharso and Ghorashi, 2020). Table 3.3 outlines the three dimensions of gender in terms of a person's physical body, a person's identity and the social setting in which a person chooses to communicate how they see themselves. It also provides the definition of each dimension.

Table 3.3 The relationship of the dimensions of gender

DIMENSIONS	DEFINITIONS
Body	Reproductive anatomy and functions that we have been born with
Identity	Our internal experience and naming of our gender. It can correspond to or differ from the sex we were assigned to at birth
Social	How a person communicates their gender to other through clothing, hairstyles and mannerisms

Source: Adopted from Gender Spectrum (2019)

A person may be comfortable with their gender if they are comfortable with the body they have been born into. Their identity is how they portray themselves in a social setting and how they communicate through clothes, mannerisms or hairstyles (Gender Spectrum, 2019). For the purpose of this study, the researcher will identify gender as the personal sense in which persons may identify themselves as. This can range from being male, female, neither or both or whichever gender identity a person identifies with in order to be inclusive of all and non-identified genders.

The diverse workforce of the twenty-first century includes people with diverse identities, experiences, and backgrounds (Roberson, 2019). Encouraging equal opportunity and equitable employment is necessary in workplace so that individuals can advance in their careers (Joubert, 2017). Gorman and Mosseri (2019) find that the gender gap influences the hiring, promotion and earnings of employees. Men tend to be favoured over women in the workplace. Women still face bias and discrimination in relation to how they are treated at school or work. They also face bias with regard to being employed, the amount of compensation received and the way in which they are evaluated and promoted (Kang and Kaplan, 2019). The South African labour market is more favourable to men than it is to women and men are therefore participating in the labour market at a higher rate as opposed to females (Statistics South Africa, 2021).

3.7.2.1. Gender in South Africa

South Africa, a country that has the apartheid stigma attached to it, has managed to rank 17 out of 153 countries in terms of gender equality (World Economic Forum, 2020). While South Africa has progressed to turn the page on its apartheid past and propel itself forward in attaining racial liberation, women continue to endure inequality regarding employment opportunities. The gender gap in reaching equal pay remains a gaping one (Mlambo-Ngcuka, 2021). Statistics South Africa (2021) produced the Quarterly Labour Force Survey during the second quarter of 2021. The survey indicated that the South African labour market is more favourable to men than women. Furthermore, the unemployment rate among men is lower than women. Figure 3.5 depicts the differences between the first quarter of 2021 and the second quarter of 2022 in relation to the unemployment rate according to gender in South Africa.



Figure 3.5 Unemployment rate in South Africa by gender
Source: Statistics South Africa (2022)

The labour market continues to favour men and indicates no signs of making real progress concerning improving prospects towards women. Over the periods 2021 to 2022, the unemployment rate has indeed fluctuated. However, as of the second quarter of 2022 the number of unemployed women is 35.50% as opposed to 32.60% men (Statistics South Africa, 2022, p18). This indicates that there is a gap between the ratios of men being employed and females being employed in the workplace.

Furthermore, there is an under-representation of women in senior positions in organisations and it is not an isolated phenomenon (O'Connor, 2019). With women being educated and gaining knowledge, organisations should take note and aim to employ more females in senior management positions (Kim and Jeong, 2018). According to the World Economic Forum (2020) the gender gap tends to broaden at higher levels. The representation of women in higher positions should be considered in an organisation in order to prosper. Efforts should be made to employ equal numbers of men and women at the different job levels (Wiley and Monllor-Tormos, 2018).

By diminishing the gender gap, the objective would be to empower women and attain a culture where everyone has an equal opportunity to thrive. The benefits of having women in the workplace include a boost to the economy and higher productivity by removing barriers that hold women back from job opportunities (Lagarde and Ostry, 2018). Furthermore, more females are enrolled at undergraduate levels at tertiary institutions; however, there are more men at postgraduate levels (Moosa, 2017). The big problem is the type of opportunities that exist for females once they graduate (Moosa, 2017). According to Kele and Pietersen (2015), higher education institutions in South Africa are still unintentionally gender biased, regardless of the achievements that women have attained. Women are discriminated against due to their maternal responsibilities. Also, there are complaints that their management styles are more emotionally biased and less effective (Shober, 2014).

3.7.3. Education

Education and the ways in which people are educated are constantly evolving. Today, business environments have undergone immense technological changes, which have been driven by technological improvements and economic growth. Consequently, re-examining the prerequisites of employers with regard to what capabilities an employee should possess has become more vigorous and complex (Chernyak-Hai and Rabenu, 2018). There is a demand for knowledgeable workers and competent graduates (Pang, Wong, Leung and Coombes, 2019). There is a need for an understanding and knowledge of how the world operates in order to remain abreast of new undertakings (Butler-Adam, 2018). With the introduction of the Fourth Industrial Revolution,

individuals need to acquire the skills needed to implement tasks. They must adopt a new way of working in order to be successful and work with new technologies (Butler-Adam, 2018). The future workforce will continuously need to advance work skills through upskilling and reskilling themselves as they progress through their career and strive to maintain their employment (Li, 2022). Lawson and Spours (2011) argued that education encompasses key aspects as pointed out in Figure 3.6.

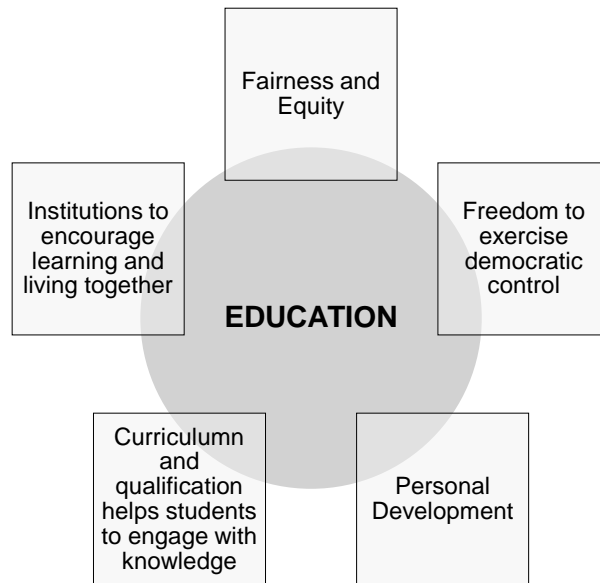


Figure 3.6 The aspects of education
Source: Adapted from Lawson and Spours (2011)

Figure 3.6 demonstrates what education is about and how it can be viewed in its entirety. Industry 4.0 allows for producing unique life-long education systems that guarantees a future-ready workforce (Li, 2022). Kohl (2022) points out that individuals are accountable for their ability to learn, unlearn and relearn in order to be productive and economically practicable members of society. People need to be able to adapt to their changing environments and they need to ensure that they possess specific competencies. Education, therefore, needs to attach certain abilities, skills and information that can co-exist with technologies including robots (Shahroom and Hussin, 2018).

The education and training of a country’s workforce will determine how well their economy will perform (Radcliffe, Boyle and Kvilhaug, 2022). In the twenty-first century, the critical skills needed are communication, problem solving, self-management,

teamwork, planning, organisational skills and life skills. This will assist individuals to adapt to changes and improve their career opportunities (Demartini, Benussi, Gatteschi and Renga, 2020). In addition to critical thinking, creativity, innovation, collaboration and information literacy will be required to keep abreast of evolving workplaces (Gravett, 2019).

Therefore, individuals need to possess these skills to engage with their workplace and advance in their careers (Foutty, 2019). Economies with skilled labour exist because of education and this leads to a more productive economy (Radcliffe, Boyle and Kvilhaug, 2022). For universities, the new technologies may impact their teaching and learning curricula going forward (Aldowah, Rehman, Ghazal and Umar, 2017). In saying that, universities are required to redesign their curricula as the world changes. This is to ensure that they deliver content that is relevant (Aldowah *et al.*, 2017). Education is required to explore new and creative ways to upgrade future learning (Shahroom and Hussin, 2018).

For basic education, the curriculum needs to be inclusive of twenty-first century skills that are incorporated into all subjects (Gravett, 2019). It will be essential for universities to consider the way programmes are structured (Haseeb, 2018). Rogerson and Rossetto (2018) mentioned the challenges to cater for a diverse society. However, diverse teams will incorporate dissimilar backgrounds, opinions and standpoints that can be used to improve curricula to be beneficial (Shemla and Wegge, 2019). Industry 4.0 are bringing about various changes in the workplace. The demands of Industry 4.0 require changes, not only to technical education but also to education in its entirety (Haseeb, 2018). People need to educate themselves be it via formal qualification or informal learning, the onus lies on a person's willingness to upskill themselves. It is important that education is at the forefront of the future workforce. Therefore, lifelong learning is being promoted as a concept (Haseeb, 2018). Education plays a central role in developing the knowledge, attitudes, values and skills that allow people to contribute to and benefit from an inclusive and sustainable future (Organisation for Economic Co-operation and Development, 2018).

3.8. Resource-based view theory

The study follows a resource-based view approach. The resource-based view theory analyses and interprets resources of the organisations to understand how organisations attain a sustainable competitive advantage (Madhani, 2010). The study focused on Industry 4.0 technologies and three diversity traits namely, age, gender and education. The impact that Industry 4.0 has on workplace diversity acts as the integration between technology and the diversity traits as to how people are impacted by the technologies. According to the resource-based view, it is essential that organisations use their resources in such a way that it builds a competitive advantage for the organisation (Sameera, 2018). The dawn of interconnected technology has resulted in globalisation. Compelling organisations to continuously innovate and find enhanced ways to thrive and survive in a more competitive environment (Assensoh-Kodua, 2019).

Ultimately, the impact that new technologies have on a modern workplace and the diversity traits are dependent on the internal competencies such as staff capabilities to adapt to these new technologies in order to develop a competitive advantage. For instance, big data, cloud computing, and the IoT have been recognised to be crucial in generating a competitive advantage (Gupta, Tan, Ee and Phang, 2018). The organisations would need to identify how the different generational cohorts and gender groups relate to Industry 4.0 technologies and how education will need to be adopted and updated to incorporate Fourth Industrial Revolution competencies and capabilities to build and maintain a competitive advantage.

Each generational cohort have inherent values that differ from the previous generation, as a result of the environment in which they may have grown up (Weeks and Schaffert, 2019). For instance, their experience shape the way in which they face issues and react to the modern workplace (e.g. continuously shifting labour markets, competitive intensity and technological and innovation advancements) (Guerrero, Amorós and Urbano, 2021). The younger generations have grown up in a digitally advancing world, whereas the older generations generally have strong experience but can be resistant to change (Guerrero *et al.*, 2021). The generational divide can hinder teamwork and communication or seize the opportunity to embrace the differences and strengths each generation brings into the workplace (Cambell-Wilson, 2020).

The values each generational cohort may have can inspire employee engagement, teamwork and support the organisational values and vision (Cambell-Wilson, 2020). Where an organisation may fall short, they would need to reorganise their internal resources and assist staff in upgrading skills or reskilling themselves, or further education (formally and informal learning). It is also important to achieve gender equality in order to be compliant with legislative and policy requirements. Therefore, organisations need to ultimately, utilise their internal resources in order to advance to new resources (technologies) being incorporated into organisations (Assensoh-Kodua, 2019). Barney (1991) had categorised three types of resources: physical resources (technological), human capital resources (training, education, experiences, a person's insights) and organisation capital resources (the formal structure and infrastructure of the organisation). These resources are integral in the functioning of an organisation in order to achieve the objectives set and to sustain a complete advantage.

3.9. Conclusion

Over the years, the workplace has transformed, and people were expected to adjust to an era where the workforce comprises of diverse groups of individuals. This chapter has covered what diversity entails and why it is important to understand diversity in the workplace. Thereafter, the researcher investigated how to manage diversity in the workplace. The opportunities and challenges regarding diversity were presented in Figures 3.2 and 3.3 of this chapter. Each opportunity and challenge of diversity were explained thereafter. The study looked at the chosen diversity traits for this study. It explained each trait individually to arrive at an understanding of each diversity trait. It did so by means of explanations, tables and figures, to allow the reader to understand the concept better. The resource-based view as the underlying theoretical foundation for the study was also discussed. The next chapter will cover the research methodology of the study and provide an outline of the chosen research methodology used for this study.

CHAPTER 4: RESEARCH METHOD

4.1 INTRODUCTION

The two previous chapters presented Industry 4.0 and workplace diversity in detail. This chapter explains the research methodology and it provides a detailed discussion of the research design, research philosophy, methodology, research population and sample, data collection strategy and analysis used in this study. Figure 4.1 is a schematic representation of Chapter 4. The aim of this study is to explore the impact of Industry 4.0 on the workplace diversity traits such as age, gender and education in the South African workplace. Furthermore, the secondary aim was to explore how Industry 4.0 technologies affect the modern workplace and to find out how age, gender and education currently find application in an automated and technological workplace. The research study, therefore, set out to address the issue of the impact of workplace diversity as a result of new technologies that change how work is being performed.

The **primary research** question of this study is:

How has the Fourth Industrial Revolution impacted the diversity traits of age, gender and education in the South African workplace?

The **secondary research** questions are:

- How do Industry 4.0 technologies affect the modern workplace?
- How do age, gender and education currently find application in an automated and technological workplace?

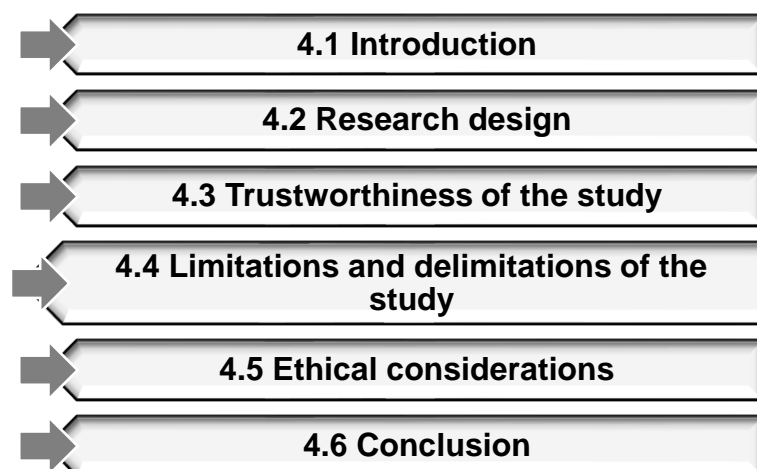


Figure 4.1 Schematic diagram of Chapter 4
Source: Authors own compilation (2020)

4.2 RESEARCH DESIGN

The research design provides the tools to assist in determining what methods are going to be used to conduct the research study (Abbott and McKinney, 2013). Creswell (2009) pointed out that the research design includes the plans and procedures for research, as well as the methods of data collection and analysis. Once the research question is determined the researcher decides which research methodology to employ (Rutberg and Bouikidis, 2018). Qualitative research looks at gaining understanding of how individuals or groups of people provide meaning to social or human problems (Creswell and Creswell, 2017). The researcher believes that a qualitative design allows for rich data gathering through in-depth probing of the occurrences of the phenomenon being studied. The qualitative design allowed the researcher to be actively involved in the data collection process.

The topic of this research, namely how workplace diversity in the form of age, gender and education affects people's ability to function in the era of the Fourth Industrial Revolution, is largely unknown. The qualitative approach allowed the researcher to probe participants with additional questions to clarify the data that were collected. Due to the small sample size, the qualitative research design allowed for knowledgeable and informative individuals to convey their opinions, feelings and viewpoints on the research topic. Quantitative research design nearly always records and verifies information in the form of numbers and typically transfers the data into computable-readable format (Neuman, 2006). The quantitative strategy has a weakness in that the strategy does not allow for a human perception, beliefs and in-depth description of a person's experience on the related research topic (Choy, 2014). Therefore, the qualitative research design is best suited for this study. Figure 4.2 depicts the outline of the research design applied in this study.

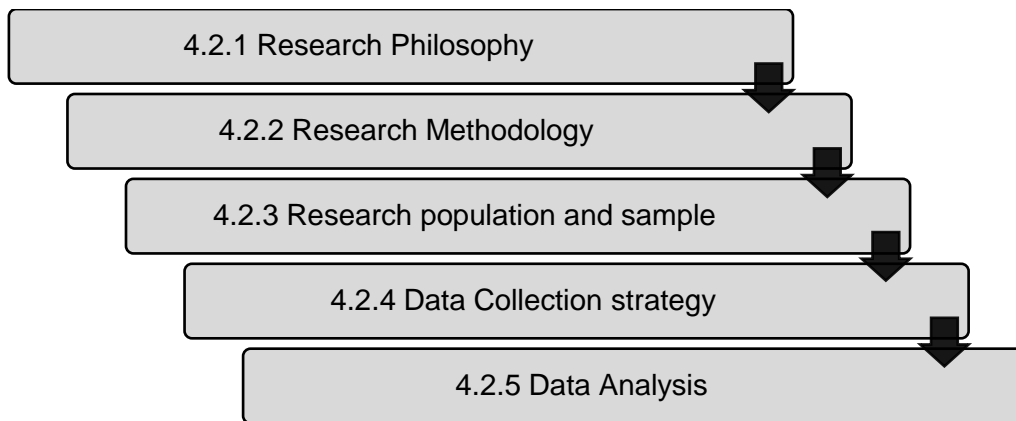


Figure 4.2 Outline of the research design
Source: Authors own compilation (2021)

4.2.1 Research philosophy

Saunders, Lewis, Thornhill and Bristow (2015) conveyed that a research philosophy affects the manner in which data are gathered, explored and confirmed. For this study the researcher has chosen the interpretivist epistemological worldview.

Table 4.1 Interpretivism research philosophy

INTERPRETIVISM			
ONTOLOGY (Nature of reality or being)	EPISTEMOLOGY (What constitutes acceptable knowledge)	AXIOLOGY (Role of values)	TYPICAL METHODS
Complex , rich	Theories and concepts too simplistic	Value-bound research	Typically inductive
Socially constructed through culture and language	Focus on narratives, stories, perceptions and interpretations	Researchers are part of what is research subjective	Small samples , in-depth investigations, qualitative methods of analysis, but a range of data can be interpreted
Multiple meanings , interpretations and realities	New understandings and worldviews as contribution	Researcher interpretations key to contribution	
Flux of processes, experiences , practices		Researcher reflexive	

Source: Adopted from Saunders, Lewis and Thornhill (2009)

Due to the exploratory nature of the study, the researcher followed the interpretivist paradigm. Table 4.1 outlines the essence that interpretivism entails. The aim of this exploratory study was to retrieve detailed responses form participants on the subject matter (O’Neil and Koekemoer, 2016). Interpretivists place emphasis on an individual’s life experiences and seek to include their participants’ interpretations in the research Saunders *et al.*, 2009). Additionally, the researcher can create a new and richer

understanding and interpretations of the research topic (Saunders *et al.*, 2009). The philosophy permitted the researcher to attain a better understanding of how the Fourth Industrial Revolution has impacted the diversity traits of age, gender and education in the South African workplace. The researcher conducted the study by providing an equal opportunity to each participant and did her best to remain neutral and unbiased while conducting the study.

4.2.2 Research methodology

An inductive-reasoning approach was undertaken. This enabled the researcher to make predictions about situations (Hayes and Heit, 2018) in terms of the existing knowledge of Industry 4.0 and how it may affect workplace diversity. Inductive reasoning follows a bottom-up approach. The researcher collected data and made inferences from the responses from the participants (Patten and Newhart, 2017). This led to the emergence of themes during the coding process while content analysis was being conducted.

For this study qualitative research methodology was applied. Mohajan (2018) expressed that qualitative research is used to explore the perceptions, feelings and experiences of people. Furthermore, the purpose of qualitative research is to explain and interpret phenomena from the point of view of the individual and generate a theme that leads to an understanding of the research topic (Mohajan, 2018). Table 4.2 provides an overview of the characteristics of qualitative and quantitative research approaches.

Table 4.2 Characteristics of qualitative and quantitative research approaches

QUESTION	QUALITATIVE	QUANTITATIVE
What is the purpose of research?	-To describe, explain, explore, interpret, and build theory	-To explain, predict, confirm, validate, and test theory
What is the nature of the research?	-Holistic, unknown variables, flexible guidelines, context bound, personal view	-Focused, known variables, pre-planned methods, detached view, established guidelines
What are the data like and how are they collected?	-Textual data -Informative -Small sample -Loosely structured and non-standardised, interviews/observations	-Numerical data -Representative large sample -Standardised instruments
How are the data analysed to determine meaning?	-Search for themes and categories -Primarily inductive reasoning	-Statistical analysis -Stress on objectivity -Primarily deductive reasoning
How are the findings communicated?	-Words, Narrative, individual quotes, personal voice, literacy	-Numbers, statistics, aggregated data, formal voice, scientific style

Source: Adopted from Leedy, Ormrod and Johnson (2014)

Table 4.2 outlines the different characteristics of qualitative and quantitative research approaches. Due to the exploratory nature of this study, the researcher aimed to understand the participants' feedback in response to the research topic. The researcher acknowledges the quantitative research approach, however as outlined in Table 4.2, the characteristics of the qualitative approach was best suited for this study.

4.2.3 Research population and sample

Under this section a detailed description of the population, sample and sampling method is outlined and discussed.

4.2.3.1 Population of the study

The target population refers to the population which the researcher intends to study (Majid, 2018). The target population included three organisations in the Gauteng province that are already using Industry 4.0 technologies in their operations. The

organisations included in this study were from different industries. The first organisation offers training workshops to address skills gaps within an organisation, the second organisation was from the automotive industry and finally, the third organisation specialises in freight logistics. The organisations were chosen purposively. The organisations had to be in Pretoria, Gauteng and all organisations selected had to be using Industry 4.0 technologies within their organisations. Furthermore, the organisations needed to be willing to participate in the study. The size of the organisation was not a requirement, and the researcher selected a small organisation (less than 50 employees) and two larger organisations to form part of the sample. All three organisations conduct work internationally. The target population comprised senior managers, middle managers and lower-level employees. However, due to the COVID-19 pandemic the population was chosen according to their accessibility and willingness to participate in this study.

4.2.3.2 Sample

Sampling is the technique used by the researcher to methodically handpick a smaller number of representative individuals from a pre-determined population to represent a data source (Sharma, 2017). The sample is the number of individuals who participate in the research study (McCombes, 2019). The sample is a subset of the population (Salkind, 2014). Sampling is the method to draw valid conclusions from the results, by carefully deciding how you will select the sample (McCombes, 2019). As it was unachievable to study the entire population, a sample is studied which is sufficient and represents the entire population (Acharya, Prakash, Saxena and Nigam, 2013). Therefore, for this master's research, only three organisations were purposively chosen to participate in the study.

Initially eighteen participants were targeted to participate in the study. However, a total number of nineteen participants were purposively selected for data to be collected. Throughout the sampling phase, one had to bear in mind to sample until data saturation was achieved. This means that no new information arose and that the feedback provided by the participants contained no new information with regard to the study phenomenon (Moser and Korstjens, 2018). There were three organisations chosen for this research study. The researcher chose to interview six participants per organisation. However, when the participants were approached the researcher opted

for people who were willing and readily available to participate given the challenges that arose during the COVID-19 pandemic. Participants were chosen according to their subject knowledge, experience, availability and their enthusiasm to participate in the study.

As each person was interviewed, information was revealed, and various insights were made available for the researcher to include into the study. Due to the nature of the study, the researcher chose the participants in accordance with the diversity traits (see Chapter 3, section 3.7). The organisations and participants were chosen according to their accessibility and willingness to participate in this study. The criteria required by the researcher were:

- **Age:** 18-65 years of age.
- **Gender:** The researcher accepted any gender that the participant identified with to alleviate any bias or prejudice.
- **Educational Background:** Participants who possess a formal educational background and participants who do not possess a formal educational background were interviewed to ensure the data collected were from both perspectives.

4.2.3.3 Sampling Method

For this study the non-probability, purposive sampling method was applied. According to Acharya *et al.* (2013), non-probability sampling is referred to as the probability that a subject that would be selected, is unknown. Non-probability sampling is inclusive of unknown probabilities (Vehovar, Toepoel and Steinmetz, 2016). Non-probability sampling assisted the researcher to subjectively select the unit that is representative of the population being studied (Etikan, Alkassim and Abubakar, 2016). Therefore, non-probability sampling is based on judgement (Sharma, 2017). A purposive sample allows for characteristics that are defined for a purpose that is appropriate to the study (Andrade, 2021). The researcher made the decision of whom to include in the study and the respondents made the decision themselves to participate in the study (Link, 2018). Sharma (2017) mentioned that purposive sampling depends on the judgement of the researcher when it comes to the selection of the people, organisations and pieces of data that are to be studied. Table 4.3 provides the advantages and disadvantages of purposive sampling:

Table 4.3 The advantages and disadvantages of purposive sampling

ADVANTAGES	DISADVANTAGES
Provides the researcher the justification to make generalisations from the sample being studied	Possibility of researcher bias
Provides a wide variety of non-probability sampling techniques for the researcher to draw conclusions	May be difficult to convince the reader that the judgement of selecting the units was applicable

Source: Sharma (2017)

Purposive sampling allows the researcher the justification to make generalisations from the sample and provides a variety of non-probability sampling techniques for the researcher to draw conclusions. However, the disadvantages may mean there is a possibility of the researcher being bias. The researcher strived to have the specific diversity traits of the research to form part of the sample (Vehovar *et al.*, 2016). Therefore, the researcher deliberately and purposefully selected the sample that she believed was the most effective in answering the research question. This was in order to generate rich data, which contributed to the study phenomenon (Farrugia, 2019).

4.2.4 Data collection strategy

Data collection is the procedure of gathering and evaluating information on the research topic by instituting questions and analysing the outcomes (Kabir, 2016). Salkind (2014) expressed that primary sources are original reports of the original work, whereas secondary sources are acquired information that was previously used in another original research. For this study, the researcher collected secondary data by conducting an extensive review of desktop and physical literature. For primary data collection, the researcher chose to conduct in-depth semi-structured interviews and opted for observations of the participants during the interviews. The purpose was to triangulate and obtain descriptions of the meanings of central themes from the participants' work and personal lives (Moser and Korstjens, 2018).

To collect primary data, the researcher relied on asking questions as this is a type of qualitative research. Interviews encompass interactions between the interviewer and the participants that took place as a result of the interview questions (Moser and Korstjens, 2018). Interviews can take place in various forms; they can be structured, unstructured or semi-structured (Kumar, 2011).

The researcher opted for semi-structured interviews. The interviewer phrased the interview questions that were open-ended, leaving the participant free to respond in any way (Magnusson and Marecek, 2015). An interview schedule {Addendum D} was designed, using a list of open-ended questions in order to aid in the data-collection process, resulting in an in-depth interview. The interview schedule and questioning approach included open-ended questions and probes (Moser and Korstjens, 2018). Open-ended questions allowed the interviewee to go into detail when answering the interview questions (Salkind, 2014). This allowed the interviewee to provide their personal understanding and respond to the questions as they saw fit. Kumar (2018) and Bryman (2016) pointed out some advantages of choosing open-ended questions:

- It provides in-depth information.
- Participants answer the questions on their own terms.
- Participants express themselves freely, eliminating biasness from the researcher.
- Allows for unusual responses, useful for exploring the limited research topic.
- Participants' levels of knowledge and understanding of the research topic can be recorded.

With the above-mentioned in mind, the researcher designed the interview schedule {Addendum D} accordingly. During the semi-structured interviews, the researcher probed participants further with regard to their responses to the interview questions. This allowed the researcher to obtain rich descriptions from their feedback. In Figure 4.3 the researcher illustrated the choices made to conduct semi-structured interviews for this research study.

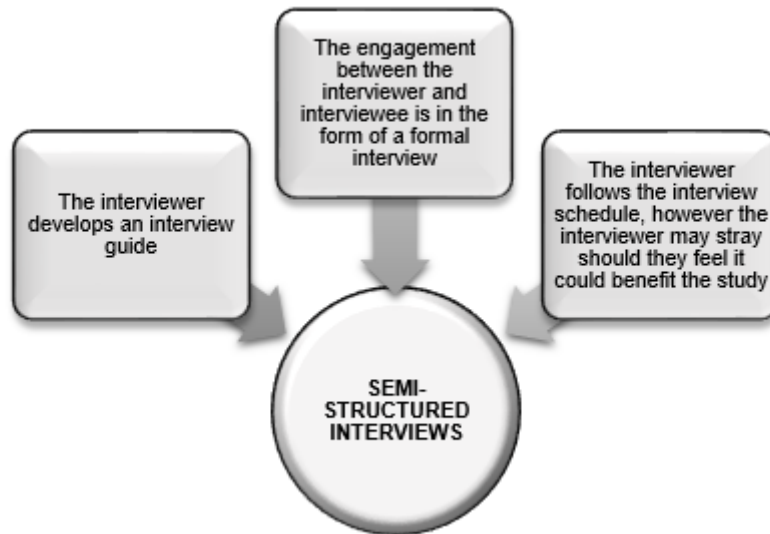


Figure 4.3 Semi-structured interview characteristics
Source: Adopted from Kabir (2016)

Figure 4.3 alludes to semi-structured interviews where the interviewer develops an interview guide, and the engagement between the interviewer and interviewee is conducted in the form of a formal interview. Also, the drawn-up interview schedule is followed. However, the interviewer may stray from the questions should it be beneficial to the study. The researcher initially opted to conduct face-to-face interviews and physical observations. Due to the COVID-19 pandemic, there were several policies and procedures that were imposed during lockdown stages in South Africa, and everyone had to follow these. The pandemic hampered the study in terms of accessibility to participants and change had to be made to the face-to-face interviews that were to be conducted.

Data collection via semi-structured interviews and observations were further complicated by the restrictions of social distancing and prioritising the safety of the participants and researcher (Roberts, Pavlakis and Richards, 2021). The researcher adhered to all policies and procedures during the pandemic. The researcher was allowed to conduct face-to-face interviews with one organisation when lockdown restrictions eased for a short while, and in-person observations of the participants could take place. The researcher ensured at all times that social distancing, the wearing of a mask, sanitising hands and temperature checks were conducted to protect the researcher, the participants and the organisation and their employees.

Virtual interviews and observations via the Microsoft Teams platform were conducted with regard to the other two organisations. The researcher observed the participant virtually in terms of tone of voice, change of voice patterns, the feelings conveyed and how the participant came across. The researcher emailed each participant the information sheet {Addendum C} and consent form before an interview took place. Once signed consent was received from each participant, the researcher emailed the interview schedule to allow the participants to familiarise themselves with the content before the interview could take place. A convenient time was scheduled for the interview to ensure that the participant was available for the interview. The researcher audio recorded all the interviews to guarantee the trustworthiness and accuracy of the data gathered. The semi-structured in-depth interviews were the primary source of data collection. Furthermore, the researcher initially planned for eighteen participants. However, nineteen participants participated in the study in order to achieve data saturation.

4.2.5 Data analysis

Figure 4.4 provides a schematic representation of the data analysis for this study.

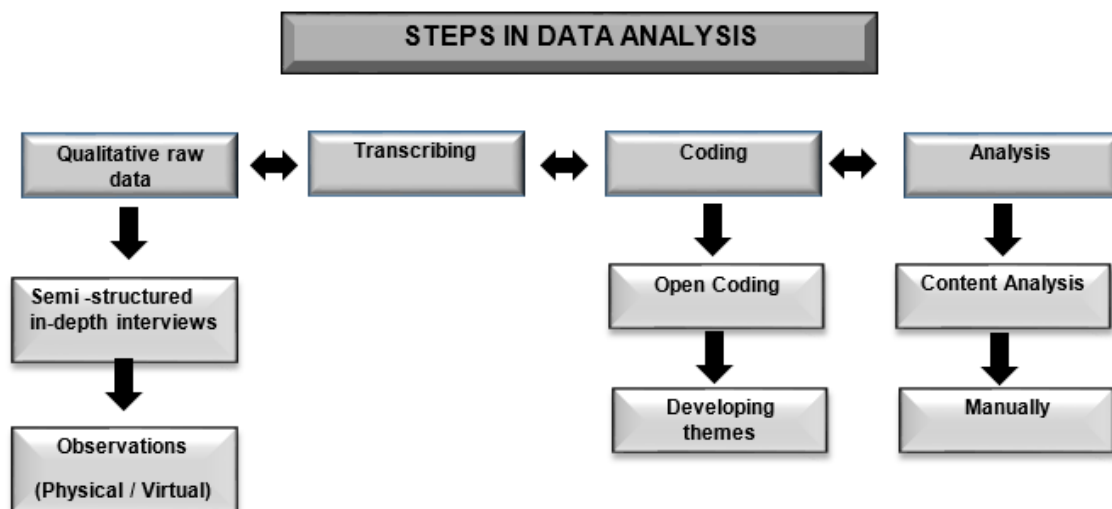


Figure 4.4 Steps in data processing
 Source: Authors own compilation (2020)

Figure 4.4 provides an illustration of the steps that the researcher followed in the data analysis process. Data analysis consists of working through the data that have been

collected to make meaning of and identify themes (Gibbs, 2018). For this study, the qualitative data were collected in the form of in-depth interviews which were conducted. Observations were performed physically (with face-to-face interviews) and virtually (via Microsoft Teams) with the participants. The collection of the data allowed the researcher to attain feedback from the participants in the form of verbal communication (Gibbs, 2018).

Once the interviews were conducted, the audio was transcribed, and transcripts were created. The researcher then conducted content analysis and coded the interviews before member checking could be done. The researcher went through the audio recording and transcripts several times and ensured that the feedback from all participants was incorporated. Once the data were transcribed, coded, and reviewed thoroughly, content analysis was employed to analyse the data. Content analysis is the research technique creating replicable and valid inferences from texts to the context of their use (Krippendorff, 2018). Each transcript was analysed manually where codes and themes were identified from the data. It contributed to the findings of this study through a process of open coding. Open coding allows the researcher to identify distinctive concepts and themes for categorisation (Williams and Moser, 2019). Once the researcher had coded the documents and themes were created, the researcher sent through the transcripts and the coded document to be member checked. This was in order to ensure the trustworthiness of the data.

Bengtsson (2016) suggested stages in data analysis, which the researcher chose to use. The researcher familiarised herself with these stages and applied it when analysing the data. The stages of decontextualisation, recontextualisation, categorisation and compilation as identified by Bengtsson (2016) will be discussed further.

Stage 1: Decontextualisation

The process of decontextualisation involves familiarising oneself with the data which have been provided by the transcribed text. The purpose is to gain a sense of what is going on before the data can be broken down further. In this research it was employed through the collection of data, transcribing the audio into transcribed text and then making sense of the transcribed data.

Stage 2: Recontextualisation

A process that combines texts, signs or content from its original context. The research is recontextualised by the researcher when she familiarises herself with the raw data, the transcripts are read and re-read and the audio is listened to while reading the transcripts. This is to ensure that no responses are missed and that the audio recording matched the transcript. The researcher identified the themes that emerged from the data that were relevant and applicable to achieve the objectives of the study.

Stage 3: Categorisation

Categorisation is a leading element of qualitative data analysis by which investigators endeavour to code group patterns observed in the data into meaningful units or categories. Categorisation was employed in the study through identifying and categorising themes, and by using the process of content analysis. Furthermore, the researcher ensured that the data, which were sub-divided into categories and the themes identified, assisted in reaching the objectives of the study and ensuring that reasonable explanations had been given (Bengtsson, 2016).

Stage 4: Compilation

Data compilation involves the collection of raw data and its modification into a format that can be easily manipulated or combined with other data in preparation for further analysis. In the final stage, once the themes were established, the analysis and the writing up of the findings began. The researcher needed to understand the feedback from each participant in order to analyse the data and write up information according to the themes that were identified. The researcher conducted a manual analysis to ensure that the codes assigned were done correctly and that no data were discarded. The coded themes and transcriptions were sent to the participants for them to check and confirm. This also provided them with an opportunity for participants to correct any misrepresentations that may have arisen during the analysis process.

Thus, the data collected were audio recorded, transcribed, categorised, coded, and rechecked. The purpose was to see if the correlated data were a true reflection of the interview data and aligned to the aim of this research study. The analysis of the data

permitted the researcher to interpret the data, make inferences and comprehend the research problem better.

4.3 TRUSTWORTHINESS OF THE STUDY

Nowell, Norris, White and Moules (2017) mentioned that qualitative research is a valued paradigm which requires rigorous methods to create a valuable result. Trustworthiness is a way to persuade the researcher and readers that the findings of research study deserve recognition (Lincoln and Guba, 1985). Furthermore, Lincoln and Guba (1985) expounded the concept of trustworthiness by introducing the criteria of credibility, transferability, dependability and confirmability in qualitative research. In quantitative research it is referred to as validity and reliability.

Kumar (2018) views bias as a deliberate attempt to disguise information found in the research study or to deliberately use a method knowing that it is incorrect. According to Bryman (2016), bias refers to the obtrusion of judgements in a decision, leading to the misrepresentation of the research. The interviews were audio recorded which allowed for an unbiased record of the feedback from each participant, thereby increasing the trustworthiness of the data collected. The researcher ensured that she remained neutral and non-judgmental during the interviews and considered the data from a neutral perspective (Bengtsson, 2016).

The data were collected personally by the researcher to confirm the relevancy to the study and to ensure that the participants answered without being influenced. In addition, the researcher ensured that once an interview was completed, the data were immediately transcribed and coded. The researcher allowed the participants to review the transcripts and the coded document as part of the member-checking process to further ensure the trustworthiness of the data. This led to the elimination of misrepresentations that could have occurred during the interview, thereby ensuring that the data collected were trustworthy. The observations during the interviews were used to triangulate the data. There are key criteria for evaluating the trustworthiness of qualitative data namely credibility, transferability and dependability. These criteria will now be discussed further.

4.3.1 Credibility

Credibility reflects the authenticity of the data (Lincoln and Guba, 1985). The research findings need to be plausible and trustworthy (Stenfors, Kajamaa and Bennett, 2020). The findings of the study should share some relationship with one another, and credibility can be promoted through triangulation (Stahl and King, 2020). Therefore, the researcher used different secondary resources such as scholarly articles, books, online posts, videos and reports. This was to further validate that the researcher did an extensive review of the research topic.

The next step was to complete the interviews, then link it with the literature and identify the findings of the research study. Member checking was conducted where each participant was emailed their transcript and coded document to verify that the researcher captured the essence of their responses. The purpose was to enhance the credibility further (Stenfors *et al.*, 2020). Furthermore, the researcher initially planned for eighteen participants. However, nineteen participants participated in the study in order to achieve data saturation.

4.3.2 Transferability

Transferability refers to whether the findings of the study are applicable to other contexts, groups or settings (Amankwaa, 2016; Stenfors *et al.*, 2020). Transferability allows for a detailed description of the context in which the research was performed and how this shaped the findings (Stenfors *et al.*, 2020). Transferability is possible when a thick description provides a rich enough portrayal of circumstances for application to other situations (Stahl and King, 2020). Lincoln and Guba (1985) alluded to thick descriptive data to establish a narrative about the context. This is so that others who wish to apply all or part of the findings elsewhere can make judgements to fit their context. The study used in-depth interviews, which allowed for the personal opinions and views of each individual. The sample size was relatively small and therefore does not represent the entire population. However, certain aspects that were highlighted by the study may be transferrable.

4.3.3 Dependability

Dependability conveys that the findings are consistent and can be replicated (Lincoln and Guba, 1985; Stenfors *et al.*, 2020). The researcher was responsible for the analysis of the data in order to identify the findings of the study (Haven and Van Grootel, 2019). The researcher ensured that once the data were collected, the audio recordings were immediately transcribed and coded, thereby preventing any misconceptions or misinterpretations. Once transcribed, the transcripts were checked in accordance with the audio recording. This was to ensure further dependability of the data coded. All participants' feedback was captured and was forwarded to each participant part of the member-checking process. Observational notes were made during all interviews. Furthermore, for the virtual interviews the researcher listened back to the recordings to ensure that nothing was missed and that everything was observed when the virtual interview took place. This was conducted by listening to the tone of voice, the voice patterns, the pitch and documenting any further observations that could have been noted.

The researcher conducted a continuous desktop review of secondary literature sources throughout the study. Triangulation took place where several sources of information were used to repeatedly establish identifiable patterns (Stahl and King, 2020). This led to a deeper understanding of the research topic (Pandey and Patnaik, 2014). For this study the researcher triangulated data via primary interview data, secondary literature data and observations during both physical and virtual interviews. To demonstrate that this study is the original work of the researcher, the Turnitin system was employed. Turnitin is an internet-based teaching tool which is used to check the authenticity of documents by comparing texts in monumental databases (Turnitin, 2020). The manuscript was submitted to Turnitin to ensure that all sources have been accurately used and acknowledged to enhance the authenticity of the dissertation.

4.4 LIMITATIONS AND DELIMITATIONS OF THE STUDY

The limitations of the study are its weaknesses. These limitations and delimitations exist due to constraints such as research design, methodology and unforeseen circumstances. Such limitations and delimitations impact the findings of the study. In this study the researcher acknowledges that there are many other organisations as

well as diversity traits that could have been used in this study. However, only the mentioned aspects were considered due to time and cost constraints. The limiting factors of the study were that there were only three organisations who participated in this study and they were located in the Gauteng province. There are only three diversity traits which have been chosen by the researcher in order to complete the study, and these are age, gender and education. The sample of the study was initially eighteen participants per organisation. However, the researcher interviewed nineteen participants. The small sample will have the implication that the study may not be transferable to the larger population. Furthermore, the COVID-19 pandemic forced the researcher to abide and adjust the study as per government, university and the organisational policies and procedures. The study had some limitations and delimitations that the researcher acknowledged in Section 1.4. and expands further on this in Section 7.6.

4.5 ETHICAL CONSIDERATIONS

Bryman (2016) believed ethics to be the study of morals and moral behaviour, whereas the ethical code is the set of morals that a researcher is obliged to follow. All professions are guided by a code of ethics that has evolved over the years to accommodate the changing ethos, values, needs and expectations of those who hold a stake in the professions (Kumar, 2018). Iphofen and Tolich (2018) mentioned that research should be conducted with honesty and integrity. The current study was conducted with the above-mentioned considerations in mind.

The participants' interest was protected and informed consent {Addendum C} was obtained from each participant. The researcher acted honestly and complied with the rules when conducting the research (Denscombe, 2010). Permission was obtained from the ethics committee of the University of South Africa to conduct the study. An ethical clearance certificate {Addendum A} was granted to the researcher. Once ethical clearance was issued the researcher contacted each organisation. The researcher sourced the preliminary permission letter from each respective organisation and a gatekeeper was identified for each organisation. The letter outlined the details, requirements and information of the study and detailed information was given of what was expected from the researcher to complete the interview. The

gatekeeper from each organisation assisted the researcher to identify individual participants who had to individually consent to participating in the study.

The participants were informed about the study via email with an information sheet and a consent form {Addendum C}. The information sheet informed each participant about the details of the study and, once they accepted, the consent form was signed and returned to the researcher. The informed-consent letter indicated that a person might withdraw if he/she/other needed to. The researcher informed each participant that all communication and participation in the study were completely anonymous. The participants were assured by the researcher that their participation in the study is completely anonymous, and it is ensured that pseudonyms will be allocated to help enclose their identities. The researcher ensured that no identifying information of the participants were available in any of the information given in the analysis chapter. The researcher ensured at all times that the best interest of the participants was always considered and therefore the researcher made all her personal details available to each participant.

Finally, all the data collected were stored under password-protected files to ensure the safety of the data. All hard copies were kept in files in locked cabinets that only the researcher can access. As per UNISA's policies and procedures, all data must be kept for five years and thereafter destroyed. The researcher will ensure that all hard copies are shredded and all password-protected files that are stored in the cloud are deleted after five years. The researcher also confirms that none of the participants were compensated in any form. In addition, the researcher ensured all participants' data collected were only used for academic purposes to expand new knowledge and insights into Industry 4.0 and workplace diversity.

4.6 CONCLUSION

Chapter 4 presented an in-depth research philosophy. The research methodology, research population and sample were explained. Thereafter, the data collection methods were explained, and Figure 4.4 provided a schematic representation of the data analysis of this research study. The trustworthiness of the study was described in detail in terms of the credibility, transferability and dependability of the study. The researcher outlined the limitations and delimitations of the study. Finally, the ethical

considerations taken into account to carry out the study were explained. This concluded the chapter. In the next chapter, the data collected will be presented.

CHAPTER 5: PRESENTATION OF DATA

5.1 INTRODUCTION

In this chapter the data collected for the study are presented. The researcher analysed the data and conducted content analysis of the feedback received from the nineteen participants. The interview data have been arranged according to the coded themes and sub-themes that were identified from the primary data that were collected. The researcher adhered to ethical procedures through the protection of all the participants' information by allocating pseudonyms to the participants and; removing any identifying information as indicated in Chapters 1 and 4 of this study.

The chapter firstly outlines how the concept of Industry 4.0 was understood by each participant. The participants spanned across various levels of the organisations. Thereafter, the chapter focuses on workplace diversity, specifically the diversity traits of age, gender and education. The diversity traits are presented individually. Then the conclusion of the chapter is given, summarising what the chapter entailed. Figure 5.1 presents a schematic diagram of the layout of Chapter 5 and the sections thereof.

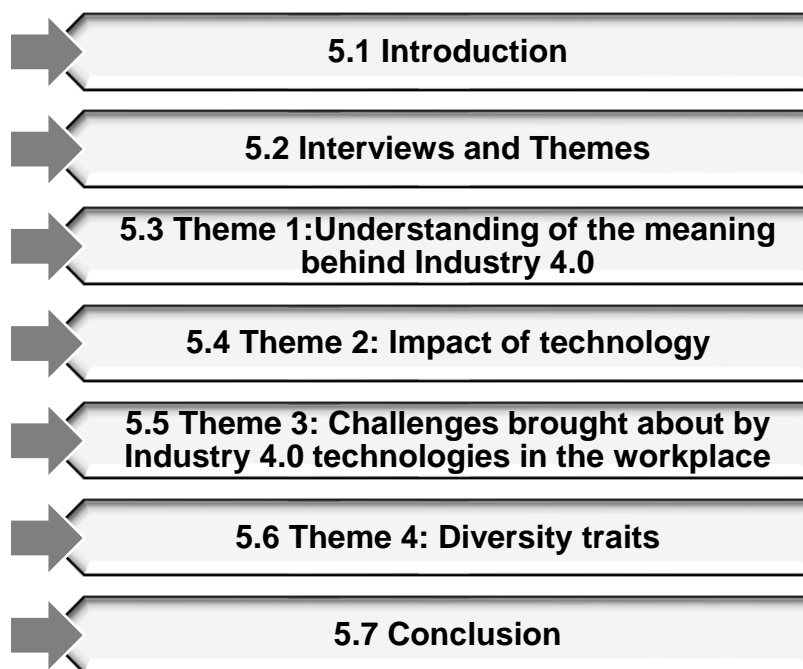


Figure 5.1 Schematic diagram of Chapter 5
Source: Authors own compilation (2022)

5.2 INTERVIEWS AND THEMES

The researcher initially opted for face-to-face semi-structured interviews to be conducted with each participant. However, due to the COVID-19 pandemic, face-to-face interviews were restricted as a result of lockdown policies and procedures that were imposed by the South African government. Face-to-face interviews were conducted with one organisation, and all Covid-19 protocols were observed to protect the participants, the organisation and the researcher. The protocols included: sanitising before entering the premises; conducting temperature checks; wearing a mask at all times; adhering to social distancing; sanitising of hands during the interview and when leaving the organisation and sanitising the desk the researcher occupied and the stationery used to limit the potential transmission of the virus. In this way the researcher, the participants and the organisation were protected. Online interviews were conducted for the other two organisations via the Microsoft Teams platform.

The interviews were audio recorded and transcribed verbatim. Thereafter the researcher listened to each audio and rechecked the transcripts to ensure that the transcribed data corresponded to the recorded audio. The data were then analysed, using content analysis. The researcher read the transcripts, familiarised herself with the data and completed coding by means of identifying themes. An inductive approach was used for the coding process to develop codes which emerged from the raw data. This allowed the researcher to explore the research topic further. Common themes were identified, and the main themes and sub-themes were distinguished. The transcripts and the coded documents were sent to each participant to verify that the correct interpretations were applied to what was said during the interview through a process known as member checking. By returning the transcribed interviews and the analysed data to each participant the researcher further ensured the credibility of the data (Brit, Scott, Cavers, Campbell and Walter, 2016). This is because each participant was allowed the opportunity to correct any misinterpretations that the researcher might have made.

The researcher triangulated the data by means of interviews, desktop analysis of secondary sources and observations made during the interview. The researcher physically observed participants from one organisation. The two remaining

organisations opted for interviews to be conducted via Microsoft Teams, where each participant was also observed virtually.

Four main themes emerged from the data. The first theme was understanding of the meaning behind Industry 4.0. The second theme was the impact of technology and consisted of two sub-themes: (1) the impact on staff and (2) the impact on the workplace. The third theme was the challenges brought about by Industry 4.0 technologies in the workplace, consisting of two sub-themes: (1) the financial cost of implementing Industry 4.0 technologies in the workplace, and (2) the shortage of skilled employees who work with Industry 4.0 technologies. The fourth theme incorporated the diversity traits of age, gender and education. Education was divided into two sub-themes: categories of: formal education and informal learning. These themes are presented to explain the primary data that were collected. The noted observations, conducted during the interviews, are presented in a box throughout the chapter. This is to ensure that there is a differentiation between the participants feedback and the observational notes taken by the researcher, allowing the reader to easily identify each.

5.3 THEME 1: UNDERSTANDING OF THE MEANING BEHIND INDUSTRY 4.0

Industry 4.0 has been described as the revolutionary change that occurs when Information and Communication Technology (ICT) rapidly expands into all industries and is based on the recent diverse technologies (Lee *et al.*, 2018). Industry 4.0 allows hardware, software and people to interact in order to execute tasks proficiently (Baldassari and Roux, 2017). For example, smart factories, smart networks and smart products have been incorporated into the creation of future smart infrastructures and manufacturing capabilities. This has reduced the processing time, optimised productivity, assisted with the active allocation of resources and allowed for individual customisation and increased flexibility (Mohamed, 2018).

The researcher followed the interview schedule with regard to all the participants and began by probing each individual understanding of Industry 4.0. The researcher gave each participant an opportunity to express their own understanding of Industry 4.0 as

well as how they perceived the impact of incorporating the technology into their work environments.

Each participant was given the opportunity to express their personal understanding of Industry 4.0. However, some believe that Industry 4.0 is still in its infancy and that it is a conceptual state which intends to incorporate many dynamic technological concepts (Yang and Gu, 2021). Seventeen out of the nineteen participants gave their personal understanding of Industry 4.0, and the consensus observed was that the Fourth Industrial Revolution is technologically driven.

Technologies they use in the working environment to make things easier for us, it's very technological oriented. – Participant G

It's about technology in the workplace. – Participant B

The Fourth Industrial Revolution is connected to technologies. There were other participants who mentioned that Industry 4.0 aid the way in which work is performed and how business is conducted. There were a few participants who mentioned that using technology assist them in their work activities within their organisation. According to them this makes the delivery of work tasks easier and improves the way in which tasks are completed.

It's a smart way of [...] doing things [...] interacting with our equipment [...] remotely [...] we also be able to obtain [...] much more data [...] quicker [...] and integration of [...] systems [...] making it easier for use to work. – Participant O

Using technology [...] in the workspace to improve [...] the time how we deliver work. – Participant P

Embracing new technologies including things like Internet of Things uh using the cloud and [...] to compute and analyse and also artificial intelligence and machine learning in production facilities as well as things like ERP and our supply chain and customer service [...] it will be increased [...] automation and also help us to optimise our processes. – Participant S

The interconnectivity between [...] previously disjointed fields [...] science, 3D printing, nanotechnology [...] Industry 4.0 is where these become [...] one [...] and [...] the organisation or our lives become a lot more [...] digitised and new technology that's in the workspace allows us to improve the way in which we work. – Participant N

The Fourth Industrial Revolution will alter the way in which people live and work, how the economy works and the way in which people are governed (Nwaohiri and Nwosu, 2021). The following participants shed some light on Industry 4.0 and understood the

term as being related to making work easier. Other participants looked at Industry 4.0 from an industry perspective and the role that a human would play in this revolution.

Ongoing automation [...] changing over the years [...] using modern smart technology [...] machine- to-machine communication [...] Internet of Things uh also to increase automation [...] improve communication and also monitoring and evaluation and production of smart machines to basically diagnose issues [...] without the need of human intervention [...] because we don't want to replace human beings [...] from a Fourth Industrial Revolution is basically to automate uh traditional manufacturing and industrial practices [...] to more robust thinking. – Participant J

The use of smart technology [...] for the purpose of automating manufacturing processes [...] the end goal is to improve communication between systems and allow your production line to sort of self-analyse problems without the need for human intervention [...] its where your smart manufacturing line can identify problems challenges, blockages, bottlenecks without [...] the need for a human to do so [...] like a self-diagnosis. – Participant L

One participant mentioned that there is not sufficient awareness created about what Industry 4.0 entails. The participant believed that people only became aware of Industry 4.0 when they are working with the technology or when they read about it. Others generally have heard the terminology but are unable to make the connection of what Industry 4.0 means within their own environments.

Most people are not aware of Industry 4.0 [...] there's a lot of hype around it [...] you read a lot about it [...] to see how many people know exactly what it's all about its normal people [...] everyday people but also businesses what you know what is it about and how can it work for them and how can it impact them [...] there's not a lot of that around [...] so people that are actually only [...] aware of it are people like us can go onto the internet and read about it or [...] see what's happening other than that there's a whole group of people that don't know uhm what it's about unless you in that space you know [...] working with it. – Participant K

There is a sense that not all people are aware of Industry 4.0 era. This was confirmed by two participants. Participant K revealed that 'most people are not aware of Industry 4.0'. This was also stated by two other participants. The researcher further provided an observation of Participant A and Participant D.

I have no idea what that is [...] I didn't know it was termed as that [...] terminology [...] Industry 4.0. – Participant A

If I can be honest this is the first time that I hear [...] of it Industry 4.0. – Participant D

The researcher conducted a face-to-face interview with Participant A and conducted a virtual interview via Microsoft Teams with Participant D. In doing so, the researcher observed the two participants via two different settings, one being physical and the other virtual. However, the researcher observed the two participants and made notes during the interview to substantiate the participants' feedback above with regard to not knowing about Industry 4.0. The observations from the researcher are:

Observation of Participant A: Participant A expressed via the use of body, language from slowly shaking of the head from side to side, pursed lips and the facial expression of being unaware of what the researcher is talking about. The use of the body and facial gestures suggested that Participant A was unaware of what Industry 4.0 is or what it entails. Once the researcher explained what Industry 4.0 entails, Participant A laughed, as a sign of knowing of the technologies used but not the term associated with the newer technologies. The participant further conveyed the emotion (facial expression of a smile and nod of the head) and words of "feeling stupid" of not knowing what Industry 4.0 is.

Observation of Participant D: Participant D response to not knowing of what Industry 4.0 is came across as unsure. This was conveyed in the tone of voice and slight pause as there was an emphasis on the word 'first' time that Participant D heard of Industry 4.0, as the tone of voice increased on this particular word. The participant began their sentence with: 'If I'm going to be honest' this indicated to the researcher via the participants tone that they were sincere in not knowing about the topic. Once the researcher explained the industrial revolutions and what 4IR is and the participant responded "Great, sho at least now I know", this was said in a relieved tone as there was emphasis placed on the sentence.

As the conversation progressed, Participant A and D learnt that the technology they worked with formed part of what is associated with the Fourth Industrial Revolution, but they did not understand that. There is no single and clear standard for Industry 4.0, as each country is executing its own version of Industry 4.0 (Yang and Gu, 2021). For instance, China, the USA and Europe are incorporating smart manufacturing and smart production in a move towards digitisation and the automation of ICT in the manufacturing sector. This is because Industry 4.0 enables more efficient use of resources and cost optimisation (Oesterreich and Teuteberg, 2016; Ortt, Stolwijk and Punter, 2020). The data generally indicate that the participants had an idea of what Industry 4.0 entails. Some participants had a high-level understanding, but for the most participants gave pertinent explanations that were relatable to Industry 4.0.

Organisations are lacking the know-how with regard to the concept of Industry 4.0 in relation to their field of business (Sony and Naik, 2019). To further complicate the

matter, there is no a general model for determining the readiness of the organisation with regard to Industry 4.0 (Sony and Naik, 2019). With this statement in mind, three participants indicated shortcomings in terms of understanding what the Fourth Industrial Revolution really is. The evidence is shown in the excerpts extracted from the data collected. The participants expressed their opinion in the following way:

Nobody understands 4IR or how to implement it; they read about in school [...] what's it called block chain, but they don't understand what the hell it is [...] or the application. – Participant E

I think there is a lack of understanding on this particular topic [...] if we looking at it from a South African context [...] we are not ready for yes there is a lack of knowledge and there is a lack of infrastructure on the previous industry revolutions if we look at think like robotics and stuff in South Africa many factories do not even have a robot in their company [...] and now we talking about using artificial in information so we actually trying to skip Industry 3.0 and go into Industry 4.0 [...] I totally understand why we do it we are capitalising on the resources of our own country [...] I'm not saying that Industry 4.0 is uhm something bad I'm just saying that we need to advance a little bit further before we jump into Industry 4.0. – Participant S

Its about how you convey the information how you entice people [...] if people understand it better [...] with 4.0 [...] the idea is actually not really to make it easier for people [...] its more getting the information from people to computers to [...] AI and that's what I don't like so much maybe I'm not a very good candidate for that [...] there needs to be a relative level basic level of infrastructure technological advancement or somebody to be able to latch on to that. – Participant R

The biggest hurdle currently with Industry 4.0 is there a lot of uh a lot of things are quite obscure still [...] a big learning of Industry 4.0 here is that something complex has to become tangible [...] to even the least technically capable. – Participant I

Participant E alludes to an example of 4IR technology, but people don't understand what it is or how it is applied. The point that Participant E makes is that we may know about something but not necessarily understand how to use it, which clearly points to a training gap. Participant I further mentioned that the problem with Industry 4.0 is that a lot of things are unclear. This is because it requires new skills, resulting in new types of jobs. Industry 4.0 moves towards creating new concepts, business models and synergy (Ortt, Stolwijk and Punter, 2020).

Things need to be easily understood and adapted within the workplace and within our personal lives. Finally, Participant K shared a similar perspective to Participant I, with regard to understanding technology.

In terms of 4IR there will be capacity issues in terms of uhm depending on what technology you bring into your business [...] you need people to understand that technology [...] they will have to be trained on that [...] where the capacity constraint is that people don't know what's out there [...] that can be used within an organisation you know unless you a you a IT- savvy person and you always checking the internet [...] depending on what tech is brought into the workplace, people need to be trained in order to be efficient [...] people also need to be educated further on what is out there to be offered . – Participant K

Creating awareness about Industry 4.0 can be achieved through various sources, such as videos, articles or any other sources of information. This can aid the organisation and its staff to learn about and interact with the new technologies. Larger companies have relatively more of the financial or non-financial resources required to implement Industry 4.0 technologies compared to small or medium-sized companies (Sarı, Güleş and Yiğitöl, 2020). With this sentiment in mind, the researcher learnt from the participants that the financial cost of implementing Industry 4.0 technologies in the workplace is a constraint (further discussed in Section 5.5).

5.4 THEME 2: IMPACT OF TECHNOLOGY

The impact that new technology has on people's jobs and working lives must be considered. This is because the impact will increase even further when the role of technology becomes more important in the modern work environment (Houghton and Baczor, 2020). Developments in technology have not only altered the jobs available to us, but also transformed the nature of work performed (Johnson *et al.*, 2020). Therefore, understanding the impact of technology on the staff and the workplace should be taken into consideration.

Having described what Industry 4.0 entails, each participants understanding varied. The question of which technologies were used in their workplace was posed and the participants provided the technologies that their organisation used in or order to conduct daily tasks. From the feedback, it was noted that some of the technologies used in the three organisations were: augmented reality; virtual reality; cloud-based services; communication platforms (Microsoft Teams and Microsoft Outlook); machine

learning; informed decision-making systems; AI; autonomous drones; Radio Frequency Identification (RFID) tags; smart manufacturing; smart metering; automated air-conditioning systems; supervisory control, and; data acquisition systems, to name just a few. Some of the technologies mentioned appear in Chapter 2, Section 2.4 of this study. The responses as to what impact these new technologies have on the staff and the workplace, allowed the researcher to group the various responses into two sections. This theme has therefore been divided in to two sub-themes namely: (1) the impact that technology has on the staff and (2) the impact that technology has on the workplace.

5.4.1 The impact that technology has on the staff

Industry 4.0 adopts the notion that there are differences between the work of people and the work of machines (Ślusarczyk, 2018). Technology will bring about transformation for employees, organisations and society as work and the meaning of work are changing (Ross and Maynard, 2021). Employees, organisations and people will need to reimagine what the new ways of working might look like and how it will fit in with innovative workplace design and concepts. This is important while balancing the efficiencies of the technological innovation with new jobs (Ross and Maynard, 2021). The researcher posed the question of describing how Industry 4.0 technologies used in the workplace impact staff. The following feedback was received from the participants:

It modernises us [...] helps us work more effectively. – Participant G

Adaptation [...] has been [...] different for everyone [...] at the end of the day everyone manages to adapt [...] we get used to the new way and [...] we still in that space of trying to improve [...] and adapt as quick as possible [...] the workplace [...] has actually pushed us [...] to even try more technology or [...] things we didn't deem as necessary before. – Participant P

They have allowed for the upskilling of staff to integrate and use these technologies on a daily basis [...] allow companies to achieve new levels of efficiency, which creates the opportunity for growth, and thus employment and localisation. – Participant M

I've learned to be much faster. – Participant H

Participants G, P, M and H provided their insights as to the impact that technology has on staff. From the feedback, it was easy to determine that there were positives such as that technologies modernise people and allow people to adapt better while working

with technology. Also, people adapt to the changes differently. The change that technology brings leads to the upskilling of staff. This is to achieve efficiency through learning and it results in the faster completion of tasks. Thus, there are positives with regard to the impact that technology has on staff. However, there were a few participants who shared their feelings with regard to the negative impact that technology can have on staff:

In certain ways it made our lives easier in some ways it's made us lazy [...] you are relying on software to do things and you need to make sure you understand what you are doing [...] you need to have the right inputs to be able to make that solution so I think that also becomes a bit of an issue with new technologies is people get excited because you know put in xyz and you get out this entire structure [...] it may not necessarily be the best solution if you don't know what you putting in [...] I think it's definitely made our lives easier but we have become lazy. – Participant N

If you sit looking at a computer screen or any kind of screen [...] for more than six hours a day all kinds of things can set in depression, backache. – Participant A

People are living in the past and I think the biggest challenge is change [...] we making business smarter [...] there's a big change in modest there's there needs to be a big paradigm shift psychologically staff need to be, there's a big change-management process that need to happen [...] new set of skills need to be learnt and developed [...] because there's a new way of doing business. – Participant J

Train someone internally but if you had to roll out into an entire factory there's gonna be a lot of resistance [...] there's gonna be labour disputes [...] people who are going to say [...] I now press a button on a robot that was not in my job description I now need a higher pay increase because I'm now working with computers [...] or I'm now working with robots. – Participant S

The four participants N, A, J and S elaborated on the negative impact that technology has on staff. From the data it was clear that people rely on software to complete tasks, but in doing so they also need to understand what they are doing. Therefore 'utilising software has made us lazy in the way we apply ourselves, as most of the work is done for us'. It is clear from the statement made by Participant N that people have become too reliant on technology to complete work. A person needs to understand what they are doing. Specific skills are needed to operate, for example, machinery, software programmes or robots and this can be done through self-education and upskilling. Participant S alluded to the fact that people are there to do the job they sign up for and that there will be labour disputes should new technology come into the workplace. This is because it will leave staff feeling that they are not compensated for tasks that were

not disclosed in the contract they initially signed. This speaks of the resistance of people towards change in the workplace that may be brought about by Industry 4.0. Organisations need to adapt to the required change in order to maintain their competitive advantage. Staff who are unwilling to change as required will pose significant challenges to organisations. Participant A highlighted how certain types of technologies may negatively impact the body, for example looking at a computer screen for a lengthy period.

Technological adoption and the change in organisational activities, developing new competencies and skills (Trenerry *et al.*, 2021). Organisations need to develop innovations based on the competencies and make differences in comparison to their competitors (Bal and Erkan, 2019) The impact that technology has on staff varies across organisations. Participant N, J and S indicated some of the disadvantages that technologies have on a person and what can possibly be done to adapt to the change that technologies bring. Technology has impacted people in terms of their social lives; there has been an increase in social isolation, an increase of lifestyle diseases and changes in the education sector (Mishra, 2019). On the positive side, technology boosts organisational advancements in education. It has also improved transportation, communication, and homes by enabling smart homes using devices and appliances.

5.4.2 The impact that technology has on the workplace

As the momentum of technological innovation increases on a continual basis impacting the way we live, work and relate to each other, the environment is profoundly ever-changing (Ross and Maynard, 2021). The transformation of digital machinery has improved technological intelligence. This has reshaped communication and how tasks are executed (Muhuri, Shukla and Abraham, 2019). It has improved response times, on-time completion of work and it has also limited inaccuracies in order to acquire a sustainable competitive advantage (Lipovich, 2020).

The researcher asked each participant to explain how the workplace has changed with the introduction of Industry 4.0 technologies. Participants indicated that technology has allowed the workplace to become more advanced, modernised and much more digitised in terms of how work tasks are executed. There has also been mention that an organisation needs to remain relevant in order to maintain a competitive advantage. The participants alluded to investing in technology as it reduces inefficiencies.

It's a fundamental [...] shift in how businesses operate which is also how can I say like you used to power something with electricity before or from steam trains [...] to electric trains [...] and businesses are also like that now. – Participant J

For example if you look at documents [...] I can [...] complete a document and sign it off and send it through for signatures [...] Adobe allows you now to sign allows you to sign a document it wasn't the case before [...] you find that there's less printing [...] you don't have to waste time running from one office to the other office [...] by just sending an email [...] you spend less time trying to get signatures and more time on doing the work. – Participant O

Companies and individuals as well should invest a lot [...] in technology whether it be workspace [...] or in your own social life cause that's where the world is going and don't want to be left behind [...] a lot of people were little bit hesitant into [...] taking [...] progress of technologies seriously [...] with the introduction it has actually changed the way people think and people are starting [...] to use more of the technology [...] and [...] forced everyone to [...] start new things and [...] general forced the workplace [...] it actually forced everyone [...] to try and [...] find ways [...] to minimise the work. – Participant P

Participant J referred to how businesses operate, alluding to the movement from steam trains to electric trains. The participant referred to how businesses have changed over the years and from how work was previously done to how work is completed today. Participant O provided a practical example from the change that has been brought about by Industry 4.0. The participant indicated how documents can now be signed digitally whereas previously a person needed to be physically present for a signature to be manually placed on a document. There are benefits to digital signatures such as: saving time in delivering documents via email or file-sharing platforms; signing the documents remotely and reducing the cost of stationery (reduction in the use of paper and ink) (Adobe, 2021). Participant P felt that people should 'invest in technology', either in the workplace or in their personal lives to remain relevant.

The adaptation of organisations to new technologies is important (Borland and Coelli, 2017). The interviews were conducted during the COVID-19 lockdown. Many participants provided interesting viewpoints as to how technologies have assisted them to work remotely.

5.4.2.1 Remote Working

During the COVID-19 pandemic, lockdown conditions had to be enforced by governments throughout the world. This impacted the way we lived, worked and

conducted our day-to-day activities, thereby moving work activities from offices to homes (Kylili, Afxentiou, Georgiou, Panteli, Morsink-Georgalli, Panayidou, Papouis and Fokaides, 2020). Remote working is the combination of ICT (information and communications technology) with flexible working conditions (Kylili *et al.*, 2020). In the excerpts presented, the participants have referred to remote working and the experience of working remotely. They also touched on how the communication tools used assisted them in completing their work.

Look at what lockdown has done in the workplace [...] everybody's doing things on Teams [...] the impact of technology during lockdown has taken it to another level [...] its created economic impact. – Participant J

With this whole pandemic going on we can work from home and we can have meetings throughout the day [...] wherever so even throughout the night [...] 4.0 allows us to is to have that uh connectivity [...] with colleague's uhm in not at the office right now. – Participant C

I think working from home gives you a lot more flexibility [...] it gives us a lot more productivity I don't know if everyone would agree with that because obviously there would be people that kind of take advantage of the system. – Participant N

Working from home you actually get a lot done than being in the office. – Participant O

Participant J believes that Microsoft Teams is now the new norm to conduct meetings. Work can be completed virtually, and remote working allows for more flexibility which leads to better productivity according to Participant N. However, there are people who engage in other non-work-related activities, and they don't necessarily focus on work tasks. Another participant shared similar views:

People have got to be responsible [...] I know my people are not sitting and watching Netflix the whole afternoon [...] if you manage like a really large organisation of 1000 people, I think you may struggle. – Participant L

Remote working may cause staff to be distracted, but managers need to monitor and manage staff and staff performance. One participant believed that remote working allows for more work to be completed. Some participants indicated that a flexible working arrangement (called a collaborative working environment by some participants) would be beneficial. Remote working alleviates the time taken to commute to the office and there is less of a rush to get to the office. Here are some of the excerpts:

I prefer at home but not full-time I would say [...] there needs to be some kind of balance [...] you can do more in a day [...] cause you not travelling around and things like that, so it is a challenge [...] but it needs to be managed [...] depends on the environment. – Participant K

It's easier to have those check-ins in person its easier just to walk to someone's desk and ask a question but the working from home I think you can get more meetings done in a day [...] you not driving around you not stuck in traffic some from an efficiency perspective [...] people have a bit [...] a bit of a better work-life balance because you can manage your time better you not sitting in traffic you not rushing so I mean our team has sort of acclimatised quite well to the change. – Participant L

I enjoyed working from home situation because it gave you enough time to do as much work as you needed without sort of wasting time going into an office [...] driving, sitting in traffic [...] a flexible working environment is probably the best. – Participant N

I prefer a collaboration [...] that's the best way to work actually because I mean in the office [...] me being here doesn't mean I'm working [...] having a laptop next to me at home or when required or doing whatever I need to do when I'm done and you know for me working from home was very nice actually [...] you manage your time if you have contractors that you need to attend to you go to site you attend to them and you done [...] I prefer [...] collaboration just manage your work. – Participant O

However, there were participants who provided some insights into the difficulty of balancing work and family life, internet connectivity constraints, numerous interruptions to work, physical struggles and having no time boundaries.

Some people might have the issue of is you at home you might have disruptions [...] or certain families. – Participant F

Observation of Participant F: Participant F laughed when mentioned 'certain families' in saying this the indication that Participant F did not want to pass judgement on peoples' families, as Participant F seemed as if they also did not want to potentially offend the researcher. Participant F smiled while mentioning the feedback and smirked slightly. This made the researcher believe that some families can be a disrupting factor in getting work done, however for Participant F, it was no problem working from home or the office.

Was difficult because where I live I have uhm signal problem [...] can't get my job done I do but it was slow [...] it was slow so compared to the work and some of the things I don't have enough resources [...] it's hard to work [...] from home [...] because you have back pain you get even lazy [...] you become a hobo at least when you at work you more productive you know you need to get things done [...] but you know when you at home you don't you get demotivated by a lot of things. – Participant H

Observation of Participant H: Participants H's body language and facial expression was not in agreement with working from home. The participant shook their head as they explained the reason why working from home is not for them. Hand gestures were expressed, to justify what they were saying and even slamming hands onto their legs, indicative of slight frustration. When Participant H made mention of being a 'hobo', Participant H shrouded shoulders and had an annoyed look (eyes went smaller and slightly closed and shaking of the head) this was a presumably annoyed look. Participant H seems to take a lot of pride in their dressing and how they come across, so image seemed a significant factor for Participant H, this was in reference to their home situation and that how you dressed or came across physically was an important factor to note.

With the emergence of Industry 4.0 everything's connected it's not like back in the day [...] everything was at your desk and [...] once you once you left work [...] and someone says oh we've got an emergency [...] unless you literally drove to the office you couldn't do it [...] nowadays work follows you on your holidays on [...] your days off on your weekends while you sleep [...] so there is that big impact of [...] the requirements of not only working within your country working with clients all over the world [...] taking into account on uh what time you can have meetings with those individuals and uh who's available to do that and what are deadlines [...] the worlds moving so quickly deadlines are much more [...] shorter than they used to be. – Participant I

The downside of the flexibility is [...] you can have multiple meetings which is also not at uh good thing where you have back to back [...] if not two or three meetings because it's virtual now [...] the divide between your normal work life and your family life is its bit of a challenge to manage that because that time well most times your meeting are extending to six seven o' clock [...] where do you draw the line yes you at home but obviously you cannot work on a continual basis uh so it's good to have the technology but the down side is that it has to be managed [...] by your managers. – Participant Q

When you work from home there no boundaries [...] if there discipline among the employer and employee then its fine then I'll work from home anytime [...] I enjoy working from home if I'm going to be honest with you [...] the only problem I have its what I have in lockdown is fatigue [...] workplace fatigue and home [...] I think you have to find your balance between your work life and [...] then you have to balance your life now family wife child. – Participant J

Participant J indicated that boundaries must be managed through a mutual agreement between employer and employee. This is because lockdown fatigue, workplace fatigue and family responsibilities can impact on their productivity. There needs to be a work-life balance. Participant I referred to the concept of no boundaries as work infringes on holidays and weekends and even sleeping patterns are affected due to deadlines and urgent work. Participant Q felt that the pandemic had forced people to communicate via Microsoft Teams to conduct meetings and complete work tasks.

Participants Q further believed that all work (home, virtual or office) must be managed. In the same light, Participant J also alluded to the line between work life and family life and that working from home intrudes on your family life if it's not managed. The government, organisations, education systems, health and transport, among others, are remodelling, resulting in a modification to the way in which people work, communicate, express themselves and live (Acioli, Scavarda and Reis, 2021). Amidst the pandemic, physical, in-person interactions were limited and replaced with computer-based interactions (Tibbetts, Epstein-Shuman, Leitao and Kushlev, 2021). Yet, human connection is an integral aspect of human society (Mayo Clinic, 2021). The next topic will highlight what the participants had to say in relation to the importance of human interaction and what it meant to them.

5.4.2.2 Human Interaction

In the workplace people work with one another as their job tasks often depend on another person's output. Having no physical interactions in the workplace due to the pandemic had a different impact on different people. Employees who have been working from home did not have the opportunity to socialise with colleagues, as physical engagements were reduced, and online platforms were used to socialise virtually for work purposes (Tavares, 2017). For some staff, working from home was not a viable option. This was because their home environments were not conducive to perform work functions optimally and these staff preferred to return to their employers' work offices. This led to working according to a flexible working arrangement (working from home and working from the office). The data revealed some platforms that people used in order to connect and communicate with each other.

You still have face-to-face type of learning [...] you can do via Teams or uhm Zoom [...] the digital part but some stuff you physically you can do [...] you do lose a bit of you know the human aspect [...] of not interacting with your colleagues per say on a daily basis [...] working from home is pro and con but I think if you can get a balance [...] three days working from home and two days at the office [...] so you don't lose that personal touch I think that's still important.
– Participant C

I loved working from home when COVID just struck [...] but now [...] I actually prefer being at the office [...] I prefer the people interaction [...] and also, we learn from each other every day [...] I also miss the people. – Participant D

Observation of Participant D: Participant D was a very bubbly, eager and came across as person who always wanted to improve themselves. This was evident in some of the examples given by Participant D, towards what they had to do to keep relevant. In saying this Participant D is a Baby Boomer, so they felt that they needed to re-innovate themselves to remain relevant. The eagerness in their voice came through, and the examples that was given sparked a discussion as Participant D wanted the researcher to know that they have the drive to upskill themselves.

I prefer at home but not full-time I would say [...] there needs to be some kind of balance for you [...] it doesn't need to be that often I think from depending on the type of work you do [...] If you managing people [...] you need to interact at some point with them [...] personal uhm contact is still important [...] there's still a need for that. – Participant K

It's also nice to meet with your older (job title of Participant N disclosed) [...] to meet face-to-face and discuss a problem or a project it's a bit different to doing it over the phone. – Participant N

It is a very unnatural situation I do miss the human element however in my company I feel that we are in an open hybrid of an open-plan office [...] there's too much of noise and I cannot concentrate in office [...] it is important to me I do like to have people around me [...] at times it can be a distraction [...] we are already used to this independent working where you uhm work with emails and sign so it wasn't too much of [...] inconvenience for us that we had to relearn uhm learn something new. – Participant S

I think the human element definitely for me is critical [...] especially also if you trying to convey things and teach people it was easier for me but it physically shows somebody and they can see what I point to [...] if I had to do audits remotely it's very difficult for me [...] to get them to show me something by the time they show me something I already forgot what I was looking for whereas if I'm physically there I walk and I see [...] I observe doing it virtually is almost very difficult for me maybe that's just the way I'm set up. – Participant R

Participant C mentioned that learning can be done virtually via online platforms, but there is no physical interaction among colleagues. However, staff can still remain in contact with each other. Participant D enjoyed working from home during the beginning of the pandemic. However, as time progressed, Participant D would have preferred to be based in an office.

Participant K stated that managers must interact with their staff to ensure that tasks are up to date and job descriptions are met by all staff. The participant also mentioned that personal contact is important. Participant N observed that younger employees can learn from the more experienced colleagues through interaction with them. The

participant also mentioned that human interaction through face-to-face interventions and discussing issues or projects in person is still important.

Participant S shared that remote working, although unnatural, is preferred. The main office distraction is the noise in an open-plan office, but having people around is good. Participant R agreed that people are important to interact with and interaction between colleagues has improved since lockdown was imposed. For participant R, human interaction is a critical element. This is because physically talking to someone can improve understanding of the work compared to following a slide show or an online presentation, for example. Theme 2 provided the impact that Industry 4.0 has on staff and the workplace. The impact that Industry 4.0 has on the workplace was further divided into two categories, namely remote working and human interaction. The next section will present the third theme of this study.

5.5 THEME 3: CHALLENGES BROUGHT ABOUT BY INDUSTRY 4.0 TECHNOLOGIES IN THE WORKPLACE

There are challenges that are brought about by Industry 4.0. Chapter 2, Section 2.5, highlighted the challenges of Industry 4.0. The researcher was aware of some of the constraints posed. However, the data revealed some of the challenges indicated in Figure 2.5 and the others identified were provided by the recurrent themes in the data. The researcher asked each participant which challenges, capacity constraints and shortcomings were brought about by Industry 4.0 in relation to workplace diversity. Two main challenges have been identified from the data, namely the financial cost of implementing Industry 4.0 technologies in the workplace and the shortage of skilled employees who work with Industry 4.0 technologies.

5.5.1. The financial cost of implementing Industry 4.0 technologies in the workplace

Sony (2020) reveals that the initial cost for implementing Industry 4.0 technologies is relatively high. However, in the long run, the cost of implementation will be recovered, resulting in increased profitability for the organisation (Sony, 2020). There were participants who mentioned that the financial costs of Industry 4.0 inhibit the

implementation of Industry 4.0 technologies as well as the maintenance of the technologies after implementation.

Technologies are causing hectic transformation [...] the whole tech impact on a global automotive value chain uh is like changing drastically everyday there's new things coming into the market [...] they have to find funding right [...] if you don't have funding, you to have capitalise this innovation you gonna be left behind. – Participant J

In terms of cost perspective [...] companies are well aware of the technologies they need to be globally competitive [...] our private sector are exceptionally [...] clued up on what is happening [...] they're aware of the cost and investments that they need to make into necessary technologies in order to be successful [...] they are factoring these costs in when they are doing their RFQ's and they know what they can and can't afford [...] they are making a plan to ensure [...] That they have the right [...] technologies [...] and at the end of the day it's an investment but it's an investment that ultimately secure them the business they need [...] you really need to have the greatest efficiencies to make sure you are making money in the industry that's exceptionally low margin and [...] companies are [...] excited and very eager to sort of bring on Industry 4.0 technologies and anything that is improving the inefficiencies. – Participant M

It does cost a lot of money to [...] bring in these systems 4IR systems [...] in terms of technology because there's lot of companies in South Africa [...] that are providing 4IR technology [...] things that can be done in manufacturing at low cost as well so you can digitise you can automate [...] and reduce your costs [...] when you talk to a small business about putting in a robot to do something we can't afford it [...] cause it's too expensive but they not aware of what can be done [...] at lower cost for example you can take an old robot [...] and refurbish it [...] to do what you want to do maybe at not at the cost you thought you were going to pay [...] so those things are there that people don't know about. – Participant K

I think cost would definitely be a big one [...] technology is expensive even just to maintain the technology that we have is expensive. – Participant N

When we make certain products it is molded and it is welded by robots [...] if we have to do that in South Africa [...] if we have to in Europe that is feasible because there's a high labour cost [...] the technology is already there in South Africa if we have to do that we run the risk of we do not have the expertise to do that at the moment as well as high investment cost for the companies [...] If we now have to start investing in molding and robotic welding whereas we already have a supply of semi-skilled workers to do the job and economically because in South Africa we do have a fair we have trade unions here that ensure that our workers have living wage have a fair living wage. – Participant S

Participant J stated that the implementation of technologies has caused transformation in the workplace. Acquiring new technologies requires funding and insufficient funding structures may result in the organisation falling behind its competitors. Participant M

was of the view that technology is needed to be 'globally competitive'. Participant M mentioned that technology is seen as an investment to secure work. Participant K said you can 'digitise and automate', in order to reduce costs. Nevertheless, when you approach a small business about incorporating a robot, for example, the small business's response would be: 'no we can't afford it'. Technology in whichever form is not affordable and the maintenance thereof is expensive as disclosed by Participant N. Companies want to implement these newer technologies in order to be profitable. Perhaps costs can be reduced by refurbishing older technologies or upgrading components of software or hardware. The next discussion will centre on the shortage of skilled employees who work with Industry 4.0 technologies.

5.5.2 Shortage of skilled employees who work with Industry 4.0 technologies

People need to acquire new digital skills, while others may need to change career paths and improve their skills in order to adapt to the new job market (Geraldès *et al.*, 2021). Employees are encouraged to attain a more diverse set of skills (Ing, Lee, Chan, Alipal and Hamid, 2019). Some of the skills that are lacking are critical thinking, problem solving and attention to detail (Dishman, 2016). As tasks are becoming less routine, continuous knowledge and skills development is necessitated (Ras, Wild, Stahl and Baudet, 2017). Labour markets are tested according to the shortages of specific skills and at the same time there are certain skills that are no longer required (Lee *et al.*, 2018). Industry 4.0 has triggered differences in job types and job characteristics which is the result of high digitisation and the use of ICT (Ada, Ilic and Sagnak, 2021). Organisations respond to and embrace the changes within their own work environments.

There are several occupations where there is fundamental transformation, and more occupations will be affected in the future. Some jobs have disappeared, and new jobs have emerged that are linked to information and technologies. Also, existing jobs are redefined through radical changes that are required in existing skill sets (Ada, Ilic and Sagnak, 2021). Talent and skills are recognised as the drivers of the successful adoption of Industry 4.0 (Maisiri and van Dyk, 2021). The development of new methods to identify the required needs and skills gaps that affect people, and the workplace is needed (Geraldès *et al.*, 2021).

It is, therefore, imperative that people develop skills which will match the advancement of machines, allowing people to operate under specified working conditions (Zhong *et al.*, 2017). Automation necessitates people to advance their skills and capabilities, as information and knowledge on future job requirements (Josten and Lordan, 2022). Although automation can be perceived as a job threat, the prioritisation of what is required to carry out new forms of work will result in the creation of new types of jobs (Frost and Sullivan, 2017). Participants who were interviewed referred to upskilling and reskilling of people to remain relevant and employable. Having the right skills in the workplace is important for the success of an organisation. When interviewed, some participants revealed that possessing the correct skill set was seen as one of the challenges of Industry 4.0 era. In addition to a significant amount of capital investment, there is also a need for knowledge and training as well as qualified human resources (Sarı, Güleş and Yiğitol, 2020).

Industry 4.0 technologies are so popular that we always don't have enough people [...] skills that are coming out of university is actually in my opinion somewhat lacking [...] if you want me to write this 4IR thing then I'm going to write it {Participant was assisting with module development at a university and alluded to the content they was writing for a module} to try and build people that I want to hire. – Participant E

From Participant E's perspective, 4IR technologies are popular and there are not enough people to conduct tasks and operate the newer machinery or software. The people that Participant E has referred to are the newly graduated students and Participant E believed that their skills are lacking. This raises the question as to whether universities are doing enough to equip students with the necessary skills in addition to the academic qualifications being offered. Participant E previously assisted a tertiary institution to develop learning material. The participant observed that the content material written would produce candidates that the participant would want to hire for Organisation A. The content of curricula is therefore important and should align to industry standards.

We need to now look at more skilled people or academically inclined individuals [...] so we have to upskill and [...] go out into the market and go and recruit [...] look at technology and you go back to your 4IR is where is South Africa compare to the world if you have to rank them from a technology perspective [...] that's why we bring a lot of expats into the country [...] in multinational companies [...] we borrow skills from other countries. – Participant J

Participant J also believed that academically inclined people are needed to carry out specific job tasks. The participant also expressed that South Africa import scarce skills from other countries. This is because there is a scarcity among South Africans with regard to the correct skills sets needed. Another participant expressed their viewpoint on outsourcing skills.

The first thing is to define and find resources and build that capacity to try and get the right structures in place a lot of organogram structures and business structures in place where we have the skills sets [...] to be able to do that work internally but then what happens in the interim process [...] when we find ourselves short and we don't have the skill sets that's when we look to [...] outsourcing [...] pieces of work that where we specialised work and we don't have the skill sets within the organisation [...] we try and bring that from an external market be it in a contract or be it on an ad hoc basis to try and close that gap so the long term would be is to try [...] to basically have all the skills that you need in the organisation and then the initial thing is where we try and cover those gaps by using people from the outside market. – Participant Q

To be able to use that uhm that technology [...] the 4IR I mean if you read the material in terms of what the skills are required [...] you need to have creativity [...] analytical thinking problem solving [...] decision-making [...] leadership skills and all kinds of things it's I mean those things [...] people have those things not like they don't have it [...] I don't think that's an issue in terms of that we always come up with these ah skills you need for 4IR [...] but you telling me people don't have uhm leaderships skills and [...] analytical thinking and creativity and all that people have those things its maybe some of the other things they might not have the technology skills [...] I would say maybe you know if they don't have that uhm [...] but those other skills its comes it's within everybody they can you know maybe they might need some teaching around how to use it [...] but I mean they have it. – Participant K

Industry 4.0 clearly the people that are currently employed in the organisation do not have the relevant or the appropriate skills to embed the technologies and sort or leverage that so they have to invest in reskilling upgrading [...] peoples skill sets but also restructuring the way that companies are restructuring the hierarchy of roles and responsibilities [...] we see them (companies) spending their skills spend and sending people to technical skills. – Participant L

There's a narrative that says introduction of 4IR technologies will result in the reduction of staff [...] generally, what we've, however, seen is that the introduction of these technologies has been positive for staff in the following ways [...] they have allowed for the upskilling of staff to integrate and use these technologies on a daily basis [...] allow companies to achieve new levels of efficiency, which creates the opportunity for growth, and thus employment and localisation. – Participant M

In all the excerpts from the various participants, it was interesting to see that obtaining the skills sets needed to conduct work was apparent in their statements. Participant Q

confirmed that their organisation also made use of outsourcing. When the skills were needed by Organisation C they would bring in people with the required skill set by outsourcing the work, either through a contract or on an ad hoc basis. This was done if insourcing was not an option. Participant K stated that the skills required for 4IR include creativity, analytical thinking, problem solving and leadership skills. Participant K observed that employees can be taught skills that they do not currently possess.

As the need for highly skilled employees intensifies, it will be more challenging to meet the needs of the organisation (Sony, 2020). Therefore, retraining and reskilling of staff are unavoidable. Educational goals, lifelong learning and developing the right skills will become the norm with regard to the future (Kim and Park, 2020). As demand for mathematics, computing and data analysis grows, so too will the need for human attributes like creativity, critical thinking, persuasion and negotiation. On-the-job training through using multiple stakeholders could become more important than traditional routes (Kumar and George, 2020). The employee will also need to display a desire to upskill themselves and not only rely on their company to train them; it needs to be every person's initiative and own drive to stay relevant and employable.

The future workforce will need to be adaptable, resourceful, robust and interdisciplinary with regard to interaction and collaboration in the industrial market (Flores, Xu and Lu, 2020). Therefore, people in the workplace will have to learn how to use and interact with new software and hardware which are developed to advance the digital integration (Flores, Xu and Lu, 2020). Even though technological efforts are made to support human adoption of new systems, people will need to engage in continuous learning. The workplace will need to adapt to changes constantly and be up to date with what their industry and other organisations are doing to stay relevant. During the COVID-19 pandemic people were retrenched, and many jobs were lost. However, there are still issues of a shortage of skilled employees in some of the organisations interviewed.

We are understaffed by 80 people [...] to COVID number one [...] but it's also due to changes in the economy [...] changes in the sector [...] the sectors demand [...] our plan is to increase production in South Africa [...] it's a fact we need to localise we need to increase production we need to double employment [...] we need to create more economic activity so you can create more jobs. – Participant J

We are always understaffed [...] that's a problem I think [...] no we've been understaffed for a while [...] in government sector its bit of a issue because you want to reduce costs and [...] people it's just that they look in the wrong place but you know what that's a political [...] discussion for another day. – Participant K

Not pushing forward [...] the technology side of things and [...] not investing much on [...] IT as well uh support staff [...] because [...] you introducing new technologies to people [...] having [...] enough staff to accommodate [...] everyone [...] in the company uh so turnaround time [...] one of the shortcomings uh IT staff not being [...] enough to [...] assist [...] all the employees [...] in terms of skills [...]] people have not been replaced and in terms of specialising [...] you don't have enough staff and [...] send someone to [...] learn something but due to being understaffed and [...] the quality driver most of [...] the work it becomes difficult [...] where you need some people to specialise in some of [...] the departments [...] that's one of our shortcomings not having enough staff [...] because of people leaving and company not being able to replace those individuals. – Participant P

In my organisation I do feel we are understaffed [...] we have people who leave which is just one of your natural things that happen and their positions are never filled and then five years down the lines its not filled [...] the reason [...] we are a government organisation and it is more about budgets [...] and budget cuts. – Participant S

The South African labour market has been marked by a high level of unemployment and inactivity (World Bank, 2021). However, the pandemic has caused a short-term fiscal impact and a long-term economic impact globally (Shang, Li and Zhang, 2021). The economic impact, mainly within South Africa, were skills scarcity in the labour force, a high cost of non-tradeable inputs (e.g. recurring power outages), corruption and changes to financial markets (World Bank, 2021).

For Participant P, the investment in staff and not having enough people to assist the number of staff you have becomes difficult. With regard to technology, people needed to be employed to assist employees. However, those that leave the organisation are not replaced, which impacts on the output of Organisation C. Specialists are required to work with new technology to optimise coordination, creativity and strategic intent (Flores, Xu and Lu, 2021). Under Theme 2, recurring topics found were the financial cost to implement new technologies and the shortage of skills required to thrive within Industry 4.0. The themes specified the challenges that the three organisations are currently facing. The next theme will focus on workplace diversity.

5.6. THEME 4: DIVERSITY TRAITS

The previous themes were centred around Industry 4.0 and the impact that it had on staff and the workplace as well as the challenges associated with Industry 4.0. This section will present workplace diversity in the context of the diversity traits that were identified for this study, namely age, gender and education.

5.6.1 Age

Diverse age groups bring their knowledge and differences into the workplace (Mothe and Nguyen-Thi, 2021). In Chapter three the researcher extensively discussed age under Section 3.7.1. There are different generations that coexist with one another, namely Baby Boomers (1946-1964), Generation X (1965-1978), Generation Y/Millennials (1980-1994) and Generation Z (1997-2012). Across the generations there are similarities and dissimilarities in the way that the age groups associate with events, people and experiences (Mahmoud, Fuxman, Mohr, Reisel and Grigoriou, 2020). The world is continuously changing, and organisations need to acclimatise to the diverse nature of the multigenerational workforce (Mahmoud *et al.*, 2020). The researcher posed the question to all the participants with regard to how the different age groups relate to the newer technologies.

I think it's a very delicate topic [...] it does come down to a person-to-person thing but I think that there is a difference in a way that different uhm generations actually respond to change and respond to new technology. – Participant N

Participant N indicated that the topic of age is sensitive and differs from one person to another. However, there is a definite difference in how different generations react and respond to change and the use of newer technologies. Another two participants believed that attitude was a contributing factor in how people from different generational cohorts relate to one another.

Millennials and the [...] newbies [...] Z'z [...] they are a lot more [...] up to scratch with what's happening [...] technological wise as to the uh Baby boomers [...] you have to engage in change [...] the attitude no matter what your age is actually or wanting to keep up with the trends is important. – Participant C

Across all generation's the difference is [...] the attitude [...] because it's never all of their capabilities [...] whether you are old or young you still have that capability to learn something new. – Participant P

Especially younger people but uhm if you but people under forty might definitely be interested in it and [...] if you've got a basic understanding of what what it entails and how you fit in to it and how it will actually allow you to grow. – Participant R

Participant C and Participant P believed that a person's attitude can impact the way in which they relate to technologies. These participants believed that, whether you are from a newer generation or an older generation, the attitude a person has makes a difference. If you have the ability, capability and the willingness to learn and keep up with newer trends and advancements in technology, it will benefit you personally and as an employee. In essence, the attitude that a person has towards learning and self-improvement is important. Furthermore, some participants believed that the way in which technology is used (in terms of tools, applications and the understanding of the technology) is related to how the different generations react to technology.

You need simplicity well when it comes to the maybe the earlier age groups [...] the younger generation have to deal with too much data all at once [...] because they know like we understand mobile applications [...] we understand like internet apps how to interact with these interfaces [...] an older person might know the question is and what they want to get out [...] but they just not might know how to use the actual instruments or tool that they using [...] while a younger person may know exactly how to use it but they might not know what exactly what they want to answer. – Participant I

With the lower end (younger generation) of the distribution in terms of age is they know how to use technology [...] they don't seem to understand technology [...] they sort of grew up with an App with the phone and they know how to use an App but they have no idea as to like how does a computer work [...] they probably used the Tablet mostly And they hardly ever used the laptop [...] but my (millennial) generation sort of had the best combo. – Participant E

Participant I and E had similar sentiments with regard to age and pointed out the difference between understanding the technology and knowing how to use technology; an older person will understand what they want to get from using technology but may not necessarily know how to use the technology. In contrast, a younger person would know how to use applications or tools but may not know what to achieve from using the technology. Two more participants indicated that the older generations may not necessarily want to change.

The older generation [...] do not embrace change [...] as we do [...] it makes it a bit difficult, but they are very informed [...] about how to do things. – Participant O

The Boomer generation are quite resistant to change [...] they are not always willing to change especially if they've been doing something a certain way for more than twenty years however [...] there are a few people that are actually [...] they trying to be tech-savvy and they are willing to learn and they want to [...] stay on top of the game for as long as they can [...] the majority are a bit resistant to change there are obviously those that are willing to stay on top for a longer times and be relatable to the different generations. – Participant N

Generation X these older people you will find a lot of resistance from these people because we must bear in mind that these are people that came from the former apartheid regime where they were educated on Bantu education [...] and they have been trained on the job to do the things they do they have the fear of losing their job and if we implement things like tech Industry 4.0. – Participant S

Participants O and N were of the view that the older generations do not embrace change, or that they are resistant to change. However, Participant O mentioned that the older generations are informed and know how to organise and carry out tasks.

I wouldn't say reluctant but uhm more faced with a speed bump [...] I don't think older people are reluctant to it. – Participant G

Participant G had an opposing view and mentioned that the older generations are faced with a 'speed bump', indicating that one needs to slowly go over the bump to get to the other side. In other words, it may take the older generations more time to learn and overcome challenges and they are not necessarily reluctant to change. An observation was noted when the researcher was talking about age with participants.

Observation of Participant G: When participant G spoke about the older generation Participant G came across as having sympathy towards them. Their facial expression, with response to the word 'reluctant', hand gestures and a quieter tone of voice pointed towards having sympathy with them. These gestures signalled to have empathy and patience with the older generation. This was further verified as Participant G provided their personal story of teaching their mother how to use technology and also mentioned that they were unaware that it could be done while using technology. Participant G is from the younger generation, so participant G wanted to teach and also be taught.

The last two participants mentioned that the younger generations, mainly Millennials and Gen Z, adapt easily to the change that technology brings. The reason could be that the younger generations have grown up with technology and that it's ever-changing.

Gen Z entering the workforce their mind-set is very different [...] they are definitely tech tech-savvy but to an extent because I don't want to generalise [...] the entire generation but also a

little bit entitled and I've seen this with the Millennials lot as well where you come in and because you can use the software that maybe the Boomers can't necessarily use you think that you know more than them but that's not the case because they've got maybe thirty years of experience. – Participant N

Your younger generations are more quickly able to adopt, understand and fully utilise new technologies. – Participant M

Gen Z's that are now entering the marketplace [...] these kids grew up with cell phones in their hands and are more open to technology [...] so we need to be mindful of that that we have different age groups in our workplace and all of them will react differently in uh with Industry 4.0. – Participant S

However, Participant N felt that the younger generations, particularly Gen Y and Gen Z, have more of a sense of entitlement, and they also behave as if they may know more than the Baby Boomers. However, the older generations have more experience than the younger generation as compared to knowing how to use technology or being tech-savvy.

Age may explain changes in employees' work attitudes. It affects their needs and expectations concerning future prospects and the value that is attached to them at a particular stage in life (Mothe and Nguyen-Thi, 2021). Age diversity may encourage diverse values, ways of thinking and competencies, which should foster positive relationships between employees (Mothe and Nguyen-Thi, 2021). The next diversity trait that is discussed is gender.

5.6.2 Gender

Gender refers to how a person identifies on the inside (Zambon, 2020). The term gender extends beyond the notion of males or female in a biological sense; it can also describe someone's chosen identity, which may be male, female or something in between (Bosch, 2021). The researcher is aware that gender is perceived as a sensitive topic. However, to compact the study, the researcher will only mention males or females that were interviewed as participants and who identified themselves as either male or female. Therefore, the researcher will present the data in this way. The researcher discussed gender in detail in Chapter 3, Section 3.7.2. The researcher allowed each participant the opportunity to choose the gender they identified with. Ensuring that the researcher was not directly bias (Stahl, 2021). Herewith, some data presented by the participants regarding gender:

In terms of where we are [...] to get the ratios right [...] we have targets that we have to meet we on target [...] for females that's in the organisation so now we've gone behind in terms of the males uhm so we trying to bring those levels back up [...] there's a balance between males and females in the organisation [...] senior and executive levels to having a balance of males and females in the organisation there's also in terms of that in those levels the strategic levels there's a transformation process [...] that we going through to make sure there's a balance not only between males and females but also its subjective of the demographics of [...] the country [...] there's a number of senior position occupied by uh female employee in the organisation [...] we see there's a lot more female employees at an EXCO level than it was ten years ago.
– Participant Q

Our sector I think is pretty traditional [...] the gender spilt is you seen at an executive level almost exclusively men [...] they also of a certain age group [...] I'd say they probably like 45 and older [...] for us you know we seeing women in the sector tend to progress quite quickly through the ranks but you kinda get stuck at this like senior executive level and they don't seem to go any further that maybe just a factor that they don't have enough years of experience maybe the challenge but also the thing is a lot of the women in the sector are not in technical engineering roles in our sector [...] the participation of women in the automotive sector as whole apparently about 35% of [...] staff in the sector are female [...] they have to make more of a concerted effort to integrate more women and people of colour into their companies. – Participant L

Management level is uh there's more male's [...] than females [...] why is that I'm not sure but [...] they were looking at bringing in more females into you would know that at one point they were having a problem there were too many male ministers and then they started bring in more [...] female ministers and so it is a challenge you know but in within our own organisation[...] In terms of management [...] there is still uh challenge there's more male than female. – Participant K

Many graduates coming in now uh there are many females [...] the older generation you find more males than females but recently you even find more females coming in more than males [...] that's the change and obviously in the next few years [...] we will see you know equality [...] achieved [...] recent appointment is more females [...] but currently obviously there were more males [...] some industries you find more males and then in some industries you find more females [...] I'd say 50/50 depends on the industry [...] in an engineering environment [...] its technology environment [...] people there already not to hesitant [...] whether they male or female [...] to be honest I haven't noticed much in terms of differences between [...] genders [...] both gender group to adapt more or less similar way. – Participant P

Engineering as a whole is still very much male-dominated [...] I wouldn't say its necessarily equal [...] there are quite a few females specifically within engineering [...] there's definitely more males uhh it could be that people have been in those positions for a longer time [...] very

much male dominated previously and a lot of our managers are fairly old [...] like in their fifty's so obviously at that time there were not so many females in the industry so it could be as a result of that [...] we do have some females managers but it's very few. – Participant N

We uh driven to be compliant with that and I think at the moment we more than compliant [...] most of the companies they actually comply. – Participant R

Feel that uh there is a quite a good balance [...] of male female [...] it's quite balanced [...] and we need to fill a certain ratio. – Participant S

Diversity aspects race, gender don't care [...] we've got a pretty good balance. – Participant E

In Organisation A, Participant E who is from top management level believed that they had a good balance of the male to female ratio in their workplace. Within South Africa, a company must adhere to legislation and policies in terms of the employment quota for males and females being employed. From Participant Q's point of view within Organisation C, there is a balance between the number of males and females who are employed. At higher levels in Organisation C there is a balance of males and females with regard to other demographics (age, race) and the executive committee. There are now more females as opposed to ten years ago according to Participant Q. From this, it is evident that there has been progress in terms of employing more females and being inclusive of females at senior levels within Organisation C.

According to Participant K, Organisation B employs more males than females at the management level. For Organisation B, there is still a challenge in terms of the number males who are employed as opposed to the number of females on various levels of the organisation. From Participant L's viewpoint, in their organisation there are exclusively men at the executive level, and they are from particular age group, '45 and older'; although women are being employed, the progression is still slow. According to Participant L, the lower number of women employed could be due to insufficient experience and females not having technical and engineering qualifications. Three participants shared similar feelings about gender, and these were expressed and their observations were captured. The researcher understood that gender had no importance for Participant E, J and H.

There's no real difference between male and female [...] everybody is on the same level [...] there's no biological basis for it. – Participant E

Observation of Participant E: When the topic of gender was posed to Participant E, the participant seemed to not even want to acknowledge that gender was something of importance. This was conveyed as Participant E shook their head left to right, signifying there are no differences between males and females. When the participant mentioned 'there is no reason for it', Participant E's body language came across as a little bit annoyed when they explained that there was no basis for gender. From their facial expressions such as the pursed lips and skewing of the mouth, body gestures such as shrouding of the shoulders and Participant E the hand gestures it was evident that there was no interest that the participant showed on the topic of gender in the workplace, their facial expression further indicated that it was of no interest and made no difference to Participant E what gender one may identify with. The researcher then felt there was no interest as if the participant did not want to dwell on the topic, so the researcher continued with the interview.

Another participant felt that gender should not be a determining factor with regard to how a person interacts with or adapts to technology. This participant was observed virtually. Their tone of voice, high pitch, and the way in which the message was conveyed, confirmed to the researcher that gender played no role of importance to Participant J.

I'll be wrong to say that females or males are more dominant [...] when it comes to technology [...] because it's not a fair thing to say [...] the whole gender thing uh especially from a diversity perspective [...] I think it's more the [...] equality part [...] if somebody's good at what they doing [...] it's not based on gender it's based on skill [...] gender shouldn't be linked in my own opinion [...] to technology or any field of work or study. – Participant J

Observation of Participant J: Participant J felt that there should be no determining factor that a male and female is better at something. Participant J's tone of voice changed, and their voice became higher pitched when made mention of 'I'll be wrong to say that females or males are more dominant'. Participant J seemed to be frantic when gender was brought up, the words conveyed seemed to have an impact as there were pauses between mentioned sentences which the researcher felt. Participant J almost seemed shouting, however the participant has very loud, clear voice and perhaps to someone other than the researcher it may be presumed that Participant J seemed upset but was not. The participant was just trying to get their point across. However, the tone and pitch of voice lowered between mention of 'equality' and 'it's not based on gender it's based on skill'. Furthermore, when Participant J mentioned, 'Gender shouldn't be linked to technology in their opinion or any field of work or study'. It made the researcher believe that if observed physically Participant J would presumably have shaken their head and would seem to not be interested in elaborating further. However, this was the feeling assumed by the researcher. Participant J believed that gender is not a determining factor in their opinion should not play importance or linked to technology or any field of study or work and if someone is good at what they do it's not based on gender but skill from Participant J's perspective.

In an observation that was conducted at Organisation A, the researcher observed the behaviour of Participant H who responded to question: 'do you think in your workplace that there's a difference between the male and female role?':

No, I don't have issues. – Participant H

Observation of Participant H: The participant's body language (shook head) (side to side) and facial expressions showed no interest in the question as she mumbled 'no I don't have issues'. This made the researcher feel that the participant did not want to answer the question as they showed no interest on the topic. The researcher noted Participant H's body language showed the feeling of being uncomfortable and being eager to move on with the interview or rather change the topic.

Participant P and Participant N provided feedback regarding the number of graduates and female managers within their organisation. Participant P shared that the graduates that are currently recruited or employed are females, although the older generations have more males employed. Also, Participant P believed there will be change in reaching gender equality in the future. Participant P also viewed gender employment quotas to be industry dependent. However, Participant P expressed that both male and female can adapt to technology and both males and females adapt in one or more way. Participant N said that the higher number of males employed in engineering may be due to it to being a more male-dominated sector. The participant felt that the reason could possibly be that males have been employed for longer periods before women entered the workplace.

According to the various viewpoints there has been a progression in the employment of females. However, there is still room for improvement across all organisations and industries as females are still under-represented. Organisations need to create a culture that fully leverages the benefits of diversity where women and all employees feel comfortable conveying their unique ideas, perspectives, and experiences (Thomas, Cooper, Cardazone, Urban, Cardazone, Bohrer and Mahajan, 2021). The diversity trait of education will be presented next.

5.6.3 Education

Modernised workplaces continuously transfer knowledge and skills through education (Terziev, 2020). Formal educational is allegedly institutionalised training and needs compulsory education, with specific outcome certifying the learned competencies and skills (Dumitru, 2018). With informal learning, a person needs to feel inspired and self-

driven to acquire the information they are seeking (Gardner, 2020). Formal education and informal learning are both forms of education and will be discussed further. All the participants responded to the question ‘do you believe that obtaining a formal qualification is necessary in the Industry 4.0 era in your organisation?’

5.6.3.1 Formal education

The data exhibits the findings from each participants comments on the question posed with regards to education. The results were diverse. Table 5.1 indicates a tally where the researcher opted to depict the feedback from all the participants to assist the reader in order to improve their understanding.

Table 5.1 Feedback on if a formal qualification is necessary in the Industry 4.0 era

YES	NO	YES AND NO	OTHER
5	6	5	3
Participants: A,B,C,N,O	Participants: F,G,K,L,M,P	Participants: D,E,J,Q,R	Participants: H, I,S

Source: Authors own compilation (2022)

Table 5.1 illustrates the number of participants that responded to the question Number 4b on the interview schedule {Addendum D}. The participants who responded to the various feedbacks are mentioned in the column that pertains to the feedback they provided in Table 5.1. Table 5.2 that follows, sets out the meaning of the various responses captured in table 5.1.

Table 5.2 Meaning of answers

KEY	MEANING
Yes	Obtaining a formal qualification is necessary
No	Obtaining a formal qualification is not necessary
Yes and No	Obtaining a formal qualification is both necessary and not necessary
Other	Other beliefs on obtaining a formal qualification

Source: Authors own compilation (2022)

Table 5.2 indicates the key terms and their meanings to make it easier for the reader to understand what each key represents. Five participants stated that obtaining a

formal qualification is necessary. Six participants stated that it is not necessary, while five participants were undecided. The remaining three chose 'other' in their feedback. The researcher also included which specific participants felt a certain way, by including their pseudonym in Table 5.1. This allowed the researcher to gain perspective into their thoughts and the reasoning behind their thoughts. This will be discussed further in the analysis chapter. The data were vast, and the researcher thought to place the data in tabular form, for the ease of reading and to reflect which participant felt which particular way. Table 5.3 provides the feedback with regards to the confirmation that obtaining a formal qualification is necessary.

Table 5.3 Feedback from participants who said “YES”

PARTICIPANT	FEEDBACK
A	'Generally yes [...] in that industry software development [...] you have to have it to work in the industry [...] you need to definitely complete your degree because otherwise you scattered you all over the place'
B	'I'd think so I think even its [...] course [...] it's necessary to have the background [...] you can go and say okay I know the basics then we can focus on something more intricate for example'
C	'Yes I do think so because [...] I don't think you can replace education'
N	'I think that a formal qualification is a good start [...] the foundation will still be there so that I will understand how to design a building but the way in which I design it going forward will change [...] a formal qualification is necessary as a foundation, but I don't think that's where your leaning journey should end'
O	'Yes its important [...] to get educated [...] I strongly believe uh whatever you do after that then it's up to you but it's it's a good foundation[...] to be able to understand [...] something before even being implemented [...] a formal qualification helps a lot [...] the higher ... the level the more advanced I am in terms of [...] problem solving [...] having a degree [...] in the 4IR space [...] with the level of understanding that [...] I can implement some of those things or I can understand where they come from and [...] how they gonna benefit me [...] education helps a lot'

Source: Authors own compilation (2022)

Table 5.3 provided the participants and the excerpt from each conversation to illustrate why the participants confirmed that obtaining a formal qualification is necessary in the era of Industry 4.0. From this group of participants obtaining a formal qualification was deemed as necessary. This is because education is seen as the building block which is used to support employment (Hlobo, Moloi and Mhlanga, 2021). Education guides a person along a chosen career path. Some of the feedback from the participants was that the attainment of a formal qualification is a necessary foundation. This is because it allows a person to have the basic understanding or knowledge on a specific subject matter. Education is irreplaceable according to Participant C. Participant A believed that a degree will direct one's path and create focus towards the end goal. Table 5.4

will provide the feedback from the participants who said that it is not necessary to obtain a formal qualification in the era of Industry 4.0 era and their reasons for saying so.

Table 5.4 Feedback from participants who said “NO”

PARTICIPANT	FEEDBACK
F	'Personally, I don't think so [...] it's a lot of dependencies [...] if your lecturers are willing to help willing to assist you or not [...] I've experienced times where it's just me alone [...] and your lecturers are just like there's Google [...] and they not gonna sit with you and help you and do something'
G	"No not really [...] it's something that can be taught [...] with training programmes that companies offer [...] yes it could be a bonus to have a background knowledge [...] but I don't think it's completely necessary no"
K	"I don't it's not necessary no [...] you need to have knowledge so short courses are [...] Good enough [...] to understand"
L	'No because I think many of the companies [...] are adopting [...] self-taught self-learned [...] spontaneous learning that they've done [...] we have some companies that have enormous engineering teams with PhD's and Masters [...] and they haven't performed any better than the companies that don't have those kinds of people [...] it's got nothing to do with an educational I think people need to have like base level of skills you know problem solving , quality [...] I don't think a formal qualification has anything to do with it I think it's a calibre of leadership like the willingness to learn of the people on the shop floor'
M	<p><i>Participant L mentioned that "I don't think a formal qualification is necessary".</i> <i>Participant M therefore agreed with participant L's feedback</i></p> <p>'I am inclined to probably agree with that [...] we seeing Industry 4.0 sort of across all levels of the company so the adoption is equally as successful at sort of your top level and your lower levels which [...] indicate that the adoption at least isn't necessarily entirely down to formal qualification [...] it's down to leadership, implementation [...] the necessary support [...] when implementing those technologies to ensure they successful [...] so not necessarily directly linked to formal qualifications'</p>
P	'In the next three to five years I [...] definitely say no [...] because [...] technology [...] it's not only in the workspace [...] its pushing boundaries even outside [...] even learning a new skill [...] someone doesn't need [...] a formal qualification [...] you can upskill yourself just enrolling online or [...] going through videos'

Source: Authors own compilation (2022)

Table 5.4 provided the participants and their feedback on why they said that a formal qualification is not necessary in the era of Industry 4.0. This particular group of participants believed that a formal qualification is not necessary. Fisher and Gonzalez (2020) point out that qualifications are important but not as important as personal qualities and attributes. It is therefore necessary to differentiate between skills acquired through training and skills gained through experience (Fisher and Gonzalez, 2020). There are also dependent factors in terms of the assistance you may receive from universities, or the quality of the teaching received. Training or short courses can help someone to learn; it may be necessary to have background knowledge, but it's

not a deciding factor according to Participant G. According to Participant M there are other important factors such as leadership, implementation, support and the success achieved while implementing those technologies. Another participant believed that a person may be highly educated but perform at the same level as uneducated staff.

Performance is dependent on the skills one may possess such as problem solving, quality control, the calibre of leadership and the willingness of people to learn. Participant P also agreed with Participant L that upskilling oneself is important whether informally, through online courses or videos, or formally. Participant P predicts that there will be a change with regard to qualification requirements in the coming years. Table 5.5 provide the responses from the five participants who were undecided when asked whether obtaining a formal education is necessary in the era of Industry 4.0.

Table 5.5 Feedback from participants who said “YES and NO”

PARTICIPANT	FEEDBACK
D	'Yes and no [...] It's good to teach yourself things like IT [...] I'm for both with self-study but definitely for formal study as well'
E	'The only thing that a formal qualification does is it tells me you can put your butt in a chair and get something done [...] that you know how to learn okay it almost guarantees those two [...] functions the skills themselves a good portion the universities aren't teaching'
J	'There's is yes and no [...] obviously do you need a qualification it depends [...] on the work environment or application [...] of technology now in a workplace [...] industry training how do you now link yourself to it formal qualifications [...] will be sector based [...] everything has to be learnt [...] and the higher qualifications you get based on the economy and what the economy needs is important [...] so my answer to that is yes [...] no it depends on the application [...] then you need to reskill [...] I think education is a very important to this 4IR [...] because of the advancement in technology'
Q	'For me its two folds [...] sometimes peoples educational level does not maybe drive them [...] it's not a requirement [...] for their function but it does not stop the learning and ability of the person and [...] there's certain people that don't have a formal qualification but they understand [...] how to operate systems and [...] the smart phone content [...] they've learnt how to operate a computer they able to learn and they don't have a formal qualification [...] the formal qualification will be ideal uhm in order for them to grow but also [...] people have their own limitations [...] that also determines on what they their level of education and their drive to achieve a formal qualification [...] you can have the technical ability just by learning and if somebody teaches you and their inquisitive nature [...] to learn information and the willingness to be a student and to learn'

R	‘It’s obviously a stepping stone if I didn’t have my little diploma which now I think is void almost to it used to be equivalent to a degree [...] I would never be able to get a job but by the same token when I studied the majority of the stuff that I studied was outdated by the time I got to apply [...] but what it also did was it gave me the opportunity to learn how to see how to think and how to relate to things so I would say yes to a formal qualification I wouldn’t say like a five year thing maybe like a diploma [...] a short course that’s highly focused on inputs and outputs and getting you up to speed with somethings and then you can rather build on that because I think from what I read in the past by the time we finish studying even the textbook is outdated’
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Source: Authors own compilation (2022)

Table 5.5 provided the feedback of all the people that provided an undecided answer to the question posed and the reasoning behind their choice. The participants mentioned both that obtaining a formal qualification is necessary and not necessary. The future of work will not be about formal qualifications, it will be about job skills. Also, people need to navigate those people who do not have a formal qualification towards successful careers and increase diversity among their workforce (Kumar and George, 2020). Participant D leaned towards self-study, thus leaning to individuals taking responsibility for their own learning and progress. The type of education should depend on the industry in which a person is in. Participant Q believed that education is not a prerequisite as some people can operate systems without having a formal qualification, but the willingness to learn is important. Finally, Table 5.6 incorporates the last three participants that seemed unsure or really didn’t have a clean-cut answer.

Table 5.6 Feedback from “Other” participants

PARTICIPANT	FEEDBACK
H	‘It really doesn’t matter [...] if you have experience it also works [...] sometimes you can have the degree but not like you just unable [...] to apply what you learnt [...] you still need experience [...] a formal qualification doesn’t define a person [...] because now sometimes people when you don’t have a formal qualification be like they get sceptical about you’
I	‘I think the structuredness of [...] some of an institution [...] it builds your character [...] to get that kind of knowledge you can possibly get it from other places [...] so that’s why I said it’s kinda tough to make that kind of decision’
S	‘Sometimes the university is more concerned about pushing its own agenda [...] getting its own finances and their books in good [...] running it’s like a business where they trying to get profit because [...] very often students who theory knowledge but are not actually capable of working in a factory they come out thinking that someone’s going to be holding their hand trying to instead of them coming out and learning like I have [...] maybe its just goes to a generational gap [...] I’m seeing a trend that universities [...] with technical Technicon’s of education [...] they are pushing [...] as a student does their exponential learning immediately do their uh Bachelors [...] industry does not want a B.Tech student [...] without the experience [...] I know that industry does not really want a graduate with no experience’

Source: Authors own compilation (2022)

These participants' feedback revealed that one can have a qualification without being able to apply it to their work environment. Also, a formal qualification does not define a person. For Participant I, being at a university builds character. However, knowledge can be acquired from other sources. The data from these categories will be further discussed in the next chapter. The next categories are those that emerged from the data, namely the collaborative relationship between industries and universities, and informal learning.

5.6.3.2 The collaborative relationship between industry and universities

Industries have experienced three prior industrial revolutions, which have led to upheavals in all activities of human life, predominantly in the field of education (Gueye and Exposito, 2020). Universities have been the source of tertiary education for many years and there are different establishments locally and internationally. The integration of technology in education moves towards ultra-connected universities integrating people, robots, objects and services of learning (Gueye and Exposito, 2020). There are approaches to align workplace experience with education through internships, school-organised workplace experience and the integration of the workplace into school programmes (Fisher and Gonzalez, 2020).

The younger generation's transition from education to the workplace is of vital experience to ensure that graduates are employable (Fisher and Gonzalez, 2020). There must be collaboration between the industry and universities in order to produce graduates with the relevant skills, and the curriculum must reflect practical realities (Hlobo, Molo and Mhlanga, 2021). Participants indicated that universities in South Africa were inadequately collaborating with the industry regarding curricula and the practical exposure of graduates. The participants responded as follows:

There definitely needs to be more focus on Industry 4.0 at a university level [...] at university most of the work that you are doing is pen and paper [...] it is a great foundation but there also needs to be that element of moving forward and [...] when you leave high school and you go to university there's a big jump [...] and then also when you leave university and you start working there's also a massive jump and something needs to happen to close that gap [...] Industry 4.0 is the way to actually close that gap. – Participant N

There has to be that integration between [...] collaboration between universities [...] there's this divide [...] between universities Technicon's and TVET colleges [...] because it's seen there's no integration. – Participant Q

There's a lot of introspection a lot of things that I want the student to do that makes them useful [...] to the organisation the content I feel is quite lacking [...] secondly the I think there's gonna be quite a big shake up with Industry 4.0 as to how full qualifications are done anyway. – Participant E

I don't know how many academia that you have that are foreign or coming from other countries [...] but you'll find it's a big trend [...] and also from Africa [...] because they using antiquated teaching methodologies in university [...] that they not keeping up to the current trend of the sector. – Participant J

Our members will frequently complain about the misalignment between what particularly your grads coming out of TVET colleges and other tertiary institutions the skills and the knowledge and that they are entering the industry with versus what industry actually requires. – Participant M

Participant N mentioned that universities must focus more on teaching students about Industry 4.0. Furthermore, there must be an integration between the curriculum that the university teaches to their graduates and what is expected from them in the workplace. Some of the participants felt that the skills and knowledge that people bring into the industry are misaligned to the requirements of the needs of industry. A participant believed that the content from the university is lacking and the way in which qualifications are completed will change in the future. Two participants felt that the universities are interacting with the industry, albeit that the interaction occurs with larger companies. The responses were as follows:

There is that transformation there is sort of that integration [...] between universities and the working world [...] the curriculum of what is being taught there is that adjustment to so that it aligns. – Participant O

I think the universities are doing fine with it [...] they are moving ahead [...] universities are more ahead I would say and it's good [...] in terms [...] the interaction with industry its only starting now [...] there are universities assisting companies but mainly the bigger companies. – Participant K

There are still challenges for the collaboration between universities and the industry as they need to identify the best practices to follow in order to establish and sustain collaboration (Awasthy, Flint, Sankarnarayana and Jones, 2020). With the accelerated integration of technology with education, we must move towards an ultra-connected university integrating connected people, robots, objects and industry requirements (Gueye and Exposito, 2020).

5.6.3.3 Informal learning

Education is forever evolving, and this forces us to rethink what education really is all about. In Section 5.6.3.1 it is clear that a formal education is a good foundation to have. However, it is not completely necessary as there are other means to educate oneself according to the participants' point of view in this study (Table 5.4). Informal learning inspires people to be self-driven and to acquire information they need, which raises curiosity (Gardner, 2020). Currently, there are endless tools and instruments for learning that are readily available (Dumitru, 2018).

Informal learning allows a person to educate themselves through reading, watching videos and doing short courses or online courses. Informal learning can also be a form of formal education as universities do offer short courses to better equip people who require specific skills. The researcher took the opportunity to probe the participants with regards to self-learning and in terms of what can one do to upskill themselves in the workplace. In many of the interviews, the participants alluded to how they used the internet to upskill and self-educate themselves. In informal learning there are some forms of formal education, supported learning with small components which are structured in order to master a particular field of curiosity (Rogers, 2014).

There is vast amount of information on the internet, an individual will need to sort through what is relevant to the topic of interest on which they seek to self-educate through informal means. This could be done via online articles, YouTube videos, online blogs, and online videos among many other means to self-learn. Many participants talked of using YouTube videos as a form of informal learning. Here is some of the feedback:

You need to first identify the gaps [...] the nice thing about the internet is that you can find anything [...] on almost all subject matters [...] so there's an opportunity for you to [...] learn to [...] upskill yourself [...] through the information that you can get online and [...] videos on YouTube [...] you identifying the gaps and taking the necessary steps to [...] try and close those gaps. – Participant P

People need to be more open to the technology [...] you have difficulties [...] there's a lot of stuff on YouTube and Google [...] because you can find a whole tutorial on YouTube [...] or Google or Zoom for example [...] It's out there its available if you really interested [...] you find a way to learn you teach yourself and use it so I don't think there's any excuse [...] not to know. – Participant K

YouTube has changed our lives [...] training is so much easier [...] there's so much of content that you can find for free on the internet [...] it makes learning a lot more accessible and a lot more affordable for everybody [...] it's made learning easier but also its created [...] in a way it makes people feel that [...] because you watch a YouTube video on something doesn't make you an expert [...] you still need to do your due diligence. – Participant N

When people see things practically, they learn from it so there's certain videos that are helpful [...] there's certain videos that aren't helpful so depending on what you watch. – Participant Q

If you go on the internet there's a lot of YouTube videos [...] we have the tools to help us. – Participant B

YouTube is a video-sharing application which allows users to watch and collaborate with videos (Listiani, Suwastini, Dantes, Adnyani and Jayantini, 2021). YouTube is mostly free, but advanced functionalities are available on YouTube at a Premium level via smart devices (Listiani *et al.*, 2021). From Participant P's perspective, a person needs to identify areas where you need more information and then sort through the cast information or watch a video to inform you on what you are lacking. Participant K expressed that using informal learning platforms such as Google or YouTube can assist with your responsibilities at work as information is readily available.

Participant N mentioned that content or information is generally free on the internet and accessible. It has made learning via informal means easier However, you need to be cognisant that you are not an expert on the subject matter but have obtained more knowledge. Participant Q mentioned that there are videos that are beneficial and those that are not. For Participant B, the videos are tools to help them to become better at what they do and gain knowledge and insight into what they are trying to accomplish. Watching videos to upskill oneself gives you the ability to complete tasks quicker and gaining knowledge is an added benefit. YouTube is easy to access for most people and the information is readily available. Therefore, should you lack knowledge and have access to YouTube, there is no excuse to not learn. A person needs to take the initiative to learn and upskill themselves. Informal learning allows an organisation to remain relevant in today's shifting workplace and to be at the forefront of the succeeding generation of learning. It also allows an organisation to be well-positioned for success (Gardner, 2020). Whether a person choses formal education of informal learning as their preference, there is always the initiative that needs to come from a person.

5.7 CONCLUSION

The presentation of the data collected is divided into four themes: understanding the meaning behind Industry 4.0, the impact of technology, the challenges brought about by Industry 4.0 technologies in the workplace and the diversity traits. With the first theme, the data revealed that people understood Industry 4.0 and some did not have an idea of the terminology. The second theme presented the findings with regard to the impact that Industry 4.0 had on staff and the workplace, further dividing into remote working, the new normal for many people and workplace, and human interaction that has been absent in the workplace. The third theme provided the challenges that are brought about by Industry 4.0. These included the financial cost of implementing Industry 4.0 technologies in the workplace and the shortage of skilled employees who work with Industry 4.0 technologies. Finally, the last theme was that of the diversity traits namely, age, gender and education. The themes identified were all in line with the research objective of the impact that Industry 4.0 has on workplace diversity. The next chapter will provide a detailed discussion of the interpretation of the data.

CHAPTER 6: DISCUSSION OF RESULTS

6.1 INTRODUCTION

In the preceding chapter the data that were collected through semi-structured interviews were presented. The chapter reflected as much of the information that was gathered during the data collection process as possible. This was because not all of the participants provided permission for the transcripts to be added as addendums to the study document. The data encompassed the feedback from nineteen employees, from the three organisations within the Gauteng province that made up the sample of the study. These participants were a diverse selection of people from different backgrounds, age groups, gender groups, educational backgrounds and job titles in their respective organisations. Chapter 6 provides a discussion of the interpretation of data that were presented in Chapter 5. Chapter 6 also identifies the findings and the implications of the data collected for this study. The participants provided meaningful insights from the interview questions {Addendum D}. The researcher collected all the data, which were analysed by means of content analysis and grouped according to themes as presented in Chapter 5.

In addition to the semi-structured interviews, the researcher also observed the participants during the interviews. This was conducted by physically observing participants from one organisation by means of face-to-face interviews as well as virtual interviews that were conducted during the COVID-19 lockdown period. The observations during the interviews are illustrated in a box that contains the observational notes made during the interviews. A desktop literature review was conducted throughout the write-up of this dissertation. This was done to ensure that the researcher consulted sources that were relevant, trusted, acceptable and in-line with the policies and procedures of the university. It also ensures the credibility of the researcher's work. Therefore, data triangulation was achieved through using various sources of literature, interview data and observations to confirm the data that were collected. The data consulted and the data acquired by the researcher is relevant to the research topic.

The following were the research questions and the objectives for this study:

The primary research question of this study is:

How has the Fourth Industrial Revolution impacted the diversity traits of age, gender and education in the South African workplace?

The secondary research questions are:

- How do Industry 4.0 technologies affect the modern workplace?
- How do age, gender and education currently find application in an automated and technological workplace?

The objectives of the study :

The **primary objective** of this study is to explore the impact of Industry 4.0 on the workplace diversity traits such as age, gender and education in the South African workplace.

The **secondary research objectives** of the study were:

- to explore how Industry 4.0 technologies affect the modern workplace;
- to explore how age, gender and education currently find application in an automated and technological workplace

Figure 6.1 presents a schematic diagram of the layout of Chapter 6 and the sections thereof.

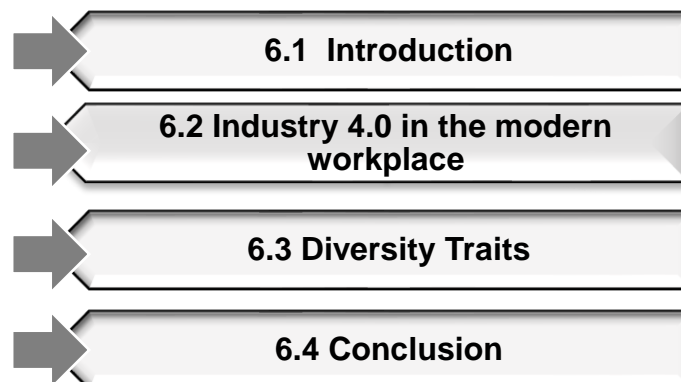


Figure 6.1 Schematic diagram of Chapter 6
Source: Authors own compilation (2022)

The analysis of the feedback from the participants is discussed in the following section in detail. The discussion in this chapter does not occur according to the themes and subthemes but according to the initial research question as well as the primary and secondary objectives of this study. The researcher will now discuss the findings from the data collected and the impact of Industry 4.0 in the modern workplace.

6.2 INDUSTRY 4.0 IN THE MODERN WORKPLACE

6.2.1 Impact of technology on the modern workplace

Industry 4.0 is the relationship between technological innovations connecting the real and virtual worlds through collaboration (Acioli, Scavarda and Reis, 2021), while integrating people, intelligent machines, smart products, production processes and systems (Pereira and Romero, 2017). It results in societal transformation by disrupting existing behaviours and economic life. It also alters how we learn, behave, communicate and relate to one another and our environments (Ross and Maynard, 2021). People interact with different types of technology daily. The participants generally understood Industry 4.0 personally and expressed their responses as they saw fit. Some responses were more technical, while others expressed a basic understanding. Nevertheless, participants were allowed to convey their personal understanding to set the tone for the rest of the interview. In understanding Industry 4.0, the researcher then explored the impact of Industry 4.0 on the modern workplace as the feedback from the participants spoke about how technology had impacted their own workplace.

The gradual impact of technology on the workplace has caused revolutionary changes over the years as outlined in Chapter 1, Figure 1.2. Participant I mentioned '*From the First Industrial Revolution and uh towards the Second Industrial Revolution [...] people went from building things manually to having machines build them [...] I feel that was the elevation of humanity [...] we no longer had to manually build something.*' Considering what Participant I said, the human race has moved from the manual filing of documents to online storage, from physical calculations to using software that computes for us, and from physical labour to having automated machines or robots to complete mundane and repetitive work tasks. Face-to-face physical meetings were replaced with online meetings via platforms that connect people despite geographical

boundaries. Therefore, there has been a noticeable move from manual labour to performing automated tasks. Technologies are therefore helping people to complete tasks of a better quality and faster, while enabling significant changes in the ways in which work had previously been conducted within the workplace (Cascio and Montealegre, 2016).

Technological advances allowed the workforce to access limitless volumes of online information and to conduct work tasks either in-person or remotely at anytime and anywhere (Johnson *et al.*, 2020). In fact, there is so much of information available that people may battle to make sense of it. Industries are under constant pressure to integrate emerging technology into their operations and processes to remain competitive. This change in the workplace was expressed by four participants. They provided an insight of how the workplace has changed from years ago until today.

It has been such a gradual process that I've not even feel it [...] there used to be copious amounts of paperwork [...] just laying around it was just so hard to get through the paperwork [...] now everything is so streamlined and digitised. – Participant A

Observation of Participant A: When Question 6 of the interview schedule {Addendum D} was asked, Participant A had to ponder on the point. The moving of the head to one side, the look of thought in their eyes and the slight nod of the head indicated that the participant was thinking about the point they were intending to make. The participant further emphasised and paused while saying the word 'uhm' also indicating the thought process. Thereafter, the participant mentioned that 'it has been a gradual process'. The tone of voice had a lowered register as the participant looked as if the change that technology brought was indeed gradually implemented so that participant A did not feel a difference. The word 'feel' was also highlighted and there was a slower tone of voice and the facial expression of slightly closed eyes indicated that there was not a major noticeable change that technology brought about. The researcher further noted that Participant A was a Gen X and they did not really experience the change that technology has brought. Furthermore, the participant used their hands to describe how the work has changed. They indicated that there used to be a copious amount of work by keeping their hands apart, indicating 'copious amounts', to placing their hands forward and closer together indicating a more 'streamlined approach'.

Participant A was from Generation X. This generation had not particularly experienced the change. It which was also noted in the participant's behaviour and body language during the face-to-face interview. A few other participants provided their input and illustrated by means of examples how the workplace changed and how technology has made their lives easier.

Look at documents [...] I can [...] complete a document and sign it off and send it through for signatures [...] Adobe allows you to sign a document it wasn't the case before and allows you also to add text to a PDF document so you find that there's less printing involved [...] you don't have to waste time running from one office to the other office [...] just sending an email to the [...] person also uses Adobe and sign on and [...] you spend less time trying to get signatures and more time doing work. – Participant O

The nature of the work that I do it has gone from [...] the hand calculations [...] drawing by hand now everything is done on a laptop [...] on the computers I'd say that's where I say Industry 4.0 is evident. – Participant P

We went from using like hand calculations where we would literally calculate things by hand using an exam pad [...] pen and page whereas now we've got all of these [...] structural modelling's software design software drawing software [...] really make our jobs a lot easier. – Participant N

The participants expressed that workplace changes were brought about by technologies. These changes range from manual interventions to now using technologically enhanced programmes or software to help aid with work tasks. From physically walking from one office to another for signatures to obtaining online signatures from fellow employees all contribute to getting the work approved and completed faster. Technological advances made it possible to move from tedious, time-consuming tasks to tasks that are completed quickly and digitally. In explaining these changes, technology has reduced the amount of time spent on mundane work tasks. Now an employee can spend time on other work tasks that can add further value to the organisation.

The above-mentioned interviewee's viewpoints lend itself to help understand the shift that the technological evolution has brought about in the modern workplace. Therefore, Industry 4.0 has significantly condensed the level of manual intervention by new computerised and interconnected technology (Cirillo, Rinaldini, Staccioli and Virgillito, 2021). The use of technological improvements and efficiencies meant combining resources such as man and material, safety, capabilities and profitability into the business structure (Maasz and Darwish, 2018), thereby, allowing the workplace to become more modernised. The incorporation of more digitally driven programmes and systems has inevitably resulted in faster completion times when compared to previous completion times, and the storage of work is easier and more reliable. Work stored on online platforms can be retrieved using different computers

and can be accessed from different locations. The backup of information is simplified, and knowledge management can be better coordinated. The researcher provided some excerpts from the interviews to shed some light as to how technology has impacted the modern workplace.

Technology makes life so much easier [...] the electronic stuff makes life so much easier for us and I'm sure we saving a lot of time [...] production is better. – Participant D

I think technology is there to make our lives easier that's why we [...] ad opt these different technologies and I think if people know how to use them then it can have a really big impact [...] on our efficiency as a company [...] Industry 4.0 definitely reduces inefficiency [...] it improves the overall way in which workplaces operate [...] reduce lag times you have smooth operations where there's more transparency. – Participant N

It's a smart way of [...] doing things [...] interacting with our equipment [...] remotely [...] we also be able to obtain [...] much more data [...] quicker [...] and integration of [...] systems [...] making it easier for use to work. – Participant O

Using technology [...] in the workspace to improve [...] the time how we deliver work. – Participant P

Embracing new technologies including things like Internet of Things uh using the cloud and [...] to compute and analyse and also artificial intelligence and machine learning in production facilities as well as things like ERP and our supply chain and customer service [...] it will be increased [...] automation and also help us to optimise our processes. – Participant S

With all the feedback presented, the data show that technology has indeed made our lives easier. It is everywhere in our daily lives, and we should embrace the change in order to remain relevant. This study could continue during the COVID-19 lockdown because the researcher was able to connect with participants using online platforms. All the participants mentioned in their own way that technology has in some way been advantageous in uplifting humanity and allowing change to happen. People have been learning to adapt to change since the earlier industrial revolutions. The difference in how we react to the change and how we choose to integrate changes remains an individual choice. Technology and the way we interact with our programmes, software, and work systems inevitably help us to grow and improve ourselves. It also pushes forward organisational and personal objectives. Technology has enabled more effective and efficient working methods and people need to adapt and get used to the modern way to conduct work. Technology sparks curiosity to learn to improve ourselves and we need to welcome the change to stay relevant. The workplace has

indeed become much more modernised and the way in which we carry out tasks has changed and will continuously change.

First Finding: Technology has enabled more interconnectedness in the workplace through modernised platforms and workflow processes that have reduced geographical and organisational distances and bureaucracy.

6.2.2 Robots and jobs in the workplace

Industry 4.0 has allowed for millions of jobs to be created, with new opportunities gratifying people's potential and goals (Ratcheva, Leopold and Zahidi, 2020). Nevertheless, to turn these opportunities into reality, innovative sources of data and inventive approaches to understand evolving jobs and skills are immediately required across the globe. There is also a global need to empower people to take effective action (Ratcheva *et al.*, 2020). When the word robot is used in this study, it is inclusive of robotics, automation and AI, related to Industry 4.0. Robots and jobs in the workplace have increased rapidly and this has changed how workplaces function. Through the years, human labour has evolved from physically completing work tasks like proofreading a document, bookkeeping or data entry, to being largely replaced by robotic machinery, AI systems or software. For example, today AI systems or programmes can assist in the workplace to make job tasks easier and less repetitive through automation. Some examples are proofreading software to ensure that the document produced is grammatically correct, accounting software or programmes to assist in transcribing or data capturing. Advancements in AI, robotics and automated technologies have propelled work being traditionally conducted manually to now being conducted automatically from anywhere at any time.

A robot is therefore an autonomous machine with the competencies to make decisions and execute actions in the real world (Guizzo, 2020). Pre-programmed robots, tele-operated robots, autonomous robots and augmenting robots, have already been incorporated into workplaces. These are being used in the workplace and in our personal lives. Robots have become the driving force of automation (Galin and Meshcheryakov, 2019). Organisations have introduced and integrated robots into their workplaces due to the fact that they are cost-saving, decrease inefficiencies are innovative, improve outcomes and can increase productivity (Smids, Nyholm and

Berkers, 2020; Harris, 2020). Media channels have used provoking headlines to communicate widespread apprehension about robots replacing humans in the workplace, with the intention to arouse interest and entice readership (Dahlin, 2019). Movies and literature generally portray robots as a destructive force for humans or friendly cohabiters. These are stories portrayed in a fantasy version of the future. Robots have come to interrupt our work rather than destroy our lives (Orduña, 2021). In other words, how work has traditionally been done is being changed through technology for greater output. While automation can reduce certain types of work, various new types of jobs are also created. Two participants have in fact mentioned the dramatisation created by onscreen movies of robots invading the world.

The robots are going to take over their jobs but that's what they see as you say on TV [...] it's not what's in reality [...] and we are far away from that where [...] that robots is gonna take over. – Participant K

I think people watch too many Hollywood movies and [...] dramatise that the robots are coming for us Industry 4.0 is about a human-machine [...] interfacing getting a machine to do rudimentary tasks that are inefficient when done by a human and where a human has a likelihood of making a mistake [...] it's going to change the way that humans are deployed on the shop floor there's going different kinds of jobs that they need to do but I don't think its going to be a direct replacement. – Participant L

Observation of Participant L: The participant mentioned that people watch too many Hollywood movies, and this made the researcher giggle. The way it came across amused the participant as well. The participant came across as unsure as to why people think that robots will come to take their jobs as this is not the case in Organisation B. The tone of voice was not initially serious but led to a serious more in-depth tone when explaining why robots taking over was not the case.

Participant L also expressed similar sentiments to Participant K. Participant L mentioned that people watch too many movies and dramatise that robots are taking over all the jobs as in their fields of work this is not the case. Participant K believed that we are far from robots taking over jobs and that robots, as seen on the television, do not reflect reality.

Industrial revolutions have shifted from manual physical labour to tasks completed by machines. It has led to machines eventually take responsibility for most of the jobs that are: challenging (robots used in medicine or for military tactics and for the assembly of motor vehicles); boring (cleaning an office can be done by a cleaning

robot); or dangerous for people (robots can be used in the diffusion of bombs) (Demir, Döven and Sezan, 2019). As the workplace becomes more modernised, increased applications of artificial intelligence and robotics, which are computer-based technologies, are used in the workplace. It has become a common occurrence (Borland and Coelli, 2017). Organisations and employees need to re-imagine new ways of working and how it will fit in with new workplace strategies and plans (Ross and Maynard, 2021). Automation is an advancement and a necessary revolution for industries to increase productivity and competitiveness. It should not be something to be afraid of (Badet, 2021).

The conviction that robots can complete tasks of a better quality than a human does not precipitate job displacement. This is because there are situations in which a robot and automation may displace an employee and in other cases it may not (Dahlin, 2019). Technology encourages people to improve their lives, it allows for better productivity, living standards and it raises the average life span. It also allows people to strive to attain personal fulfilment (Brown *et al.*, 2017). There is reason to believe that people are uneasy about the topic about the robots taking over jobs. Job tasks are changing and how we perform work is changing. Using modern ways of completing work tasks is necessary, but the issue of robots coming to steal jobs is exaggerated by media and film to entice people into reacting. In essence, humans are needed to assist with managing and supporting robots and there will always be a need for people in the workplace. There is a relationship that needs to exist between man and machine. There will not be a direct replacement but a change of a job role perhaps. Human error is real, and robots aim to eliminate errors and inefficiencies. There needs to be a collaborative relationship between humans and robots.

Organisations seek diverse people, with diverse interests and experiences, who add new insights to their teams. Whereas robots lack humanity, individual quirks and the rare and distinctive qualities that make people who they are (Orduña, 2021). Jobs with creative, intuitive and emotional labour are challenging to automate. Therefore, there is a need for a human-robot collaboration, where humans perform cognitively, or physically multifaceted tasks, while robots perform monotonous and easily automated tasks (Dahlin, 2019). This means that a working collaboration between humans and robots is needed in the workplace. There were participants who mentioned there needs to be a collaborative relationship between humans and machine.

We still trying to bring electric vehicles into the country and we still struggling with that [...] there are robots [...] working in industries but it doesn't take away the jobs [...] but people need to [...] because they (robots) also breakdown and [...] stop working and you need to program you need to set them up [...] they bringing a lot of uhm uh robotic intelligence robots [...] I guess its it's slow on the uptake but yah there is there is use of it and it is coming in slowly. – Participant K

So you've used your human-machine mix to optimise a better outcome for the company [...] it's not like they decided I'm automating this line I'll retrench these humans [...] because it would be impossible for their certain quality requirements a machine cannot tell the difference with [...] only a human can so I think it's unreasonable to say the robots coming [...] they going to take our jobs I don't think so I think they need to be leveraged in a smarter way to free up humans to make these more high-ordered decision making things that human that robots can't. – Participant L

Observation of Participant K: Once the participant mentioned that people watch too many movies, the participant then alluded to how people should not worry. The tone and register on the participant's voice changed, to a more serious tone and lower register and slower speech, saying that it is unreasonable to say the robots are coming. The way in which this was said made the researcher notice that the participant did feel that this was not the case and there should be no panic. Rather, Participant K believed that humans are needed, and robots are here to make our lives easier.

Participant K felt that even though there are robots in the workplace, people need to maintain and assist the robots when: they break down or; if there is a need for reprogramming; and to set up systems in order for the robot to function. People are needed to fix problems that occur as robots cannot fix themselves. Therefore, human intervention is needed. This is because there are certain qualities that humans possess that robots do not. The relationship between a human and robot can aid in reaching organisational objectives, given that these two components (man and machine) work together. However, humans will always be needed to create and manage the new technology (Arnold, 2018). As humans depend on the robot, so too does the robot depend on the human to be programmed and maintained. This is because the collaboration between the human and the robot is a sequence of shared actions towards shared goals (Weiss, Wortmeier and Kubicek, 2021). The human-robot collaboration creates a relevant factor in the industry for improving job performances and flexibility. It can only be attained with systems that are primarily safe, intuitive to use and easy to set up for human operators (Matheson, Minto, Zampieri, Faccio and Rosati, 2019).

There is a dependable relationship that exists between human and robots as they work alongside each other and depend on each other. This poses the question of how jobs, work and technology should be designed (Parker and Grote, 2022). For example, in the field of radiology medical diagnoses are increasingly automated via machine learning. However, employees are needed to order an X-ray, set the machine up to X-ray the relevant body part, talk to the patient and their family, and send a bill to the client (Parker and Grote, 2022).

Robots and the 4IR technologies have been created by humans. The point remains that there needs to be a human-robot collaborative workplace. Humans remain in control and technology provides what it is programmed to deliver (Arnold, 2018). There are financial, legal and ethical obstacles involved should an employee be replaced by a robot (Arntz, Gregory and Zierahn, 2016). Therefore, to contemplate that technology would replace the need for creative thinking, problem solving, leadership, teamwork and initiative is unthinkable as people need to leverage technology to thrive in a better world (Arnold, 2018).

Second Finding: Integrating robots into the workplace will require a change in organisational job functions, how work is performed and how people and machines will co-exist.

Some robots simply automate mundane and repetitive tasks, while other robots can run factories via remote interventions from people. However, robots can malfunction, and people are required to ensure that processes run smoothly. People also affect maintenance as required. Job automation has received much attention for many years (Omary, 2018). As the possibility of robots taking over jobs looms, some people may argue that robots may add to unemployment, whereas the counter argument is that new jobs that are created (Demir *et al.*, 2019). In essence, robots may take over mundane and cumbersome job tasks, allowing people to have time for tasks requiring creativity and higher cognitive thinking (Demir *et al.*, 2019).

Experts envisage that the development and quick adoption of new technologies, including AI and advanced robotics may have an impact on automation advances of jobs at an exceptional rate (Omary, 2018). Automation in the workplace may cause a

displacement of lower job functions as robots take over tasks executed by humans (Dauth, Findeisen, Suedekum and Woessner, 2019). There have been numerous articles and workplace discussions where employees and people are concerned that robots will take jobs. The argument to be made is that technology is reducing the number of jobs available; or that machines are rapidly substituting humans; and the rate at which job destruction occurs is requiring employees to churn between jobs at a faster speed than previously (Borland and Coelli, 2017).

Technologies that are labour saving such as computer-assisted machines and robots have moved production towards a more automated process. Industrial robots can now autonomously weld, paint, handle and package materials (Schmidpeter and Winter-Ebmer, 2021). The technological developments benefit employees by achieving new skills that are suitable. However, increased productivity through the use of robots may indeed lead to job losses (Hirschi, 2018). According to the World Economic Forum's 'Future of Jobs Report 2020', it was expected that 85 million jobs may be displaced by the transformation in labour between humans and machines by 2025. However, there may be the emergence of 97 million new roles (World Economic Forum, 2020, p. 29).

Technological trends drive the expansion of new job profiles, which requires upskilling of staff that training programmes should address (Pontes, Gerales, Fernandes, Sakurada, Rasmussen, Christiansen, Hafner-Zimmermann, Delaney and Leitão, 2021). Technological advancements may eliminate some jobs, cause changes to jobs or even cause the removal of certain current occupations (Hirschi, 2018). The extent to which the change will lead to an overall reduction of jobs is difficult to estimate. There is no consensus in literature on the effect to which digitisation and automation may have (Hirschi, 2018). Every past technological wave eventually produced more jobs than it destroyed. It also delivered improvements, from sophisticated living standards and life expectancy to productivity and economic growth (Reif, 2018). Automation and digital advancements are fundamental issues that shape future career choices, career developments and career counselling (Hirschi, 2018). In the workplace, job profiles are constantly changing, and, with rapidly changing technology, there are some job profiles that do not yet exist. Participant I expressed the following in their feedback, discussing the change of job profiles and the job profiles that are not yet in existence.

I had a discussion with one of my co-supervisors a couple of years ago [...] he said that he's almost worried for his kid in grade 1 [...] he said by the time he's at university [...] the jobs might want to grow up to do [...] might no longer exist [...] but new things might exist. – Participant I

With the introduction of [...] Industry 4.0 [...] some of the jobs are being deemed unnecessary [...] they being replaced by Industry 4.0 technology [...] jobs [...] it also made us [...] relook [...] what we call [...] a skill and [...] to hold onto to a skill if the same skills is being replaced by an introduction of some sort of technology [...] it has definitely changed the way we think and the way we look at jobs and [...] it's pushed us more into looking for jobs where we can achieve in technology and not be obsolete that it can be replaced by technology [...] they (people) need not to worry simply because I can imagine someone that was a postman once [...] and introduction of emails all this technology communication [...] there's always gonna be new jobs created with the introduction of technology so [...] now tech companies will employ lot of people and back then [...] people would assume there a lot of jobs they gonna evaporate and people will be left without jobs but actually there are more jobs created with the introduction of technology because [...] with technology to be monitored [...] you need to [...] make sure that it works, and the maintenance side is not really discussed but [...] it should be something that people are aware of, so they can see opportunities. – Participant P

Observation of Participant P: When the discussion ventured into robots taking peoples' jobs, the participant mentioned 'they need not to worry'. The participant further explained that how jobs have changed over time from a person being a postman to now where we receive emails and communicate via online platforms. The participant's tone of voice was very relaxed and low which came across as calm as if there was indeed no need to worry. Furthermore, the participant's speech pattern remained constant and at a slow pace; the participant came across as calm which made the researcher feel that there really was no reason to panic. Participant P explained that people have been going through changes and this revolution is another change that we need to get through, rather than fear it.

Participant P mentioned that skill is an important factor and where jobs have become redundant, new jobs will be created. Organisations need to bring awareness that there are jobs created with the introduction of technology. The Fourth Industrial Revolution provides further advances in scientific knowledge, human health and economic growth. It causes fear among people that current and future prospects of robots performing human jobs are concerning (Reif, 2018). People believe that a substantial number of existing job profiles which will be obsolete as a result of the technological changes. However, new job profiles will emerge (Pontes *et al.*, 2021). From a macro-economic perspective, wherever there are sectoral job losses, other sectors are being developed and contribute to wage growth and overall employment (Nugraha and Murniawati, 2021). Industry 4.0 technologies compelled by AI may possibly not lead

to large unemployment, but AI continues to modify the world and the way we work and live (World Economic Forum, 2020). Instead, AI technology has created further jobs than it automated (World Economic Forum, 2020). Two participants were very knowledgeable about Industry 4.0 as they worked directly with the technologies and also produced academic material with reference to 4IR. Participant E and I both had very in-depth and technical knowledge and expressed the following similar sentiments on augmentation.

The AI side [...] it's gonna be humans augmented with AI [...] not AI replacing humans [...] and support the robots [...] make sure the robot doesn't breakdown [...] there's still a huge amount of qualitative stuff that humans need to do [...] so here's humans for the cognitive reasoning and then use computers and AI's to do massive data crunching and augmentation of those people things are changing so flippin fast [...] that you gonna be learning for the rest of your life if you wana stay relevant [...] yes your job's gonna be replaced [...] but its gonna replaced with something [...] in some way it's not gonna be completely replaced [...] augmenting us its making our lives easier [...] that's what technology is for its for making humans lives easier [...] Industry 4.0 technologies are so popular that we always don't have enough people. – Participant E

The main goal is actually [...] to have people work more efficiently so I think that's like the end goal [...] a lot people think that stuff from Industry 4.0 is meant to replace [...] the idea is uh I think uh people who go to quick into the industry [...] assume that that's the end goal but that's not the end goal at the end of the day [...] it's to actually augment [...] and make people more uhm efficient [...] where the where the upcoming skills requirements is people that do quality checks people that understand uh what's outputs from data from data processing uh platforms are how to actually use that to drive strategy [...] so that's where we as humans also have to adapt [...] we have to augment ourselves to accept this technology as well to make our lives better. – Participant I

Participant E alludes to people working with robots and that humans will always be needed. People are needed to support the robots. Jobs might be replaced but not completely replaced. People will be augmented with AI and not replaced by technology. Technology is there to make our lives easier. People assume that technology is meant to replace jobs but according to Participant I that this is not the case. Technology is meant to augment people and humans need to adapt our skills accordingly. With the technological advances, organisations do not have another option. They have to change to adapt and to remain competitive in the marketplace. When an organisation implements new technology, its work processes are affected, and a new balance must be established (Furxhi, 2021). Should the change destruct

job security, it is highly probable that there will be resistance to change (Rodríguez-Abitia and Bribiesca-Correa, 2021).

Resistance to change is a resistance against losing something that is known by moving towards the unknown (Yılmaz and Kılıçoğlu, 2013). People are fearful of the unknown and job losses that could occur because of technological advancements. Therefore, there will be some resistance to change in the organisation. However, there needs to be a change in management processes to manage this resistance to change. This is because employees play an integral role in change management and employees are the main factor in change implementation (Furxhi, 2021). Employees have diverse education backgrounds and experiences. This impacts the way they accept change (Furxhi, 2021). Some of the participants mentioned that change is not always accepted in their workplace.

We often find that like on a yearly basis our software license will expire and I think specifically in my department say if there's one software that they will no longer renew and then they telling us now to use something else then there is sometimes a bit of resistance because people are used to doing things in a certain way and they don't necessarily want to change that. – Participant N

With a big company [...] they are not always willing to change they not always willing to try out new things when you [...] make certain suggestions it's like you know what this old this works and it's still working [...] and it's been working for us for forty years do we really want to change [...] people are still so so scared of technology they don't understand and realise technology can make your life so easy. – Participant D

Participant N explained that in Organisation C a simple change in outdated software that the employees were used to can cause resistance to change. This is because employees have become accustomed to the way the software worked. An update in that very software causes people to not be as enthusiastic about the change. People become comfortable and complacent in doing their job tasks. According to Participant D change is not easy to introduce in bigger companies. Even though there may be employee suggestions to better optimise work processes and try something new, it is not always well received. Some participants believed that we need to adapt to this change that technology brings if we want to move forward. Also, that we humans need to have the right attitude to change, or we will be left behind.

You gotta change with the times otherwise you stay behind [...] you go with it and whatever works it comes down to what works [...] and you adapt to what works [...] if you don't have the

attitude [...] of wanting to change and keep up with trends [...] you will definitely be falling behind at a rapid pace. – Participant C

Part of humanity we adapt we change [...] we see what are the trends where are the newest things are appearing. – Participant I

Automated machines and software can perform difficult tasks which people today may not be able to accomplish. However, people are needed for decision-making, problem solving, thinking out of the box, being imaginative and using ingenuity (Javaid *et al.*, 2021). Participant L mentioned that machines ‘*need to be leveraged in a smarter way to free up humans to make these more high-ordered decision-making things that human that robots can’t*’. The machines need to be used in smart ways and ways that are advantageous to us humans. People are needed for higher order thinking, whereas a robot cannot think for itself, it has to be programmed by a human.

However, the rapid improvements in robots’ abilities have fuelled apprehensions about the consequences of robot adoption for jobs (De Vries, Gentile, Miroudot and Wacker, 2020). Although robots have been used in manufacturing capabilities for several years, the use of autonomous robots that can be controlled remotely has received more attention in recent years (Pfeiffer, 2016). There are people and communities that welcome the opportunities created by the advancement of digital technology. However, the impact on the labour market remains a concern (Nugraha and Murniawati, 2021).

Although technology makes our lives easier, we have to upskill to retain our jobs and be employable in new jobs and roles. People need to not to fear but to understand and adapt to the modern workplace changes. The introduction of new skills and technologies occur more rapidly as opposed to a decade ago (Li, 2022). The top skills required include critical thinking, innovation, complex problem solving, active learning, analytical thinking, and skills in self-management such as stress tolerance and flexibility (Li, 2022). The participants mentioned that technology has modernised society and helped people work more effectively, allowing for the upskilling of staff. Participant G mentioned that technology helps people work more effectively.

It modernises us [...] helps us work more effectively. – Participant G

They have allowed for the upskilling of staff to integrate and use these technologies on a daily basis [...] allow companies to achieve new levels of efficiency, which creates the opportunity for growth, and thus employment and localisation. – Participant M

We need to now look at more skilled people or academically inclined individuals [...] so we have to upskill and [...] go out into the market and go and recruit [...] look at technology and you go back to your 4IR is where is South Africa compare to the world if you have to rank them from a technology perspective [...] that's why we bring a lot of expats into the country [...] in multinational companies [...] we borrow skills from other countries [...] innovation and creativity [...] and that's 4IR [...] be because the product that you making in traditional technologies are being disrupted. – Participant J

Integrating newer technologies into our daily lives allows companies and people to achieve better outputs and attain efficiency, as outlined by Participant M. However, there needs to be more skilled people employed and recruited in the organisation so that we in South Africa do not need to recruit from other countries as expressed by Participant J. The feedback all points to education and training that needs to happen in the workplace.

Third Finding: Robots will not take over jobs but will assist in workplace-related tasks. Job roles will change and continue to change as technology is updated. This necessitates continuous upskilling of staff in order to stay relevant and be able to adapt to changes.

6.2.3 Shortage of skilled employees who work with Industry 4.0 technologies

There is an increase in the need for highly skilled employees, leading to competition for top talent and an increasing income gap (Rodriguez-Bustelo, Batista-Foguet and Serlavós, 2020). With the progression of people's work skills, the future workforce aims to upskill and reskill endlessly as people advance in their careers and secure employment (Li, 2022). A study revealed that in large companies, senior executives believed that there is a need to rethink their role in helping employees to develop the right skills and meeting the need for upskilling (Illanes, Lund, Mourshed, Rutherford and Tyreman, 2018). With the rise of remote working, the future of work has lead teams to learn how to be more agile and adapt to ever-changing conditions. A formal qualification has become a virtual prerequisite for the jobs. But some skills are normally outdated by the time you finish a four-year degree (Kasriel, 2017). As technology and automation become fully integrated, eradicating skills gaps becomes an ongoing process and those gaps will continue to appear (Friedman, 2021). Identifying where upskilling efforts could be most useful and valuable could be done by engaging in a collaborative relationship with employees (Friedman, 2021). People's

longer life span impacts business models, talent ambitions and pension costs. Older employees must learn new skills and work for longer. The scarcity in economies that age fast initiates the need for automation and productivity improvements (Brown *et al.*, 2017).

Automation may displace particularly jobs with low-level education and/or skills that can be simply automated (Badet, 2021). However, there will be a creation of other jobs which requires higher levels of skills to be learnt (Badet, 2021). Therefore, education and training are very important in order to remain relevant in the workplace. Jobs that are newly created necessitate new skills and demand major investment in upskilling and reskilling the young generation and adults (Ratcheva *et al.*, 2020). Reskilling allows employees to acquire the knowledge and skills to assume different or completely new roles (Li, 2022). The challenge for the future is the alteration in required skills and knowledge rather than a noteworthy change in employment levels (Rodriguez-Bustelo *et al.*, 2020). Having an idea of where the skills gaps are and how to tackle them is essential to organisational success. This is because work will continuously be disrupted by changes (Crowley and Overton, 2021). However, skilling and reskilling are high on organisational agendas. Yet, there is still hesitation about whether learning professionals are equipped to respond to the gaps that have been identified (Crowley and Overton, 2021).

There is a mismatch between skills required for newer technologies and those being replaced. It presents a continuous challenge (Acemoglu and Restrepo, 2018). For instance, an automated car assembly line may replace an employee, but the employee may not simply be retrained to technically oversee that assembly line (Rodriguez-Bustelo *et al.*, 2020). Retraining employees with redundant skills sets are imperative. Many organisations do not undertake such retraining since the costs are considered externalities. Therefore, training employees may allow for organisations to retain many of the employees (Cardullo and Ansal, 1997). As 4IR technologies are reshaping job profiles, a visible increase in high-skilled activities exits while there is a noticeable decrease in the demand for low-skilled activities (Pontes *et al.*, 2021). Upskilling consists of attaining knowledge that help you to progress in your career. It closes the skills gaps. There are numerous digital tools that can be accessed online at no cost through YouTube videos, or one can invest in taking online courses (Orduña, 2021). Upskilling allows employees to achieve new skills to aid them in their existing job

responsibilities (Li, 2022). Participant N, Q, K and I mentioned that being upskilled is a necessity and expressed their views.

If a robot [...] can do your job then you need to be upskilled and it's not necessarily your place as the as the individual but it's the company's [...] responsibility to then upskill their workforce so if your implementing a system that [...] makes your operation more efficient go for it but for me there's always going to be a need to have a person there but maybe if someone is doing [...] data capturing [...] and [...] you get a system that can then do it easily quickly and then you eliminate the need for that persons job it doesn't mean that you eliminate the person and think that's where companies need to get onboard as well because they need to then upskill their workforce and focus on what they want the future of their business to look like when the world is not gonna be run by robots entirely [...] there's always [...] be a need for a human element it just means that someone whose job is redundant needs to be taught something else within the company to then create value for the company going forward [...] people need to be able and willing to adapt because everyone's jobs are changing. – Participant N

Somebody has to program that robot to do what it does and [...] that's why I say skills set come in [...] you cannot replace everything with robots because at the end of the day somebody has to maintain that robot [...] make sure that the systems are there so that's moving your skills set to a level where it will always be desired and [...] it's a lifetime process of learning [...] yes there will be job losses uh due to new technologies coming on but again we need to look at there's alternatives and what can be done to mitigate the job losses and there's full of some robotics or might be robots coming into play it might create a whole new maintenance department. – Participant Q

To be able to use that uhm that technology [...] the 4IR I mean if you read the material in terms of what the skills are required [...] you need to have have creativity [...] analytical thinking problem solving [...] decision-making [...] leadership skills [...] people have those things not like they don't have it [...] I don't think that's an issue in terms of that we always come up with these ah skills you need for 4IR [...] but you telling me people don't have uhm leaderships skills and [...] analytical thinking and creativity and all that people have those things its maybe some of the other things they might not have the technology skills [...] they might need some some teaching around how to use it [...] but I mean they have it. – Participant K

You have to upskill yourself [...] it's kind of bringing together [...] of people [...] very niche specialist [...] but also people who are jack of all trades. – Participant I

A company is responsible to upskill their employees as the business cannot be run by robots entirely. The human elements are important and redundant jobs will be phased out. People will need to acclimatise to changes and acquire new skills in order to adapt to different job roles. The participant also alluded to that sometimes a system is being implemented that eliminates a person's job. But it does not necessarily eliminate the

person as the person can be upskilled or trained for a different role. Participant I indicated that job changes will be there and what may not exist now will exist in the future. The main goal of working with robots is to help people work more efficiently. New job roles will be created with the introduction of technology.

People must not become comfortable in their positions and must continuously learn new skill sets. These participants believed that acquiring new skills and reskilling oneself are important for the Fourth Industrial Revolution. These participants expressed that a person needs to be upskilled in order to stay relevant. Education and training are important factors to assist with skills development. The employees that may be replaced can be retrained and upskilled. They can also self-educate themselves.

Diverse authors had diverse opinions regarding the future of employment with robots, AI and automation. However, robots, AI and automation have replaced some jobs but simultaneously created additional jobs as well (Badet, 2021). Investing in high-quality, holistic education, and upskilling opportunities paired with multisector initiatives prepares society for the future while embracing the benefits of AI (Ratcheva *et al.*, 2020). People who wish to participate fully in the future workplace need the opportunity to develop their skills. This will create an inclusive, sustainable economy and society where no person is overlooked (Li, 2022).

As the industrial revolution has evolved over the years, the skills required to conduct tasks have also evolved. Some skills have become redundant while others become valuable and 4IR brings with it the replacement of jobs and skills (Maisiri, Darwish and Van Dyk, 2021). A skill is a physical task which helps a person to perform one or more job tasks. Skill allows you to apply knowledge and use skilfulness when completing work (Alhosani and Ismail, 2021). As newer technologies are introduced, different skills are required (Li, 2022). Organisations need to focus on skills training and upskilling the existing workforce to ensure the organisations' competitive edge (Mehta and Awasthi, 2019).

It is essential for organisations to understand the connection between trends, job profiles and skills training programmes which encourage the creation of a reskilled workforce (Pontes *et al.*, 2021). Human skills must be adapted to the changing work requirements as a result of the implementation of new technology (Golsch and

Seegers, 2021). The responses from the participants echoed that skills need to be taught, be it by the organisation, universities or self-education. They also alluded that people needed to be upskilled, trained and retrained in order to remain employable.

The first thing is to define and find resources and build that capacity to try and get the right structures in place [...] where we have the skills sets [...] we find ourselves short and we don't have the skill sets that's when we look to [...] outsourcing [...] pieces of work that where we specialised work and we don't have the skill sets within the organisation [...] we try and bring that from an external market be it in a contract or be it on an ad hoc basis to try and close that gap so the long term would be is to [...] have all the skills that you need in the organisation and try and cover those gaps by using people from the outside market. – Participant Q

We need to now look at more skilled people or academically inclined individuals [...] so we have to upskill and [...] go out into the market and go and recruit. – Participant J

Industry 4.0 clearly the people that are currently employed in the organisation do not have the relevant or the appropriate skills to embed the technologies and leverage that so they have to invest in reskilling upgrading [...] peoples skill sets but also [...] restructuring the hierarchy of roles and responsibilities [...] we see them (companies) spending their skills spend and sending people to technical skills. – Participant L

Proper training programmes for upskilling the workforce are required as technology developments impact job profiles and skills (Pontes *et al.*, 2021). As technology progresses, some people are vulnerable to apply for jobs due to a lack of the appropriate skills and others are afraid of low-skilled jobs being threatened by automation (Li, 2022). This results in skills gaps which are unavoidably increasing. Employees at risk of losing their jobs must learn new technology and be willing to acquire the skills required for future employment (Li, 2022). People themselves must take responsibility for their own learning and embark on self-learning initiatives to upskill themselves so that they remain relevant and employable.

Fourth Finding: As people are retrained and upskilled, more jobs can actually be created instead of being lost.

6.3 DIVERSITY TRAITS

The diversity traits for this study were inclusive of age, gender and education. Diversity recognises that all individuals are unique and embraces these differences. For this study, diversity traits are the characteristics that a person possesses. The researcher will discuss the three chosen diversity traits in order as mentioned and discussed in detailed in Chapter 3, Section 3.7 of this study.

6.3.1 Age in the workplace

The workplace has become more diverse over the past few decades with growing employment of diverse employees in several sectors of the economy (Hauret and Williams, 2020). Everyone possesses their own strengths and skills. Everyone learns how to harness their strengths and skills to improve themselves in the workplace (Poirel and Coppola, 2021). The modern workplace embraces a workforce from diverse generations (Calk and Patrick, 2017). This is because technological innovation within the workplace has compelled different generational cohorts to work together. This has permitted intergenerational knowledge transfer and cohesion. Managing age diversity to support the technological innovation has become progressively imperative (Mothe and Nguyen-Thi, 2021).

Organisations must encourage employees from different age groups and backgrounds to collaborate to maintain productivity and innovation (Poirel and Coppola, 2021). Diverse variables may be impacting the use of and engagement with technology. One of these factors is age and people are divided according to their age into generational cohorts (Calvo-Porrall and Pesqueira-Sanchez, 2020). Cohorts are groups of people born in similar periods and journey through life together (Schewe *et al.*, 2013). Generational cohorts' personal experiences provide a way to understand how different people interact with differing lifestyles and people's interpretations of the world (Dimock, 2019).

The generational cohorts that the researcher identified in Chapter 1 were: Baby boomers (born in 1946-1964); Generation X (born in 1965-1978); Generation Y / Millennials (born in 1980-1994) and Generation Z (born in 1997-2012). Older employees possess skills and intelligence leaning towards communication and problem solving. The younger generation is technologically inclined and possess technical skills. This allows the younger and older generations to exchange

experiences and types of knowledge while learning from one another (Mothe and Nguyen-Thi, 2021).

6.3.1.1 Younger generations in the workplace

Organisations need to persuade different age groups and backgrounds to work collaboratively in order to maintain productivity. The pandemic has forced employees to be flexible and resilient. Their organisations needed to support their employees by grabbing the opportunity to help them thrive, in all their diversity (Poirel and Coppola, 2021). The younger generations in the workplace are Millennials and Gen Z. These two generational cohorts have grown up with technology and are comfortable with technology. Appelbaum, Bhardwaj, Goodyear, Gong, Sudha and Wei (2022) expressed that there is a stereotype that the older generations are not as comfortable with technology as compared to the younger generations. This could be a potential obstacle to employment. For example, Gen Z takes shortcuts by leveraging technology to achieve desired goals (Chillakuri, 2020). Gen Z learnt the desired skills that are pertinent to their job and are conscious of the fact that keeping up with technology requires ongoing learning (Chillakuri, 2020). The younger people were born and raised in a fully digital environment (Rodriguez-Abitia and Bribiesca-Correa, 2021) with access to all types of information, thus adapting quicker to technological changes. Today everything is at our fingertips, as opposed to years ago one needed to wait for an updated version of an encyclopaedia or wait for the latest news from a printed newspaper.

During the past decades, the way in which people have been trained and educated has undergone a transformation due to digital technologies (Insights, 2019). To grasp how the younger generational cohorts are adjusting to the change, Figure 6.2 demonstrates who the generations believed are responsible for preparing Millennials and Gen Z for Industry 4.0. The two generational cohorts expressed who they thought are responsible in preparing Millennials and Gen Z for Industry 4.0. A total number of 16425 people were surveyed for this study across countries and territories. Millennials believed that 30% of organisations are responsible for preparing employees, followed by educational institutions with 24%. Gen Z's stated that colleges, universities, secondary and vocational schools are at 36%, and then employers at 25%. Gen Y and Gen Z agree that individuals can learn through self-education and continuous

professional development and that government is least responsible for developing employees.

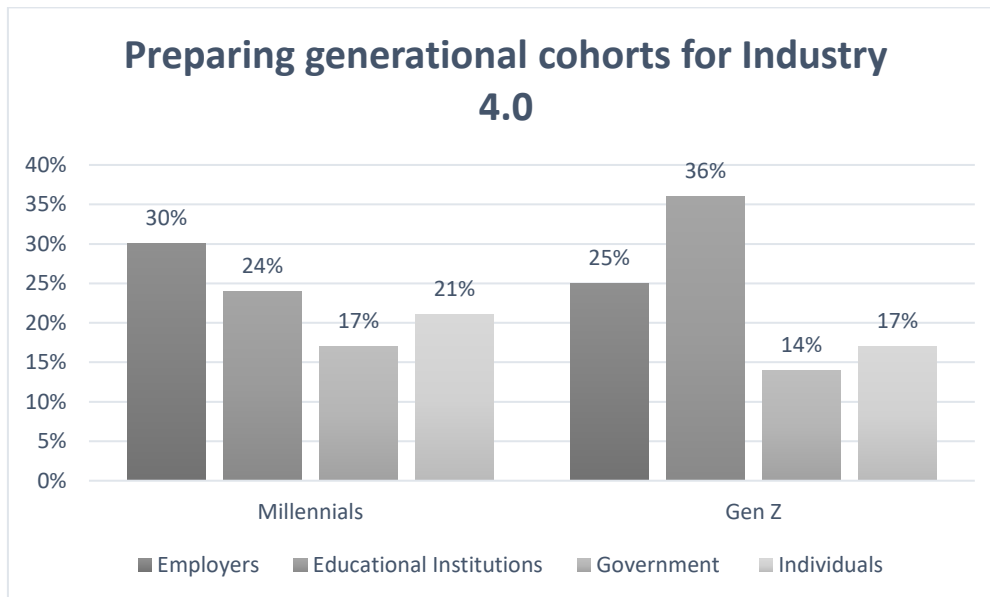


Figure 6.2 Preparing generational cohorts for Industry 4.0
Source: Adapted from Insights (2019)

From Figure 6.2, there is a difference of opinion between young employees and older employees regarding their work roles and developing talent for Industry 4.0. Approximately one in five respondents believes that they have the skills and knowledge they will need for a world being shaped by Industry 4.0. Seventy per cent said that they may only have some or few skills required and will need to advance their capabilities to increase their value (Insights, 2019, p.13).

Each generation brings unique viewpoints, expectations, patterns of learning, sharing of knowledge and their own workplace cultural norms (Deluliis and Saylor, 2021). The younger generations were born into a digitalised world and learnt how to use a smartphone before they have learnt to read or write. In contrast, the older generations used digital technology in their midlife. They had to adapt and learn new skills to be able to perform work tasks at a much later stage in their lives (Pásztor and Bak, 2020). The older generations have experience, knowledge and intuition with regard to work tasks. They may not have had the internet, but they have worked hard to develop skills, re-innovate themselves and continuously evolve as technology does. The older

generations can impart knowledge to the younger generation. However, there needs to be a mutual respectful relationship when one generation learns from another, in the same as when diversity brings together diverse people, viewpoints, opinions and backgrounds.

The researcher set out to allow people from different age groups to participate in the study. However, due to the difficulty of COVID-19 and the organisations having different age groups, the researcher opted to interview those who were able and willing to participate. Gen X, Millennials and Gen Z's expressed their viewpoints on how the younger generations adapt to technology. Table 6.1 indicates the eight participants' generational cohort and the direct excerpts from the interviews conducted.

Table 6.1 How do the younger generations adapt to technology?

PARTICIPANT	EXCERPT
<p>Participant C Gen Y</p>	<p>'Millennials and the newbies and Z (Gen Z) [...] they are a lot more and up to scratch with what's happening [...] technological wise as to the uh baby boomers'</p>
<p>Participant J Gen X</p>	<p>'The younger generation if [...] the millennium guy [...] they would take faster to change'</p>
<p>Participant S Gen X</p>	<p>'The Gen Z's that are now entering the marketplace [...] these kids grew up with cellphones in their hands and are more open to technology [...] we need to be mindful of that that we have different age groups in our workplace and all of them will react differently in uh with Industry 4.0'</p>
<p>Participant N Gen Y</p>	<p>'The younger side of the spectrum and I think that in general I think that my age group is a lot more able or willing to grasp these new technologies [...] we (millennials) grew up with technology [...] if we looking at Gen Z entering the workforce their mindset is very different [...] they are definitely tech tech-savvy'</p>
<p>Participant Q Gen X</p>	<p>'The younger generation coming in [...] you'll find that they are more keen in willing to embrace those technologies and they more willing to learn about those technologies'</p>

Participant M Gen Z	'Your younger generations are more quickly able to adopt, understand and fully utilise new technologies'
Participant H Gen Z	'Majority of the people here (at Company A) are youngsters [...] so we don't I just feel like when it comes to that there's no issues'
Participant E Gen Y	'20 to 30 tend to be quicker on the technology [...] 30 to 40 no issue'

Source: Authors own compilation (2022)

The eight participants reflected in Table 6.1 indicated that they felt that the younger generations tend to adapt easily to technology and the change that technology may bring. These generational cohorts expressed that the younger generations adopt technologies easier as opposed to the older generations. This is because Millennials have grown up with technology and learnt to adapt quicker. The excerpts are testaments to their feelings on the matter. Gen Z's are people who do not know a world without the internet or even a smartphone. The participants revealed that the younger generations adapt easily to change, they are quicker with technology and the younger generations do embrace technology.

Due to the ageing workforce and technological changes, there is a need to capture their knowledge, meet the changing needs of the multi-generational workforce and handle information overload. Technology assists employees to find what is required in order to work faster (Hamburg, 2019). Nevertheless, people need to be mindful of the different generations in their workplace and they must try to work together to achieve the organisational goals. Being diverse lends itself to bringing differences into the workplace that need to be accepted and acknowledged. Appelbaum *et al.* (2022), mentioned the stereotype that older generations are not as comfortable with technology as the younger generations. The interview data actually confirmed this sentiment which will be discussed next.

6.3.1.2 Older generations in the workplace

With a growing number of older employees in the workforce, cultivating an age-friendly working environment becomes increasingly important (Yeung, Zhou and Chong,

2021). The older generations referred to in this study are Baby Boomers and Generation X. With the impressive improvements in health and mortality of people, people are allowed to work longer surpassing the accepted retirement age. Older employees have been left behind by the demand and requirement for new skills as opposed to their current skills, which were cherished when they started their careers (Li, 2022). Braga (2016) expressed that the different generations brought their individuality into the workplace. Younger generations are more technologically aware as opposed to the older generations who thrived when technology was less important. The following participants from the aforementioned generational cohorts provided their feedback with regard to the older generations in the organisation:

It does come down to a person-to-person thing but I think that there is a difference in a way that different uh generations actually respond to change and respond to new technology. – Participant N

I think especially younger people [...] but people under forty might definitely be interested in it and [...] with students well they very intent to ask about this and they quiet positive about it so yes I definitely think it could work the older people that obviously haven't had uh a good experience with computers yet uh and obviously this is gonna be even worse for them in my opinion but [...] If you've got a basic understanding of what what it entails and how you fit in to it and how it will actually allow you to grow. – Participant R

You need simplicity well when it comes to the maybe the earlier age groups. – Participant I

These viewpoints indicated that it may be a mindset and not an age factor. People need to want to interact with technology. Therefore, it is a personal thing and a mindset. The person must learn and adapt to the changes occurring daily. The older generations contribute specialised knowledge and skills that were developed through experience. Therefore, the older generations are leaders and mentors for other more inexperienced employees (Hecker, Spaulding and Kuehn, 2021). The older generations are more hands on. They believe skills and knowledge can be acquired (Appelbaum *et.al*, 2022). Even though the older generations believe in their abilities, they are assumed to be resistant to change (Harris, 2015). The older generations do not want change to take place in the workplace as it will alter their typical working day (Li, 2022). With the data collected, participants expressed that the older generations were indeed resistant to change by expressing:

The older generation [...] do not embrace change [...] as we do [...] it makes it a bit difficult, but they are very informed [...] about how to do things. – Participant O

Observation of Participant O: Participant O paused many times and was stammering with words of **uhm** and **uh**. Even though the older generation according to this participant do not embrace change, the older generations are very informed. The tone of voice changed and the speed at which Participant O spoke increased as if to indicate that the researcher should not get the wrong idea. Even though the older generation do not embrace change, they are informed, and the participant emphasised the point to the researcher. The participant went on to give relative examples of how the older generations do not embrace change to make the researcher understand the reasoning behind the resistance to change. This interview was done virtually but the way the participant came across made the researcher believe that they were not being harsh towards the older generations. They wanted to justify why there is resistance from the older generation.

The Boomer generation are quite resistant to change [...] they are not always willing to change especially if they've been doing something a certain way for more than twenty years however [...] there are a few people that are actually [...] they trying to be tech-savvy and they are willing to learn and they want to [...] stay on top of the game for as long as they can [...] the majority are a bit resistant to change there are obviously those that are willing to stay on top for a longer times and be relatable to the different generations. – Participant N

Generation X uhm these older people you will find a lot of resistance from these people [...] these are people that came from the former apartheid regime where they were educated in Bantu education [...] and they have been trained on the job [...] and they have the fear of losing their job. – Participant S

If I'm in a workplace and an older employee whose closer to retirement if you bring in new systems and thinking and technology where he's set in his ways right he would he would take longer to change because [...] you have old-school thinking. – Participant J

Participant N, a Millennial believed that there are older people who want to change and learn, but the majority are resistant to change. From the perspective of Participant S, who was a Gen X, alluded to the fact that, in South Africa, the older generations formed part of old school education, and the older generations have been trained on the job. The older generation fear losing their jobs and they are set in their ways and are therefore resistant to change. This was also the sentiment of Participant J, Gen X, in saying that the older generation have old-school thinking and ways of doing things.

The researcher found that even though Gen X is from the older generation, they felt that the older generation (Baby Boomers) are resistant to change. The Millennials felt the same when they look at the older generations such as the Baby Boomers and Gen X. These participants felt that the older generation are indeed resistant to changes within the workplace. The researcher added in further observational notes to justify

why the participant felt the way they did. The older generations have been working for a long time and they conduct work in a specific way, having adapted to workflows through experience and proven results. Even though there may be resistance to change, there have been some participants who had a different explanation. They mentioned that older generations resistance to change might be due to their different backgrounds or having to deal with constant changes all the time. The younger generations have been living with technology and using technology throughout their lives, so it is easier for them to adjust to keep abreast of the new technology. Organisations need to include older, experienced and knowledgeable employees when creating opportunities for young employees. In this way they will not alienate the older employees who need to also feel included and required in the modern workplace (Poirel and Coppola, 2021).

Fifth Finding: Older generations are resistant to technological changes, but they should not be alienated because of their vast knowledge and experience.

6.3.2 Gender in the workplace

The researcher explored gender within the workplace. Gender during the past industrial revolutions has indeed changed from the norm of only referring to two genders, male or female, to gender being on a continuum. Presently gender is anything a person may identify with including gender neutral, pangender, genderqueer, transgender, non-binary, agender, two-spirit and all or none or a combination of these. Some people may identify themselves as a man, woman, others may identify as neither, both or somewhere in-between (Zambon, 2020). The participants who participated in this study either identified as male or female when asked the question of which gender they identify with; this was before the interview began. For the purpose of this study, the researcher identified gender as the personal feeling in which people had identified themselves. The gender of a person was noted to be whatever a person personally identified as, and the researcher ensured that she remained unbiased and open to any person who identified as whatever gender they felt comfortable with. During the discussions the researcher noticed that the participants brought the subject of gender and the gender ratios in their workplaces in South Africa to the fore.

Currently in South Africa the country is still failing to overcome gender inequality in the workplace, and it is one of the major hindrances regarding female development (Musetsho, Isac and Dobrin, 2021). The Employment Equity Act (No. 55 of 1996) in South Africa was employed to address inequalities in the workplace, such as gender inequality (Musetsho, Isac and Dobrin, 2021; South African Government, 2023). However, gender stereotyping persists in spite of the provision of equal opportunities in the workplace (Tabassum and Nayak, 2021). The South African labour market is more advantageous to men than to women. Men are therefore participating in the labour market at a higher rate as opposed to females (Statistics South Africa, 2021). Figure 3.5 in Chapter 3 illustrated the participation rate of males compared to females in the labour market, indicating more males as opposed to females.

In this study the researcher found that gender was not viewed as a determining factor as to how people interact with the technology. Within South Africa, all companies need to adhere to the principle of equity, as the principle upholds and protects women's rights and forbids discrimination on the foundation of gender {Constitution of the Republic of South Africa, 1996} (South Africa Government, 2023). Therefore, each company needs to be cognisant of the employment ratio of men compared to women. The interviewees revealed that their organisations needed to be compliant with the laws and regulations of the country. This compliancy was expressed by Participant R and Participant S. Their view was that the male to female ratio in the organisations was compliant with the laws of the country. However, Participant S did mention women tend to stay in more traditional roles and men were in more technically inclined job roles.

At the moment we more than compliant [...] it's mostly uhm I don't know if I can say its black females [...] so with a smaller company they also focus on compliance but [...] most of the companies they actually comply [...] the majority of engineers were male. – Participant R

There is a quite a good balance [...] of male female [...] its quite balanced because obviously our companies are working, we are government and we need to fill a certain ratio [...] my company that's fine but when you go into factories you do see [...] for instance more men in the factories [...] and if women are there they are more assigned the more traditional kind of roles. – Participant S

Furthermore, the data revealed that women occupied fewer posts than men at the higher levels of the organisation. Participants pointed out that this is still a concern.

Our sector I think is pretty traditional [...] the gender spilt is you see at an executive level almost exclusively men [...] they also of a certain age group [...] I'd say they probably like 45 and older [...] we seeing women in the sector tend to progress quite quickly through the ranks but you kinda get stuck at this like senior executive level and they don't seem to go any further that maybe just a factor that they don't have enough years of experience maybe the challenge but also the thing is a lot of the women in the sector are not in technical engineering roles in our sector [...] the participation of women in the automotive sector as whole apparently about 35% of [...] staff in the sector are female [...] they have to make more of a concerted effort to integrate more women and people of colour into their companies. – Participant L

There's a number of senior positions occupied by uh female employee in the organisation [...] We see there's a lot more female employees at an EXCO level than it was ten years ago. – Participant Q

Management level is uh there's more male's [...] than females [...] why is that I'm not sure but [...] they were looking at bringing in more females [...] in terms of management [...] there is still uh challenge there's more male than female. – Participant K

Engineering as a whole is still very much male dominated [...] I wouldn't say its necessarily equal [...] there are quite a few females specifically within engineering [...] there's definitely more males uhh it could be that people have been in those positions for a longer time [...] very much male dominated previously and a lot of our managers are fairly old [...] like in their fifty's so obviously at that time there were not so many females in the industry so it could be as a result of that [...] we do have some female managers but it's very few. – Participant N

The participants mentioned that males occupying senior roles in the organisation were confirmed in the analysis by Statistics South Africa. In Figure 6.3 there is a representation of the participation of male to females who occupy job positions at top management level.

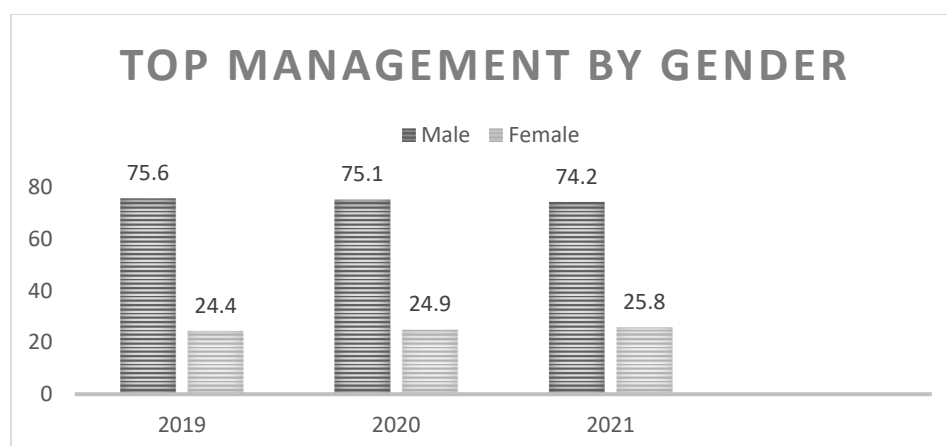


Figure 6.3 Top management by gender (2019 to 2021)
Source: Adapted from Statistics South Africa (2021)

Figure 6.3 illustrates the trend analysis in the top management occupational level with regard to gender from 2019 to 2021. From this illustration it is clear that males have dominated the occupancy of top management levels by a far higher percentage than women. There had been a minor increase in female representation at the top management level, causing a 1.4% increase from 2019 to 2021. This minor increase indicates that women remain under-represented at the top management level which raises concerns on gender equality in the workplace. Figure 6.4 illustrates senior management with regard to gender.

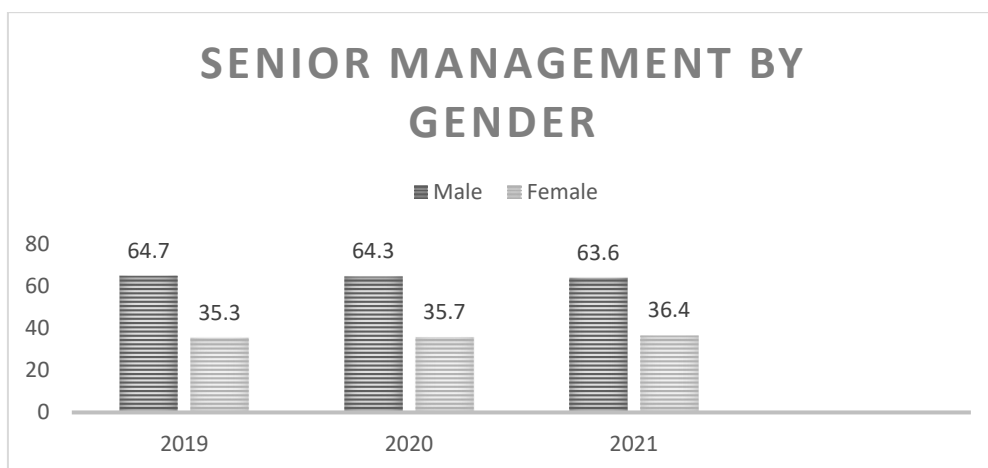


Figure 6.4 Senior management by gender (2019 to 2021)
Source: Adapted from Statistics South Africa (2021)

Figure 6.4 shows females who are still underrepresented at senior management level. There is a gradual increase of less than 1% of female representation, whereas male representation remains to be dominant at this level and remained consistently above 63% from 2019 to 2021. With Figure 6.3 and 6.4 it is easy to conclude that males dominate positions on higher levels and more attention is mandatory to reshuffle and try to get the female ratio to an acceptable level. With these reports it's clear there is gender inequalities. However, the responses from the participants pointed out that there are more males in positions at higher levels. However, their organisations are trying to incorporate more females into the workplace and on management levels.

Then participants shared that there are still more males than females and that more men occupy positions at higher levels in the organisations. However, the data indicated that there is still gender inequality in the workplace. It is visible in the form of a higher number of males working at the three organisations that formed the sample for this study. Also, there were more males employed on senior level and top-level

management positions in South Africa. The researcher uncovered through the data that females are being recruited and are being employed in the three organisations as per the South African legislature. This is to ensure equality in the workplace.

In summary, regarding gender in the workplace for the three organisations, participants expressed that their companies are trying to recruit more females and manage the gender imbalance. The data revealed that the gender roles in senior and top management positions are male dominated.

Sixth Finding: More males occupy positions at higher levels in organisations as opposed to females. This indicates that there is still gender inequality at higher levels in the sample organisations.

Technological changes could expose new opportunities for men and women in the labour market and help to create gender equality (Golsch and Seegers, 2021). However, there is very little theoretical and empirical knowledge about whether men or women perceive technological change at work differently (Golsch and Seegers, 2021). The researcher observed the behaviour, tone of voice, speech pattern and body language during the discussion on gender. The observational notes concurred that the participants were uncomfortable with gender. Through their facial expressions, body languages, gestures, tone of voice and voice patterns it was clear that gender was no issue. The following participants shared their thoughts on gender in the workplace.

There's no real difference between male and female [...] everybody is on the same level [...] there's no biological basis for it. – Participant E

Observation of Participant E: When the topic of gender was introduced to Participant E, the participant seemed to not even want to acknowledge that gender was something of importance. This was conveyed as participant E shook their head left to right, signifying there are no differences between males and females. When the participant mentioned, 'there is no reason for it', Participant E's body language came across as a little bit agitated when explaining that there was no basis for gender. Their facial expressions such as the pursed lips and skewing of the mouth, body gestures such as shrouding of the shoulders and their hand gestures signalled disinterest in the topic of gender in the workplace. Their facial expression further indicated that it was of no interest and made no difference to Participant E what gender one may identify with. The researcher then felt there was no interest as if the participant did not want to dwell on the topic, so the researcher continued with the interview.

Participant E felt there was no real difference observed in their organisation and no real significance of gender in relation to technology. The participant's body language and facial expressions indicated that the participant was really not interested in the topic and that it was of little importance. There is no 'biological basis' for the interaction between gender and technology.

One of the best engineers that I ever worked with [...] she was really good engineer [...] and until today if I really have an issue she's one of the people I would call up [...] I've worked with females even one of the biggest companies that I've worked with that got the main liaison [...] is a main technician which is a female and she's got a very good technical understanding but she's hands on she doesn't mind getting hands her fingers dirty and stuff and wearing safety shoes so I think there's a good penetration of [...] females uhm in industry.– Participant R

Observation of Participant R: The participant struggled to answer questions regarding gender. It came across as they did not want to talk about it and their expression via the virtual meeting was that of confusion, as if it made them uncomfortable. This was expressed in verbal pauses and uhm's that they expressed, their tone of voice changed and the participant spoke slower, stammered and stuttered. Participant R expressed that they had learnt a lot from a female and still does. Participant R mentioned that their mentor was a female, indicating that gender was not a determining factor for this particular participant. The participant came across virtually as if they would have been baffled by trying to discuss the topic of gender.

Participant R was from an older generation. The participant was lost for words when discussing gender. There were long pauses between their feedback and the speed at which they replied was slower as opposed to prior feedback. There was an uncomfortable energy that was felt and that came through during the discussion as the participant was not keen on the topic of gender. The participant therefore related gender to a person who they look up to and a female that they regard as a liaison. The participant explained this to let the researcher know that they are not discriminative towards females.

I'll be wrong to say that females or males are more dominant [...] when it comes to technology [...] because it's not a fair thing to say [...] the whole gender thing uh especially from a diversity perspective [...] I think it's more the [...] equality part [...] if somebody's good at what they doing [...] It's not based on gender it's based on skill [...] gender shouldn't be linked in my own opinion [...] to technology or any field of work or study. – Participant J

Observation of Participant J: Participant J felt that there should be no determining factor that a male or female is better at something. Participant J's tone of voice changed, and their voice became higher pitched when made mention of 'I'll be wrong to say that females or males are more dominant'. Participant J seemed to be frantic when gender was brought up, the words conveyed seemed to have an impact as there were pauses between mentioned sentences which the researcher felt. Participant J almost seemed as if he was shouting. However, the participant had a clear voice and perhaps to someone other than the researcher it may be presumed Participant J seemed upset but was not. The participant was just trying to get their point across. However, the tone and pitch of voice lowered between the mention of 'equality' and 'it's not based on gender it's based on skill'. Furthermore, when Participant J mentioned that gender should in their opinion not be linked to technology or any field of work or study, it made the researcher believe that if observed physically Participant J would presumably have shaken their head and would seem to not be interested in elaborating further. However, this was the feeling assumed by the researcher. Participant J believed that gender is not a determining factor and in their opinion should not play an important role or be linked to technology or any field of study or work. If someone is good at what they do it's not based on gender but on skill.

Participant J was a person who said and expressed their feelings. Even though this was a virtual conversation, the researcher observed through participants J's expression that a lot of feeling and emotion could be gathered on the topic of gender. As indicated in the observational notes Participant J deeply felt that gender should not be a determining factor for anything.

No I don't have issues. – Participant H

Observation of Participant H: The participant's body language (shook head from side to side) and facial expressions showed no interest in the question as she mumbled 'no I don't have issues'. This made the researcher feel that the participant did not want to answer the question as they showed no interest on the topic. The researcher noted Participant H's body language showed the feeling of being uncomfortable and eager to move on with the interview or rather change the topic.

Participant H was a person with very little facial expression and showed no interest in the topic of gender. Participant P expressed that they have not really noticed a difference as to the way the genders may interact with technology. Participant P mentioned that in their technologically driven environment, they have not noticed a difference between the males and females.

*In an engineering environment [...] its technology environment [...] people there already not to hesitant [...] whether they male or female [...] to be honest I haven't noticed much in terms of differences between [...] genders [...] both gender group to adapt [...] more or less similar way.
– Participant P*

With regard to gender in the workplace as per the feedback collected during the semi-structured interviews and the observational notes, the certain conclusions were drawn. The researcher concluded that gender was not a determining factor for how a person interacts with technology, or a significant factor that is being considered in the workplace. The diversity trait of gender had no significance in relation to technology as to which gender adapts better. However, the conversation did swerve where the participants discussed the ratios of male to female employees in the three respective sample organisations.

Seventh Finding: Gender was not a determining factor as to which gender adapts better to technology.

6.3.3 Education in the workplace

Employees with little education and qualifications may face declining employment opportunities (Arntz *et al.*, 2016). It is assumed that employees with lower education have a lower ability to cope with technological change (Omary, 2018). Curriculum reform and skills training programmes are often suggested as being critical for providing opportunities in the world of formal employment (Buchanan, Allais, Anderson, Calvo, Peter and Pietsch, 2020). Employees whose jobs are susceptible to automation are at risk of facing wage or job losses as a result of technological change (Zeyer-Gliozzo, 2020). As the labour market requirements are constantly changing, individuals are dependent on the qualifications attained after a formal tertiary education (Popovic, Relja and Gutovic, 2017). A quality education can nourish an individual's cognitive, interpersonal and intrapersonal capabilities. Education permits for producing a population of well-educated people as well as established domains of expertise and the provision of quality credentials that help coherent educational and occupational progression (Buchanan *et al.*, 2020). Education and further training are important elements in the workplace which can help employees keep abreast of technological changes, new qualifications and task demands (Zeyer-Gliozzo, 2020). Participant G and Participant J shared their views on education and training.

With regards to education and the knowledge in how to use the technologies [...] I feel like it's something that can be taught [...] to the people especially with training programmes. – Participant G

Companies need to remain at the forefront of the industrial revolution so you cannot do it without with some form of training [...] whether it's formal or informal but there must be some sort of qualification that you get [...] everything has to be learnt [...] and the higher qualifications you get based on the economy and what the economy needs is important [...] then you need to reskill [...] if we doing a new computer system that needs to advance payroll [...] so they'll go to that service provider who's basically selling the system [...] and they will offer that type of training and they reskill the person on a new system [...] I think education is a very important to this 4IR [...] because of the advancement in technology [...] are we training people for what the economy needs [...] we not. – Participant J

Participant G felt that education, knowledge and how to use the technologies can be taught and can be done through training programmes. According to Participant J, 4IR companies need to remain at the forefront and training is an important aspect. Whether it is informal or formal there must be some sort of qualification that one obtains. However, Participant J believed that the company is not training people for what the economy needs.

Education has shifted from traditional classroom education to the use of more online platforms and classes that can be conducted via video conferencing by means of Zoom and Google Meet (Pandey and Pal, 2020). Online teaching has further increased during the COVID-19 pandemic. The COVID-19 pandemic has challenged organisations as well as learning and development to step outside their comfort zones; to be inquisitive; and embrace innovative ways to deliver learning with high impact for the digital age (Crowley and Overton, 2021). Demir *et al.* (2019) believes that there will be issues pertaining to the acceptance of robots in the workplace. The education and training of employees is one issue. Also, the workplace needs to be redesigned so that robots to can be integrated into it. Training is essential when new technologies are implemented in the workplace as it ensures people are empowered and comfortable with the new technologies to complete daily tasks (Zeyer-Gliozzo, 2020).

Organisations are investing in innovating learning technologies. They are pursuing an alignment between learning and increasing the value that these technologies may add (Crowley and Overton, 2021). Even though robots have existed in the workplace for some time, the workplace will continuously need to be redesigned to accommodate these new types of co-workers (Caymaz, Demir and Meral, 2017). Additionally, jobs comprising of repetitive tasks are more susceptible to automation and do not require

a high level of education, as opposed to jobs that involve more thinking and creativity (Badet, 2021). Training and education of employees will be an indispensable step in adapting to robots in the workplace (Caymaz, Demir and Meral, 2017).

The people entering the workplace need to be adaptable, committed to being educated by taking online classes, attending seminars, watching relevant videos, listening to podcasts, reading books or completing traditional advanced degrees (Arnold, 2018). Decades ago, a college degree was a concrete foundation for a person to be hired (Orduña, 2021). Nowadays, that foundation is the starting point. To be a competitive contender, you would need to acquire and learn the most recent skills, tools and digital trends relevant to your field of work (Orduña, 2021).

Participant L mentioned that there is no necessity to have a formal qualification, but there needs to be continuous self-learning and the willingness to learn. Participant L believed that having a degree does not set you apart from the rest. This is because a person with a degree or an advanced degree does not really, in their opinion, perform any better than a person who may not have obtained an educational qualification. The cost of training employees and retraining employees will be less than having to rehire and retrain other potential employees. Throughout the organisation there needs to be continuous learning opportunities with the objective to instil a culture of lifelong learning and openness to transformation (Rodriguez-Bustelo *et al.*, 2020). The Fourth Industrial Revolution allows for producing a unique life-long learning system that warrants a future ready workforce (Li, 2022).

I think many of the companies are adopting it a lot of it is self-taught self-learned [...] spontaneous learning that they've done [...] we have some companies that have enormous engineering teams with PhD's and Masters [...] and they haven't performed any better than the companies that don't have those kinds of people [...] it's got nothing to do with a educational I think people need to have like base level of skills you know problem solving , quality [...] I don't think a formal qualification has anything to do with it I think it's a calibre of leadership like the willingness to learn of the people on the shop floor. – Participant L

When we look at dynamics of South African economy we have a lot of semi-skilled workers in the country and by using automation we are actually taking away jobs from the semi-skilled, so Industry 4.0 is something good, but we have to actually remember that we need to educate our people something good, but we have to actually remember that we need to educate our people [...] there is also a possibility there will be resistance to training of new technology as people are afraid technology will take away jobs. – Participant S

Preparing people for future work is crucial. It is necessary to creating awareness among employees about the challenges and opportunities offered by automation. Therefore, continuous training and education with regard to the new requirements in their workplaces are essential (Rodriguez-Bustelo *et al.*, 2020). Technological breakthroughs, automation, robotics and AI are progressing to shift the nature and number of jobs accessible (Brown *et al.*, 2017). Omary (2018) believed that the answer to the advancement in technologies is education. Additional learning would keep employees a step ahead of automation. However, it is not clear that acquiring education on its own, will be enough for people to survive the threat of job losses due to automation (Omary, 2018).

I think people are panicked about it for sure [...] but it's not necessarily what we've been seeing on the ground when we've been going and implementing Industry 4.0 technologies is not the case where now suddenly seeing the mass retrenchment of shop floor staff. – Participant M

Participant M expressed that a demand has been created for skills that is needed by Organisation B. Participant M runs a programme at Organisation B that recruits people with the skills required by the organisation in order to remain ahead of their competitors in their already competitive work environment. There is a noticeable gap between the knowledge and skills acquired through formal education and the requirements of the labour market (Popovic, Relja and Gutovic, 2017). Having a formal educational qualification is not the only necessary form of education there is. There has been an accelerated need for graduates with training in specific specialties (Omary, 2018). Therefore, there is a need for lifelong learning in various forms, be it formal, informal learning or non-formal education (Popovic, Relja and Gutovic, 2017).

Robots allow for humans to be productive when compared to previous times. It is essential that employees develop technical skills and retain skills by keeping their skills constantly updated as there is continuous technological change (Arnold, 2018). Therefore, education plays a crucial role in the new jobs that ultimately leads to automation. The value of skill depends on the quality of the educational system (Badet, 2021). An inconsistency will exist between skills and technologies if the educational systems are not up to date with the skills requirements that new jobs require (Badet, 2021).

There has been limited research with regard to the magnitude in which training actually helps employees to change their job task content. This increases their

complementarity to computers and reduces their risk of being replaceable (Zeyer-Gliozzo, 2020). Informal training revealed that those types involving media use are most relevant. Further training is relevant for employees whose jobs are at risk of automation in order to keep up with technological changes. However, not every form of further training appears to be helpful (Zeyer-Gliozzo 2020). Automation is not a threat, but rather an advantage. This is because employees and potential employees should prepare themselves by focusing on the kind of training and skills development that new technology may require (Badet, 2021). The participants of this study mentioned the importance of training and why it is needed in the modern workplace.

If you know how to use it (technology) and what you have to do with it but if you haven't been exposed to it [...] you need training and its learning process so it can have its negativities [...] it can either help you be more efficient [...] or it can actually take up some time because of that training aspect. – Participant F

Even though [...] the technical qualification does not meet the explicit requirements and they going to have to do a lot of their own training on on the shop floor [...] its absolutely critical [...] young people need to be smart enough to pick skills that are generic enough that they have a broader application [...] so they were taking previously retrenched workers from the auto sector training them in new technical skills and then trying to place them uhm in a new role. – Participant L

I think all staff if they get trained properly and they understand the what the what the output of the training is supposed to be or the goal and they can relate it to something and then they are interested they add value [...] when employees understand their job and they understand how it helps them to become better and also that's it's a sellable asset. – Participant R

In your management positions it should be important that you actually have a formal qualification on how to do Industry 4.0 [...] when it filters down to the shop floor level [...] like training and on the job training becomes more important [...] I will never ever put experience down the drain [...] when you actually think about putting in newer technologies into uh a factory we need to be reminded that we have the human factor there that needs to be trained and also that there will be resistance to training because also we also have this perception when robots take over the world we going to lose our jobs [...] we have to actually remember that we need to educate our people. – Participant S

Automation will take jobs away from semi-skilled people and there is a necessity to educate people on Industry 4.0. [...] this comes back to [...] having awareness or training uhm to people [...] especially for for environments that are are going through this technological changes [...]

there needs to be more awareness to people to say this is what's coming [...] otherwise people are always going to be afraid. – Participant K

Training can have a positive impact in terms of what one may know. But then there's the negative part where it can be time-consuming in terms of the time taken to train and learn. Participant L mentioned that even though a person may have a technical qualification, a person needs to advance their skills and learn generic skills applicable to their sector of work. If a person wants to have a basic understanding of technology and what it entails, training is necessary. Participant R's responses indicated that having training experience can create opportunities and develop highly technical and specialised people. There needs to be awareness around Industry 4.0 technologies. It is necessary to train people when their workplaces are going through technological changes. There needs to be an awareness of the technologies that are currently in use and those that may be introduced in the future or else people will be afraid. Training and education are required in order to upskill and reskill employees in the workplace.

Formal education is known to be a college degree. In contrast an informal learning is when learning is conducted through other means such as viewing videos, self-study, reading online articles or interacting with online sessions or classes. Formal and informal learning are dissimilar methods of learning: both have their unique values and functionalities and their limitations (Rodgers, 2014). Industry 4.0 skills requirements mandate a reconsideration of the importance that is attached to qualifications attained from technical and vocational institutions (Maisiri, Darwish and Van Dyk, 2021). For this study, the researcher posed the question of whether the participant believed that obtaining a formal qualification is necessary in the Industry 4.0 era in their organisation {Addendum D}. From the data collected it was clear that five participants acknowledged that a formal qualification is needed in 4IR. The participants who mentioned that a formal qualification is needed in the era of the Fourth Industrial Revolution consisted of: one person from Gen X; one person from Gen Z and; the remaining three were from Gen Y.

From this analysis, it was noted that Generation Y/ Millennials felt that obtaining a formal qualification is necessary to have in this modern day. These participants believed that having a formal qualification was a good foundation to have and you can use this qualification in your line of work. The participants expressed that having a

formal qualification guides you into the path of career that you have chosen. Furthermore, it gives you an understanding of the potential work field and having the education can allow for a better understanding of these technologies. For instance, Participant N, a Gen Y, expressed that a formal qualification is a good foundation to have. However, that is not where learning should stop.

I think that a formal qualification is a good start [...] the foundation will still be there so that I will understand how to design a building but the way in which I design it going forward will change [...] a formal qualification is necessary as a foundation, but I don't think that's where your leaning journey should end. – Participant N

With the participants from the **'No'** category, the majority of the participants were from the younger generations and only one person was from Gen X. Even though there are so many other ways to upskill and educate oneself, the participants felt that a formal qualification is not needed in the 4IR space. Six participants mentioned that it was not needed. Participant G expressed that a formal qualification is not necessarily needed and that things can be taught via training programmes which a company may offer. However, it is necessary to have some background knowledge, but a formal education is not a necessity.

No not really [...] I feel like it's something that can be taught [...] with training programmes that companies offer [...] yes it could be a bonus to have a background knowledge [...] but I don't think it's completely necessary no. – Participant G

The **'Yes and No'**, category of people consisted of four participants from Gen X and only one person was from Gen Y. From these participants' perspectives a qualification is needed but is not necessary. This is because it forms a foundation for a particular field of work. According to these participants learning and educating oneself can be also completed through other avenues. These include short courses, online sessions, reading academic or magazine articles, taking an online quiz on a specific subject and the list goes on. A person may obtain a formal qualification. But as time goes on and the world changes so does the knowledge produced and required. So a person will continuously need to upskill, reskill, retrain and re-innovate in order to stay relevant. Participant Q, for example expressed that a formal education and an informal education is necessary, but you can learn via other means.

For me its two folds [...] sometimes peoples educational level does not maybe drive them [...] it's not it's not a requirement [...] for their function but it does not stop the learning and ability

of the person and [...] there's certain people that's don't have a formal qualification but they understand [...] how to operate systems and [...] the smart phone content [...] they've learnt how to operate a computer they've learnt you teach them they able to learn and they don't have a formal qualification [...] the formal qualification will be ideal uhm in order for them to grow uhm but also [...] people have their own limits and limitations [...] that also determines on what they their level of education and their drive to achieve a formal qualification [...] you can have the technical ability just by learning and if somebody teaches you and their inquisitive nature [...] to learn information and the willingness to be a student and to learn. – Participant Q

Finally, there were three participants who had other viewpoints on whether a formal education is necessary or not in the 4IR space. These participants were from the older generation (Gen X), and the younger generation (Gen Y). For example, Participant H mentioned the following:

It really doesn't matter [...] if you have experience it also works [...] because sometimes you can have the degree but not like you just unable [...] to apply what you learnt [...] you still need experience [...] I just feel like a formal qualification doesn't define a person [...] because now sometimes people when you don't have a formal qualification be like they get sceptical about you. – Participant H

The researcher conveyed the data collected about formal qualifications in Tables 5.3 to 5.5 in Chapter 5. Each table consisted of the feedback from each participant as collected by the researcher. With regard to a formal qualification the researcher asked prior to the interview if the participants possess an educational qualification. Eighteen participants possessed a formal qualification, and one person did not. The nineteen participants expressed their views concerning a formal qualification. In essence, a formal qualification is a good foundation to have. However, there are other avenues to learn and acquire knowledge, through online videos, podcasts, short courses and many more. In today's age, people felt that with the internet there's so many free resources available to upskill yourself and there is no reason that a person should lag behind. This is because you could potentially upskill yourself where you feel you have shortcomings. A person needs to have the desire and willingness to learn as well as upskill themselves. They must continue to self-learn and self-educate.

6.3.3.1 Informal learning

Education is forever evolving and forces us to rethink what education really comprises. Therefore, an informal education also allows a person to educate themselves. The researcher took the opportunity to probe the participants with regard to self-education

and what can one do to upskill themselves in the workplace. In many of the interviews participants alluded to how they used the internet to upskill and self-educate themselves. By identifying the gaps, you will be able to sort through information that is relevant to you and what you trying to accomplish. Participants alluded to using YouTube as a form of self-education. Here is the feedback received:

YouTube has changed our lives [...] training is so much easier [...] there's so much of content that you can find for free on the internet [...] it makes learning a lot more accessible and a lot more affordable for everybody [...] it's made learning easier but also its created [...] in a way it makes people feel that [...] because you watch a YouTube video on something doesn't make you an expert [...] you still need to do your due diligence. – Participant N

You need to first identify the gaps [...] the nice thing about the internet is that you can find anything [...] on almost all subject matters [...] so there's an opportunity for you to [...] learn to [...] upskill yourself...through the information that you can get online and [...] videos on YouTube [...] you identifying the gaps and taking the necessary steps to [...] try and close those gaps. – Participant P

People need to be more open to the technology [...] you have difficulties [...] there's a lot of stuff on YouTube and Google [...] because you can find a whole tutorial on YouTube [...] or Google or Zoom for example [...] It's out there its available if you really interested [...] you find a way to learn you teach yourself and use it so I don't think there's any excuse [...] not to know. -- Participant K

When people see things practically, they learn from it so there's certain videos that are helpful [...] there's certain videos that aren't helpful so depending on what you watch. – Participant Q

If you go on the internet there's a lot of YouTube videos [...] we have the tools to help us. – Participant B

The YouTube application has become a primary application which is generally pre-installed on smartphones, iPads, computers and televisions. This video streaming service allows a person to watch anything and everything you can possibly think of from data sources from all around the world. Participants mentioned that training is now easier as you can simply watch a video pertaining to what you wish to learn. Video content and knowledge are easily accessible and mostly at no cost. The onus is on people to upskill themselves and to learn what they can. They can get information that pertains to their job or general information that is accessible from YouTube, mostly for free, but it may also attract a cost (Listiani *et al.*, 2021). Watching videos to upskill oneself gives a person the ability to complete tasks quicker and gain knowledge at a time

that is convenient to the individual. Self-education is an important factor to consider. It aids in education and the drive to acquire knowledge. Continuous training and competence development in the Industry 4.0 does exist; however, it is uncertain what kind of knowledge, learning and competency development programmes should be in place to appropriately contain and respond to the transformative effects of Industry 4.0 (Rangraz and Pareto, 2021).

Eighth Finding: A formal qualification is a good foundation to have. However, you can self-educate through other informal avenues by having the willingness to upskill yourself through online resources.

6.3.3.2 The collaborative relationship between industry and universities

Industry 4.0 brought forth the requirements of upskilling, re-qualification, and changes in job profiles (Geraldes *et al.*, 2021). Education is guided by the demands of the world of work, which almost all educational institutions have addressed (Nugraha and Murniawati, 2021). Universities and academic institutions are determined to enhance their research and academic productivity through development and the implementation of digital technology in research, teaching and learning (Nwaohiri and Nwosu, 2021). A visible gap exists between theoretical knowledge and practical experience as well as the application of knowledge in areas of education, recruitment and the employability of people. This is a concern for educational institutions and employers (Fisher and Gonzalez, 2020). New tactics and innovative thinking are required in developing new certifications, qualifications, knowledge and experience (Fisher and Gonzalez, 2020). Curricular alignment to Industry 4.0 skills is vital in the modern workplace (Li, 2022). Many people today favour work experience over a degree as employers mentioned that students who graduate are not ready for the workplace (Fisher and Gonzalez, 2020). The collaboration between industry and institutions of higher learning must move towards solving real world problems (Maisiri, Darwish and Van Dyk, 2021).

There needs to be collaboration in terms of the industry and universities working together to produce employable and knowledgeable employees for the future workforce. This collaboration between industry players from all sections in a workplace

can add value to the content that is produced by a university. Academics can use relevant information provided by the industry to incorporate into their curricula and the industry can use scholarly work to improve their workplace. This collaboration can allow for a harmonious relationship between the two role players with regard to the future of work.

University and industry collaboration provides a vital opportunity for the transfer of knowledge or interacting with technologies. It inspires growth and innovative activities. It helps to equip employees with crucial skills, knowledge and abilities. Conducting research has furthered the need to have robust partnerships between universities and industries (Othman and Omar, 2012). However, setting up collaborations between universities and the industry can be difficult to achieve (Kleiner-Schaefer and Schaefer, 2022). There are still challenges for the collaboration between universities and the industry. It is necessary to identify the best practices that have to be followed in order to establish and sustain collaboration (Awasthy *et al.*, 2020).

The partnership between universities and the industry can overcome the potential mismatch of theoretical curricula and provide a bridge to solve practical problems (Othman and Omar, 2012). Existing efforts employed by the industry alone may not be able to cater for the needs they have, and university knowledge is also necessary (Othman and Omar, 2012). Universities contribute to economic development through teaching, research methodologies and, by extension, through generating knowledge and stimulating interaction between individuals and organisations (Bürger and Fiates, 2021). The interviewees also recognised the need for more collaboration between the industry and universities.

There definitely needs to be more focus on Industry 4.0 at a university level [...] at university most of the work that you are doing is pen and paper [...] it is a great foundation but there also needs to be that element of moving forward and [...] when you leave high school and you go to university there's a big jump [...] and then also when you leave university and you start working there's also a massive jump and something needs to happen to close that gap [...] Industry 4.0 is the way to actually close that gap. – Participant N

Our members will frequently complain about the misalignment between what particularly your grads coming out of TVET colleges and other tertiary institutions the skills and the knowledge and that they are entering the industry with versus what industry actually actually requires. – Participant M

There's a lot of introspection a lot of things that I want the student to do that makes them useful [...] to the organisation the content I feel is quite lacking [...] secondly the I think there's gonna be quite a big shake up with Industry 4.0 as to how full qualifications are done anyway. – Participant E

There has to be that integration between [...] collaboration between universities [...] there's this divide [...] between universities Technicon's and TVET colleges [...] because it's seen there's no integration. – Participant Q

Academia [...] or coming from other countries [...] it's a big trend [...] and also from Africa [...] because they using antiquated teaching methodologies in university [...] that they not keeping up to the current trend of the sector. – Participant J

I feel as though sometimes the university is more concerned about pushing its own agenda for instances getting its own finances and their books in good or in good in should I say running it like a business where they trying to get profit because I meet very often students who theory knowledge but are not actually capable of working in a factory they come out thinking that someone's going to be holding their hand trying to instead of them coming out and learning like I have [...] maybe its just goes to a generational gap as well I'm seeing for a trend that universities is uh are pushing like for instance I work mostly with technical Technicon's of education [...] they are pushing that a student soon as a student does their exponential learning immediately do their uh bachelors [...] and however industry does not want a B.Tech student [...] without the experience [...] so why are they pushing it because I being in a position where I'm working with unemployed graduates I know that industry does not really want a graduate with no experience. – Participant S

These participants felt that there was indeed a misalignment between university and the industry and that there needs to be more collaboration between the two entities. The participants expressed that perhaps Industry 4.0 may close the gap between the tertiary education and the workplace. The knowledge learnt, and the skills required are misaligned. The industry and universities will need to collaborate in order to close this gap. University's theoretical content is lacking according to Participant E, and organisations want people who are useful to the organisation. Participant S expressed that they felt that the universities advance their own agendas instead of focusing on producing students with the appropriate skills and knowledge who can adapt to the workplace. With the change that the industrial revolutions may bring, so too will the way in which qualifications are completed.

The impact of 4IR on a graduate's employment opportunities is not yet clear. The Fourth Industrial Revolution is expected to create job losses and equally generate new

employment opportunities (Hlobo, Moloji and Mhlanga, 2021). Employees would need to be reskilled for these new employment opportunities created by 4IR. This is because the technological trends are disturbing job profiles and the skills required by the workforce. There is a demand for proper training programmes with regard to upskilling (Pontes et. al, 2021).

If universities, employers, and employees can imagine and define a resolution together, continuous training could become a crucial tool to support individuals to adapt to changes in the workplace (Reif, 2018). There needs to be more emphasis placed on: sectors with higher employment opportunities; creating more jobs; enabling reform in education and skills training; generating a curriculum that is compatible with 4IR; and creating policies to drive the rapid adoption of 4IR technology (Mehta and Awasthi, 2019). As centres of learning, universities need to collaborate with universities in other countries, industry clusters, and organisations within the public and private sectors to achieve these objectives (Li, 2022).

The main goal of education is to equip students with the knowledge that can be exchanged for money in a job and thus become more employable. Therefore, education provides theoretical knowledge and some practical skills which students can use as an employee (Gajek, Fabiano, Lauernt and Jensen, 2022). Universities are no longer solely highlighting degree programmes; non-degree options are offered as part of the higher education curriculum (Li, 2022). Companies need to create opportunities for their employees to learn, allow free internet access and information, and provide financial support for training (Li, 2022). Universities are faced with challenges such as the decomposition of degrees into smaller-source learning networks which can provide credentialed skills needed for a job (Rodriguez-Abitia and Bribiesca-Correa, 2021). Knowledge acquisition through open educational resources, unsanctioned content and online videos are all accessible online, at no cost (Rodriguez-Abitia and Bribiesca-Correa, 2021). There is an increase in demand for innovation and, due to complex product and service demands that companies pursue, new sources of information and knowledge (Bürger and Fiates, 2021). However, the collaboration between universities and industry remains a cloudy theme (Bürger and Fiates, 2021). One consequence of Industry 4.0 will be the change in skills development and, consequently, in technical and academic intuitions (Maisiri, Darwish and Van Dyk, 2021).

Ninth Finding: There needs to be a collaboration between the industry and universities. The purpose is to ensure better employability of training graduates with regard to how to convert theoretical knowledge into practical skills in order to solve real-world problems in the modern workplace.

6.4 CONCLUSION

Technological changes are ever-present and ever-changing. These changes have indeed impacted the modern workplace and people by affecting how work is conducted and how organisations stay competitive. The relationship between technology and people shows that people cannot function without some form of technology in their lives. Examples range from looking up a telephone number online as opposed to years ago using the yellow pages, to surfing the internet, to online shopping instead of in-store shopping. Industry 4.0 has changed the workplace through the newer technologies and applications that have been deployed. There are concerns that robots and other 4IR technologies will cause job losses, but people need to embrace the change and learn new skills. People need to remain employable through learning new things and by upskilling themselves to remain an asset for the organisation. The technologies might be expensive, but it is deemed necessary to stay relevant.

The younger generations grew up in the technological age and have been able to better adapt to changing technological needs. The older generation was impacted by the adoption of newer technologies and appear to be more resistant to change. The data revealed that gender was not necessarily a determining factor on how a person interacts with technology or is being employed in the modern workplace. The data indicated a prevalence of more males occupying more senior roles in the workplace. In interviewing employees from the three organisations, it was clear though that more females were recruited and employed in the workplace as opposed to years ago. However, there is still a gap that exists.

Most of the participants possessed a formal education. However, some of them believed that although a formal qualification is a great foundation, it is not the only form of education that can be used. People need to upskill, reskill and re-invent themselves if they want to stay relevant and employable in the competitive job market. It was also conveyed that universities need to adapt and align to changes in terms of collaborating with the industry to prepare graduate students for the workplace. People from diverse

backgrounds, ethnicities, cultures, and languages all interact on a daily basis with one another and with technology in the workplace. Therefore, humans must adapt to changes to remain relevant and employable. The next chapter will provide the summary, recommendations and conclusion of this research study.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1. INTRODUCTION

The previous chapter presented a discussion on the data that were gathered during the data collection process. The data were inclusive of the feedback from the nineteen participants who participated in the semi-structured interview process. This data were integrated with a literature review and the physical as well as virtual observations of the participants that occurred during the interviews. The interviews were analysed using content analysis. The current chapter provides a recapitulation of the previous chapters. The findings have been grouped according to the objectives of the study, and the chapter further outlines the conclusions and recommendations for the industry, government and theory. It also makes recommendations with regard to future research. Figure 7.1 illustrates the outline of chapter 7.

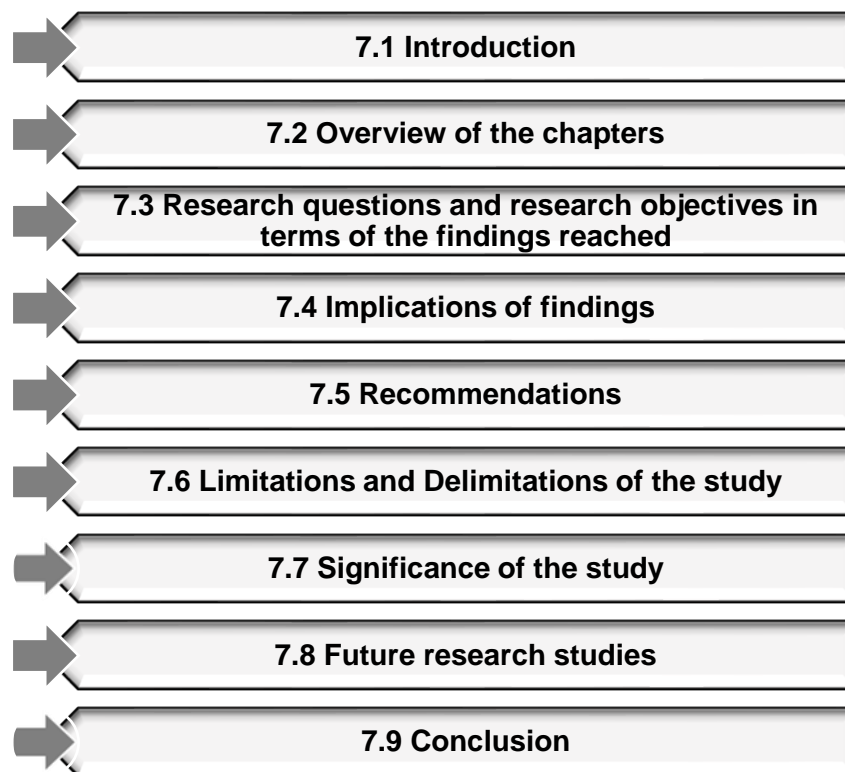


Figure 7.1 Schematic diagram of Chapter 7
Source: Authors own compilation (2022)

7.2. OVERVIEW OF CHAPTERS

Chapter 1 provided the justification for undertaking the research. It presented: the research problem; research objectives; the research questions; methodology; trustworthiness of the study; ethical considerations; the expected impact and significance of the study; the limitations and delimitations and; finally, the chapter outline of the research study. Essentially, Chapter 1 outlined the blueprint for the study.

Chapter 2 presented: the background of Industry 4.0; an in-depth discussion of the various perspectives with regard to Industry 4.0; the technologies associated with Industry 4.0; a discussion of the opportunities and challenges of the Fourth Industrial Revolution from a South African perspective and finally the skills required for Industry 4.0.

Chapter 3 presented workplace diversity by defining and discussing the importance of understanding diversity. The chapter provided: a detailed discussion of workplace diversity; diversity management and the opportunities and challenges that various diversity traits bring to the workplace. The chapter highlighted the three diversity traits chosen for this study, namely, age, gender and education.

Chapter 4 discussed the methodology that was used in the study. This study employed the qualitative research methodology. The data collection strategy, data analysis and the trustworthiness of the study were discussed. Data collection methods chosen for this study were semi-structured interviews and physical as well as virtual observations of the sampled participants during the interviews. Finally, the limitations of the study of the gathered data were discussed.

Chapter 5 included the presentation of the data collected for this study. The chapter consisted of the themes that the data conveyed during the process of content analysis. There were four themes that were found. These were understanding of the meaning behind Industry 4.0, the impact of technology, the challenges brought about by Industry 4.0 and finally the diversity traits which were presented with each of the main themes and sub-themes.

Chapter 6 provided a discussion of the interpretation of the data. The chapter discussed how the findings were formulated from the interview. It also discussed the

observations data that were collected with regard to the participants' perception of Industry 4.0 and the impact that it has on workplace diversity.

Chapter 7 presents the overview of the previous chapters; restating the research questions and objectives in relation to the findings; the implications of the findings; the conclusions reached for this study; the recommendations that emerged from the findings; the limitations and delimitations of the study; the significance of the study and; finally recommendations for future research studies. By having answered the secondary objectives, the primary objective of the research has been achieved.

7.3. RESEARCH QUESTIONS AND RESEARCH OBJECTIVES IN TERMS OF THE FINDINGS

The focus of the study was to explore the connection between Industry 4.0 and workplace diversity. The crucial questions that the research intended to answer were:

The primary research question of this study was:

How has the Fourth Industrial Revolution impacted the diversity traits of age, gender and education in the South African workplace?

The secondary research questions were:

- How do Industry 4.0 technologies affect the modern workplace?
- How do age, gender and education currently find application in an automated and technological workplace?

The findings of the research will now be reflected with the secondary research objectives of this study.

The **primary objective** of this study is to explore the impact of Industry 4.0 on the workplace diversity traits such as age, gender and education in the South African workplace.

The **secondary research** objectives of the study were:

- to explore how Industry 4.0 technologies affect the modern workplace;

- to explore how age, gender and education currently find application in an automated and technological workplace.
- **To explore how Industry 4.0 technologies affect the modern workplace**

The findings that have bearing on the stated objective are as follows:

- Technology has enabled more interconnectedness in the workplace through modernised platforms and workflow processes that have reduced geographical and organisational distances and bureaucracy.
- Integrating robots into the workplace will require a change in organisational job functions, how work is performed and how people and machines will co-exist.
- Robots will not take over jobs but will assist in workplace-related tasks. Job roles will change and continue to change as technology is updated. This necessitates continuous upskilling of staff in order to stay relevant and be able to adapt to changes.
- As people are retrained and upskilled, more jobs can actually be created instead of being lost.
- **To explore how age, gender, and education currently find application in an automated and technological workplace**

The findings that have bearing on the stated objective are as follows:

- Older generations are resistant to technological changes, but they should not be alienated because of their vast knowledge and experience.
- More males occupy positions at higher levels in organisations as opposed to females. This indicates that there is still gender inequality at higher levels in the sample organisations.
- Gender was not a determining factor as to which gender adapts better to technology.
- A formal qualification is a good foundation to have. However, you can self-educate through other informal avenues by having the willingness to upskill yourself through online resources.
- There needs to be a collaboration between the industry and universities. The purpose is to ensure better employability of training graduates with regard to

how to convert theoretical knowledge into practical skills in order to solve real-world problems in the modern workplace.

Technology has connected people to each other and the world. It has allowed for work to be more streamlined, more integrated and conducted remotely from anywhere at any time. With the implementation of new technologies people have become concerned that the newer technologies will make their job tasks redundant, and they are anxious about high levels of unemployment. However, with the constant technological changes, technology will empower people to upskill, reskill and conduct self-learning in order to better their skills required to conduct their assigned of tasks. This ensures that as the workplace evolves so does the attainment of new skills or being re-trained in order to work with newer technologies. With the reskilling and upskilling the fear of jobs being lost will lead to jobs being created and in future the creation of new job roles and tasks.

The study found that with regards to age; the older generations are resistant to technical changes as technology has become so advanced that keeping up seems like a daunting task. The older generations are more inclined to conduct work tasks as they have for many years, while technology has made things easier but for the older generations it has made things harder for them to learn and reskill. The older generations are very knowledgeable as they have moved from a world where technology was to where technology has been integrated into various aspects of work and private life. Nevertheless, the older generations possess vast knowledge and experience that can assist the younger generations to learn from them and so to can the older generations learn from the younger generations.

Gender was not a particularly determining factor when identifying which gender adapts better to technology. This was covered in the chapters that a particular gender group does not adapt better to technological change over another gender group. However, the study identified that inequality within the sample organisations still exists in this modern age. The workplace has changed drastically over the years and more females from part of the workplace, but more men still occupy more senior positions when compared to females within the three South African organisations of this study.

With regards to education, the study revealed that a formal education is a good foundation to have, however there are other avenues that a person can use to self-

educate and upskill. The responsibility rests on a person who has the willingness to better themselves and take initiative to be a step ahead in order to remain employable in the future. Furthermore, industry and universities need to join forces and adopt a collaborative approach towards education to produce graduates that are employable and possess the necessary skills and knowledge to work in the relevant industry. The training of graduates to convert what they have learnt at university education into practical skills needs to be applied to the modern workplace to solve real world problems. The collaborative relationship will produce people that are skilled, knowledgeable and well informed on subject matter related to the relevant industry. The researcher has provided the findings under the relevant secondary research objectives of the study. The researcher will further discuss the implications of the findings of this study.

7.4. IMPLICATIONS OF THE FINDINGS

First Finding: Technology has enabled more interconnectedness in the workplace through modernised platforms and workflow processes that have reduced geographical and organisational distances and bureaucracy.

Using modernised technology in organisations allows for workflow processes to be more streamlined. With the advancements in technology people can complete their work faster, with ease and accuracy. The workplace is changing. As opposed to work being carried out manually years ago, work is now being completed using programmes, systems, robots, AI technology and so many more applications and technologies. People can be connected from anywhere at any time and through various platforms. The implication of remote working post-COVID-19 means that people can work anywhere and at any time. Therefore, there is a requirement for the relevant assistance and access to ensure that their employees are able to conduct work tasks than they would while being physically present in the office.

Organisations must ensure that they have the infrastructure, equipment, funds and technological ability to assist and support their staff. This is because remote working allows for an organisation to have a virtual office as opposed to a physical office that all employees report to. Employees need to ensure that they have the relevant equipment and internet connectivity to complete work tasks. Also, people need to ensure they have their personal space set up in a way that is conducive to complete

their work. The disadvantages of remote working are a lack of human interaction; internet or intranet connectivity issues; work time occasionally infringing upon personal time; security concerns and; external South African-specific problems such as constant electricity outages. Organisations and people need to find the balance between work and personal time. They should also resolve whether remote working or working in a physical office is suitable for their business model. As technology evolves, it is imperative to remain relevant, employable and informed about innovative technology that will continue to change daily.

Second Finding: Integrating robots into the workplace will require a change in organisational job functions, how work is performed and how people and machines will co-exist.

Job profiles, tasks and work are constantly changing as technology changes. People need to find ways to accept the change and learn how to work in a collaborative environment where man and machine or robots can co-exist. There needs to be a synergy between how robots work and how a person works. There will always be the need for people in the workplace as machines and robots need to be maintained and upgraded. There is a symbiotic relationship that exists between man and technology in the modern workplace and in their daily lives the type of work being performed, and the skills needed to carry out that work will continue to change.

Third Finding: Robots will not take over jobs but will assist in workplace-related tasks. Job roles will change and continue to change as technology is updated. This necessitates continuous upskilling of staff in order to stay relevant and be able to adapt to changes.

Integrating robots into the workplace has indeed caused uneasiness about job security. However, the need for a human will always be there. As robots are created by man, so too are the tasks that people will need to carry out in order to service the machine, run an update or help to reboot systems. People need to constantly think of how to remain relevant and employable. They must therefore be willing to adapt to changes through continuous learning. There will indeed be some jobs that will be phased out and new job profiles that will be created. Nevertheless, innovation and technology will drive the process of creating new jobs. Technology has become part of our daily lives and people will continue to coexist with technology. As technology

evolves so should people. People need to constantly upskill, retrain and reskill in order to keep up with the changes that technology brings. Robots, machines, and AI are created by humans, and they are created with intelligence. However, AI and robots lack the emotions that people have and there will always be a need for humans to assist in producing new and innovative technology.

Fourth Finding: As people are retrained and upskilled, more jobs can actually be created instead of being lost.

New jobs roles will be created with the introduction of technology. Specialised skills are required to operate a robot and people are needed to do maintenance on the robots. Employees need to enhance existing skills sets, allowing them to grow in their current role and bring further value to an organisation. Retraining and upskilling helps to update an employee's skills to match the different job requirements due to technological advancements or changes in workplace practices. Irrespective of how well robots are programmed to complete tasks, they cannot develop emotional connections as humans do. People need to take the initiative to continuously learn in order to remain employable and relevant. The onus is on people to take the initiative to learn new skills and upskill themselves. There is indeed the responsibility of the organisation to assist their employees with the training that they may require. However, a person is solely responsible for upskilling themselves. This is because there are numerous online platforms to assist when a person feels they need to upskill, retrain and gain skills to improve themselves.

Fifth Finding: Older generations are resistant to technological changes, but they should not be alienated because of their vast knowledge and experience.

The older generations have been working for a long time and gained valuable experience over the years. The older generations need to at least try to adapt to the technological changes as the changes can assist them with completing tasks faster. If the older generations resist change, then they will struggle and be left behind. Baby Boomers are moving towards their retirement. With new technological changes, perhaps organisations could have policies in place to compel the older generations to transfer knowledge and mentor younger generations. In return the younger generations could assist the older generations with any problems they may experience with technology and benefit from a two-way mentor-mentee relationship. Furthermore,

training could be provided within the organisation to assist those who have difficulty with adapting to new technologies. Older generations need to take responsibility for their learning capacity. The onus should also be on the older generations to want to learn and adapt to changing circumstances. It is incumbent on the management team (leadership) to harness these strengths and adequately manage knowledge transfer and preservation within each company.

Sixth Finding: More males occupy positions at higher levels in organisations as opposed to females. This indicates that there is still gender inequality at higher levels in the sample organisations.

Within the three organisations who participated in this study, the participants provided insight that South Africa is still working towards alleviating gender inequality in the workplace. The data indicated that gender inequality is more prevalent in senior and top management positions in the sample organisations. Each company would need to structure their own plan to overcome this issue and align gender numbers on all levels within their organisations. In addition to gender, there are other imperatives such as the different generations that may also enhance different types of value for the company.

Seventh Finding: Gender was not a determining factor as to which gender adapts better to technology.

The diversity trait of gender had no significance as to whether one gender group adapts better to using technology than the other. With each interview there was no feedback that indicated that men or women are better at adapting to technology. Gender was not really a factor with regard to how participants felt that gender groups in their organisations interact with and use technology. This is because there was no biological basis for how a person would use technology.

Eighth Finding: A formal qualification is a good foundation to have. However, you can self-educate through other informal avenues by having the willingness to upskill yourself through online resources.

People who wish to educate themselves today can do so through various platforms and not only through a formal education. Training is readily available today as opposed to years ago. The internet has so much accessible information for one to upskill.

Universities today have tried to implement informal training into their curriculum. They have also integrated some simulations and application-based training into their formal education. The universities and people need to keep up to date with recent technological advancements and developments in order to remain relevant and create employable graduates. People need to be cognisant that the onus is on them to improve through a constant willingness to learn and re-invent themselves in order to remain current and relevant.

Ninth Finding: There needs to be a collaboration between the industry and universities. The purpose is to ensure better employability of training graduates with regard to how to convert theoretical knowledge into practical skills in order to solve real-world problems in the modern workplace.

The industry and universities must find a better working relationship to produce employable and knowledgeable employees for the future workforce. The collaboration between the industry and educational institutions will enhance the capability to address any gaps in the current curricula. The purpose is to produce effective workers that can thrive and fit into the current running of the organisation. What was taught five years ago is irrelevant today. Therefore, the industry and universities should converse with one another in order to produce the type of employees that they would like to employ one day. Industry role players can serve on university advisory boards to provide input into curricula and study material.

7.5. RECOMMENDATIONS

The recommendations of this research pertain to the industry, government and theory. The researcher acknowledged that she initially undertook this study to explore the connection between Industry 4.0 on workplace diversity, focusing on the diversity traits of age, gender and education. The researcher aimed to explore what impact Industry 4.0 has on the modern workplace.

7.5.1. Recommendations for Industry

Organisations who have employed Industry 4.0 technologies can use this study to benchmark themselves against other organisations. In this way they can gain knowledge from the different perspectives and share the knowledge in their organisations to improve the management of their employees. The organisations could

use this study to inform their employees of the impact that Industry 4.0 can have in the modern workplace. They can also provide continuous learning, upskilling and reskilling programmes for employees to keep up with the rapidly changing modern workplace. Furthermore, employees can personally take the initiative to proactively become better equipped, skilled and informed in order to accommodate technological advancements that continually occur. This is if the leadership provides the impetus and culture for continuous improvement to occur.

From the researcher's observations it was clear that perhaps not all people understand what the revolution entails. Nor do they understand the opportunities and challenges that arise and what is required to be successful in this era of rapid change. Organisations can use training programmes to create awareness about the new technologies that are used within their organisation or that are relevant to their specific field of work. The industry could use the study to develop insight with regard to any shortcomings that generational cohorts, the gender of a person and the educational background may present to the workplace. They can then strategise better ways to adapt to technological changes and the advancements in the workplace in order to help employees be more competent and productive at their job tasks.

With this study, organisations can improve their own growth and develop a better understanding of the ways in which they can improve or acknowledge viewpoints from different sample organisations. They can use this to benchmark themselves against these organisations. The researcher acknowledged that the participants had mentioned that the older generations were resistant to change. Perhaps organisations could assist the older generations by providing training with regard to implementing new technologies or assigning people to assist them directly should they have difficulty.

7.5.2. Recommendations for Government

The government is meant to put legislation and policies into place from which industry policies can be derived. This study could aid in implementing policies and procedures with regard to employment and what the industry needs when employing people to work in a technologically driven world. Bridging the gap between the lack of skills and the skills needed can be done through offering reskilling and upskilling programmes. The purpose will be to help South Africans to extend their skill sets and become more

employable. Government needs to encourage innovation and allow for investment into education and training around Industry 4.0 and any interests with regard to how technology changes.

7.5.3. Recommendations for Theory

The study will aid in understanding how resources can be used to optimise the impact of the Fourth Industrial Revolution on major organisations as well as on employees in the workplace. Academics can learn that certain diversity traits namely, age, gender and education could be used as the basis to conduct further research. Scholars can explore the impact of Industry 4.0 and workplace diversity from different contexts. The study could be used to further conduct more intricate and in-depth studies with a larger sample. Universities should join forces with the industry by collaborating in terms of producing curricula or allowing students to conduct research.

There needs to be a convergence that allows universities and the industry to do research with regard to various fields through adapting curricula content and through developing mutual understanding. With the diversity trait of gender there is still a gender gap that exist within the three organisations with regard to the male to female ratio in senior and top management positions. However, it was noted that the three organisations are employing and recruiting female employees in the organisation in order to adhere to the laws of the country. Finally, with education the researcher found that a formal qualification is a good foundation to have, but there are other ways to upskill, educate and learn. These include trainings, online classes and seminars to help improve their competencies.

It is recommended that the organisations focus on their internal resources and improve the use of their resources by means of the resource-based view. A resource-based view seeks to ensure that an organisation should leverage their resources better instead of looking to only outsource in order to remain competitive in their respective markets. The three organisations in this study are from markets that compete internationally. They will always be looking for ways to reduce and improve costs. However, maintaining a competitive advantage is always priority in order to remain relevant in business. The different generational cohorts in the workplace have their own lived experiences and understanding of the world. The different generations can assist and teach one another what knowledge they have acquired through the years.

They can also assist by contributing to the operations of the organisation as well as by respecting each other's viewpoints, opinions and beliefs. Using the internal skills and knowledge that each person brings into the organisation can be beneficial. This is because it will save on the costs of outsourcing to someone with the same skills that an internal employee may already possess. The contribution to theory is that other smaller organisations could use their internal resources by finding a way to better use these. In this way they can save on costs but also to try educating and communicate about newer technologies in a way that is understandable to anyone.

7.6. LIMITATIONS AND DELIMITATIONS OF THE STUDY

The study had some limitations and delimitations that the researcher acknowledged in section 1.4. The following are some of the limitations and delimitations of the study:

- The three chosen organisations were located in Gauteng. The findings cannot be generalised to all organisations. However, an adequate representation can be applied to the South African economy based on the local and international markets that are serviced by the three organisations. The researcher acknowledges that there are many other organisations that could have been included in the study. However, due to the availability and accessibility of the three organisations the researcher chose to conduct the study in Gauteng.
- Accessibility to some participants was not easy. However, the researcher was considerate, patient and ensured that people who wished to participate were well informed about the study. The researcher was also readily available for each participant. Many participants who were originally chosen to form part of the study were not available to be interviewed. Due to this, these participants had to be replaced by others who also complied with the required criteria. To address this delimitation the researcher contacted and communicated with the participants regularly to ensure that the researcher was available according to their busy schedules. The researcher remained honest, open and professional while communicating with all participants.
- The COVID-19 pandemic had placed an unexpected limitation on the study. The researcher had to take the fact that the study timeline would be impacted into consideration. This is because there were government policies and procedures as

well as international lockdown regulations that were imposed on everyone. The researcher had to ensure that she adhered to the university's, the organisation's and the government's policies, procedures, rules and regulations. The rights of the participants involved the study during the COVID-19 pandemic also had to be considered. Furthermore, the researcher opted for face-to-face interviews. However, the researcher could only conduct face-to-face interviews at one organisation once restrictions were eased and the researcher was able to access their premises, adhering to the COVID-19 rules and regulations. The researcher then conducted the other interviews virtually with the remaining two organisations. This is because COVID-19 was still rife, and participants needed to be reached virtually as they were working remotely.

- There are many online communication platforms available. However, the researcher had to use Microsoft Teams (the preferred communication application of the university). The participants were made aware that this application needed to be used to ensure the credibility and trustworthiness of the study. The researcher and participants furthermore encountered connection issues and technical difficulties due to the participants being remotely available. Even though there were such issues, the researcher ensured that the participants were informed of the issues. Also, if they had any problems, the researcher had alternatives to ensure that the participant was comfortable to continue with the interview. The researcher had to ensure that she read any new rules and regulations that the university had put into place during the COVID-19 pandemic. This was in order to further ensure the trustworthiness of the study.

7.7. SIGNIFICANCE OF THE STUDY

This study contributed to a gap in the literature by combining the Fourth Industrial Revolution with workplace diversity, focusing on the specific diversity traits of age, gender and education. The organisations involved in the Fourth Industrial Revolution can use this study as information to benchmark themselves against other organisations. They can view the feedback from the different organisations and share this knowledge with their employees. For academia and scholars, the study will signify a step forward for those academics who wish to explore research on Industry 4.0 and workplace diversity. For scholars, it will aid in understanding the impact of the Fourth

Industrial Revolution on major organisations and the impact that it could have on the employee in the workplace. Managers can use the insights gained from this research to improve the management dynamics in the workplace, influence change-management strategies and plan for training interventions to reskill and upskill their employees. With regard to theory other organisations may use the resource-based view to leverage their resources better. The purpose will be to reduce costs and use the employees who possess the skills and knowledge needed to inform other employees via training or informative sessions. This, in turn, saves costs, but it also upskills the workforce to improve the attainment of organisational objectives.

7.8. FUTURE RESEARCH STUDIES

The study provided an insight into the impact of Industry 4.0 on the workplace diversity traits of age, gender and education. Potential future research areas comprise of the following:

- The study excluded various other sectors. Further research could be conducted at other organisations in different fields to determine the impact that Industry 4.0 has on workplace diversity in more industries.
- The study was limited to selected organisations within the Gauteng province and future research could be conducted in other provinces in South Africa.
- The study explored only three diversity traits namely, age gender and education. Future research could include other diversity traits which could be explored further.

7.9. CONCLUSION

Chapter 7 presented an all-inclusive summary of the conclusions and recommendations based upon the analysis of the results outlined in Chapter 5. In this chapter the findings regarding the research objectives and implications were discussed. The recommendations for the study, the limitations and delimitations were discussed, significance of the study and future research studies were presented.

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ADDENDUM A: ETHICAL CLEARANCE CERTIFICATE



COLLEGE OF ECONOMIC AND MANAGEMENT SCIENCES
DEPARTMENTAL ETHICS REVIEW COMMITTEE
OPERATIONS MANAGEMENT

Date: 30 November 2020

Dear Ms V Jagunandan

**Decision: Ethics Approval from
30 November 2020 until 30 November
2025**

NHREC Registration # : (if applicable)

ERC Reference # : OPS/2020/007

Name : V Jagunandan

Staff # : 43818088

Researcher(s): Dr AP Amadi-Echendu
Department of Operations Management
College of CEMS
Email address: amadap@unisa.ac.za
Contact number: 012 4292627

Ms CM Maseko
Department of Operations Management
CEMS
E-mail Address: masekcm@unisa.ac.za
Tel number: 012 4296953

Title: An exploratory study into the connection between Industry 4.0 and workplace diversity

Thank you for the application for research ethics clearance by the Unisa Department of Operations Management Ethics Review Committee for the above-mentioned research. Ethics approval is granted for 5 years (**see period mentioned above**).

*The **minimum risk application** was reviewed by the Department of Operations Management:*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.



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2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Department of Operations Management Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.

Note:

The reference number ERC Reference number OPS/2020/007 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee. Please provide the ERC with the letter of consent for the language editor and transcriber as soon as this is available.

Yours sincerely,



Signature

Ethics Chair : Department : Operations Management

E-mail: vanans@unisa.ac.za

Tel: (012) 429 4988




Signature

Executive Dean : CEMS

E-mail: mogalmt@unisa.ac.za

Tel: (012) 4294805

**Prof RT Mpotu
Deputy Executive Dean
(on behalf of Prof Mogale)**

 URERC 25.04.17 - Decision template (V2) - Approve

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ADDENDUM B: REQUEST TO CONDUCT RESEARCH



Dear Sir/Mam

RE: Permission to Conduct Research Study

My name is Vidya Jagunandan and I am currently enrolled for a Masters in the College of Economics and Management Sciences at the University of South Africa (Student Number: 45818088).

The topic of my research study is **An exploratory study into the connection between Industry 4.0 and workplace diversity**. Involves how the 4th Industrial Revolution would impact workplace diversity, focusing on the specific diversity traits of age, gender and education. Moreover, the study will explore the challenges or opportunities that may be considered within an organisation as we move towards a more digitised and automated workplace.

The findings of the research will be made available to participants and participating organisations for internal use. From an academic perspective, an article will be published in an accredited journal.

I, Vidya Jagunandan, herewith request permission to conduct research within your organisation.

The research study will involve the following:

An open-ended interview schedule will be developed and one-on-one interviews with the chosen participants will be conducted. The interviews will be recorded and thereafter transcribed for data analysis. The transcribed interview will be broken down into constructs that will be sent back to each participant as part of the member checking process. This will allow each participant to confirm the interpretation that has been attached to the various elements of the interview that will be used in the study.

The interview questions will seek to collect data regarding how Industry 4.0 affects employees of different age groups, gender and educational background. The qualitative interview schedule will consist of five (7) questions, which will be made available to participants beforehand so that participants are not taken by surprise and will be in a position to prepare themselves for the interview. The interviews will be scheduled beforehand, to ensure the availability of the participant.



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All participants will be requested to give their signed consent to the researcher before the interview will be conducted.

Once permission is granted from the organisation, six (6) participants from the organisation will be interviewed as follows:

The participants will be chosen as per three diversity traits (age, gender and education) that has been identified to form part of this study. The requirements for the participants will be males and females between the age group of 18-65 years, with different educational backgrounds to participate in the study. The participants may comprise of three managers. The other three participants can be from lower levels of the workforce who will be able to provide feedback to the interview questions.

By agreeing to grant permission for data to be collected from your organisation, you (the organisation) agree that the information provided may be used for research purposes, including dissemination through peer-reviewed publications and conference proceedings.

It is anticipated that the information the researcher will gain from the interviews will allow the researcher to explore how Industry 4.0 impacts workplace diversity particularly with regard to age, gender and education. We do not foresee that the researcher and/or the organisation will experience any negative consequences by participating in the interview. The researcher undertakes to keep any information obtained during the interview confidential.

The records will be kept under lock and key for five years for audit purposes where after it will be permanently destroyed, hard copies will be shredded and electronic versions will be permanently deleted from the hard drive of the computer/ laptop or any other storage devices. Please note that participants will not be reimbursed or receive any incentives for participation in the interviews to be conducted. All participants will be kept anonymous by the removal of any identifying information. All information that will be used in the study will be sent to each participant beforehand for member checking.

I would like to request the following information from the organisation:

Email addresses, contact numbers of staff members who may form part of the study any reports and documents on workplace diversity that may be available to be used in the study (if any), and a formal letter of consent to conduct the study from the organisation in order to obtain ethical clearance from UNISA.



You may address any questions to me directly or to any of my supervisors whose details are as follows: The primary researcher, Vidya Jagunandan, can be contacted during office hours at 0716403607/ Vidya.jagunandan14@gmail.com. The study leader, Dr Anthea Amadi-Echendu can be contacted during office hours at 012 429 2627 / amadiap@unisa.ac.za or Co-study leader Ms Chipso Mellania Maseko can be contacted during office hours at 012 429 6863 masekcm@unisa.ac.za

Kind Regards

Ms. Vidya Jagunandan

Consent to partake in Masters Research Study

I _____ of _____ (company name)
hereby give permission to Ms Vidya Jagunandan (UNISA student 45818088) to conduct her Masters
Study and understand that she will adhere to the above mentioned.

Signed at _____ on the _____



ADDENDUM C: INFORMED CONSENT



PARTICIPANT INFORMATION SHEET

Dear Prospective Participant

My name is Vidya Jagunandan and I am doing research with Dr Anthea Amadi-Echendu and co-supervisor Ms. Chipso Maseko, in the Department of Operations Management towards a Masters of Commerce at the University of South Africa. We are inviting you to participate in a study entitled: *An exploratory study in the connection between Industry 4.0 and workplace diversity.*

WHAT IS THE PURPOSE OF THE STUDY?

This study will contribute to a gap in the literature by combining the fourth industrial revolution with workplace diversity, focusing on the specific diversity traits of age, gender and education.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The participant will be required to participate in an interview by answering interview questions with regards to the research topic. The researcher will provide these questions to the participant via email before the interview can take place. Once the participant has signed the participant information sheet and your written consent is given, then the researcher will set up a date and time for the interview to take place at your convenience.

The responses will captured anonymously only once with participant has signed the written consent, the researcher will ask the participant to verbally give consent before the interview can move forward and will be recorded on audio. The participants will be informed of the researcher's intent and the procedure the researcher will follow in order to obtain the data. The study involves audio recorded, semi-structured interviews and noted observations. Due to the COVID-19 pandemic, the researcher would conduct interviews remotely and via a chosen means of communication such as MS Teams (as per the universities COVID-19 policies and procedures). The researcher will request one (1) hour of your time to complete the interview.



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CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participation is voluntary and there is no penalty or loss of benefit for non-participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Please note the benefit of your participation is allowing the researcher to explore the proposed research title and adding to the body of knowledge. The publication of this dissertation will allow others from academia and industry to be able to understand the concept better. Kindly note that there is no compensation of any kind for you as the participant; however, your participation alone is much appreciated for this study to progress.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

Due to the COVID-19 pandemic, social distancing and social protocols are in place to protect you the participant and the researcher. There are no foreseeable risks, as you the participant and the researcher will communicate virtually and remotely.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

You have the right to insist that your name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings. The researcher will ensure that any identifiable characteristics be removed and for your reference member checking will be conducted to verify that the researcher has ensured anonymity. The researcher ensures that any person who will be associated with this study will be required to sign a confidentiality agreement.



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Your answers may be reviewed by people responsible for making sure that research is done properly, including the transcriber, external coder, and members of the Research Ethics Review Committee and the supervisors. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

The data collected will only be used for degree purposes and to produce articles thereafter. The researcher will only request that you disclose your age, gender and educational background as it is necessary for this study to progress as it relates to workplace diversity. The researcher ensures that your information remains anonymous and only used for academic purposes (the dissertation, articles, possible publication in conference proceedings). Please note that all files, communications, phone calls and any further communication between the researcher and you the participant will be confidential. Any identifiable characteristics related to you the participant and your company will be removed from the transcribed data. It is the researchers responsibility to ensure your identify and participation in this study is completely anonymous and will be conducted in a safe environment.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard at the researcher's residence for future research or academic purposes. Electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Should the information need to be destroyed the researcher will dispose of hard copies by shredding and the electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

No compensation will be received in any form from the researcher .Your willingness to freely participate in the study is much appreciated



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HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Research Ethics Review Committee of the College of Economic and Management Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Vidya Jagunandan 071 640 3607, email: Vidya.jagunandan14@gmail.com. The researcher will ensure that member checking will occur whereby the transcripts and coding will be emailed to each respondent respectively for them to verify that the correct interpretation has been attached to each theme and direct quotes that will be used in the dissertation. The participants will be allowed to provide a view of the information that will be included in the study and subsequent publication/s.

You may address any questions to me directly or to any of my supervisors whose details are as follows: The primary researcher, Vidya Jagunandan, can be contacted on 071 640 3607. The study leader, Dr Anthea Amadi-Echenodu can be contacted during office hours at 012 429 2627 / amadiap@unisa.ac.za or Co-study leader Ms. Chipo Mellania Maseko can be contacted during office hours at 012 429 6853 masekom@unisa.ac.za

Thank you for taking time to read this information sheet and for participating in this study.



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CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant full name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview and for the researcher to make notes of her observations.

I understand that once I have signed the written consent, the researcher will respond with a signed version, inclusive of the researchers name, surname and signature.

Participant Name & Surname..... (please print)

Participant Signature.....Date.....

Researcher's Name & Surname..... (please print)

Researcher's signature.....Date.....



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ADDENDUM D: INTERVIEW SCHEDULE



Date:

Dear Sir/Mam

Thank you very much for agreeing to be interviewed as part of my Masters research. I am exploring the connection between Industry 4.0 and workplace diversity. Although Industry 4.0 allows people and computers to work together, technology enable the execution of tasks swiftly, introduces new products faster to market, and expand resource effectiveness through digitisation efficiencies (Stăncioiu, 2017). Technologies refers to a system that was generated by people, utilising knowledge and organisation to create objects (e.g. smartphone, computers, printers) and techniques (e.g. programmes, algorithms, methods, procedures) for the attainment of specific goals (Volti, 2009). Diversity encompasses characteristics that we are born with and other characteristics are acquired as we develop and as we get older and these are the characteristics that we bring into the workplace (Roberson, 2019).

It is hoped that the findings from my research project can contribute to the body of knowledge and assist people who are unfamiliar with the research field. I have obtained permission from your organisation to conduct this interview. I assure you that your responses are confidential and anonymous. I will be recording the interview and taking notes to assist with accuracy when analysing the data that was collected. I shall forward a copy of the transcription and my interpretation of the data to you to review before I use it in my study. Please note that you have the right to withdraw from this interview at any point, should you wish not to continue. Pseudonyms will be allocated to each participant.

If you need clarity on any question, please do ask. This research is conducted in accordance with UNISA's Policy on Research Ethics.

I thank you for the opportunity to interview you. The questions that will be asked during the interview are as follows:



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Interview Questions:

1. Please describe your own understanding of Industry 4.0?
2. In your industry, please describe where and how Industry 4.0 is being used.
3. Please can you describe how Industry 4.0, i.e. newer technologies, used in your workplace impacts staff?

The diversity traits chosen for this study are age, gender and education

- 4.a With reference to the different age groups working in this workplace, how do different age groups relate to Industry 4.0 technologies?
4. b Do you believe that obtaining a formal qualification is necessary in the Industry 4.0 era in your organisation?
5. How do you manage challenges, shortcomings and capacity constraints that is brought about by Industry 4.0 in relation to workplace diversity?
6. How has the workplace changed with the introduction of Industry 4.0 technologies?
7. Is there any other relevant information that you wish to add that we have not already discussed.

I would like to thank you for participating and taking the time to conduct this interview. If there is anything further that you require or need clarity on anything, please do not hesitate to contact me.

Thank you

Vidya Jagunandan

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ADDENDUM E: DECLARATION OF PROFESSIONAL EDIT

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30 January 2023

To whom it may concern:

This serves to certify that I, Anne Marais, performed the copy edit on the thesis entitled:

An exploratory study into the connection between Industry 4.0 and workplace diversity

By Vidya Jagunandan

Language, grammar, punctuation and style issues were addressed using MSWord Review (Track Changes) function. I did no structural re-writing of the content. Furthermore, I was not responsible for reference checking or formatting. I attended to Chapter 1,2,3,4,5,6 and 7. I did not edit the Table of Contents, the List of Acronyms, the List of Tables or the List of Figures. I also made no changes to the verbatim transcripts. I am qualified to have done such editing, being in possession of a Bachelor's Degree from North-West University and a Postgraduate Certificate in Practical English Editing from the University of Stellenbosch. As the copy editor, I am not responsible for detecting, or removing, passages in the document that closely resemble other texts and could thus be viewed as plagiarism. I am not accountable for any changes made to this document by the author or any other party subsequent to my edit.

Yours faithfully,
Anne Marais

Member: Professional Editors' Guild RSA (PEG)