UNIVERSITY OF ZULULAND

"Perceptions of the effects of 4IR on expected job disruptions on the human capital development approach at the University of Zululand

By

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MARCH, 2020.

DECLARATION

I, the undersigned hereby declare that:

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Name: Samuel Oluwatobi TAIWO

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Date: 28th February, 2020.

DEDICATION

This study is dedicated to God, my family, the University of Zululand, South Africa and workers globally.

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ABSTRACT

Some call it ‘Digitization’, others call it ‘Automation’ yet, some others use the catchword ‘Industry 4.0’! The unprecedented, and undeniable impacts of tech-jargons such as AI, IoT, VR, AR and CPS across industries and nations has made the 4IR a buzz word globally. Subsequently, many workers, professionals, academics and people in governance are eager to know the effects that the 4IR may have on jobs, skills and the best approach to human capital development in the fast-changing work environment. Hence, in view of these questions begging for answers, this study with four research objectives and questions explores perceptions of effects of the 4IR on expected job disruption and on human capital development approach at the University of Zululand. A structured questionnaire titled ‘Fourth Industrial Revolution Skills Assessment Questionnaire (FIRSAQ)’ was designed, validated by a research analyst, and tested for internal consistency. FIRSAQ with a reliability coefficient of 0.882 was used to gather data from the randomly stratified 170 academic staff members. Findings reveal that perceptions about the **probable 4IR skill requirements is high, and the current level of awareness with regards to the effect of 4IR technologies on job disruption is high.** Furthermore, **the assessment of the significance of 4IR technologies on job disruption and human capital development** in the University of Zululand indicated that 4IR significantly affects both **job disruption and human capital development**. However, findings also showed that **the current human capital development approach in the University of Zululand is more formal than informal.** Therefore, in view of the propositions from the 70:20:10 model, a change in human capital approach to more of informal than formal approach was recommended.

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CHAPTER ONE

OVERVIEW OF THE STUDY

1.0 Introduction

This chapter gives an overview of the study by outlining its rationale, the gap it intends to bridge in concert with its aim, purpose and objectives amongst others. The chapter ends with a conclusion wherein all that is covered in the chapter is summarized.

1.1 Background to the Study

In recent times, the fourth industrial revolution (4IR) has gained attention in both professional and academic discussions across local and international platforms due to its innate ability to cause a radical shift in all spheres of human endeavour. According to Schwab (2015), the change that will be occasioned by the 4IR will be unprecedented in its measure, range, and complication. Schiuma (2017) expounds that the 4IR is characterised by new innovations that are progressively modifying the manner in which businesses and establishments execute business operations, influences the community and the existence of humans. Egbetokun, Yun, Zhao, and Kim (2018) aver that the nature of the change in the 4IR is all-inclusive as it traverses professions, nations, organisations, industries and the world at large.

Therefore, Scholars and industry experts such as Schwab (2015), McKinsey Global Institute (2017) as well as Egbetokun, Yun, Zhao, and Kim (2018) have strongly advised all the main contributors to the economy such as businesses, educational institutions and government officials to brainstorm on steps and precautions that need to be taken in ensuring that the 4IR benefits people. Schwab (2015) emphasized that in order to manage the fast-paced change in the 4IR, there is the need for a combined and all-inclusive reaction from all the key industry players in every sector. McKinsey Global Institute (2017) adds that political leaders, top executives, and employees require flexibility, creativity and fore-sight in collaborating to take advantage of the technologies that are becoming speedily prominent and ascertain productivity and prosperity while automating. Egbetokun, Yun, Zhao, and Kim (2018) assert that in view of the incomparable transformation being caused by the 4IR technologies, scholars, business men and politicians need to team up in offering ground-breaking actions and policies that will be helpful in deriving maximum advantage from the 4IR prospects and avoiding its inherent risks.

Sequel to the recommendation that every major stakeholder needs to collaborate to chart an advantageous course for the changes being occasioned by the 4IR across industries and countries, the World Economic Forum (WEF) founded by Professor Klaus Schwab has provided a good platform for a robust and multidimensional discussion in relation to 4IR. World Economic Forum is a platform that has effectively converged experts from different spheres and sectors to give a critical outlook of the fourth industrial revolution and map out strategic responses to take advantage of the opportunities while minimizing the risk therein (WEF, 2019).

World Economic Forum categorises the key issues that requires urgent attention for an effective transition into the 4IR to eight broad areas namely fusing technologies, disruption to jobs and skills, security and conflict, inequality, agile governance, business disruption technology, ethics and innovation, and innovation and productivity (World Economic Forum, 2019). Furthermore, World Economic Forum outlines and explicitly discusses diverse related themes relevant to these eight broad issues. However, from these eight broad issues, matters relating to disruption to jobs and skills has formed a major part of the deliberations and writings of Professionals and Academia. Therefore, Parham and Tamminga (2018), strongly recommend a deliberate and organized effort towards Human Capital Development to ensure that the workforce have relevant skills for the 4IR jobs. Hence, in view of the 4IR, this study explores perceptions of the effects of 4IR on expected job disruption and on human capital development approach, using the University of Zululand as a case study.

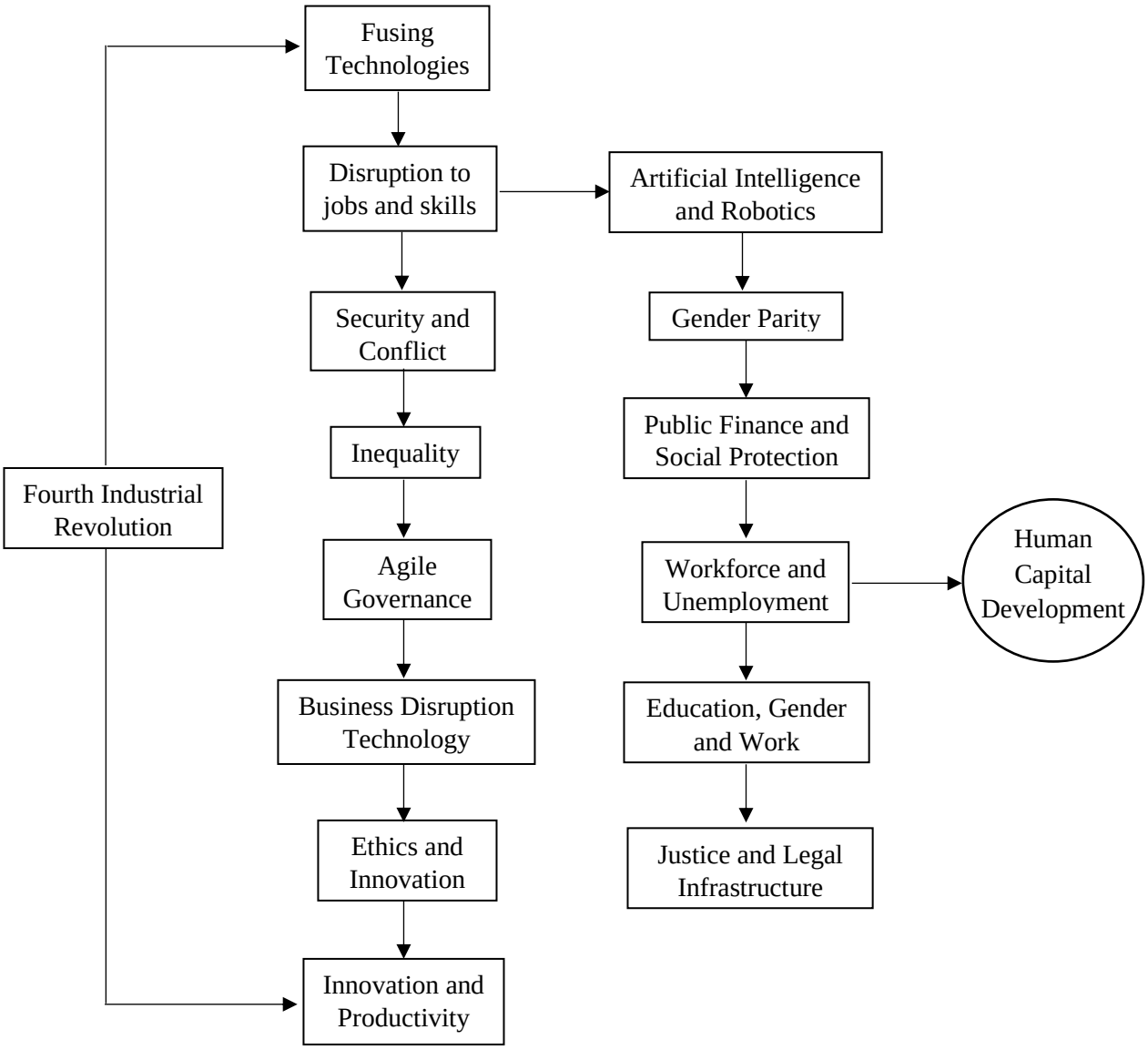

Figure 1.1: The 4IR Human Capital Development Chart
Source: Researcher's own

1.2 Problem Statement

The continuous distortion of the boundaries between the physical, digital, and biological domains by a blend of technologies in the 4IR is at an alarming rate (Schwab, 2015). Consequently, professionals and academics are beginning to raise red flags as statistics reveal that the distortion is increasingly altering the existing approaches to executing tasks in the work and business environment. Future of Jobs Report (2018) predicts that by 2025, there will be an increase in the tasks executed by machines instead of the 71% being executed by humans currently. Furthermore, by 2022, it is envisaged that 133 million new jobs will replace the 75

million jobs that will be extinct due to the quick emergence of machines and algorithms in the work environment (Future of Jobs Report, 2018). Sequel to this, to ensure human-centered transition into the 4IR, a radical workforce transformation is required across all industries through human capital development in order to upgrade the value and output of the workforce at present and equip them for evolving roles.

Future of Jobs Report (2018) forecasts that 54% of workers of big corporations by the year 2022 would require substantial re- skilling and up-skilling so as to take a holistic advantage of the prospects for growth presented by the 4IR. Subsequently, many workers, professionals, academics and people in governance are eager to know the effects that the 4IR may have on jobs, skills and the best approach to skilling, reskilling and up-skilling workers for relevance in this fast-changing work environment. Illanes, Lund, Mourshed, Rutherford, and Tyreman, (2018) disclose that 42% of executives in the United States, 24% percent of executives in Europe, and 31% of executives in the other nations are yet to understand the nature of impact that automation will have on job roles and future skill needs, thus, they seek understanding in this regard. Magwentshu, Rajagopaul, Chui and Singh (2019) assert that many organizations would have to review their labour force planning with specific focus on the possible long term impacts of technology on their labour force. Hence, this study explores perceptions of the effects of 4IR on expected job disruption and on human capital development approach at the University of Zululand, with a focus on academic staff members. Academic staff members were selected in this regard based on the notion that they are saddled with the responsibility of training and producing manpower needed in the society.

1.3 Aim and Objectives of the Study

1.3.1 Aim of the Study

To explore perceptions of the academic staff on effects of the 4IR on expected job disruption and on human capital development approach at the University of Zululand.

1.3.2 Research Objectives

1. To explore the perception of the academic staff of the University of Zululand on the probable skill requirements of the 4IR.
2. To explore the perception of academic staff of the University of Zululand on effects of 4IR technologies on job disruption.

3. To explore the perception of the academic staff of the University of Zululand on the current human capital development approach in the institution.

4. To investigate whether 4IR technologies significantly affect job disruption and human capital development of the academic staff of the University of Zululand.

1.4 Research Questions

1. How does the academic staff of the University of Zululand perceive the probable skill requirements of the 4IR?

2. What is the current level of awareness of the academic staff of the University of Zululand on effects of 4IR technologies on job disruption?

3. How does the academic staff of the University of Zululand perceive current human capital development approach in the institution?

4. Do 4IR technologies significantly affect job disruption and human capital development of the academic staff of the University of Zululand?

1.5 Rationale of the Study

The rate at which the current economically active percentage of the population are being laid off from their jobs is frightening. STATS SA (2018) in its Quarterly Employment Survey (QES) for the third quarter of the year 2018 indicates a gross decline in jobs as 7,000 job losses were recorded in the manufacturing industry, 5,000 in the construction industry, 2,000 in the mining industry, 2,000 in the trade industry, 1,000 in the transport industry, and 1,000 in the community services industry. In addition, STATS SA (2019) report shows that 28,000 workers in the formal sector were laid off from their jobs in the third quarter of the year 2019 while the annual job loss is as follows: 37, 000 in the construction industry, 22, 000 in the manufacturing industry, 3,000 in the electricity industry, and 1,000 in the transport industry.

Considering the foregoing statistics which implies that the unemployment rate in South Africa is growing daily, it is needless to mention that the current trend in the work environment signals a great threat to the economic stability of South Africa as it recovers from the backlash of the recent economic recession that plagued her. In addition, there are predictions of disruptions to jobs which come with the threat of increased job losses in the work environment of the 4IR consequently, a focus on human capital development is recommended. Therefore, in view of

the current anomaly in the South African work environment and the forecasts by experts, this study on perceptions of effects of the 4IR on expected job disruption and on human capital development approach at the University of Zululand, with a focus on academic staff members was designed.

1.6 Delimitation of the Study

This study was restricted to the academic staff of the University of Zululand due to the constraints of timeframe for this degree, manpower required and financial implications needed in administering questionnaires to every staff member in the University of Zululand and all Universities in South Africa.

1.7 Significance of the Study

The findings from this research is expected to unmistakably aid Human Capital Development in the University of Zululand, South Africa. The research findings is desired to aid further research by researchers who may be interested in investigating the effect of fourth industrial revolution on Human Capital Development in University of Zululand, South Africa. The exposure of University of Zululand workers to the immense benefits of re-skilling and up-skilling is to doubtlessly aid the building of a formidable workforce for the challenges that may be posed by the 4IR. The research instrument was newly designed and validated in order to allow researchers with related researches to adopt and adapt in their study.

1.8 Research Methodology

The quantitative approach and survey method with the aid of a questionnaire titled ‘Fourth Industrial Revolution Skills Assessment Questionnaire (FIRSAQ)’ as research instrument was used in exploring the perceptions of effects of the 4IR on expected job disruption and on human capital development approach at the University of Zululand. Further discussion with regards to the research methodology is contained in chapter three of this study.

1.9 Ethical Consideration

The researcher got the consent of the Research and Ethics Committee of the University of Zululand through the deputy dean of research in the faculty of commerce, administration, and law. The consent of the respondents was also sought before the survey was conducted. In addition, the opinions of the respondents was treated with respect as they had freedom to express themselves and withdraw at any stage of the survey. Furthermore, the respondents were anonymous so as to ensure confidentiality of their names and responses. A copy of the ethical clearance and consent letter is contained in Appendix I and IV respectively.

1.10 Key Concepts

In preparing the reader to understand the intention of this study and the problem, it is necessary to identify and clarify the meaning of key concepts used in this chapter and the subsequent chapters.

Fourth Industrial Revolution: refers to smart production using disruptive and innovative technologies such as Internet of Things (IoT), Artificial Intelligence (AI) and Cyber-Physical Systems (CPS). It is commonly referred to as 4IR (Kagermann, Wahlster, and Helbig, 2013).

Job disruption: unprecedented changes to occupations which results into new approach to existing jobs, new job roles and/or new professions entirely (McKinsey Global Institute, 2017).

Human Capital: refers to the skills, competencies, and knowledge possessed by a worker which determines their value to the organization (Becker, 2009).

Human Capital Development: refers to a process that ensures the continuous learning and improvement of the skills, competencies, and knowledge possessed by workers for continued relevance in their work and career (Currie, and Almond, 2011).

Lifelong learning: refers to a continuous, intentional and self-driven quest for knowledge that is generalized, personalized or career-related (Mullins, 2019).

Re-Skilling: refers to a learning and development process wherein the workers are equipped with new skills that is relevant for their work (World Economic Forum, 2017).

Up-Skilling: refers to a learning and development process wherein the workers are equipped with added skills that is relevant for their work (World Economic Forum, 2017).

1.11 Structure of the Dissertation

Chapter 1 contains the overview of the study wherein the background to the study, the statement of problem, aim and purpose of the study, objectives, intended contribution to the body of knowledge, research design, ethical considerations, resources, feasibility and intellectual property are all presented.

Chapter 2 comprises the literature review based on the problem statement and research objectives. These literatures were succinctly discussed under diverse relevant sub-headings which includes previous phases of the industrial revolution wherein the pre-industrialization era, first, second, and third industrial revolution were considered. The fourth industrial revolution wherein the technologies, global framework, probable impacts on the global workforce as well as South African workforce and the possible skill needs of the 4IR were also considered. Additionally, the need for human capital development with regards to reskilling and up-skilling of the workforce were considered.

Chapter 3 covers the research methodology consisting of the research design, data collection method, sampling technique and sample size.

Chapter 4 consist of the analysis and interpretation of the data collected as well as discussion of the findings from the research carried out. Statistical Package for the Social Sciences (SPSS) version 25 was used in the analysis and presentation of the data in graphs, charts and tables. The researcher proceeded to discuss the foregoing under several headings and sub-headings based on the findings of the study in relation to the research objectives.

Chapter 5 focuses on the summary of the findings gathered during the research and recommendations for an improved related study and suggestions for further research.

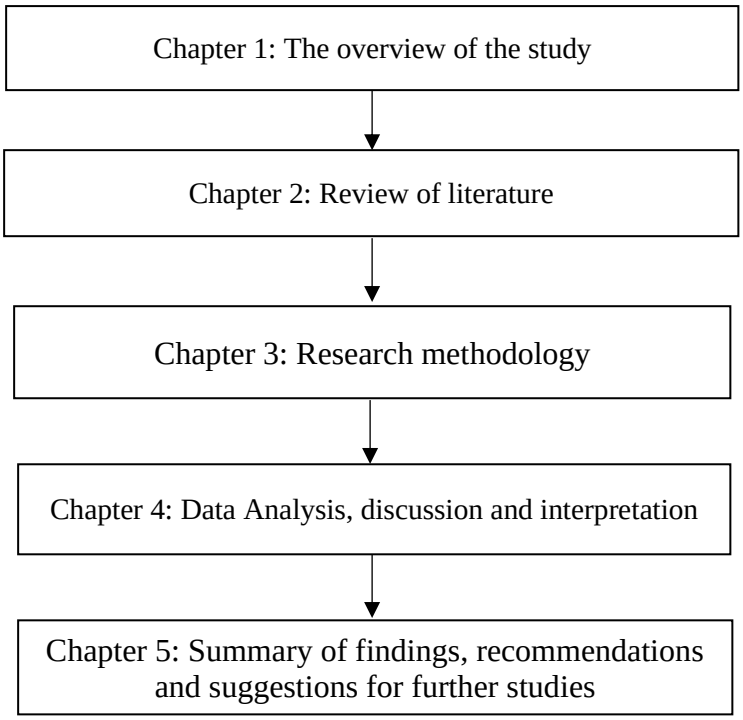

Figure 1.2: Structure of the Dissertation
Source: Researcher's own

1.12 Conclusion

This chapter provides an overview of the study by providing the research problem, aims, objectives, intended contribution to the body of knowledge and ethical issues. Having introduced the study in this chapter, the next chapter focuses on the review of relevant literature.

CHAPTER TWO

REVIEW OF LITERATURE

2.1 Introduction

In the previous chapter, an overview of the study containing the background to the study, problem statement, aims, objectives and research questions among others was presented. However, in this chapter, a review of relevant studies previously done on the subject matter of the fourth industrial revolution especially in relation to job disruption and human capital development are succinctly discussed under several headings and sub-headings. Andrew and Richard (2012) describe literature review as an all-inclusive summary of previous studies on a particular subject which reveals the established knowledge and gap in knowledge on a subject to a bibliophile in order to justify the necessity for the study being conducted.

Skills for Learning (2018) affirms that literature review is self-explanatory; a broad overview, examination, assessment and description of the obtainable writings regarding a specific research question or area. Therefore, in this chapter, relevant literatures are discussed under headings and sub-headings such as the industrial revolution wherein the previous industrial revolutions as well as the 4IR and its possible impacts were extensively discussed. Also, Human capital development in relation to reskilling and up-skilling are succinctly discussed. Hereafter, the discussion that follows focuses on the industrial revolutions.

2.2 The Industrial Revolution

Industrial revolution is a ubiquitous term used by historians in describing phases of technological shifts with an influence that has greatly affected the society (Klingenberg and Antunes Jr, 2017). Scholars such as Kagermann, Wahlster, and Helbig (2013) and Stearns (2018) otherwise refer to industrial revolution as industrialization. According to Stearns (2018), industrialization has the highest significance in terms of advancement in the history of man in the last 300 years as its effects on both the old and modern societies keep unfolding and require constant readjustment.

Studies on one hand reveal that series of industrial revolutions have occurred over the last 200 years (Klingenberg and Antunes Jr, 2017; as well as Liao, Loures, Deschamps, Brezinski, and Venâncio, 2017), or 250 years (Stearns, 2018). Thus, the exact aggregate and time lag of each industrial revolution remains unclear (Klingenberg and Antunes Jr, 2017). On the other hand,

Scholars such as Kagermann et al. (2013); Klingenberg and Antunes Jr (2017); and Liao et al. (2017) highlighted four phases of the industrial revolution from the purview of evolving technology. The first part of this section in this study chronicles the history of the pre-industrial revolution and the three previous industrial revolutions in relation to the nature of work, workplace, work requirements, and skill-needs prevalent in those revolutions. The second part of this section of this study elucidates the fourth industrial revolution.

2.2.1 Previous Phases of the Industrial Revolution: A Human Capital Perspective

2.2.1.1 Pre-Industrialization Era

Prior to the 18th Century, 'work' existed in crude form as it only involves a set of informally transferred methods and skills that are largely agrarian and artisanal. This implies that production was in distinctive little quantities and the economy was largely monopolistic as a high level of skill was required in the prevalent work environment. Bayraktar, and Ataç (2018) comment that before the industrial revolution, the economy was largely driven through cultivation, livestock farming, trading and craftsmanship hence, being energetic was an advantage. Egbetokun, Yun, Zhao, and Kim (2018) traces the era preceding the industrial revolutions to 10,000 years ago and captions it as 'the agrarian revolution' wherein livestock were domesticated, and novel agricultural technologies were introduced, bringing about enhanced production of food, sizeable increase in the populace and increase in fixed settlement.

2.2.1.2 The First Industrial Revolution

Literatures such as Xu et al (2018) and Kagermann, et al (2013) show that there are disparities with regards to the exact year that the first industrial revolution began. For instance, Xu et al (2018) reports that it started in 1760, Stearns (2018) declared that it began in the 1770s, Klingenberg and Antunes Jr (2017) stated that it started in 1784 while Kagermann, et al (2013); and Liao et al (2017) simply stated that it took-off at the end of the 18th century. However, the trend in the writings show that these researchers agree that it kicked off at the end of the 18th century. Suffice to state that the first industrial revolution commenced sometimes towards the end of the 18th century. Furthermore, Scholars such as Klingenberg and Antunes Jr (2017) and Stearns (2018) unanimously stated that Britain played host to the first Industrial Revolution. In the First Industrial Revolution, production was mechanized using water and steam power

(Kagermann et al 2013; Schwab, 2015; Klingenberg and Antunes Jr, 2017; and Liao et al 2017; Xu, David, and Kim, 2018; Stearns, 2018, Uleanya and Yu, 2019).

Animal and human efforts were replaced with water or coal or steam power (Klingenberg and Antunes Jr, 2017) and machinery such as mechanical loom (Kagermann, et al 2013). Xu et al (2018) expounded that through the steam engine, a society that was predominantly agricultural and primitive transited to a new manufacturing process wherein coal was used as the major source of energy while trains became the major channel for conveyance. This development caused an unprecedented increase in various sectors (Klingenberg and Antunes Jr, 2017) with the textile and steel industries prevailing as regards recruitment, worth of production and capital invested (Xu et al, 2018). Furthermore, the development transcended England to France and then to Germany (Ladenburg, 2007) as well as other parts of the Western Europe and the new United States (Stearns, 2018). In addition, a working-class emerged; work and private life was segregated and the urban areas grew (Hobsbawm, 2016). Thus, drastic modifications occurred in economic and social life (Klingenberg and Antunes Jr, 2017).

Klingenberg and Antunes Jr (2017) highlight that the demographic trend in the first industrial revolution era had a dual effect on the economy as demand was created and labour supply was amplified. Karanikola and Panagiotopoulos (2018) argue that the first industrial revolution has a paradoxical impact in that it is connected to the advancement of the capitalist system on the one hand and it triggered major structural alterations socially, economically and culturally on the other. Gera and Singh (2019) assert that the impact of the first industrial revolution is double-sided as mechanization assisted the capitalist to counter workers' associations and yet bestowed unprecedented power on the workers.

Several jobs were created for many with low level of skills (Gera and Singh, 2019), because neither intense scientific knowledge nor huge sums of money were required from the workers (Klingenberg and Antunes Jr, 2017). However, the workforce had to adapt to an unfamiliar work context that is stringent, draining and repetitive as well as entails a high level of restraint and education (Karanikola and Panagiotopoulos, 2018). This led to the emergence of a working-class whose only means of livelihood was their wages (Hobsbawm, 2016), consequently,the dynamics of work radically changed.

2.2.1.3 The Second Industrial Revolution

Studies reveal inconsistencies with regards to the actual year wherein the second industrial revolution commenced. For instance, Klingenberg and Antunes Jr (2017) as well as Uleanya

and Yu (2019) opine that it began in 1870, Stearns (2018) stated that its beginning is traceable to the 1880s, Xu et al (2018) deviated stating that it started in 1900 while Kagermann, et al (2013); and Liao et al (2017) chronicles early 20th century as its beginning. Nonetheless, most of these Academics consent to the commencement of the second industrial revolution commencing sometimes around the late 19th century to early 20th century. Suffice to state therefore, that the late 19th century to the early 20th century captures the second industrial revolution. Klingenberg and Antunes Jr (2017) allude that the United States spear-headed this revolution. However, Stearns (2018) expatiates that Russia, Japan, Canada, Australia, and certain parts of eastern and southern Europe, concurrently hosted this revolution on their shores. The second industrial revolution was marked by mass production through electric power (Kagermann et al 2013; Schwab, 2015; Klingenberg, and Antunes Jr, 2017; Liao et al 2017; Stearns, 2018; and Xu et al 2018).

Products were manufactured en-masse by division of labour (Kagermann, et al 2013), using mass production technologies that are power-driven with electricity (Liao et al 2017). This advancement led to an increase in the total factories (Hobsbawm, 2016) as productivity increased in several industries like railroads, steel and chemical (Klingenberg and Antunes Jr., 2017; Uleanya and Yu, 2019). According to Xu et al (2018), the advent of the internal combustion engine occasioned a period of swift industrial development by means of mass production powered by oil and electricity. The foregoing reveals that the enhancement of the transport industry fast-tracked urbanization in that the working class easily and increasingly migrated to the erstwhile small settlements that were transformed into industrial hubs by means of the railroads and automobile cars.

Furthermore, there was a notable growth in income, accessibility to long-lasting consumer goods, and the standards of living (Frieden, 2008). Hence, organisations grew significantly such that some had more influence than their governments (Klingenberg and Antunes Jr, 2017). Conversely, although, the massive production amplified the quantity of produce through the usage of specialized machineries, however, the machineries were costly. Klingenberg and Antunes Jr (2017) in their view opine that although mass production of identical products resulted in reduced prices and allowed for more demand, the process of production turned out to be extremely inflexible such that a slight difference in the product takes a lot of time and money.

Scholastic discussions vis-à-vis the impact of mass production of the second industrial revolution on the workforce show that the nature of work and skill changed favourably as more jobs were created and the workers emancipated to the point that they influenced the work policies and conditions. Frieden (2008) avers that mass production in the second industrial revolution stimulated the necessity for unskilled workers to the extent that certain nations provided benefits in order to attract workers from overseas. Karanikola and Panagiotopoulos (2018) add that the second industrial revolution afforded the working-class independence and sufficient capacity needed in requesting for improved working contexts from their employers. Gera and Singh (2019) explain that mass production assisted in the deskilling of labour by stripping artisans of their duties which are complicated and reassigning such duties amongst numerous workers in a cost-effective way, thereby, creating more jobs and boosting the demand for products as well as services.

2.2.1.4 The Third Industrial Revolution

The exact year wherein the third industrial revolution occurred cannot be accounted for as there are discrepancies in the archives in this regard. Xu et al (2018) reports that it started in 1960, Klingenberg and Antunes Jr (2017) declared that it began in 1969, Stearns (2018) stated that its beginning is traceable to the 1960s, Kagermann, et al (2013) state that it took-off in the early 1970s, and Liao et al (2017) chronicles mid 1970s as its starting point. Nevertheless, it suffices to note that most of these Scholars agree on 1960s-1970s therefore, we can safely conclude that the third industrial revolution spans through the mid-20th century to early 21st century. Klingenberg and Antunes Jr (2017) archives that the United States led this revolution.

Stearns (2018) argues that this revolution was led by the Pacific Rim and 200years later, it spread out to Turkey, India, Brazil and some other segments of Latin America. The demographic changes, technology-related developments in communications, and fierce competition brought about by the second industrial revolution forced organisations, governments and educational institutions to invest heavily in research and development. This huge investment in research and development from these trio occasioned the automation of production through information and communications technology. Therefore, the Third Industrial Revolution was marked by automated production by means of electronics and information technology (Kagermann et al 2013; Schwab, 2015; Klingenberg, and Antunes Jr, 2017; Liao et al 2017; Stearns, 2018; Xu et al 2018; and Uleanya and Yu, 2019).

The Third Industrial Revolution became notable for its automation of production using electronics and information technology in factories (Liao et al, 2017) instead of screwing or welding sub-parts with each other (Xu et al, 2018). Consequently, most tasks previously executed manually and some of the mental works were predominantly executed with machines (Kagermann, et al 2013). Hence, series of technologies called Advanced Manufacturing Technologies (AMT) which inter alia includes Computer Integrated Manufacturing (CIM), Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Flexible Manufacturing Systems (FMS) was birthed (Klingenberg and Antunes Jr, 2017). Although, this pattern implies that there was progress, nonetheless, the third industrial revolution delivered below anticipation (Klingenberg and Antunes Jr, 2017) owing to deficiencies of skilled specialists, high costs of software and the necessity of capital outlay in contemporary equipment (Freeman and Soete, 2008).

Although, through this revolution, production became more flexible, faster, accurate and customized, however, the situations surrounding the economy in this period slowed down the pace of this revolution. organisations had to develop a survival strategy in the midst of the harsh economic condition hence, in order to cut cost, many moved their production hubs from the industrial areas to the non-industrial areas where labour was abundant and very cheap. This cost-saving mechanism slowed down this revolution in that abundant and cheap labour lacked the requisite skill and the environment itself was deficient of the needed infrastructure. Thus, occasionally, organisations had to outsource from the industrialized areas to bridge the gaps.

Freeman and Soete (2008) declared that scarcity of skilled experts, increasing costs of software and the necessity for huge funding of new machineries among other factors decelerated the pace of the spread of technologies linked to computing. Findings from International Telecommunication Union (2015) reveal that regardless of the explosive use of the internet by 3.2 billion people globally, only 7% of family units in the developing nations have internet accessibility. Klingenberg and Antunes Jr (2017) juxtaposed the double-edged impact of this revolution stating that though, globalization strengthened the Information Technology application owing to the communication needs and reduced labour costs, nevertheless, outdated connections, shortage of knowledge, and organisational restrictions amongst other challenges connected to execution heightened the expenses.

Karanikola and Panagiotopoulos (2018) noted that in the third industrial revolution, workers required a high level of technical knowledge therefore, the evolution and spreading of digital

skills became a significant area of reference for sundry domestic and global educational and workers' training policies. Gera and Singh (2019) observed that the attention of capitalists moved from low-skilled workers to medium skilled workers because productivity increased with computers than existing machines, consequently, workers who possessed the required skills replaced the low-skilled workers especially in the manufacturing sector. Hence, Gera and Singh (2019) conclude that jobs were not eroded, rather, the nature of employment changed radically as the nature of skill-need changed, thereby, restoring the necessity of skills in the work environment and assisting the computer and service industries to thrive more than their manufacturing counterparts.

Table 2.1: Workforce and skills trend of the previous industrial revolutions

S/N	Phase of IR	Period	Prominent Industry (ies)	Nature of Work	Workplace	Skill(s)-Need
1.	Pre-IR	Before 18th Century	Craft and Farming	Specialized	Workshop and Farm	High level of artisanal and/or agricultural skill
2.	IR	18th century to Mid-19th century	Manufacturing - Textile, Steel and Transport	Generalized	Factory	Low level of skill-Operation and control of machines
3.	2nd IR	Late 19th century to Early 20th century	Manufacturing -Transport, Steel and Oil	Generalized	Factory	Low level of skill-Operation and control of machines
4.	3rd IR	Mid-20th century to Early 21th century	Services- ICT and Electronics	Technical	Office	Medium skill -level

Note: IR means Industrial Revolution and ICT means Information Communications Technology
Source: Researcher's view emanating from reviewed literatures

2.2.2 The Fourth Industrial Revolution (4IR)

Some call it 'Digitisation', others call it 'Automation' yet, some others use the catchword 'Industry 4.0'! The unprecedented, and undeniable impacts of tech-jargons such as artificial intelligence, drone technology, internet of things, virtual reality, augmented reality, and cyber-physical systems across industries and countries has made the 4IR a buzz word globally. However, 4IR goes beyond just a buzzword in that it refers to another phase in the human history wherein diverse unprecedented changes are taking place as a result of major technological shifts. Hence, the researcher details relevant issues at the core of the 4IR such as 4IR technologies and the distinctive elements of the 4IR.

2.2.2.1 The 4IR Technologies

In recent times, more sophisticated technologies are emerging with a potential to satisfy the dashed expectations of the third industrial revolution and possibly surpass it (Klingenberg and Antunes Jr, 2017). Schwab (2015) explains that the new blend of technologies is continuously distorting the boundaries between the physical, digital, and biological domains. The report of World Economic Forum (2016) postulates that an unprecedented, broad and all-inclusive revolution will be ushered by the recent technological developments. COEFS (2017) affirms that disruptive and innovative technologies are emerging globally at a fast pace in virtually all industries and nations. Examples of these new technological advancements include the Internet of Things (IoT), Autonomous Vehicles, Materials Science, Energy Storage, and Quantum Computing (Schwab, 2015); Artificial Intelligence (AI), Robotics, Nanotechnology, 3D Printing, Biotechnology (Future of Jobs Report, 2016); and Cyber-Physical System (CPS) (Kagermann, et al., 2013; Lee, Bagheri, and Kao, 2015; Khaitan and McCalley, 2015; Klingenberg and Antunes Jr, 2017; and Liao et al., 2017).

Taiwo, Ayandibu, Taiwo, and Vezi-Magigaba, (2019) chronicles PricewaterhouseCoopers' (PwC) 'the essential eight' viz. Artificial Intelligence (AI), Augmented Reality (AR), Virtual Reality (VR), Drones, Blockchain, Internet of Things (IoT), 3D Printing, and Robotics. PwC (2017) refers to the essential eight as the eight most prominent technological developments from the 150 emerging technologies analysed in one of their studies. PwC (2017) explains the essential eight thus:

- Artificial Intelligence (AI) - is a comprehensive term for technologies involved in the observation and acquisition of data from their environment and executes using the data acquired. Examples among others include robotic process automation, machine

learning, natural language processing, and neural networks. AI vary from general-purpose software mainly due to its ability to provide automated reply from machines to global signals outside the coverage and control of programmers.

- Augmented Reality (AR) – refers to technologies that allow the user to perceive images in the real-world, and associated 'overlaid' digital information. An example is the AR-enabled glasses via which a storehouse worker can check the details of the stocks in a closed crate.
- Virtual Reality (VR) – These are technologies used in generating 3-dimensional objects or product designs with the aid of spatial information. They include VR headsets and VR-enabled smartphones, among others.
- Drones - are miniature aircrafts that have no human pilot but are generally used for deliveries, aerial photography and sensor data collection.
- Blockchain - provides a dispersed record of all dealings trans-versing a peer-to-peer network. It is used in fund transfer and trailing of online polling, without a bureaucratic endorsing authority like a bank.
- Internet of Things (IoT) - are gadgets with in-built sensors, software and network connectivity used to gather, interchange, and act on data usually without human involvement.
- 3D Printing – is a kind of printing founded on digital models in which three-dimensional objects are formed via layering of materials. It has the capacity to modify big enterprises, small businesses, and living rooms into a factory.
- Robotics – refers to Robots that have enhanced ability to identify, control, and acumen utilised in assisting, boosting, or dehumanizing human actions. In recent times, they are increasingly being used outside the factory.

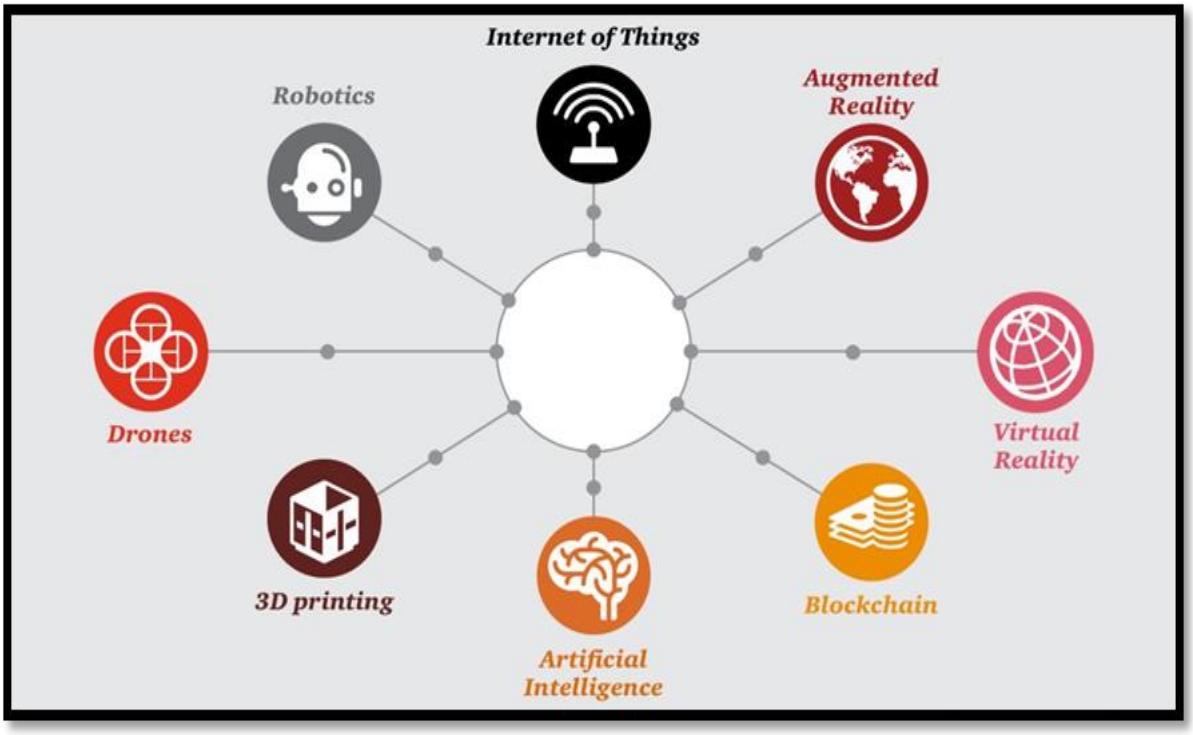

Figure 2.1: The Essential Eight Emerging Technologies
Source: PwC (2017:4) "How can boards tackle the Essential Eight and other emerging technologies?"

Lee et al (2015) opine that the most prominent technology in this wave of development is the Cyber-Physical System (CPS) which refers to the mixture of physical and cybernetic systems. CPS originates from certain significant technical developments on the internet, embedded systems, computer science and artificial intelligence (Klingenberg and Antunes Jr, 2017). Kagermann, et al (2013) forecasts that businesses will institute global networks via which machines, warehouse systems and production services will be integrated in the nature of CPS. Lee et al (2015) detail that in production, CPS facilitates independent manufacturing processes which develops decentralized intelligence with dual representation because via interaction and decision algorithms, the parts are able to select their shape and route in the manufacturing line. Crnjac, Veža, and Banduka (2017) allude that CPS will exchange data independently, prompt events and autonomously execute control.

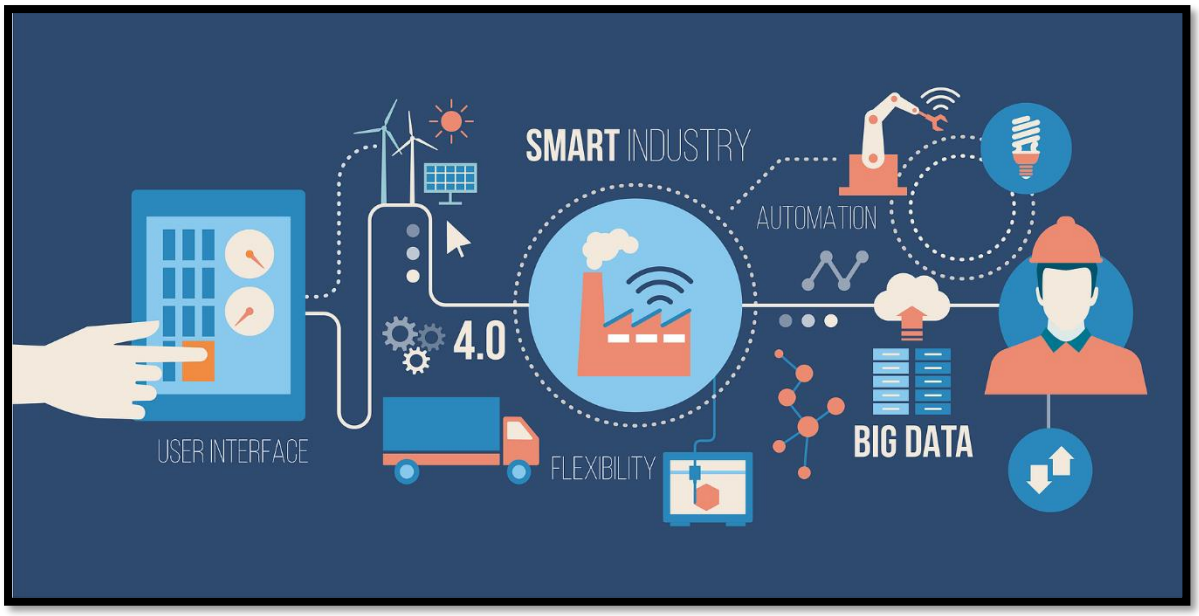

Figure 2.2: Cyber-Physical System (CPS)
Source: Jørgensen (2019) "Cyber-Physical Systems (CPS)"

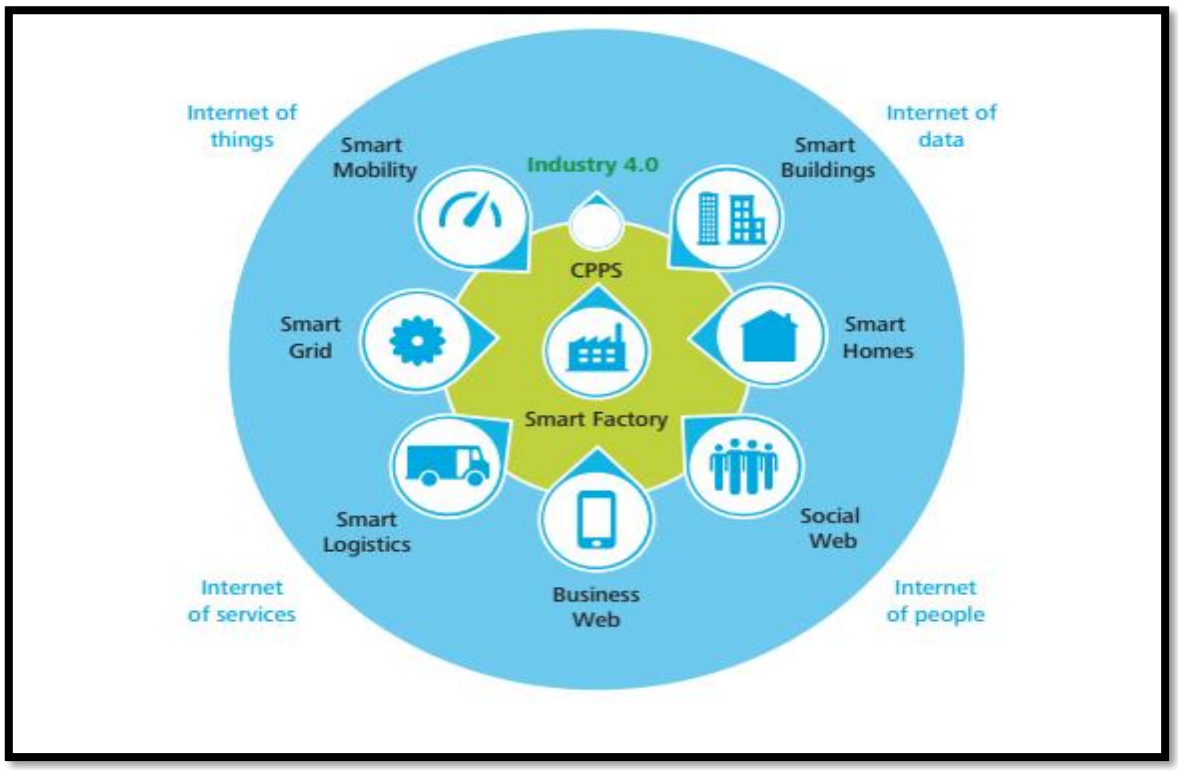

Figure 2.3: Cyber-Physical System (CPS) in 4IR environment
Source: Deloitte (2014). "Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies"

2.2.2.2 Distinctive Elements of the 4IR

Notwithstanding the several discussions on 4IR that is ongoing all over the world, within different countries and across many industries, some Scholars such as Prisecaru (2016), Lee et al (2018) have divergent opinions as regards whether these new developments represent a new revolution. Prisecaru (2016) observes that authors have varying views as to whether this revolution is indeed the 4IR. Lee et al (2018) affirms that the 4IR is marked by several arguments, however, the beginning of these arguments is whether there is indeed a 4IR. Rifkin (2011) considers the changes that is being caused by the current convergence of communication and energy as the actual beginning of the third industrial revolution. Cetrulo and Nuvolari (2019) opine that irrespective of the enormous concentration given to the industry 4.0 currently, it is not a disruptive alteration rather, it is a hype.

Schwab (2015) argues that irrespective of the varying meanings and scholarly contentions as regards the industrial revolutions, there is indeed another industrial revolution that is building on the third industrial revolution. Furthermore, Schwab (2015) contends that the 4IR essentially differs from the preceding revolutions because the manner in which technologies are merging and their interplay transverse physical, digital and biological spheres. In addition to the increased speed in industrial processes through rapidly changing technologies, Kagermann et al (2013), Brettel, Friederichsen, Keller and Rosenberg (2014), Deloitte (2014) as well as Klingenberg and Antunes Jr (2017) agree that the 4IR differs from the different industrial revolutions on the basis of horizontal integration as a result of value networks, digital integration of engineering throughout the full value chain, vertical integration and networking of production systems.

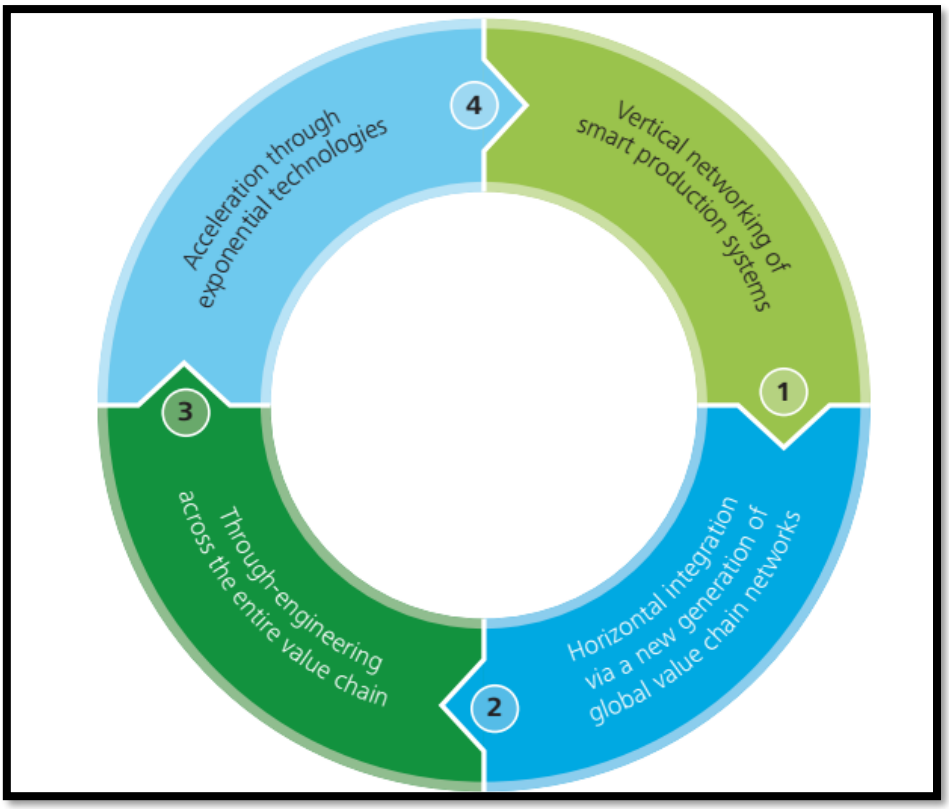

Figure 2.4: Distinctive Elements of the Fourth Industrial Revolution
Source: Deloitte (2014). "Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies"

2.2.3 Major Features of the Four Phases of Industrial Revolutions

There are diverging views regarding the major features that is common to all the four phases of the industrial revolution dependent on the standpoint. Ladenburg (2007) opines that in order to have an industrial revolution, a country requires seven features namely: mineral resources, rudimentary inventions, transport system, sizeable labour force, lump sum investment, skilled workforce, and advantageous government policy. Prisecaru (2016) highlights four features common to all the industrial revolutions namely: energy resource, technological achievement, development of industries, and improvement in transport means.

Klingenberg and Antunes Jr (2017) from the standpoint of history argue that the industrial revolutions have three features in commonwhich are: technical advances, economic scenario, and demographic condition. Although, none of these authors can be said to be wrong as the elements indeed existed from the country and historic standpoint, however, that of Prisecaru (2016) is adopted in this study as it provides a detailed summary of the major features in the industrial revolutions. Table 2.2 below summarizes the energy resource, technological

achievement, development of industries, and improvement in transport means across the four phases of the industrial revolutions.

Table 2.2: Major Features of Industrial Revolutions

S/N	PERIOD	TRANSITION PERIOD	ENERGY RESOURCE	MAIN TECHNICAL ACHIEVEMENT	MAIN DEVELOPED INDUSTRIES	TRANSPORT MEANS
1.	1760-1900	1860-1900	Coal	Steam Engine	Textile, Steel	Train
2.	1900-1960	1940-1960	Oil, Electricity	Internal Combustion Engine	Metallurgy, Auto, Machine Building	Train, Car
3.	1960-2000	1980-2000	Nuclear Energy, Natural Gas	Computers, Robots	Auto, Chemistry	Car, Plane
4.	2000-……	2000-2010	Green Energies	Internet, 3D Printer, Genetic Engineering	High Tech Industries	Electric Car, Ultra-Fast Train

Source: Prisecaru (2016). "Challenges of the Fourth Industrial Revolution."

2.3 4IR Frameworks

In view of the drastic nature of the recent and predicted changes across industries and nations, studies such as Schwab (2015), Karanikola and Panagiotopoulos (2018), Uleanya and Yu (2019) as well as Ramaphosa (2020) strongly suggest that in order to have a human-friendly 4IR, it is important for the public, private and educational experts to brainstorm and work in synergy towards providing a context within which the 4IR can function. Schwab (2015) pointed out that in order to manage the fast-paced change in the 4IR, there is need for a combined and all-inclusive reaction from all the key industry players in every sector. Karanikola and Panagiotopoulos (2018) emphasized the need for a universal platform wherein global organisations, technology corporations, supervisory bodies, scholars and civic societies can join forces together in contributing to the advancement of all human beings in general.

Magwentshu, Rajagopaul, Chui and Singh (2019) argue that in order to ensure that technology is beneficial in South Africa, there is need for combined effort amongst business owners, government, labour unions and institutions of learning. Ramaphosa (2020) maintains that if South Africa will take advantage of the opportunities presented by the 4IR, there is need for collaboration amongst government, private sector, policymakers and industry experts, and other African nations. It suffices to state from the foregoing that there is need for collaboration and integration across all levels inclusive of sectorial, national, regional and global. Diverse platforms exists both locally in South Africa and globally wherein major industry stakeholders have come together to think of the best context within which the 4IR should function. Therefore, in this section of the study, the most-comprehensive global framework and local frameworks to the best of the knowledge of the researcher are reviewed. Consequent on the advocacy for a global platform with a holistic view to the 4IR by Karanikola and Panagiotopoulos (2018), the sub-section hereafter in this section of the study thoroughly discusses the global framework for the 4IR from the submission of the World Economic Forum (WEF).

2.3.1 4IR: A Global Framework

Several universal platforms such as 'Chartered Institute of Personnel and Development' (CIPD), 'Human Resource Certification Institute' (HRCI), 'Plattform Industrie 4.0', 'Centre of Excellence in Financial Services' (COEFS) and 'World Economic Forum' (WEF) among others exist with regards to the fourth industrial revolution. COEFS was established by The Banking Association of South Africa to converge both local and international opinion shapers to advice on ways in which financial services can aid the achievement of national and international objectives, in partnership with industry specialists and researchers (COEFS, 2017). CIPD is a body for human resource (HR) professionals with a specific focus on promoting a healthier work environment via establishing ethical benchmarks for HR and people development, along with motivating constructive modification in the work environment (CIPD, 2019).

HRCI is a sovereign not-for-profit organisation that is committed to progressing the HR occupation by establishing and managing top notch accredited certifications (HRCI, 2019). 'Plattform Industrie 4.0' is geared towards developing collective suggestions intended for every stakeholder through which an unswerving and dependable framework in relation to the Industrie 4.0 in Germany can be built (Plattform Industrie 4.0, 2019). World Economic Forum

is a platform that has effectively converged experts from different spheres and sectors to give a critical outlook of the fourth industrial revolution and map out strategic responses to take advantage of the opportunities while minimizing the risk therein (WEF, 2019). However, in order to understand the impacts of the 4IR in a global dimension, this study explores deliberations and studies from WEF. The choice of WEF is because it offers a comprehensive insight into the 4IR across several spheres and industry globally as opposed to the other platforms whose deliberations are tilted towards a specific industry and/or nation. World Economic Forum categorizes the key issues that require urgent attention for an effective transition into the fourth industrial revolution into eight broad areas namely: fusing technologies, disruption to jobs and skills, security and conflict, inequality, agile governance, business disruption technology, ethics and innovation, as well as innovation and productivity. Furthermore, World Economic Forum outlines and explicitly discussed diverse related themes relevant to these eight broad issues.

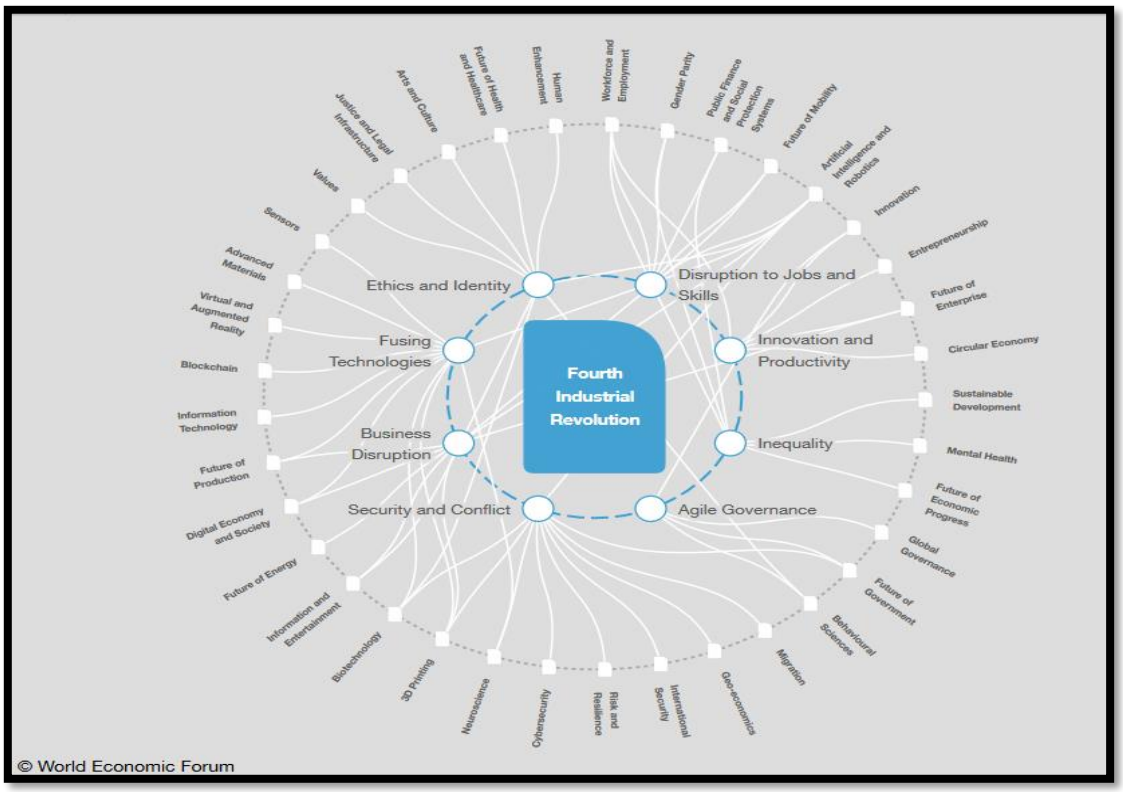

Figure 2.5: Transformation Map for the Fourth Industrial Revolution
Source: WEF (2019). 'Strategic Intelligence.'

Detailed below are these eight broad issues and there corresponding related themes through which WEF (2019) discusses the 4IR in relation to its impact globally.

a. Fusing Technologies

Currently, almost all novel development in every discipline takes advantage of digital potential. Consequently, partnership between careers in the physical, biological and digital domains is altering existing boundaries and creating new ones (WEF, 2019). Hence, human-machine partnership is increasingly becoming emphasized (WEF, 2019).

Amongst these new boundaries occasioned by career-partnership are precision genome editing, advanced robots, autonomous vehicles and 3D printing (WEF, 2019). Related themes under fusing technologies include artificial intelligence and robotics, neuroscience, information technology, block-chain, digital economy and society, 3D printing, virtual and augmented reality, advanced manufacturing and production, advanced materials, and biotechnology (WEF, 2019).

b. Disruption to Jobs and Skills

The disruption of business models is significantly influencing occupations and expertise as different sets of skills are required across industries. Furthermore, due to the somewhat fast paced and broad scaled disruption caused by the 4IR, the timeframe to cultivate new skill set is limited (WEF, 2019). Suffice to state that repurposing of employees in every industry with a specific focus on the essential skills relevant for disciplines with rapid growth is of immense importance (WEF, 2019).

Amidst the influence caused by the disruption of business models are remarkable creation and displacement of occupations, boost in output of workforce, and broadened employers-employees skill mismatch (WEF, 2019). Related themes under disruption to jobs and skills include gender parity, public finance and social protection, workforce and employment, artificial intelligence and robotics, education, gender and work, as well as justice and legal infrastructure (WEF, 2019).

c. Security and Conflict

In recent times, the battlefields are gradually being altered with the aid of modern technologies. Examples of such alterations include concurrent localization and globalization of the geographic location of battlefields, and increasing hybridization of battlefield techniques. In

essence, the 4IR is considerably influencing the extent and attributes of conflict as the differences between warfare and harmony, as well as fighters and non-fighters are already getting blurry (WEF, 2019). Subsequently, conflicts will inevitably take on an online stance, and there will be no clarifications as to who launched an attack or if an attack was launched at all (WEF, 2019).

Thus, the complexities that are currently involved in overseeing safety and conflict in the 4IR is envisaged to increase in direct proportion to those of the pioneering technologies (WEF, 2019). Accordingly, it is envisaged that relevant stakeholders will unavoidably have to collaborate in unprecedented and broad ways to arrest these latent destructive complexities in ways by which innovation and economic growth will not be hindered (WEF, 2019). Related themes under security and conflict include agile governance, cyber-security, international security, global risks, artificial intelligence and robotics, neuroscience, internet of things, geopolitics, space, values, social media, and drones (WEF, 2019).

d. Inequality

Over the years, there has been an increase in the deterioration of wealth disparity. The report of Credit Suisse Research Institute (2017) indicates that in the last ten years, there was a 27% increase in the aggregate wealth globally. However, instead of the 45.5% of aggregate global wealth possessed by the topmost 1% at the beginning of this millennium, a little over half of the total wealth of households worldwide was possessed by only 1% of the population worldwide (Credit Suisse Research Institute, 2017). Although, the current trend is startling, nevertheless, modern technologies threaten to aggravate the trend because with the current level of digitisation, people have greater anticipation which can result into major social risk if they are unable to achieve the prevalent level of wealth (WEF, 2019).

The 2018 report of WEF on Global Risks revealed significant correlation betwixt increasing inequality in revenue, joblessness or lack of gainful employment, and intense unrest in the society (WEF, 2019). Therefore, increase in disparity is a major threat economically and socially. Related themes under inequality include public finance and social protection, sustainable development, gender parity, mental health, workforce and employment, future of economic progress, values, justice and legal infrastructure, and digital communications (WEF, 2019).

e. Agile Technology Governance

The 4IR technologies offer governments platforms for better governance, accessibility, transparency, and public assets tracking (WEF, 2019). Countries such as Spain and Estonia are already taking advantage of the opportunities offered by these technologies (WEF, 2019). Conversely, these technologies can as well generate challenges for governments in that the social contract betwixt the government and populace can be adversely affected (WEF, 2019). An example of such challenges is the manipulation and misinformation of the voters via social media (WEF, 2019).

Therefore, in order to be agile, governments will be compelled to recreate themselves by adopting new methods and instruments in creating and enforcing regulations to manage the proliferation of these technologies (WEF, 2019). Furthermore, agile governance will entail an intertwined partnership between governments, businesses and civil societies (WEF, 2019). Related themes under agile technology governance include global governance, agile governance, innovation, behavioural sciences, social media, cyber-security, block-chain, and internet of things (WEF, 2019).

f. Business Disruption

The 4IR is confronting the basics of businesses in that businesses-consumers relationship is changing to a digitally enabled, real time, and round-the-clock model through modern technologies such as mobile communication services, artificial intelligence, and analytics among others (WEF, 2019). In addition, the 4IR is stimulating erstwhile unknown kinds of collaboration between conglomerates and new entrants thereby creating noteworthy value and efficient use of energy and automation for both sides and the larger economies at reduced costs (WEF, 2019). Related themes under business disruption include information and entertainment, digital economy and society, 3D printing, advanced manufacturing and production, artificial intelligence and robotics, internet of things, and digital communications (WEF, 2019).

g. Ethics and Identity

The 4IR has prompted innovations such as life extension, supposed designer babies, and memory extraction in fields such as biotechnology and artificial intelligence (WEF, 2019). However, these innovations are re-conceptualizing the very essence of humanity by shifting the borders of life expectancy, wellbeing, and reasoning into domains that used to be limited

to imaginative writings that are scientific (WEF, 2019). Hence, there is an urgent need for associated moral and ethical dialogue to help people react aptly. Related themes under ethics and identity include justice and legal infrastructure, values, arts and culture, information and entertainment, future of health and healthcare, artificial intelligence and robotics, behavioural sciences, human enhancement, and biotechnology (WEF, 2019).

h. Innovation and Productivity

Statistics show that there is a great disconnect between the rate of innovation and productivity in the 4IR. This is because innovation rates are increasing exponentially while productivity rates are either stagnant or declining. The US Bureau of Labour Statistics reveal that productivity of workforce estimated in output per hour rose on a yearly average of 2.4% from 1948 to 1983, later, it grew to 2.7% from 2000 to 2007, before declining to 1.3% from 2007 to 2015 (WEF, 2019). This paradox can be due to the inability of the traditional approach to precisely quantify the non-apparent growing productivity in the 4IR (WEF, 2019).

Moreover, the 4IR is still at infancy therefore, its effect is yet to be widespread. Hence, more time as well as new administrative methods, expertise, and critical thinking are needed in achieving the full advantage of the 4IR as was the case with the preceding industrial revolutions (WEF, 2019). Related themes under innovation and productivity include innovation, entrepreneurship, workforce and employment, and circular economy (WEF, 2019). Having considered the 4IR framework from the global context as proposed by WEF, the next sub-section focuses on the 4IR framework from the South African context.

2.3.2 4IR: A South African Framework

In recent times, the South African government under the leadership of President Cyril Ramaphosa have been very vocal about the 4IR. Ramaphosa (2020) reveals that the South African government has a threefold focus in relation to 4IR namely: agile and purposeful response, advantageous use of opportunities from technological alteration to boost global competitiveness in major sectors, preparing citizens for technological alterations and protecting them from its negative outcomes. Hence, several platforms which amongst others include conferences, workshops, seminars, symposiums, and information media are engaging the 4IR in light of the threefold focus in South Africa with diverse views and opinions.

Consequently, 4IR has become a frequently used phrase in South Africa. However, amidst the several platforms wherein 4IR is being discussed in the nation, the researcher has chosen to review the deliberations from the Presidency of the Republic of South Africa, 4IRSA Partnership, and the South African-European Union Strategic Partnership. The reason for the choice of the aforementioned platforms is due to their strategic nature in the country, besides their elaborate and systematic approach to developing a 4IR framework in the South African context. Relevant deliberations with regards to 4IR framework in the South African context from these three aforementioned platforms is hereafter discussed.

2.3.2.1 A South African 4IR Framework: The Presidency Republic of South Africa

According to the Presidency Republic of South Africa (2010), the Presidency manages government because it is the zenith of the governmental system in the Republic of South Africa. The Presidency Republic of South Africa (2019) archives that the President during his State of the Nation Address (SONA) on 7th February, 2019 announced the establishment of a Presidential Commission on 4IR while the announcement of the 30 people appointed as members of the commission was done on 9th April, 2019. This suggests the import of 4IR to the nation South Africa. Furthermore, the Presidency Republic of South Africa (2019) adds that the 30-member Commission as contained in Appendix II is saddled with the responsibility of pinpointing applicable policies, strategies and plans of action which will transform South Africa into a nation that is globally competitive.

Ramaphosa (2020) reveals that the government has constituted the Presidential Commission on 4IR in order to achieve its 2030 goal of ensuring that South Africa develops into a nation that has completely taken advantage of the inherent ability possessed by technological innovations in growing the economy and elevating the South African populace. In addition, Ramaphosa (2020) disclosed that in developing a consolidated national response strategy, the issues that the cross-functional and interdisciplinary 30-member Commission focus on include infrastructure and resources, research, technology and innovation, human capital, industrialization, as well as policy and legislation.

2.3.2.2 A South African 4IR Framework: 4IRSA

According to 4IRSA (2020), 4IRSA Partnership is coined from Partnership for the 4th Industrial Revolution in South Africa which seeks to augment and assist the Presidential Commission on the 4IR and its various activities in South Africa by prompting and promoting a comprehensive national discourse targeted at creating a logical national response to the 4IR

in South Africa. 4IRSA (2020) in discussing the 4IR within South African context, highlights four broad themes namely competitiveness, concentration and inequality, employment and the future of work, society, state and citizen, as well as opportunities. These broad themes by 4IRSA is discussed below as follows:

a. Competitiveness, Concentration and Inequality

Although, global competitiveness in the digital economy is one of the key 4IR related goals in South Africa nevertheless, there are strong indications that the inequality gap would be widened by the high level of concentration related to digitalization. Therefore, as the potentials of the 4IR are advantageously unlocked by the government and in the industry, it is important to ensure that 4IR is also advantageous to the populace. Hence, the sub-themes herein include South Africa's national and industrial competitiveness, as well as fairness and inclusivity.

b. Employment and the Future of Work

The impact of technological disruption on the nature of work, modification in skill requirements, as well as changing designs and models of employment is expected to be both beneficial and challenging. Therefore, in responding to the 4IR, an understanding of the possible advantageous and adverse impacts of automation in South Africa is required. Hence, sub-themes herein include skills development and migration strategies, concentration on segments that create job, approaches to abate potential adverse impacts on jobs

c. Society, State and Citizen

The cyber-physical limits that is becoming obscured in the 4IR possesses an unprecedented ability to redesign the interaction of society, state and citizen as seen in the current divergence, isolation and digital anti-social behaviour all over the world. Therefore, there is a need for South Africa to be proactive in responding to these changes. Hence, sub-themes herein include ethics, legal frameworks and regulation.

d. Opportunities

Considering the potential of the 4IR to speed up development in emerging economies, it is important to find reliable prospects and initiate inspiring but achievable responses that will highly impact South Arica in order to harness these potentials. Hence, sub-themes herein include prospects for increase in export, boosting competitiveness and productivity, developing future global growth segments, inclusion of SMEs in value chains nationally and globally,

healthcare transformation, education transformation, in addition to enlarging local involvement in 4IR markets and ecosystems.

2.3.2.3 A South African 4IR Framework: South African-European Union Strategic Partnership

The South African-European Union (SA-EU) Strategic Partnership with its eleven mandates in relation to science and technology exists to 'promote and leverage strategic relations for the South African Government in Europe. This is expected to leverage resources and strengthen international cooperation to bolster South Africa as well as Africa's science and technology capacities, in support of key national and regional research and innovation priorities and the promotion of global sustainable development' (Embassy of the Republic of South Africa to the Kingdom of Belgium, the Grand Duchy of Luxembourg and the Mission to the European Union, 2020).

A 4IR framework for South Africa called 'national policy options framework for 4IR' was proposed at the 2018 SA-EU strategic partnership dialogue conference on disruptive technologies and public policy in the age of the 4IR. Gastrow (2018) archives that the national policy options framework for 4IR plots and surveys the scope of a potential 4IR policy with the rationale of taking advantage of the potentials of 4IR in achieving the developmental goals of South Africa.

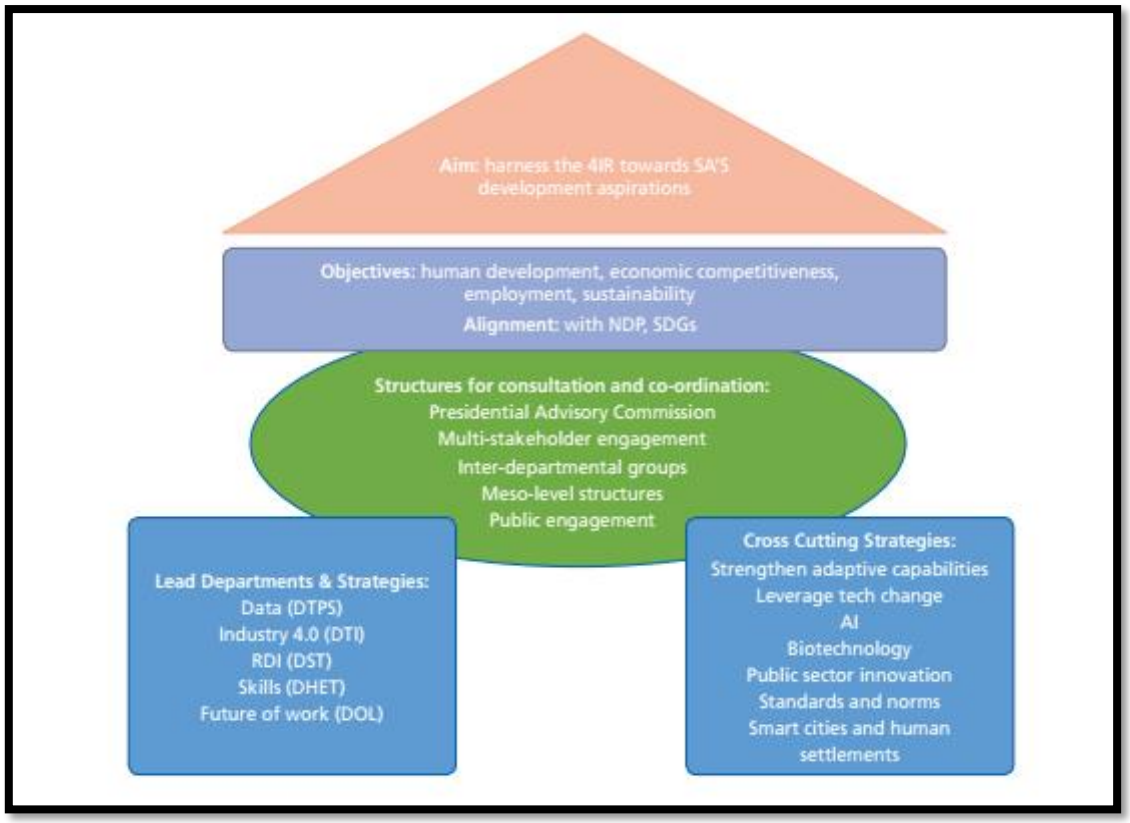

Figure 2.6: National Policy Options Framework for 4IR
Source: Gastrow (2018). 'Policy options framework for the fourth industrial revolution in South Africa'

Although, the national policy options framework for 4IR covers several aims, objectives, structures in addition to strategies, nonetheless, the strategic focus areas as discussed by Gastrow (2018) is hereafter detailed as it encapsulates the relevant information needed in this sub-section of the study.

a. Adaptive capabilities

The concept of 4IR has speedy and accelerating technological alteration at its core, thus, it requires focusing on receptivity and flexibility both as a policy objective across varying spheres and as a feature of functional policy procedures. Hence, sub-themes in this regard include responsiveness and adaptability.

b. Leverage technological change

The current set of disruptive technologies such as Artificial Intelligence, genetic medicine, robotics, and 3D printing must be central aspects of the present day policy terrain. Nonetheless, these central aspects will be altered as time goes on because the current set of disruptive

technologies will reach a climax paving the way for an incredible disruption from the emergence of other novel technologies. Therefore, continuous monitoring of modifications in technology is required for research and policy purposes. Hence, the sub-themes herein include reduction in costs of data for equity in digitalization, increasing the pace of machine learning adoption to encourage usage of systems that are off-the-shelf, and restructuring genetic change through regulation.

c. Build 4IR capabilities

There is need to build competences in the nation in order to efficiently take advantage of the 4IR in order to attain the development goals of the nation. Hence, the sub-themes herein include innovation systems, educational system, the organs of state, and the reinforcement of standards, norms, and legal frameworks.

d. Towards developmental outcomes

In South Africa, the developmental goals and how they link with the entire range of 4IR technologies provides a context that helps to determine the expected results of the 4IR policy. Hence, the sub-themes herein include development of human economic competitiveness, the future of work as well as altering human settlements and working towards smart cities.

The afore-discussed global framework from WEF and South African framework from the Presidency, 4IRSA Partnership and SA-EU Strategic Partnership have elaborately captured several broad issues, themes, and focus. Although, all the afore-discussed broad issues, themes, and focus are highly significant both globally and locally, nevertheless, matters relating to jobs and skills disruption forms a major part of their deliberations. Xu, David and Kim (2018) contends that even though, the 4IR has several probable benefits such as lowering obstacles between innovators and markets, blending of diverse expertise and fields, as well as enhanced living standards; and challenges such as cyber-attacks and inequality, however, the inherent disruption to the labour market is at the core. Runde, Bandura and Hammond (2019) admit that the predominant argument on the 4IR is the inherent ability that robots or algorithms possess in substituting manpower both physically and cognitively in the work environment. Hence, the subsequent section discusses the possible impacts of the 4IR on the global workforce, the South African workers and the probable skill-needs of the 4IR.

2.4 Probable Impacts of the 4IR

A streamlined retrospection on the work environment in the third industrial revolution from which the 4IR takes root reveals that emphasis has been placed on skill from mid-20th century. Furthermore, a broad view of the survey of trends in the previous revolutions reveal that the industrial revolutions often require workers to adapt to significant and unprecedented changes in the nature of work, workplace, work requirements, and skill-needs within that particular period and context. Hence, anticipations with regards to the impacts of the 4IR on the workforce although paradoxical, reveals that workers will need to adapt to major changes in the nature of work, workplace, work requirements, and skill-needs.

2.4.1. The Probable Impacts of the 4IR on the Global Workforce

Globally, predictions with regards to the possible impacts of the 4IR on the workforce have been divergent. These divergent expectations are on the basis of the professions being considered the inherent ability of the 4IR technologies to boost productivity and create new jobs while displacing some other jobs. Future of Jobs Report (2016) predicts that the radical interruptions that the 4IR may cause to the work domain will include: an upswing in entirely new professions, new approaches to management of work, new skills needed in every profession and new equipments to enhance the abilities of workers. Furthermore, Future of Jobs Report (2016) presumes substantial modifications concerning personality, confidentiality, possession, time span of work, relaxation period, connectedness, skills, demand trends, beliefs, values, morals and ethical restrictions in the 4IR. McKinsey Global Institute (2017) foresees that by 2030, about 14% of the workforce worldwide will require a change in the categories of their occupation because automation and advancements in AI will cause a disruption in the work environment and skill requirements. Xu, David, and Kim (2018) emphasized that the 4IR exceeds a mere alteration powered by technology because it is propelled by disruptive innovations that can unmistakably affect major industries and sectors like education, business and health.

Jee (2017) contends that 4IR provides flexibility for entrepreneurs to execute novel ideas hence, 4IR has a potential to increase the revenue and standard of living of the populace globally. Runde, Bandura, and Hammond (2019) concur that the 4IR has the potential to boost productivity in that it permits cheap products and services delivery as well as higher savings which enables more people to become entrepreneurs thereby, creating new prospects for job and adaptable working conditions. McKinsey Global Institute (2017) emphasize that regardless

of the level of increased productivity and economic growth by the 4IR technologies, certain jobs of several people will be replaced globally. Future of Jobs Report (2018) estimates that by 2025, instead of the 71% of tasks being executed by humans currently, more tasks will be executed using machines.

McKinsey Global Institute (2017) warns that by 2030, there will be about 0-30% automation of the global work-hours, contingent on the rate at which the 4IR technologies are adopted whereas the probable effect of the automated work environment on job availability will differ contingent on the profession and industry. For example, physical activities in expected environments such as maneuvering machines, making ready-to-eat food, collating and working on data are susceptible to automation (McKinsey Global Institute, 2017). Therefore, many workers involved in mortgage initiation, legal assistance, accounting, and back-office transaction processing may be dislodged from their jobs (McKinsey Global Institute, 2017). Contrarily, professions in uncertain environments like landscapers, pipe fitters, and nannies may be less influenced by automation due to the technicalities and costs involved in their automation as well as their unattractiveness as a business proposal (McKinsey Global Institute, 2017).

McKinsey Global Institute (2017) adds that the impact of automation on professions involving management, expertise, and communication may be reduced as machines are yet to measure up with the productivity of humans in these areas. Xu, David, and Kim (2018) affirm that professions that require low level of skillfulness with little remuneration are more at risk of being displaced by automation than professions with high remuneration as well as demands for a high level of skill. Runde, Bandura, and Hammond (2019) uphold that professions wherein duties are significantly physical and recurring are highly prone to automation. Subsequently, the displacement of workers due to automation may widen the gap between proceeds on capital and earnings of the workers (Xu, David, and Kim, 2018) which in the long run may aggravate the current strains in the society (Wolf, 2015).

Conversely, McKinsey Global Institute (2017) explains that dislodgement of workers may not necessarily result into decrease in availability of jobs in those professions instead, workers may be involved in the execution of new duties. Future of Jobs Report (2018) speculates that by 2022, 133 million new jobs will replace the 75 million jobs that will be displaced due to the quick emergence of machines and algorithms in the work environment. It is pertinent from the afore-discussed to note that the 4IR may positively impact productivity and efficiency of the

workforce globally, however, many workers universally may lose their jobs, be redeployed to new tasks in their existing workplace or new jobs in another workplace both of which will require new and higher skills due to automation of the low-skilled jobs.

Therefore, globally, the nature of work, workplace and work requirements will be significantly altered in the 4IR as jobs will change hands from those who are skill-deficient to those who possess the skills needed by the employers. Hence, just like every phase of the previous industrial revolutions, the global workforce will need lots of adjustments which majorly centres on acquiring the requisite skills that may be needed in the 4IR. Having considered the possible impacts that the 4IR may have on the global workforce, it is pertinent to explore the South African work environment in order to project the possible impacts the 4IR may have on the South African workforce.

2.4.2 The Probable Impacts of the 4IR on the South African Workforce

Runde, Bandura, and Hammond (2019) posit that although, all countries will be affected by the 4IR, however, the degree to which each country is affected would differ because the demographic changes and nature of the challenges that exists in each country varies. Phillips, Seedat, and Westhuizen (2018) expound that digitisation is advantageous for nations and companies whose workforce are ready to collaborate with machines because unfamiliar value will be unveiled, leading to job creation and restructuring. The Economist Intelligence Unit (2018) reveals that the developed countries are more ready for automation than their developing counterparts. Ndung'u, and Signé (2020) unveil that Africa is yet to possess the 21st century because the continent is deficient of the numerous pointers that are crucial for a fruitful digital revolution.

PricewaterhouseCoopers (2016) and Santiago (2018) state that the adoption of industry 4.0 in South Africa is low regardless of the favorable indicators in the country. Ndung'u, and Signé (2020) expatiate that many African nations give precedence to their rapidly increasing young people that are largely low skilled workers consequently, African governments are non-enthusiast of technologies in that these technologies pose a threat to current low-skilled jobs. The Economist Intelligence Unit (2018) discloses in the automation readiness index, that South Africa is lagging behind in its readiness for automation because it ranked 22nd among the 25 selected countries whose readiness for automation was assessed using 52 indicators.

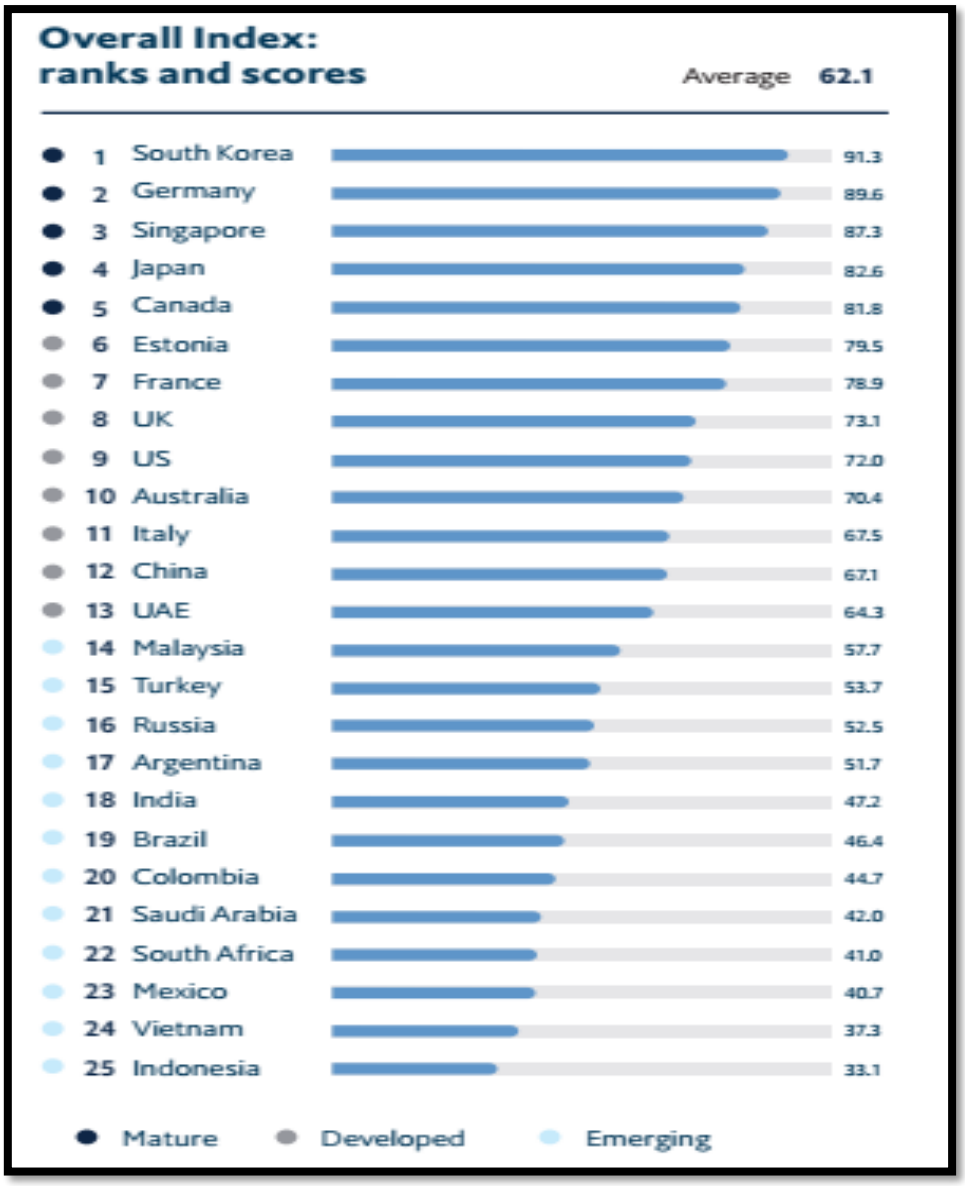

Figure 2.7: Automation Readiness Index
Source: The Economist Intelligence Unit (2018). 'The automation readiness index: Who is ready for the coming wave of automation?'

Phillips, Seedat, and Westhuizen (2018) argue that for a nation such as South Africa wherein the workforce are not really ready to collaborate with machines, digitisation will be detrimental because more jobs will be lost compared to those that will be created thereby, having an adverse effect on individuals and the economy. Deloitte (2018) conducted a survey using 1,600 top level managers in 19 countries of which 100 are in South Africa. The findings show that 73% of South African executives as opposed to about 47% of global executives predict that autonomous technologies may tend towards replacing the workforce than augmenting them. The finding of Deloitte (2018) further indicates that 82% of South African executives as

opposed to about 61% of global executives believe that their organisation -workers relationship will be contract-based, provisional and/or impromptu.

In addition, Deloitte (2018) divulges that 18% of South African executives as opposed to about 39% of global executives opine that their organisation-workers relationship will be interminable and permanent. Results from a study by Accenture show that 35% (5.7 million) of jobs in South Africa presently stands the threat of complete automation due to the manner in which digital technology is currently being used namely: stimulation of cost minimization, automation, and dislodging of human employees (Phillips, Seedat, and Westhuizen, 2018). Magwentshu, Rajagopaul, Chui and Singh (2019) argues from an assessment of work activities that professions which would experience a total automation are very limited, hence, forecasting from the perspective of the job activity level, technologies will displace 3.3 million of the current jobs in South Africa by 2030.

From the foregoing, there seems to be disagreement amongst the intellectuals as to the measure of impact that the 4IR will have on the South African workforce in that their assessment of the exact number of jobs that will be affected by the 4IR in South Africa varies. However, there seems to be a consensus on the nature of impact that the 4IR will have on the South African workforce because there is an agreement that the South African workforce stands at the brink of mass job displacement in the 4IR work environment. In addition, most South African employers believe that the 4IR jobs in South Africa will be more machine-based than human-based and employment will be more of contractual and situational than perpetual and permanent. The current trends in the South African work environment and society as alluded to by scholars such as Magwentshu, Rajagopaul, Chui and Singh (2019), Runde, Bandura, and Hammond (2019) and Asmal, Bhorat, and Page (2020) amongst others strengthen the afore-highlighted forecasts.

Runde, Bandura, and Hammond (2019) from a review of jobs created over the past 25 years in developing countries, observe a shift from the agricultural sector to the service sector. Passion Incubator (2018) reveals that the economy in developing nations have experienced great diversity in the last 10 years as the service sector grew from 30% to above 50% in its contribution to the Gross Domestic Product. Roux, Viljoen, and Samson (2019) report that about 72% of the formally employed workers in South Africa are involved in services sector. Asmal, Bhorat, and Page (2020) assert that the South African economy is moving in the direction services sectors such as finance, transport, and construction amongst others. Runde,

Bandura, and Hammond (2019) refer to the shift to service industry in developing nations as premature deindustrialization because the economic growth of developing nations is yet to reach its peak through industrialization. Asmal, Bhorat, and Page (2020) opine that from 1994 to 2017, the real GDP per capita in South Africa only increased annually by 1% thus, the country has not done much in reducing the level of household poverty with the increasing inequality gap.

World Development Report (2019) estimates that 20% of the South African populace live on Child Support Grant. Magwentshu, Rajagopaul, Chui and Singh (2019) divulge that the annual GDP growth in South Africa reduced from 3.4% to 2% between 2006 and 2018 because of a decline in productivity during the past decade. Therefore, there is reduction in wage growth, increase in unemployment and inequality. World Bank Group (2016) affirms that reduction in the pace at which the workforce gets involved in the labour market, lack of formality, underemployment and unemployment are the major problems facing the labor market in several developing countries. Asmal, Bhorat, and Page (2020) note that the effect of inequality is greatly felt by the generally low-skilled young people in South Africa in that their rate of unemployment which is about 55% as at 2018 has been on the increase since 2008 and cannot be compared with other sub-Saharan African countries.

Magwentshu, Rajagopaul, Chui and Singh (2019) bemoan that millions of South African youths that are striving to have a better life are being affected by South Africa's sluggishness in nurturing the skills required by organisations for increased competition and growth in a technology-driven society. Ndung'u, and Signé (2020) assert that the intense change that the 4IR is causing to the systems of labour and production worldwide necessitates that individuals searching for employment develop the skills and capabilities required by African firms and digitisation generally. Future of Jobs Report (2018) gives an outline of the most often cited job roles in South Africa which are likely to increase in demand from 2018-2022. Table 2.3 below contains the most often cited job roles in South Africa as outlined by Future of Jobs Report (2018).

Table 2.3: Most Frequently Cited Job Roles in South Africa as at 2018

S/N	Most Frequently Cited Job Roles In South Africa
1.	Managing Directors and Chief Executives
2.	Sales and Marketing Professionals
3.	Software and Applications Developers and Analysts
4.	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products
5.	General and Operations Managers
6.	Data Analysts and Scientists
7.	Human Resources Specialists
8.	Assembly and Factory Workers
9.	Database and Network Professionals
10.	Information Security Analysts

Source: Future of Jobs Report (2018). 'Centre for the New Economy and Society.'

Findings from the work of experts such as PricewaterhouseCoopers (2016), Passion Incubator (2018) and Asmal, Bhorat, and Page (2020) reveal that the most cited job roles lack skilled people who can take on the responsibilities involved. PricewaterhouseCoopers (2016) in a survey of 61 South African managers across the manufacturing and mining industries discloses that 58% of these organisations are deficient in digital culture and training, 40% have talent deficiency while 66% of their workforce are deficient in data analytics skills or capabilities. Hence, PricewaterhouseCoopers (2016) concludes that the major challenges combating South African organisations –culture, organisation, leadership, and skills- are more of internal than external challenges.

Magwentshu, Rajagopaul, Chui and Singh (2019) envisage that automation will cause a decline in the demand for workers that lack matric and cause an increase in demand for graduates because the novel jobs that are powered by technology will necessitate an advanced level of skills than the displaced jobs. Passion Incubator (2018) reveals that although, developing

nations have a massive workforce of 85 million workers, nonetheless, 50% of the workers possess primary education only or do not have formal education at all, barely 25% possess a paid job and 15% are educated beyond the secondary school level. Hence, the workforce of developing nations are largely low on skill and educational achievements. In the same vein, Asmal, Bhorat, and Page (2020) reveal that 48% of the South African workforce lack secondary school education.

Runde, Bandura, and Hammond (2019) emphasized that over and above the impacts of technology, developing nations have unsettled challenges revolving around the number and worth of employments being created. Conversely, Magwentshu, Rajagopaul, Chui and Singh (2019**)** argue that in the next 10 years, technology can remedy for the current trends in South Africa as it can lead to a boost in productivity**,** per capita income, and real GDP. Furthermore, Magwentshu, Rajagopaul, Chui, and Singh (2019) opine that South Africa can take advantage of technology to rekindle efficiency, development, and employment. Runde, Bandura, and Hammond (2019) state that the speed of adopting the new technologies will be affected and the process of adoption will be challenging in developing countries because of the income level, skill level, degree of internet access and cost implication of technology amongst others.

Magwentshu, Rajagopaul, Chui and Singh (2019) maintain that through enhanced productivity, strategic execution of policy and advancement in technology, by 2030, a total of 4.5 million jobs can be created with 1.8 million novel employments being traceable to digitisation, machine learning as well as automation and 1.2 million being unprecedented jobs. Ndung'u, and Signé (2020) posit that the African labour force will be one of the largest globally by 2030 therefore, the 4IR gives an opportunity for enormous growth in Africa provided the necessary structures and skills for innovation and technology use are put in place. Deming (2015) recommends combining automated technologies with task execution for individuals who intend to thrive in the future economy. Consequently, Phillips, Seedat, and Westhuizen (2018) advocate for human-machine collaboration in enhancing economic growth and taking advantage of all the potentials of digitisation in South Africa.

The foregoing implies that the South African work environment is faced with numerous challenges which inter-alia includes unemployment and lack of education. In addition, the South African work environment is changing at a fast pace because there is an abundance of data-analytics related jobs for which relevant talents are increasingly being sought from the pool of available South African workforce. However, it is sad to note that amongst other skills,

the South African workforce currently has a wide data analytics skills deficiency which is a major skill required to execute the tasks involved in the jobs cited. Hence, to ensure that the workforce are better positioned and prepared to take advantage of the positive impacts of the fourth industrial revolution, there is a need to understand the skill-needs of the revolution. Therefore, the subsequent sub-section focuses on the probable skill needs of the 4IR.

2.4.3 The Probable Impacts of the 4IR on Skill-Needs

Future of Jobs Report (2016) observes that the increasing rate of radical changes in relation to technology, demography and socio-economy is causing transformation in businesses and their frameworks thus, disrupting the skills-set that employers require and limiting the lifespan of existing skills in professions that are vulnerable to technological changes and the non-vulnerable ones. Consequently, Future of Jobs Report (2016) concludes that in every industry, location and work-group, the ability to comprehend the existing skills-set almost instantaneously and precisely predict, expect and get ready for prospective work features and skills-needs will be progressively necessary for organisations, marketplace regulators, civil societies and everyone to thrive.

World Economic Forum carried out a future of jobs survey in 2016 with specific focus on 35 practical skills and capabilities which are largely utilised from one industry and job family to another.

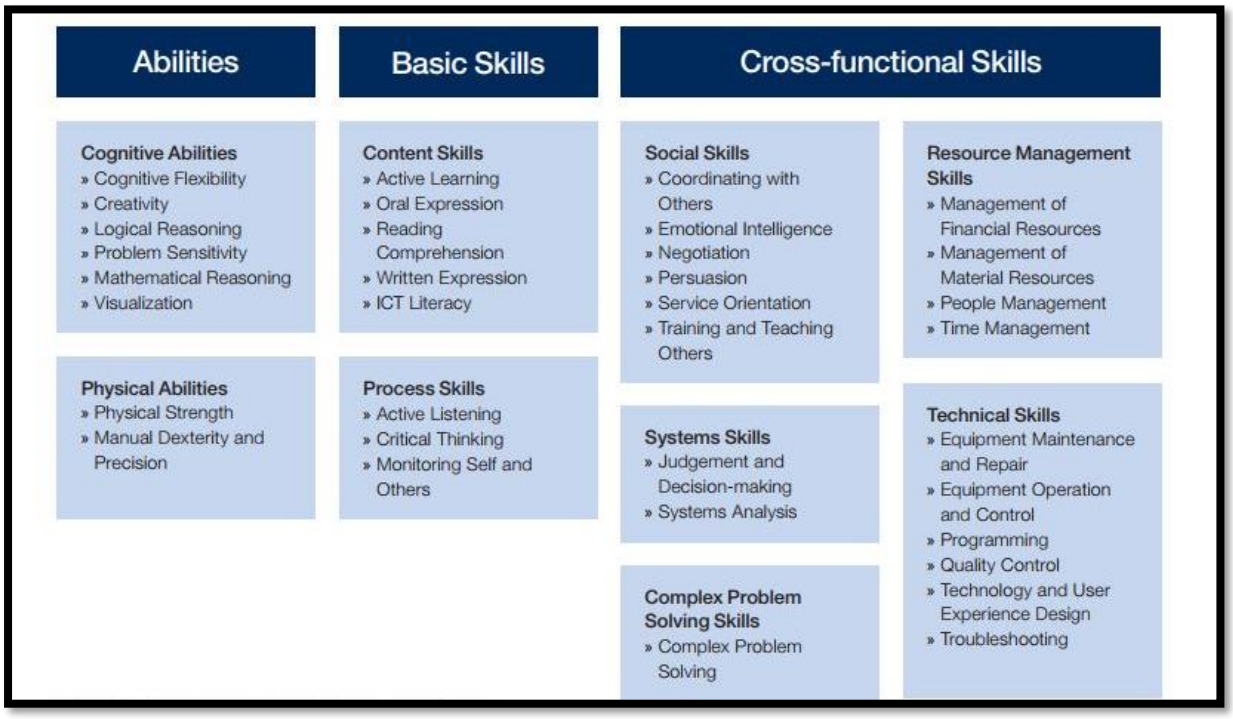

Figure 2.8: Core Work-Related Skills
Source: Future of Jobs Report (2016). 'Employment, skills and workforce strategy for the fourth industrial revolution.'

Findings from the future of jobs survey by WEF in the Future of Jobs Report (2016) reveals the following underlisted:

- By 2020, not less than one third of the skill sets that will be considered essential in a number of professions will include skills that are currently considered trivial.
- Within the span of 2015 to 2020, the Media, Entertainment and Information industry is anticipated to have the highest level of skills stability whereas the Financial Services & Investors industry is anticipated to have the highest level of skills disruption.
- In relation to the overall level of demand for different skills by 2020, 36% of every work across every industry are likely to view complex problem-solving as an essential skill, while 4% are likely to view physical abilities as an essential skill.
- Generally, from one industry to another, social skills like persuasiveness, emotional intelligence and tutoring have a higher likelihood of being demanded than confined technical skills like coding or operating and controlling machineries.
- Content skills like ICT-related knowledge and active learning; cognitive abilities like creativeness as well as mathematical logic; and process skills like active listening and analytic reasoning are expected to increasingly grow as a fraction of essential skills.
- Most profession that strictly require technical skills will begin to demand for creative and interpersonal skills.
- In summary, many participants in the WEF's future of jobs survey expect that lots of professions will need a high level of cognitive abilities like creativeness, critical thinking and problem solving as a portion of their essential skill-set.

Fullan (2016) discloses that in the 4IR, the importance of in-depth learning which involves the six Cs namely character, collaboration, citizenship, communication, critical thinking and creativity cannot be ignored. Manda and Backhouse (2017) argue that regardless of the heightened fear that technology will substitute humans, the 4IR will create job openings for which human reasoning and skills would be the most relevant. Brynjolfsson, McAfee, and Spence (2014) as well as Xu, David, and Kim (2018) affirm that creative and innovative individuals will be rare to find because beyond capital, talents will be the major factor of production in the 4IR.

Karanikola and Panagiotopoulos (2018) maintain that there are three levels of skills required in the 21st century namely: fundamental skills such as numerical competence, reading ability and rudimentary digital literacy; core capabilities together with advanced skills such as science and foreign languages; and transversal skills such as entrepreneurial ability, intellection, problem solving, teach-ability, financial intelligence, innovativeness and creativeness is another important category. Passion Incubator (2018) highlights intellectual flexibility, service inclination, negotiation skills, creative thinking, judgment and decision making, people management, emotional aptitude, critical thinking, coordination, and management of risk as the ten topmost soft skills that are currently sought for in a worker.

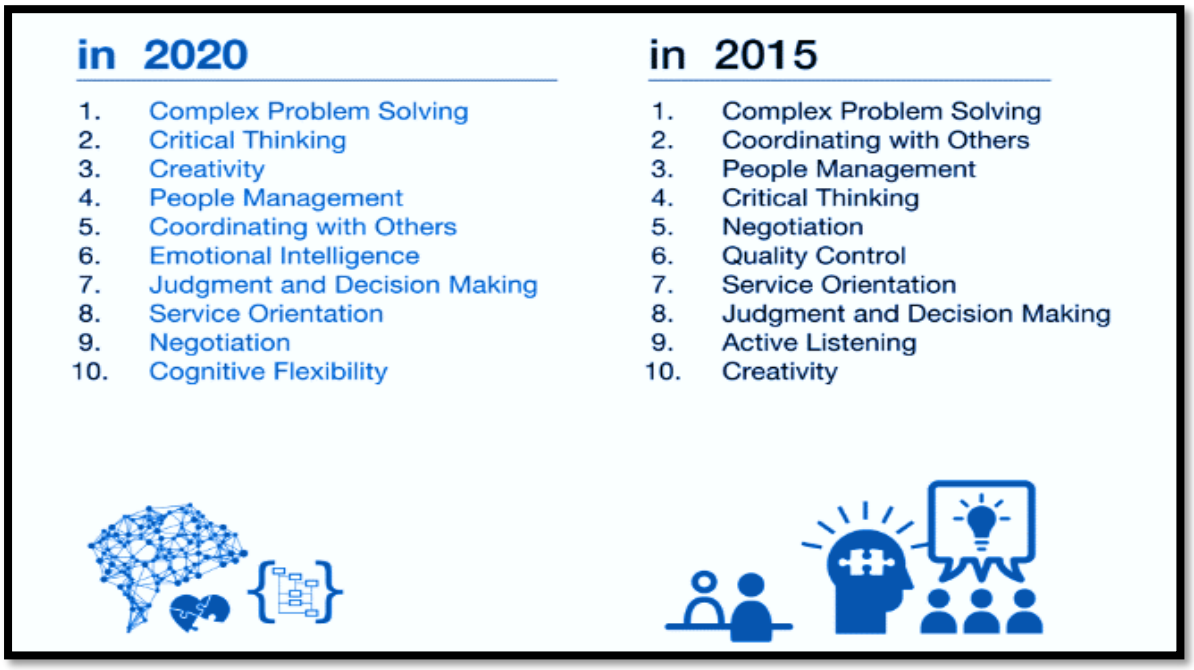

Figure 2.9: Top 10 Skills in 2015 and Expected Top 10 Skills in 2020
Source: Future of Jobs Report (2016). 'Employment, skills and workforce strategy for the fourth industrial revolution.'

Recently, the World Bank Group published a report titled 'World Development Report', based on a cross-country and cross-industry survey of 'the changing nature of work'. World Development Report (2019) explains that though, the recent technologies are causing the need for low-level skills that are repetitive and work-defined to decrease nevertheless, they have led to an increase in the need for high-level skills such as non-repetitive cognition which includes critical thinking; socio-behaviour which comprises emotional intelligence as well as collaboration; and flexibility in gaining multi-skills as they cannot be automated. For instance,

in a particular industry in Vietnam, employees who engaged in non-repetitive systematic duties make 23% higher while employees involved in interactive duties make 13% higher than their counterparts involved in non-systematic, solitary and mechanized duties (World Development Report, 2019). Furthermore, employees in Armenia and Georgia who are problem solvers and can learn new skills get an extra payment of 20% (World Development Report, 2019). In addition, managers in Benin, Liberia, Malawi, and Zambia agree that aside from technical skills, collaboration, communication, and problem-solving skills have the utmost significance (World Development Report, 2019).

Magwentshu, Rajagopaul, Chui and Singh (2019) predict that by 2030, the need for critical skills will entail an addition of 1.7 million workers with higher education to the workforce in South Africa. As shown in Table 2.4 below, Future of Jobs Report (2018) gives an outline of the most often cited workforce skills in South Africa which are likely to increase in demand from 2018-2022.

Table 2.4: Most Frequently Cited Workforce Skills in South Africa as at 2018

S/N	Most Frequently Cited Workforce Skills In South Africa
1.	Analytical thinking and innovation
2.	Creativity, originality and initiative
3.	Active learning and learning strategies
4.	Technology design and programming
5.	Complex problem-solving
6.	Leadership and social influence
7.	Reasoning, problem-solving and ideation
8.	Critical thinking and analysis
9.	Resilience, stress tolerance and flexibility
10.	Emotional intelligence

Source: Future of Jobs Report (2018). 'Centre for the New Economy and Society.'

The academic discussions with regards to the probable impacts of the 4IR on skill-needs that has been considered in this section of the study shows that the basic skills, core competencies and cross-functional skills are the three levels of skills that operate in the work environment. In addition, most of the employees currently possess basic skills or at best core competencies and a little fraction possess the cross-functional skills. Figure 2.10 below is a pyramid summarizing the current state of the skill-groups in the current work environment.

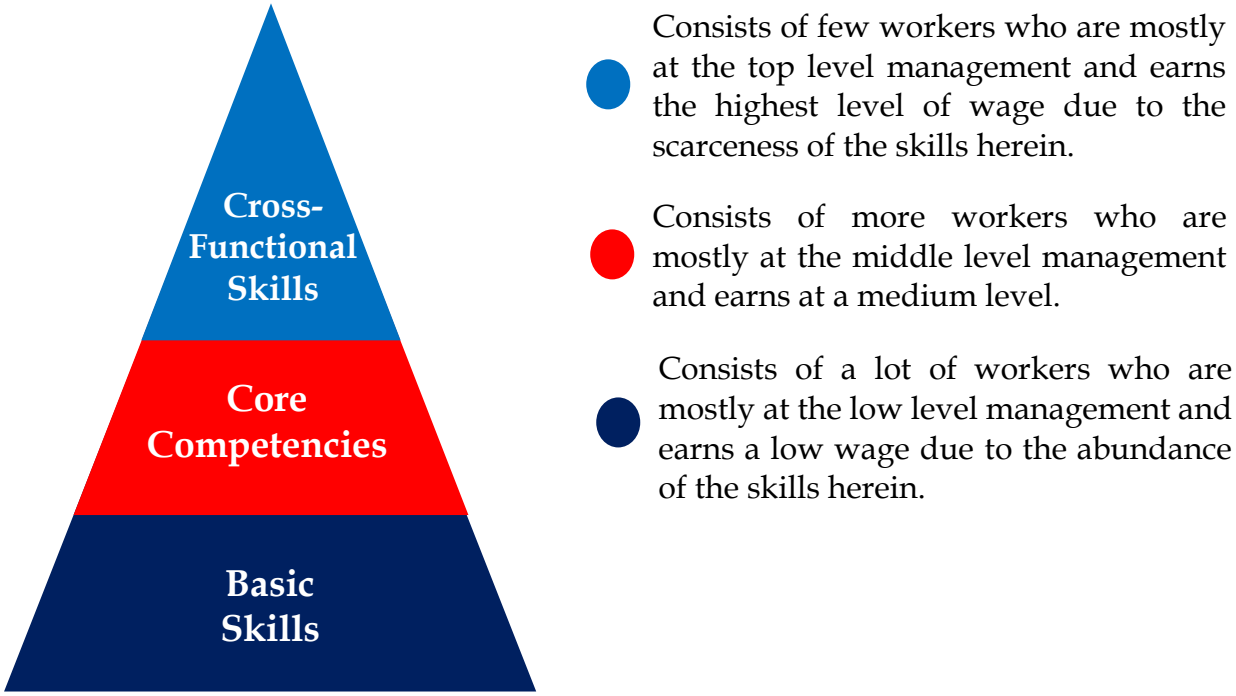

Figure 2.10: Current State of the Skill-Groups in the Current Work Environment
Source: Researcher's own

Furthermore, studies highlighted above reveal that emphasis has shifted from basic skills to the core competencies and the cross-functional skills most especially. Therefore, to ensure a beneficial 4IR, there is need to ensure that the global and South African workforce transit from skill deficiency and/or mismatch to having a high-level of the relevant 4IR skills. Sequel to the foregoing, the next section focuses on human capital development for workforce relevance in the 4IR work environment.

Figure 2.11 below summarizes the probable skills-needs of the 4IR on the basis of the extent of emphasis placed on them in relevant discussions above.

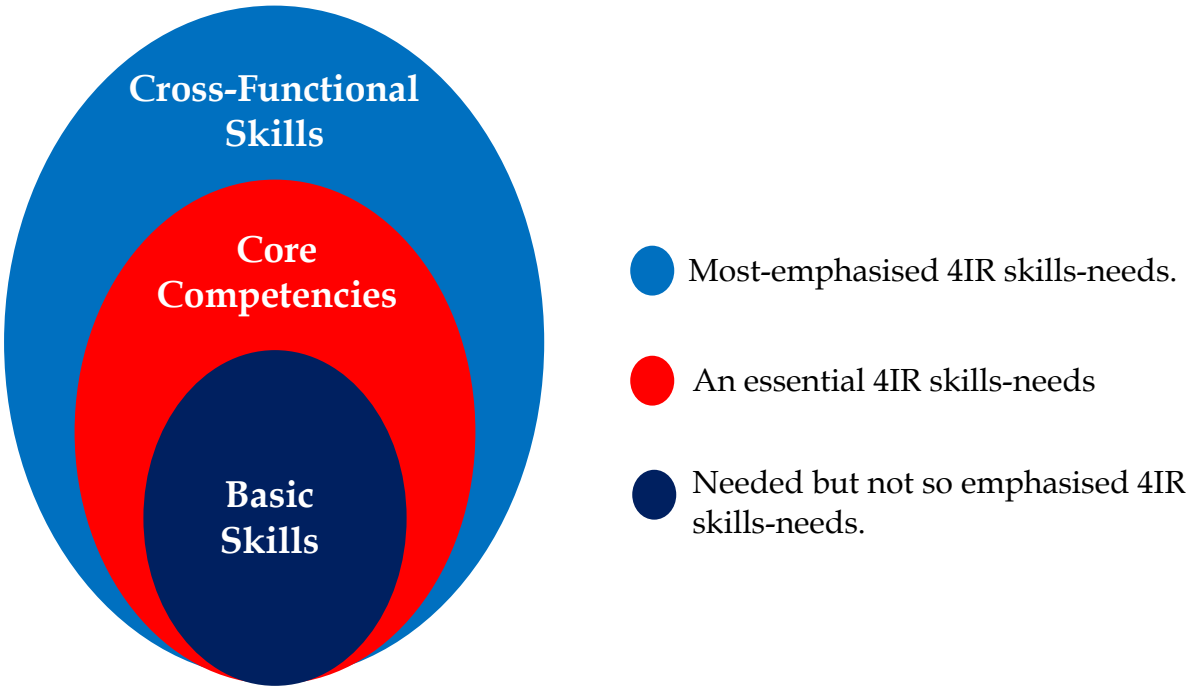

Figure 2.11: Skills-Need Emphasis In View Of the Fourth Industrial Revolution
Source: Researcher's own

2.5 Human Capital Development: The way forward for the South African and Global workforce in the 4IR

McKinsey Global Institute (2017) argues that many people globally may need to change professions or up-skill because of the changes that the 4IR would cause in the work environment. Illanes, Lund, Mourshed, Rutherford, and Tyreman, (2018) opine that all economies will be faced with a major responsibility namely: the retraining and redeployment of numerous mid-career and middle-age employees. World Development Report (2019) affirms that a new social contract focused on greater investments in human capital, and increasingly offers global social protection is required for the world to gain from technological prospects.

Ndung'u, and Signé (2020) maintain that investment in labor education and reskilling programmes is a necessity for governments in Africa to ascertain that technology is complementary instead of substituting. World Economic Forum (2019) outlines lifelong learning, reskilling, and up-skilling as the components of human capital development.

Therefore, this section of the study focuses on lifelong learning, re-skilling and up-skilling as well as the educational system from whence most of the skilling activities in a nation is done.

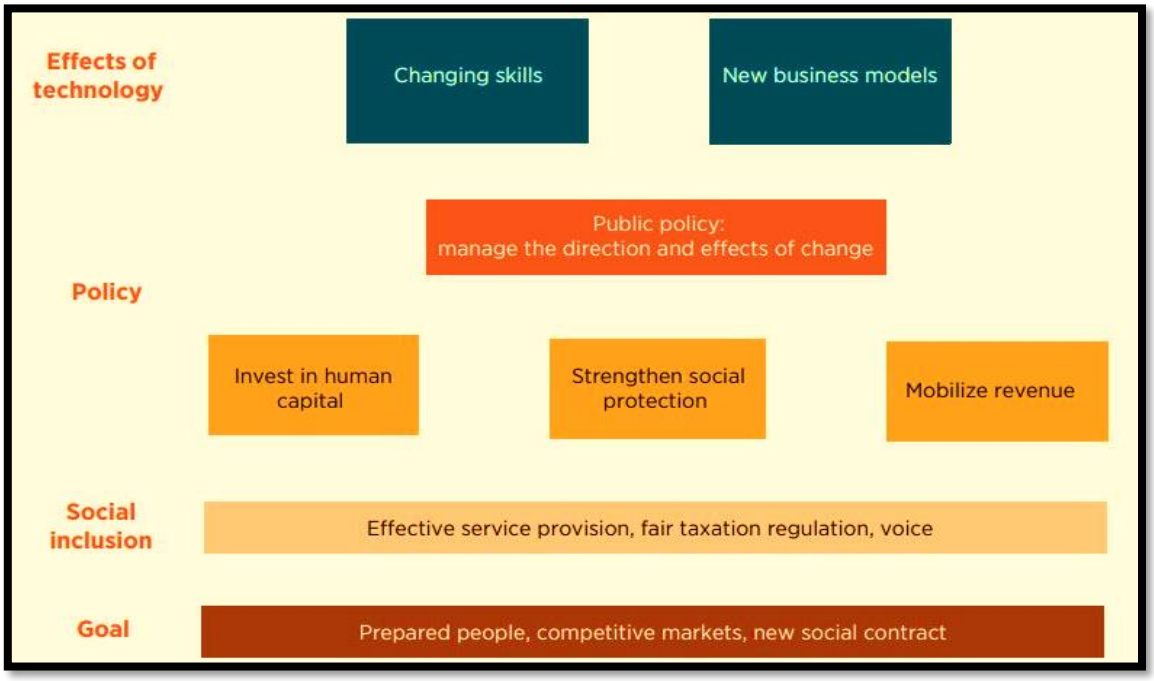

Figure 2.12: Gaining from the effects of technology
Source: World Development Report (2019). 'The Changing Nature of Work.'

McGowan and Andrews (2015) claim that in a current study of OECD nations, at least one out of four adults attest that their present sets of skills do not match those necessary to perform their duties. Naudé (2017) explains that Trends in International Mathematics and Science Study (TIMSS) in a survey revealed that South Africa ranks one of lowest nations in terms of education. Thus, South Africa is said to have one of the worst education systems globally. Passion Incubator (2018) reports that the present levels of skill in the labour force of developing nations suggests that the capacity of the labour force in adapting to the requirements of jobs of the future is low. Roux, Viljoen, and Samson (2019) divulge that the South African populace largely have outdated skills due to their opposition to re-skilling and up-skilling initiatives over the years.

Consequently, Roux, Viljoen, and Samson (2019) posit that in South Africa, proactive retraining and up-skilling is necessary in order to build an inspired, responsive and skillful labour force whose talents can be harnessed in fast-tracking the pace and depth of adopting

technology for growth in business, creation of novel employments and increasing current employments. A study conducted by Phillips, Seedat, and Westhuizen (2018) reveal that a doubled effort in South Africa to ensure that the workers obtain applicable human-machine collaboration skills can decrease the jobs at risk to 14% (2.5 million) in 2025. Magwentshu, Rajagopaul, Chui and Singh (2019) emphasize that an improvement is needed in the rate of transformation of South African graduates in order to cater for the increasing demand for workers with higher education in the workplace.

The Economist Intelligence Unit (2018) suggests that education must be central to the long term strategy that nations seek to engage in order to solve the challenges of automation. Passion Incubator (2018) recommends a restructuring of developing nations' agenda for skills development by means of reforms in basic and higher education systems that centres on the curricula, accreditation, and mode of education delivery as well as re-skilling the current workforce through adult learning, vocational and technical trainings, and apprenticeships. Magwentshu, Rajagopaul, Chui and Singh (2019) state that in managing the huge transition of the South African workforce, decision-makers in every sector will have to ascertain adequate reskilling of employees in order to retain them in the labour force. This will also help to strengthen the system of education to mass produce the needed technical and life skills.

Ramaphosa (2020) stressed that in order to prepare the South African populace for the future jobs, reskilling and huge investments in curriculum innovation are of great significance. Xu, David, and Kim (2018) explain that there was a change in the educational emphasis at every phase of the industrial revolution as standardized learning was emphasized in the first industrial revolution, standardized testing was emphasized in the second industrial revolution, and customized learning was emphasized in the third industrial revolution. Hence, the 4IR will also require a shift in the nature of the curriculum, teaching and learning (Xu, David, and Kim, 2018; Uleanya and Yu, 2019). The Economist Intelligence Unit (2018) contend that in schools, learners must be taught skills such as technical skills, critical thinking, AI skills and robotics because they are not easily replaceable.

Santiago (2018) suggests a collaborative effort between universities in developing nations and those in developed nations that centres on data science programmes and certification programmes that supports the up-skilling of the labour force. Ninan, Roy, Thomas (2019) encourage establishments to have effective training and development programmes because training is an avenue to empower workers with the necessary skills required in executing a task.

Passion Incubator (2018) avers that employers of labour engage in up-skilling programmes and opportunities to retrain the existing labour force while the employees should participate in up-skilling programs and opportunities for employees to acquire the required technical and soft skills in the dynamic work environment. Magwentshu, Rajagopaul, Chui and Singh (2019) state that on many organizations require massive reskilling and up-skilling of their current workers through up-to-date adult-learning science, thorough tracking of return on investment, and persuasion of employees for the change. Meanwhile the employees must have the readiness to reskill for continued work relevance and jobs of the future.

Sequel to the foregoing, it can be stated that human capital development which encapsulates lifelong learning, re-skilling and up-skilling cannot be overemphasized in ensuring that the workforce are equipped with the requisite 4IR skills. However, the core driver of these element of human capital development is the educational system both in an organization and in Higher Education Institutions (HEI). Therefore, relevant adjustments must be made to organizational learning and development as well as institution-based teaching and learning. A review of the works of Uleanya, Rugbeer and Duma (2018) and Uleanya and Yu (2019) show that the place of the curricula guiding teaching and learning activities is of immense importance for re-skilling and up-skilling of individuals for relevance. World Economic Forum (2017) suggests that the approach to human capital development must be reviewed and upgraded to suit the dynamic needs of the current and next generation of workforce. Therefore, the next section contains the 70:20:10 model; an approach to human capital development that has proven to be effective in meeting the dynamic training needs of the workforce.

2.6 Theoretical Framework

Several learning and development theories exist with regards to the best approach to human capital development in the workplace. Examples inter-alia include human capital theory, information processing theory, ERG theory, social learning theory, adult learning theory, reinforcement theory, expectancy theory, goal setting theory, and need theories. However for the purpose of this study, the 70:20:10 model is adopted because it holistically views employee development and has proven to be highly relevant in meeting the contemporary training needs of the fast-changing business environment. Hence, it has gained prominence in the human capital development related articles and is increasingly being implemented by human capital development experts in the workplace.

According to GoodPractice (2016), businesses whose method is guided by the 70:20:10 model record higher influence on the whole organisation as well as workers, increased advantages from learning facilitated through technology, and reduced obstacles to an updated learning approach. A recent survey by Jennings, Overton, and Dixon (2016) reveal that the 70:20:10 framework is connected to enhanced performance in that it allows for swift response to changes in business, enhancement in employee motivation, and rise in customer satisfaction quadrupled, tripled, and doubled respectively in businesses that have adopted this framework. GoodPractice (2016) maintains that only progressive and well-informed organisations can adopt the 70:20:10 model.

Although several authors such as Tough (1968), Tough (1971), Bandura (2006), and Cross (2006) have written on different elements contained in the 70:20:10 model, however, scholars such as Rabin (2014), and Joshi (2018) as well as learning and development organisations such as GoodPractice (2016) and Berkeley HR (2019) unanimously credit the pervasive 70:20:10 framework to Eichinger and Lombardo (1996) of the Center for Creative Leadership in North Carolina, United States of America.

The 70:20:10 model proposes that learning and development of the workforce mostly occurs informally as employees execute their daily tasks rather than formally through the traditional classroom approach to training and education. It is disclosed in the 70:20:10 model that 70% of employee learning and development emanates from on-the-job experiences and activities, 20% originates from relationships with, observation of and feedback from colleagues, while 10% stems from professional training and programmes (Rabin, 2014, GoodPractice, 2016, and Joshi, 2018).

Figure 2.13: The 70:20:10 Model
Source: Joshi (2018) "Learning: 70-20-10".

Learning and development experts assert that the 70:20:10 model has a wide range of applicability. GoodPractice (2016) avers that the 70:20:10 model explains how workplace learning occurs, recommends how learning and development function should arrange its learning activities and categorise its related supporting activities, and a useful catalytic tool for the learning and development function to revise the range of learning activities it currently provides. Joshi (2018) states that the 70:20:10 model is an effective tool for change, greater efficiency, employee motivation, and cost minimization as it is highly relevant to these contemporary periods and every category of the workforce be it managers, administrative workers, or technical workers.

Figure 2.14: A Range of Possible Activities Using the 70:20:10 Model
Source: Berkeley HR (2019) "70:20:10: The Key to Your Development Path"

2.7 Conclusion

In this chapter, various relevant literatures were reviewed with focus on how the 4IR is envisaged to impact jobs and skill globally and in South Africa. Also literatures revolving around the need for and approach to human capital development in the 4IR work environment were reviewed. The next chapter presents the research methodology adopted for the study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

The previous chapter contains the review of relevant literatures for this study. The reviewed literature presented subjects on the previous industrial revolutions, the 4IR, envisaged work disruption (the future of work), reskilling, up-skilling, among others. This chapter which is titled research outlines and discusses in-depth the methodology adopted for this study. Kothari (2004) expounds that research methodology is a science of examining the scientific approach to research in which numerous procedures cum rationale for the procedures generically embraced by a researcher in evaluating his/her research problem is studied. Henning, Van Rensburg, and Smit (2004) allude that research methodology is the capability to express data and findings such that it depicts the research question and its rationale in a rational collection of methods.

Greener and Martelli (2018) affirm that research methodology relates the researcher's disposition, comprehension of research, and choice of approach to research in solving research questions. Kothari (2004) synopsized research methodology as an organized approach to solving the research problem. Therefore, in this chapter, the organized approach adopted by the researcher in solving the identified research problems and achieving the research objectives are concisely discussed under different headings and sub-headings such as research paradigm, research design, sampling, data collection, among others.

3.1 Overview of the Organization

The study area adopted for this study is the University of Zululand. The University of Zululand started out in 1960 but was officially opened on 8th March, 1961 as a college arm of the University of South Africa (University of Zululand, 2020). The University College as it is called then, enrolled 41 students who are from the Zulu ethnic group, employed 14 lecturers and had limited amenities (University of Zululand, 2010 and 2020). The nomenclature "University of Zululand" was given in 1970 when it transformed from a 'bush college' to a rural based University that provides for the education need of students domiciled in the rural community of the Zulus (University of Zululand, 2010). Although, it was referred to as a "historically disadvantaged University" due to its location among the Zulus (a tribe that was

adversely affected by the Colonial rule) however, its coverage at this point included black students from every ethnic group within South Africa. (Advice and Monitoring Directorate, 2010 and University of Zululand, 2018). 1984 was a remarkable year in the institution's history, because it was granted the autonomy to be overseen by its Council which was constituted in 1982.

From 1986-1993, the University had a number of achievements including lifting of the racist embargo; establishment of the Centre for Legal Services; departments of Agriculture, Engineering and Human Movement Science; the Institute for Education and Human Development and formation of strong international ties amongst others (University of Zululand, 2020). In 2002, University of Zululand became a comprehensive university and student-intake spanned across other parts of Africa such as Namibia, Nigeria, Kenya, Zimbabwe, Botswana, Lesotho and Swaziland increased because of the inclusion of outcomes-based programmes in its curriculum upon declaration that it is the only 'institution of higher learning north of the uThukela River' (University of Zululand, 2020). In 2009, the Richards Bay Campus of the University was established. Today, the University offers about 252 accredited degrees, diploma and certificate courses, has over 17,000 students and 295 academic staff members (University of Zululand, 2018).

3.2 Research Paradigm

Functionalism otherwise known as positivism (Bhattacherjee, 2012) paradigm was adopted for this study. Bhattacherjee (2012) reveals that the term 'paradigm' gained popularity through Kuhn (1962). Bhattacherjee (2012) opine that paradigms are philosophies that underlies the research design and approach which shapes the thought and opinion of a researcher. Greener, and Martelli (2018) affirm that research paradigm is a collection of philosophies that directs a researcher's decision on the object of study and interpretation of results. Four paradigms namely functionalism, interpretivism, radical humanism and radical structuralism are generally used in social science researches (Greener and Martelli, 2018). These paradigms proposed by Burrell and Morgan (1979) are based on two philosophical assumptions called ontology and epistemology (Bhattacherjee, 2012).

Ontology refers to the world view of the researcher while epistemology refers to the most appropriate way the researcher believes the world can be studied (Bhattacherjee, 2012; Greener, and Martelli, 2018). The functionalists have a social ordered view to the world and

studies it objectively, the interpretists have a social ordered view to the world and studies it subjectively, the radical humanists view the world as socially changing and studies it subjectively, while the radical structuralists view the world as drastically changing and objectively study and enforce these changes (Bhattacherjee, 2012). Sequel to the adoption of functionalism otherwise known as positivism paradigm, this study was carried out objectively as the consideration and representation of findings was not influenced by the judgment of the researcher.

3.3 Research Design

In this study, the cross-sectional field survey research design was used. Aina (2002) views research design as a procedure or plot that is employed in data collection. Kothari (2004) explicates that research design is a theoretical construct wherein research can be done as it includes plans for research data collection, computation, analysis and interpretation. Bhattacherjee (2012) opines that research design is a process that relates to crafting a plan of action such as selection of research method, operationalization of concepts under purview and formulation of suitable sampling technique for adequately solving the research questions established in the exploration phase of the research. Positivist research design includes experimental studies, secondary data analysis, case research, and field surveys, amongst others (Bhattacherjee, 2012).

Kothari (2004) defines survey research design as an approach to research where the researcher studies a fraction sampled from a population in order to determine the peculiarities, and draws inference from sample for the whole population. Bhattacherjee (2012) adds that field surveys are non-experimental designs as the researcher does not influence the independent variables but only measures the independent variables and test their effects using statistical methods. Furthermore, Bhattacherjee (2012) classifies the survey research into longitudinal field surveys wherein the dependent variables are measured after the independent variables have been measured; and cross-sectional field surveys wherein both the independent and dependent variables are measured together. Hence, the researcher studied and drew inference from a sampled fraction of the targeted population. In addition, the researcher measured both the independent and dependent variables *pari passu*.

3.4 Research Approach

Quantitative data was primarily sourced for this study. Walliman (2011) defines data as tads of information which can be categorised based on their source and characteristic. Based on their source, data can be categorised into primary and secondary while based on their characteristics, data can be categorised into quantitative and qualitative (Walliman, 2011). Kothari (2004) considers primary data as data that are being collected first-hand by the researcher and secondary data as data that has been collected and statistically processed. Bhattacherjee (2012) asserts that primary data are personally collected by the researcher while secondary data has been collected and tabularised by sources other than the researcher. Kothari (2004) opines that quantitative data relates to 'quantity or amount' while qualitative data relates to 'quality or kind'. Walliman (2011) affirms that quantitative data are data that are collected, recorded and analysed numerically, while qualitative data are those that are collected, recorded and analysed in words. In addition, Walliman (2011) highlights accurate measurement of data, use of mathematical procedures in analysis and ease of use as some of the advantages that quantitative data offers. Bhattacherjee (2012) enumerates that quantitative data are largely used by positivist as they inter-alia contain numeric scores and metrics while qualitative data are largely used by interpretist as they inter-alia contain interviews and observations. Owing to the fact that this study adopts the positivist paradigm and its advantages, quantitative data was used in this study

3.5 Sampling

The researcher followed the three step process in performing the sampling for this study. Kothari (2004) views sampling as the choice of specific aspects of a whole from which conclusion concerning the whole is drawn. Stuart and Nicola (2009) describe sampling as the procedure of recognising the part of a broad populace that a researcher seeks to study. Bhattacherjee (2012) states that sampling is the procedure in statistics which involves choosing a fragment of the entire population that a researcher intends to study so as to observe and draw statistical conclusions concerning the entire populace.

Kothari (2004) highlights reasons for sampling, prominent of which is to conserve time and fund. Bhattacherjee (2012) affirms that it is neither feasible nor cost effective to conduct a research using the totality of the populace; hence, the need for sampling. Walliman (2011) and Bhattacherjee (2012) state that sampling involves a three step process viz. outlining the target population, choosing the sampling frame, and selecting the sample. Therefore, due to the

limitation of time, manpower and the fund available for the purpose of this research, the researcher followed the three step sampling process.

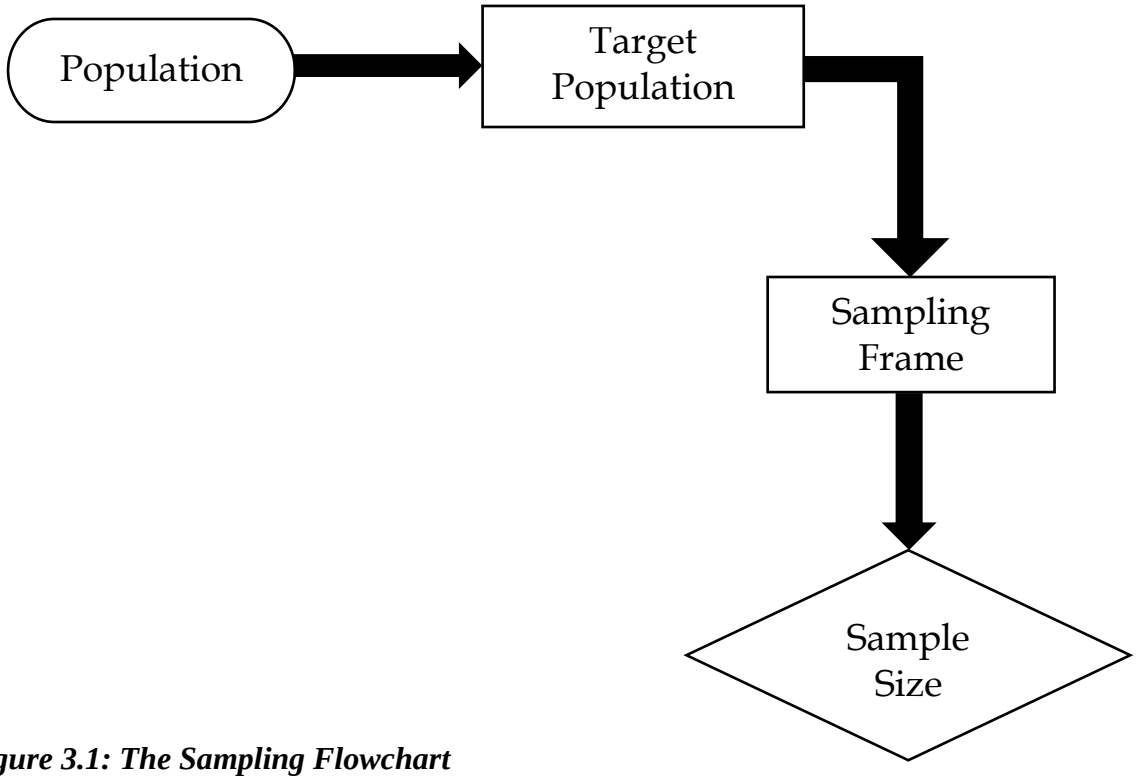

Figure 3.1: The Sampling Flowchart
Source: Researcher's own

3.3.1 Target Population

The target population for this study were the 295 academic staff members of the University of Zululand. Bless and Higson-Smith (2000) chronicle population as the whole objects or people on which a study centers. Kothari (2004) expounds that population otherwise called universe is the starting point for creating every sample design as it involves unambiguously determining the group of objects to be studied. Bhattacherjee (2012) attests that a population include the entire people or items otherwise known as unit of analysis that possess the features that a researcher intends to study.

Goddard and Melville (2001) argues that it is seldom practicable to study an entire population. Bhattacherjee (2012) states that there is need to cautiously select a target population from which the researcher intends to gather tad of information. According to Neuman (2006), target population is the subgroup which the researcher desires to study. In this study, the academic staff of the University of Zululand were the target population used in executing this study.

Academic staff members were selected in this regard based on the notion that they are vast in knowledge and exposure. Most importantly, they are saddled with the responsibility of training and producing manpower needed in the society. As at January 2019 when this study was conceived, the estimated number of academic staff members of the selected university was sought from relevant sources. University of Zululand (2018) archives 295 of her personnel as the academic staff members. Consequently, the 295 personnel of the university which constitutes the academic staff members formed the target population for this study.

3.3.2 Sample Frame

The 295 academic staff members of the University of Zululand constitutes the sample frame for this study. Kothari (2004) explains that sampling frame otherwise known as source list is an all-inclusive, precise, dependable and suitable catalogue that consists of the basic units or group of units known as sampling units typifying the population wherefrom the sample is extracted.

Shukla (2008) alludes that sampling frame is symbolic of the people or things commonly called units, out of which the researcher seeks to collect data and make inferences from a target population. Walliman (2011) asserts that sampling frame is the specific group within the population that the researcher intends to focus on due to its relevance to the study.

Bhattacherjee (2012) avers that sampling frame is the manageable unit from the target population, most often a directory that is used in extracting a sample. Greener and Martelli (2018) affirm that the sampling frame is an inventory of the entire units or people out of which the extraction of the sample can be done. Kothari (2004) argue that the possibility of the sampling frame being similar to the population exists provided there is finite population and a present or past time frame. Therefore, the sample frame can be a predefined unit of the population or self-made by the researcher to suit the study (Kothari, 2004). Hence, in this study, the researcher used the target population as the sample frame.

3.3.3 Sample Size

A sample size of 170 was used in this study. Kothari (2004) defines the sample size as the carefully chosen quantity of unit from a population that represents the sample. Singh and Masuku (2014) admit that sample size involves choosing the quantity of observations for inclusion in a sample through which conclusions about the population can be made. Glenn (1992) opines that the quantity of the sample to be used is the highest commonly queried

concept regarding sampling. Greener and Martelli (2018) affirm that the question which is most frequently asked in relation to sampling while designing a research is as regards the quantity of the sample.

Kothari (2004) elucidates that the sample size is significantly challenging for researchers because the sample size must not be disproportionately large or ridiculously small, hence, the need for optimality wherein the sample is efficient, representative, reliable and flexible. Shukla (2008) adds that choosing the sample size is complicated because there is need to align the funds at one's disposal with the quantity and quality of data collected. Singh and Masuku (2014) argue that notwithstanding the complexity involved in selecting the sample size, the choice of sample size is one of the highly significant aspects in applied statistics. They further opine that the ability to make accurate inferences hinges upon the sample size of the study.

Kothari (2004) outlines five criteria that must be considered in order to have an optimum sample size namely preferred accuracy, satisfactory level of confidence, population size, factors of concern in the study and financial limit. Shukla (2008) categorizes the factors to be reflected upon in the choice of a sample size into two namely: qualitative factors which includes the kind of research, anticipated result, significance of decision, quantity of variables, kind of analysis, financial limits, sample size in related studies. Shukla (2008) further explains that the quantitative factors includes variation in the population features, degree of preferred confidence as well as the anticipated level of accuracy in calculating the population features. Kumar (2011) highlights sample size and the degree of differences in the sampling population as the most important factors that must be considered before making inferences from a sample.

Singh and Masuku (2014) summarizes the determinants of the sample size adopted in a study into the financial implication involved in collecting the data and its sufficiency in statistical potency. Glenn (1992) as well as Singh and Masuku (2014) outlines four methods that can be employed in determining the sample size for a study namely: usage of census for small populations, duplicating a sample size of related studies, applying published tables, and using formulas to compute a sample size. For the purpose of this study, the researcher adopted the sample size table as proposed by Krejcie and Morgan (1970) in Appendix III so as to ensure that the relevant criteria for sampling are met. Considering the sample size table by Krejcie and Morgan (1970) in Appendix III, the sample size for a population of 295 falls within the range of 165-169. Therefore, a sample size of 170 was selected for this study.

3.3.4 Sampling Technique

This study adopts a probability sampling technique called stratified sampling technique. Kothari (2004), Walliman (2011) and Bhattacherjee (2012) among other scholars categorise these techniques into probability and non-probability sampling. Bhattacherjee (2012) explicates that in probability sampling, all the elements that form the sampling frame have the same chance of selection while the converse holds true for the non-probability sampling. Walliman (2011:96) adds that 'probability sampling techniques give the most reliable representation of the whole population, while non-probability techniques, relying on the judgement of the researcher or on accident, cannot generally be used to make generalizations about the whole population'. Consequently, probability sampling was adopted because the positivist paradigm requires objectivity from the researcher. In addition, the survey research design requires that generalizations be made through the findings deduced from the fraction of the population that is surveyed, hence, the need to use probability sampling.

Kothari (2004) categorises simple random sampling, systematic sampling, and stratified sampling techniques as probability samples while convenience sampling, judgement sampling and quota sampling techniques as non-probability samples. Bhattacherjee (2012) explains that stratified sampling requires that the sample frame be separated into strata prior to using simple random sampling to choose from the stratum. Betchoo (2017) supports the claim that stratified sampling involves dividing the population into at least two irreconcilable classifications depending on their relevance to the study before proceeding to randomly picking samples from each distinct classification.

Greener, and Martelli (2018) contend that stratified sampling helps to avoid the challenges that often come with simple random sampling such as unfair choice of samples based on a confined preference that does not truly capture the distinctive features of a population relevant to a study. Therefore, stratified sampling technique was used in this study. The sample frame was stratified on the basis of gender, race, rank, and nationality as provided by the University of Zululand (2018). Furthermore, the researcher stratified the sample size of the study using relevant classifications to the study namely: gender, race, and rank. Subsequently, simple random sampling was used to gather information from the respondents in relation to the pre-defined strata.

3.3.4.1 Stratification of the Sample Frame

Table 3.1 below contains the staff profile of the academic staff in the University of Zululand which serves as the stratification of the sample frame for this study.

Table 3.1: Stratification of the Sample Frame

		2018	
Gender	Female	126	42,71%
	Male	169	57,29%
	Total	**295**	**100,00%**
Race	African	220	74,58%
	Coloured	0	0,00%
	Indian	30	10,17%
	White	45	15,25%
	Total	**295**	**100,00%**
Rank	Professor	19	6,44%
	Associate Professor	24	8,14%
	Senior lecturer	53	17,97%
	Lecturer	191	64,75%
	Junior Lecturer and Below	8	2,71%
	Total	**295**	**100,00%**
Nationality	Asian	2	0,68%
	Europe	2	0,68%
	Other African	14	4,75%
	South African	256	86,78%
	SADC	21	7,12%
	Total	**295**	**100,00%**

Note: *SADC refers to Academics from countries belonging to the Southern African Development Community which includes Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, United Republic of Tanzania, Zambia, and Zimbabwe.
*Other Africans refer to Academics who are Africans but are neither South Africans nor from the SADC.

Source: University of Zululand (2018). “Facts & figures 2017/2018.”

3.3.4.2 Stratification of the Sample Size

In order to ensure proportionality of data distribution, the sample size stratified by the researcher is as shown in Table 3.2 below.

Table 4.2: Stratification of the Sample Size

Gender			**Race**			**Rank**		
Male	102	60%	African	77	75%	Lecturers	67	65%
			Indian	10	10%	Senior Lecturers	20	20%
			White	15	15%	Professor	15	15%
			Total	***102***	***100%***	***Total***	***102***	***100%***
Female	68	40%	African	51	75%	Lecturers	44	65%
			Indian	7	10%	Senior Lecturers	14	20%
			White	10	15%	Professor	10	15%
Total	***170***	***100%***	***Total***	***68***	***100%***	***Total***	***68***	***100%***

Source: Researcher's own

3.3.5 Summary of Sampling for this Study

In Table 3.3 below the details of the sampling for this study was summarized as follows:

Table 5.3: Table showing Sampling for this Study

Sampling	Target Population	295 Academic Staff of University of Zululand
	Sample Frame	295 Academic Staff of University of Zululand
	Sample Size	170 Respondents
	Sampling Technique	Stratified Sampling

Source: Researcher's own

3.6 Data Collection

3.6.1 Data Collection Instrument

A structured questionnaire was designed and used by the researcher as the instrument for collecting data for this study. Bhattacherjee (2012) avers that survey research is a method in research where questionnaires or interviews are used in systematically gathering data about the preferences, views, and conducts of individual. In other words, on the basis of data collection

method, the survey research is classified into: questionnaire surveys and interview surveys respectively (Bhattacherjee, 2012).

Questionnaires are research instrument comprising a number of structured or unstructured questions aimed at capturing answers from participants in the study formally (Bhattacherjee, 2012). A structured or closed format question requests the participants in the study to choose a response from an array of choices given while an unstructured or open format question gives room for participants in the study to give answers using their personal expressions (Walliman, 2011; Bhattacherjee, 2012). According to Walliman (2011), questionnaire as a tool is specifically appropriate for sourcing quantitative data though they can also be applied in sourcing qualitative data.

The structured questionnaire titled 'Fourth Industrial Revolution Skills Assessment Questionnaire (FIRSAQ)' which consists of two sections was designed by the researcher as the instrument for collecting data for this study. Section "A" of the FIRSAQ contains the demographic details of the respondents namely gender, rank, highest qualification and race while Section "B" contains twenty-four (24) closed ended questions in relation to 'knowledge of 4IR technologies', '4IR skill requirements', 'approach to reskilling and up-skilling of academic staff in the University of Zululand', and '4IR global job disruption'.

FIRSAQ was targeted at eliciting information as regards the probable skill requirements in the 4IR, effects of 4IR technologies on job disruption, the current human capital development approach in the University of Zululand, and the significance of the 4IR technologies on job disruption and human capital development of the academic staff of the University of Zululand. Respondents were requested to express their views on the twenty-four (24) questions therein using the 5-point rating scale which includes Strongly Agree (SA), Agree (A), Indifferent (I), Disagree (D) and Strongly Disagree (SD). A sample of FIRSAQ is contained in Appendix IV.

3.6.2 Validity of the Instrument

To validate the instrument for final study, samples of FIRSAQ was pilot tested and subjected to the scrutiny of a research analyst in the Department of Business Management for examination. Thereafter, necessary corrections were effected in the draft submitted to the project supervisor who is an expert in the field for certification.

3.6.3 Reliability of the Instrument

The reliability of FIRSAQ was performed through Cronbach's alpha on Statistical Package for Social Scientist (SPSS) version 25 so as to accomplish the internal consistency of the instrument. A copy of the Cronbach's alpha is contained in Appendix V.

3.6.4 Analysis of the Data Collected

The analysis of the data after collection was done using SPSS version 25. The descriptive or inferential statistical tool relevant to each demographic information and each research objective was adopted on SPSS version 25 as follows:

3.6.4.1 Analysis of Demographic Data

In order to analyze the demographic information of respondents in this study namely gender, rank, highest qualification and race, frequency and percentage counts was used.

3.6.4.2 Analysis of Data Related to Research Objective One

In order to explore the perception of the academic staff of the University of Zululand on the probable skill requirements in the 4IR, mean and standard deviation was used.

3.6.4.3 Analysis of Data Related to Research Objective Two

In order to explore the perception of academic staff of the University of Zululand on effects of 4IR technologies on job disruption, mean and standard deviation was used.

3.6.4.4 Analysis of Data Related to Research Objective Three

In order to explore the perception of the academic staff of the University of Zululand on the current human capital development approach in the selected institution, mean and standard deviation was used.

3.6.4.5 Analysis of Data Related to Research Objective Four

In order to investigate whether 4IR technologies affect job disruption and human capital development of the academic staff of the University of Zululand, MANOVA was used.

In brief, in order to achieve the first three objectives, mean and standard deviation was used, while MANOVA was adopted in achieving the fourth objective of the study.

3.7 Conclusion

The research paradigm, design, methods and instruments which forms the research methodology of this study have been concisely discussed in this chapter. The next chapter presents an in-depth look at the analysis of data collected from respondents in this study.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION OF RESULTS

4.1 Introduction

The preceding chapter systematically discussed the relevant components that constitute the research methodology. In this chapter, the data that was gathered are analysed, interpreted and discussed. Kothari (2004) avers that the term analysis denotes the calculation of definite measures alongside examining sequence of relationship existent among data-groups. Furthermore, Kothari (2004) expounds that interpretation of data involves inferring from the analysis of data as it is the single means via which the researcher reveals relationships and procedures upon which findings are based.

Bhattacherjee (2012) adds that data analysis and interpretation forms part of the execution phase of research. Therefore, this chapter contains calculation of definite measures alongside examination of sequence of relationship existent among data-groups. Furthermore, appropriate inferences relevant to the study were drawn based on the findings. Subheadings employed in carrying out the afore-explained includes realization rate, analysis of data and interpretation of results. Hereafter, the section that follows expounds on the rate of realization of the questionnaire.

4.2 Realization Rate

The sample size of the study consists of 170 academic staff in the University of Zululand whose rank spanned from Professor to Lecturer. In order to achieve the targeted 170 respondents, the researcher decided to accommodate the response rate by randomly administering 200 questionnaires to academic staff members across all faculties in the University of Zululand. However, at the end of the field work, the researcher could only retrieve 130 questionnaires due to the non-availability of some of the respondents after the first contact and the unwillingness of some others to participate in the survey. Therefore, the results presented in this analysis represents the 130 questionnaires that were retrieved by the researcher.

4.3 Analysis of Data and Interpretation of Results

The analysis was done with the aid of statistical tools on SPSS version 25. The demographic information of respondents namely gender, rank, highest qualification and race were analysed using frequency and percentage counts. The research objective one through three was analysed using mean and standard deviation while the fourth research objective was analysed using One Way Multiple Analysis Of Variance (MANOVA).

4.3.1 Analysis and Interpretation of the Demographics of the Respondents

4.3.1.1 Analysis and Interpretation of Gender Distribution of the Respondents

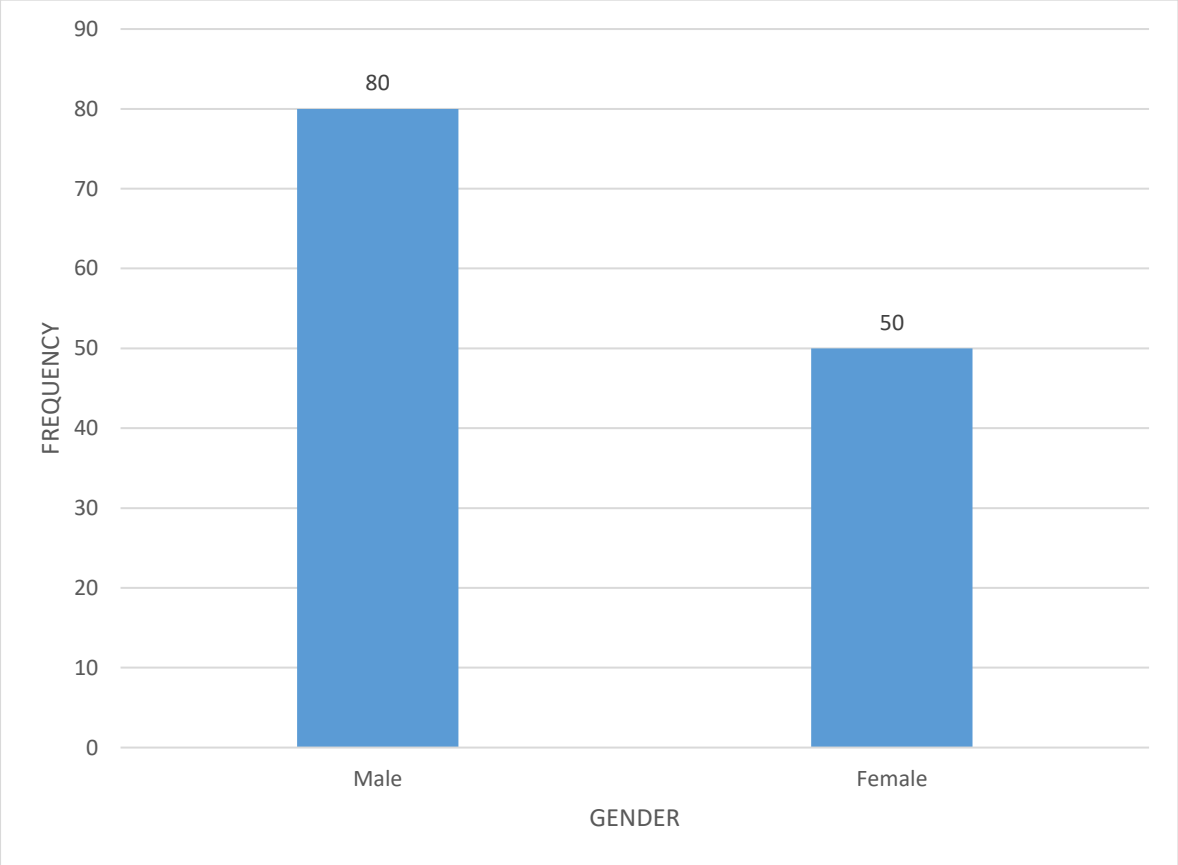

Figure 4.1: Frequency of Gender Distribution of Respondents

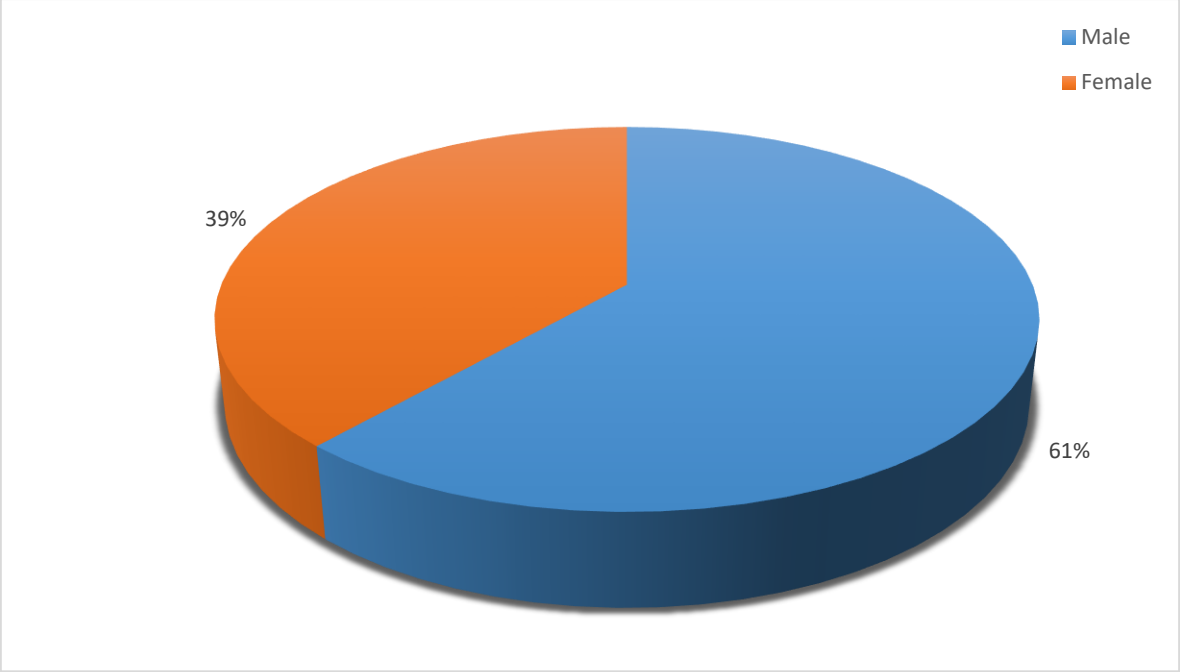

Figure 4.2: Approximate Percentage of Gender Distribution of Respondents

Figure 4.1 and 4.2 above shows the frequency and approximate percentage of gender distribution of the participants in this study. Out of the 130 respondents who participated in this survey 80 are male and formed 61.5% of the respondents while 50 are female and formed 38.5% of the respondents. Therefore, there were more male participants in this study than female. Figure 4.1 is a pie chart which gives a pictorial representation of the approximate percentages of the gender distribution of the participants in this study.

4.3.1.2 Analysis and Interpretation of Rank of the Respondents

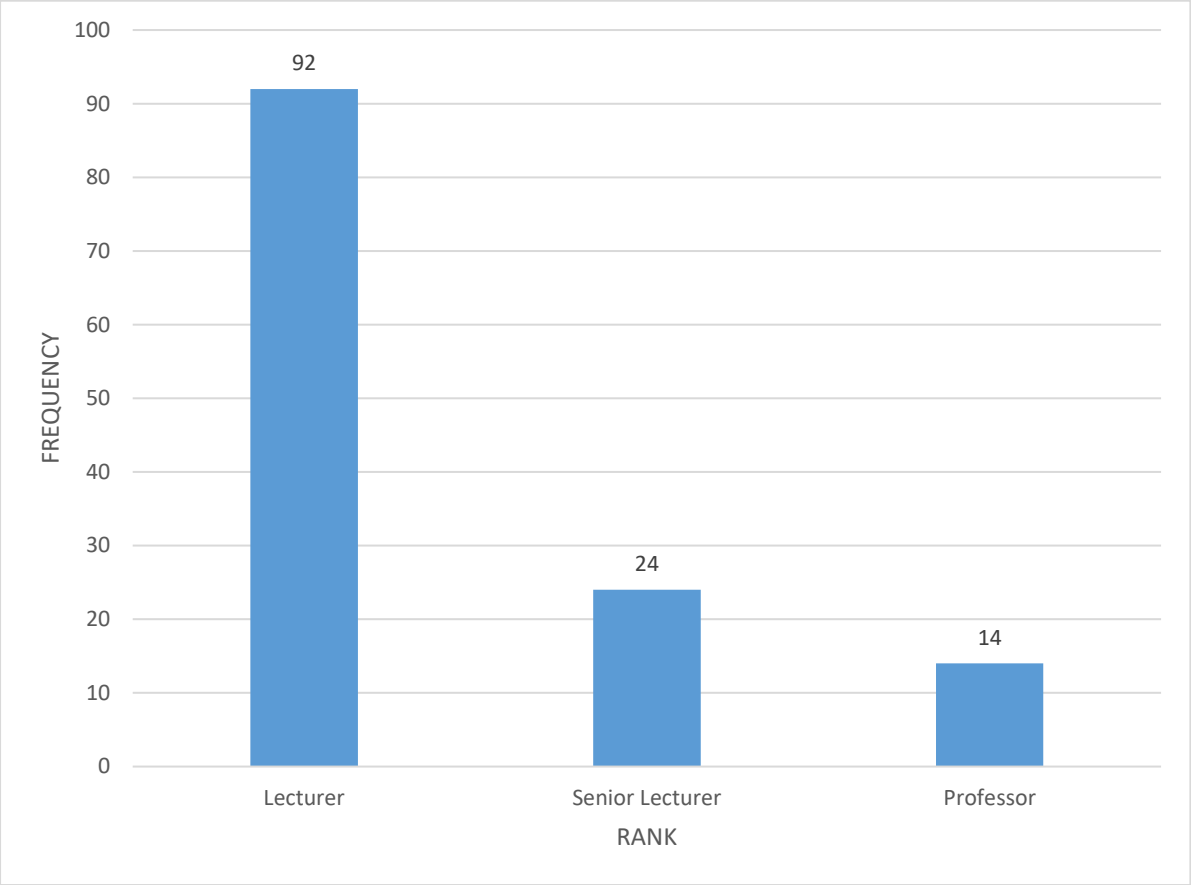

Figure 4.3: Frequency of Respondents' Rank

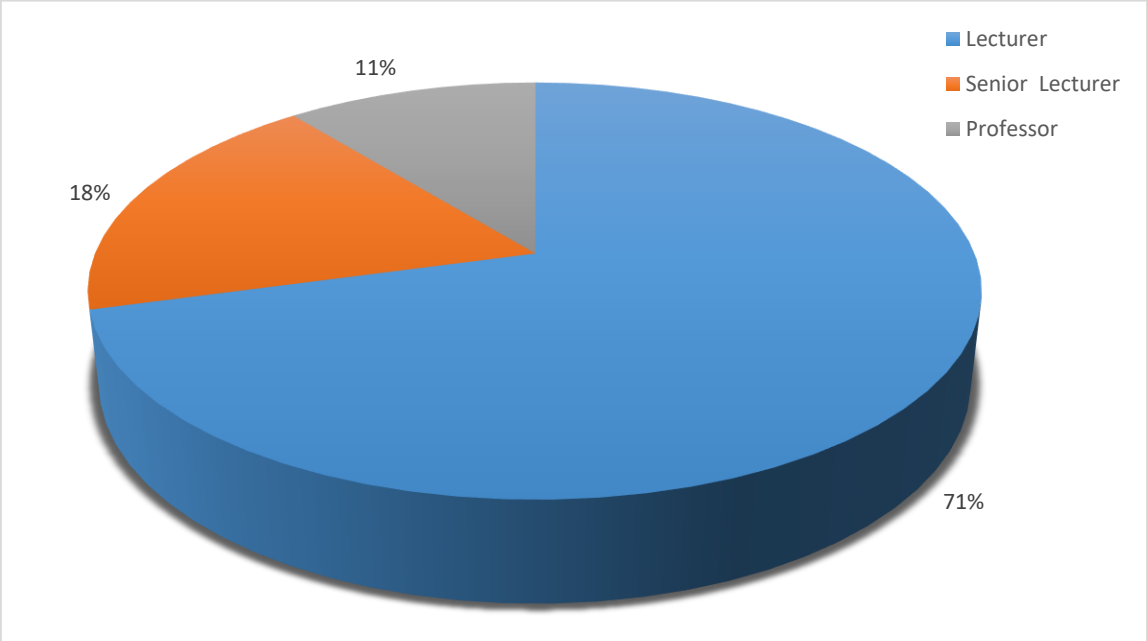

Figure 4.4: Approximate Percentage of Respondents' Rank

Table 4.3 and 4.4 above shows the frequency and approximate percentage of the rank of the participants in this study. 92 out of the 130 respondents who participated in this survey are Lecturers and formed 70.8% of the respondents. Furthermore, 24 out of the 130 respondents are Senior Lecturers and formed 18.5% of the respondents, while 14 out of the 130 respondents are Professors and formed 10.8% of the respondents. Therefore, in relation to the rank of the respondents, this study is largely made up of Lecturers than Senior Lecturers and Professors. Figure 4.2 is a pie chart which gives a pictorial representation of the approximate percentages of the rank of the respondents in this study.

4.3.1.3 Analysis and Interpretation of Race of the Respondents

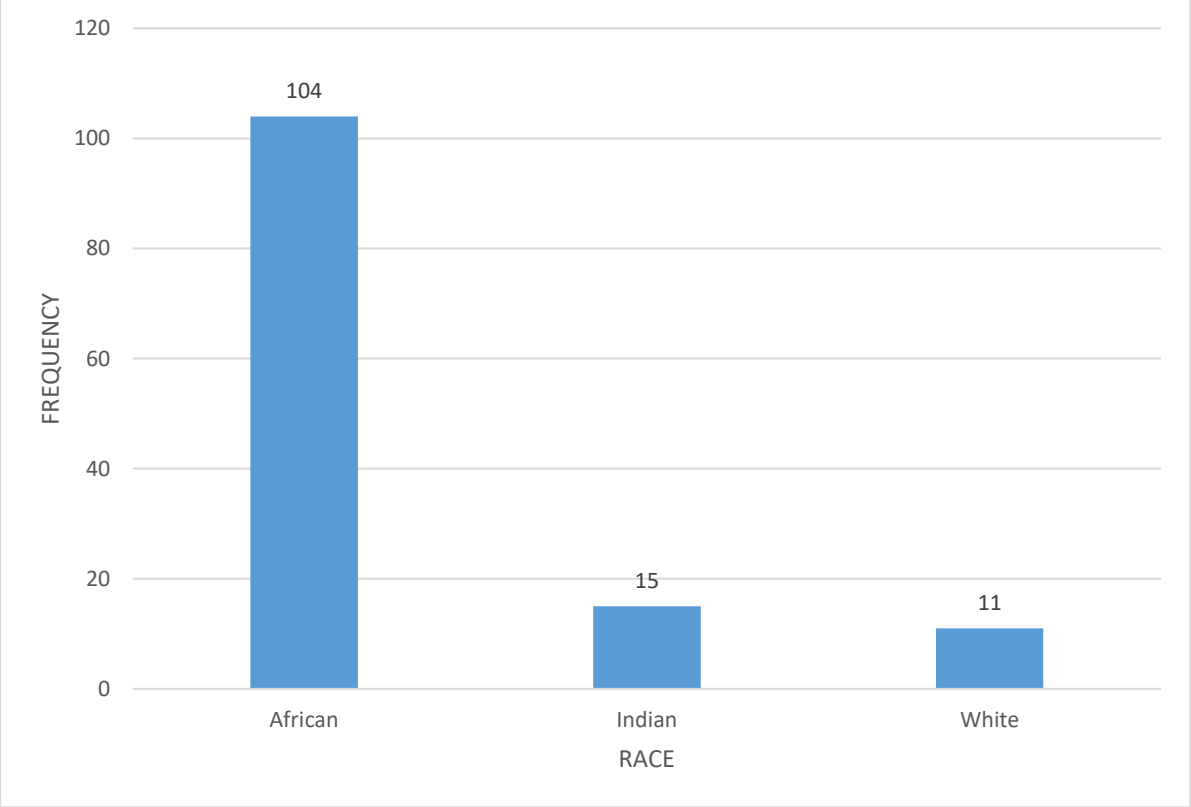

Figure 4.5: Frequency of Respondents' Race

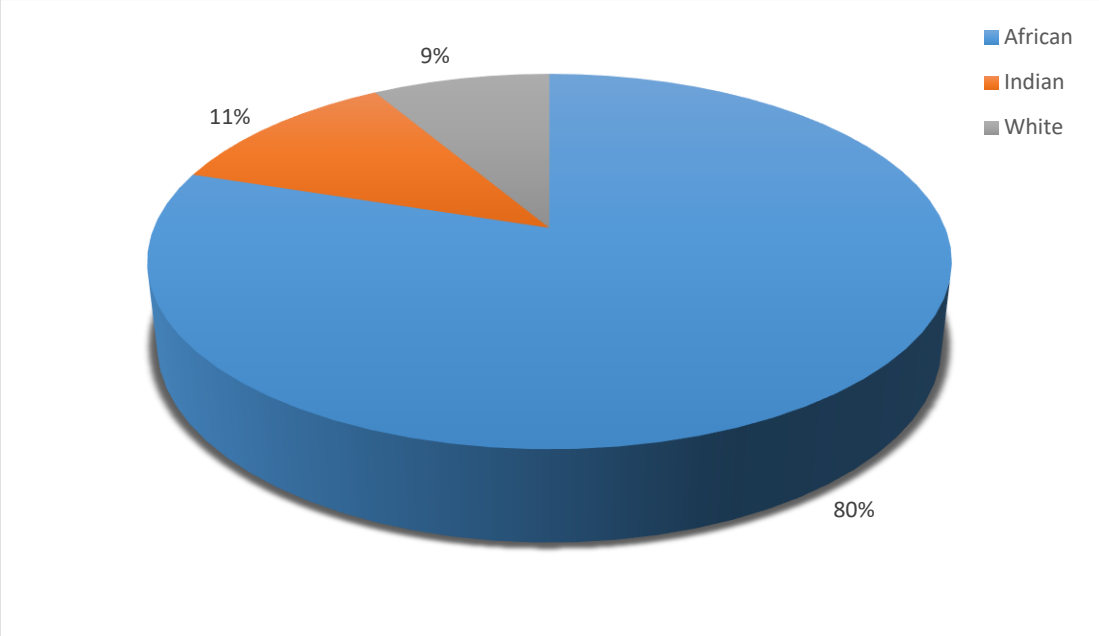

Figure 4.6: Approximate Percentage of Respondents' Race

Table 4.5 and 4.6 above shows the frequency and approximate percentage of the race of the participants in this study. Out of the 130 respondents who participated in this survey, 104 are Africans and formed 80% of the respondents. Furthermore, while 15 out of the 130 respondents are Indians and formed 11.5% of the respondents, 11 out of the 130 respondents are Professors and formed 8.5% of the respondents. Therefore, with regards to the race of the respondents, this study is constituted mostly of Africans than Indians and Whites. Figure 4.3 is a pie chart which gives a pictorial representation of the approximate percentages of the race of the respondents in this study.

4.3.2 Analysis, Interpretation and Discussion Showing the Research Objectives

4.3.2.1 Research Objective 1

To explore the perception of the academic staff of the University of Zululand on the probable skill requirements in the 4IR, mean and standard deviation was used.

Table 4.1: Perception of the academic staff of the University of Zululand on the probable skill requirements in the 4IR

S/N	Statement/Variable	N	Normative Mean	Study Mean	Standard Deviation	Decision on Respondents' Perception
1.	Beyond a book-based knowledge system, the fourth industrial revolution will require developing practical core competencies in humans.	130	3	4.33	.751	High
2.	In the fourth industrial revolution, complex problem-solving skills will be of more importance than physical abilities like manual dexterity.	130	3	4.45	.748	High
3.	In the fourth industrial revolution, broad social skills like persuasiveness, emotional intelligence and psychological teaching will override confined technical skills like coding or operating and controlling machineries	130	3	4.56	.571	High
4.	Content skills like ICT-related knowledge and active learning will be more functional in the fourth industrial revolution	130	3	4.14	.785	High
5.	Cognitive abilities like creativity and mathematical reasoning are essential ingredients for fourth industrial revolution	130	3	4.35	.794	High
6.	Process skills like active listening and critical thinking will be part of strategic skills for fourth industrial revolution	130	3	4.33	.951	High
7.	Jobs in the fourth industrial revolution will require high level of human reasoning, social skills and flexibility in learning and unlearning.	130	3	4.25	.786	High

Table 4.1 shows how the academic staff of the University of Zululand perceive the probable skill requirements in the 4IR. In the research instrument named FIRSAQ that was designed and used for this study, 7 out of the 24 variables therein relates to the probable skill requirements in the 4IR. Furthermore, in FIRSAQ, a 5-points Likert scale wherein strongly agree, agree, indifferent, disagree and strongly disagree were ranked numbers 5, 4, 3, 2, 1 respectively was used. In order to deduce a decision from the data set that constitutes the 7 relevant variables in this regard, the researcher had to obtain the normative mean which served as the benchmark against which the study mean of each of the 7 variables was measured.

The researcher obtained the normative mean which equals to 3 by applying the general formula for finding the mean of any given data set which is the sum of each number in the data set divided by the count. Consequently, variables with study mean less than 3 are low, those with study mean slightly above 3 are moderate while those with study mean of 4 and above are high. As shown in Table 4.1 above, the study mean of each of the 7 variables that relates to the probable skill requirements in the 4IR exceeds 4. This connotes that the study mean of each of the 7 variables is high. Hence, the overall decision is that the perception of the academic staff of the University of Zululand on the probable skill requirements in the fourth industrial revolution is high.

Thus, it suffices to state that the academic staff members of the University of Zululand are highly of the view that the 4IR may cause a shift in the currently prevalent skill requirement that is largely knowledge based to a different skills set that centers on practical core competencies. Furthermore, the respondents of this study opine that the practical core competencies that will be required in the 4IR includes broad social skills such as emotional intelligence and persuasiveness; content skills such as active learning; cognitive abilities such as creativity and mathematical reasoning; as well as process skills such as critical thinking and active listening. Hence, these findings agrees with the findings from the Future of Jobs Report (2016) amongst others. Findings from Future of Jobs Report (2016) includes the following underlisted:

- The skill sets that will be considered essential in a number of professions will include skills that are currently considered trivial.
- A high level of cognitive abilities like critical thinking and problem solving is likely to be considered an essential skill than physical abilities in the overall level of demand for different skills.

- Generally, from one industry to another, social skills like persuasiveness, emotional intelligence and tutoring have a higher likelihood of being demanded than confined technical skills like coding or operating and controlling machineries.
- Content skills like ICT-related knowledge and active learning; cognitive abilities like creativeness as well as mathematical logic; and process skills like active listening and analytic reasoning are expected to increasingly grow as a fraction of essential skills.

4.3.2.2 Research Objective 2

To explore the perception of academic staff of University of Zululand on effects of 4IR technologies on job disruption, mean and standard deviation was used.

Table 4.2: Perception of academic staff of University of Zululand on effects of 4IR technologies on job disruption

S/N	Statement/Variable	N	Normative mean	Study Mean	Standard Deviation	Decision on Respondents' Current Level of Awareness
1.	The radical interruptions that the fourth industrial revolution may cause to the work domain will include an increase in entirely new professions, new approaches to management of work, new skills needed in every profession and new equipments to enhance the abilities of workers	130	3	4.40	.774	High
2.	Notwithstanding the level of increase in productivity and economic growth by the fourth industrial revolution technologies, they will replace certain jobs of several people globally.	130	3	4.12	.803	High
3.	Professions in specified environments such as machine operators, legal assistants, and accountants are prone to automation and displacement from their jobs.	130	3	4.22	.809	High
4.	Professions in uncertain environments like	130	3	4.33	.820	High

	landscapers, pipe fitters, and nannies may be less influenced by automation due to the technicalities and costs involved in their automation as well as their unattractiveness as a business proposal.					
5.	The impact of automation on professions involving management, expertise, and communication may be reduced as machines are yet to measure up with the productivity of humans in these areas.	130	3	4.35	.712	High
6.	Many more new jobs will be created to replace the few jobs that will be extinct due to the quick emergence of machines and algorithms in the work environment.	130	3	4.36	.751	High
7.	In South Africa, autonomous technologies may tend towards replacing the workforce than augmenting them as digital technology is being used to stimulate cost minimization, automation and enhancement of efficiencies.	130	3	4.12	.940	High
8.	In South Africa, the relationship between organisations and their workers in the fourth industrial revolution will be more of contract-based than permanent.	130	3	4.25	.771	High

Table 4.2 shows the perception of academic staff of the University of Zululand on effects of 4IR technologies on job disruption. In the research instrument named FIRSAQ that was designed and used for this study, 8 out of the 24 variables therein relates to the effect of 4IR technologies on job disruption. Furthermore, in FIRSAQ, a 5-points Likert scale wherein strongly agree, agree, indifferent, disagree and strongly disagree were ranked numbers 5, 4, 3, 2, 1 respectively was used. In order to deduce a decision from the data set that constitutes the 8 relevant variables in this regard, the researcher had to obtain the normative mean which

served as the benchmark against which the study mean of each of the 8 variables was measured. The researcher obtained the normative mean which equals to 3 by applying the general formula for finding the mean of any given data set which is the sum of each number in the data set divided by the count. Consequently, variables with study mean less than 3 are low, those with study mean slightly above 3 are moderate while those with study mean of 4 and above are high. As shown in Table 4.2 above, the study mean of each of the 8 variables that relates to the effect of 4IR technologies on job disruption exceeds 4. This connotes that the study mean of each of the 8 variables is high. Hence, the overall decision is that the perception of academic staff of the University of Zululand on effects of 4IR technologies on job disruption is high.

The foregoing provides sufficient basis to deduce that the respondents highly hold the view that the 4IR technologies will lead to disruption of jobs. On one hand, the respondents in this study highly opine that the job disruption that will be caused by the 4IR technologies may include increase in entirely new professions, new approaches to management of work, new skills needed in every profession and new equipments to enhance the abilities of workers. On the other hand, they argue that the job disruption may also include the 4IR technologies globally replacing certain jobs such as machine operators, legal assistants, and accountants because they are stereotyped and confined to an environment.

Additionally, analysed data suggest that respondents admit that professions that are not restricted to an environment like landscapers, pipe fitters, and nannies may be less influenced by automation because of the mechanics and cost implications involved in automating such works. Furthermore, they concur that the impact of automation will be reduced on professions that requires management, expertise and communication in that machines are not as productive as humans in these areas. Respondents highly contend that in South Africa, autonomous technologies may be replacing workers than augmenting them therefore, the relationship between organisations and their workers may be more contractual than permanent.

The perception of the participants in this study as regard effects of 4IR technologies on job disruption is corroborated by several studies such as Future of Jobs Report (2016), McKinsey Global Institute (2017), Deloitte (2018), Xu, David, and Kim (2018) as well as Runde, Bandura, and Hammond (2019). Future of Jobs Report (2016) agrees that the 4IR may lead to increase in professions that are completely new, novel work management methodology, unique skill-requirements and fresh gadgets needed to boost the capabilities of workers. McKinsey Global Institute (2017) asserts that the probable effect of the automated work environment on

job availability will differ depending on the profession and industry. Xu, David, and Kim (2018) emphasized that the 4IR exceeds a mere alteration powered by technology because it is propelled by disruptive innovations that can unmistakably affect major industries and sectors like education, business and health. Findings from Deloitte (2018) affirms that many South African executives believe that autonomous technologies may tend towards replacing the workforce than augmenting them while organisation-workers relationship will be more contract-based than permanent. Runde, Bandura, and Hammond (2019) maintain that the 4IR has potential to boost productivity in that it permits cheap products and services delivery as well as higher savings which enables more people to become entrepreneurs thereby, creating new prospects for job and adaptable working conditions.

4.3.2.3 Research Objective 3

To explore the perception of the academic staff of University of Zululand on the current human capital development approach in the institution, mean and standard deviation was used.

Table 4.3: Perception of the academic staff of University of Zululand on the current human capital development approach in the institution

S/N	Statement/Variable	N	Normative Mean	Study Mean	Standard Deviation	Decision on Respondents' Current Level of Awareness
1.	The approach to re-skilling and up-skilling of workers in the University of Zululand is more formal than informal	130	3	4.34	.911	High
2.	As a staff member in the University of Zululand, I learn mostly from conferences, workshops and seminars	130	3	4.30	.784	High
3.	Most of what I know about my job today was learnt on-the-job	130	3	4.25	.883	High
4.	My training as a staff member of University of Zululand includes job shadowing, job change, and job rotation amongst others.	130	3	3.98	.773	Moderate
5.	As a staff member of the University of Zululand, I often receive mentorship from my colleagues and executive coaching from the Management.	130	3	4.46	.661	High

Table 4.3 shows the perception of the academic staff of University of Zululand on the current human capital development approach in the institution**.** In the research instrument named FIRSAQ that was designed and used for this study, 5 out of the 24 variables therein relates to the human capital development approach. Furthermore, in FIRSAQ, a 5-points Likert scale wherein strongly agree, agree, indifferent, disagree and strongly disagree were ranked numbers 5, 4, 3, 2, 1 respectively was used. In order to deduce a decision from the data set that constitutes the 5 relevant variables in this regard, the researcher had to obtain the normative mean which served as the benchmark against which the study mean of each of the 5 variables was measured.

The researcher obtained the normative mean which equals to 3 by applying the general formula for finding the mean of any given data set which is the sum of each number in the data set divided by the count. Consequently, variables with study mean less than 3 are low, those with study mean slightly above 3 are moderate while those with study mean of 4 and above are high. As shown in Table 4.3 above, the study mean of 4 variables out of the 5 that relates to the human capital development approach exceeds 4 while the only one that is less than 4 has a moderate study mean. This connotes that the study mean of most of the variables is high. Hence, the overall decision is that the perception of the academic staff of the University of Zululand on the current human capital development approach in the institution is high.

From the foregoing, it is deduced that respondents are highly of the view that the current human capital development approach in the University of Zululand is more formal than informal. Furthermore, respondents highly attests that they mostly learn from conferences, workshops and seminars thereby, providing evidence that the current human capital development approach in the University of Zululand is predominantly formal. However, respondents add that most of their job knowledge was gathered on-the-job and they often receive mentorship from their colleagues and executive coaching from the Management. Although, the current approach to human capital development in the University of Zululand is considered to be more formal than informal, there are evidences to show that the informal human capital development approach has contributed immensely to the effectiveness of the academic staff members of the University of Zululand. The 70:20:10 model asserts that learning and development of the workforce mostly occurs informally as employees execute their daily tasks rather than formally through the traditional classroom approach to training and education. Therefore, the recommendation by GoodPractice (2016) who states that the learning and development function should revise the range of learning activities it currently provides remains essential.

4.3.2.4 Research Objective 4

To investigate whether 4IR technologies affect job disruption and human capital development of the academic staff of the University of Zululand, One Way Multivariate Analysis Of Variance (MANOVA) was used.

Table 4.4: Descriptive Statistics for MANOVA Summary

	4th Industrial Revolution	Mean	Standard Deviation	N
Human capital development	Low perception	16.75	5.377	4
	Moderate perception	20.12	2.774	59
	High perception	22.69	2.176	67
	Total	21.34	2.972	130
Job disruption	Low perception	25.00	3.916	4
	Moderate perception	32.66	3.304	59
	High perception	36.01	2.440	67
	Total	34.15	3.705	130

Table 4.4 above presents the descriptive statistics for the MANOVA summary. The result shows that the mean of the participant with high perception is greater than the mean of the respondents with moderate perception while the mean of the low perception is the least.

Table 4.5: MANOVA Summary- Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.970	2014.714[b]	2.000	126.000	.000	.970
	Wilks' Lambda	.030	2014.714[b]	2.000	126.000	.000	.970
	Hotelling's Trace	31.980	2014.714[b]	2.000	126.000	.000	.970
	Roy's Largest Root	31.980	2014.714[b]	2.000	126.000	.000	.970
FIIR	Pillai's Trace	.434	17.599	4.000	254.000	.000	.217
	Wilks' Lambda	.573	20.257[b]	4.000	252.000	.000	.243
	Hotelling's Trace	.735	22.967	4.000	250.000	.000	.269
	Roy's Largest Root	.719	45.651[c]	2.000	127.000	.000	.418

a. Design: Intercept + FIIR
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.

In Table 4.5 above, one-way MANOVA was conducted to determine the effect of 4IR on respondents' human capital development and job disruption. The results show that 4IR (Wilks' $\Lambda = .573$), $F(4.000, 252.000) = 20.257$, $p = .000$, partial $\eta^2 = .243$) significantly affects both human capital development and job disruption. In order to further validate this, significant relationship from MANOVA, Univariate ANOVA and Scheffe Post Hoc tests were performed.

Table 4.6*:* Univariate ANOVA Summary- Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Human capital development	293.770[a]	2	146.885	22.067	.000	.258
	Job disruption	698.718[b]	2	349.359	41.381	.000	.395
Intercept	Human capital development	12582.986	1	12582.986	1890.416	.000	.937
	Job disruption	31131.519	1	31131.519	3687.449	.000	.967
FIIR	Human capital development	293.770	2	146.885	22.067	.000	.258
	Job disruption	698.718	2	349.359	41.381	.000	.395
Error	Human capital development	845.337	127	6.656			
	Job disruption	1072.205	127	8.443			
Total	Human capital development	60332.000	130				
	Job disruption	153414.000	130				
Corrected Total	Human capital development	1139.108	129				
	Job disruption	1770.923	129				

a. R Squared = .258 (Adjusted R Squared = .246)
b. R Squared = .395 (Adjusted R Squared = .385)

Table 4.6 above contains a summary of the univariate Analysis of Variance (ANOVA) which was used to perform the tests of between-subjects effects. The 4IR with F(2, 127) = 22.067, p = .000, and partial η^2 = 258 significantly affects human capital development and job disruption with F(2, 127) = 41.381, p = .000, partial η^2 =.395

Table 4.7: Scheffe Post Hoc Tests for Fourth Industrial Revolution- Multiple Comparisons

Dependent Variable	(I) 4th Industrial Revolution	(J) 4th Industrial Revolution	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Human capital development	Low perception	Moderate perception	-3.37*	1.333	.044	-6.67	-.07
		High perception	-5.94*	1.328	.000	-9.23	-2.65
	Moderate perception	Low perception	3.37*	1.333	.044	.07	6.67
		High perception	-2.57*	.461	.000	-3.71	-1.43
	High perception	Low perception	5.94*	1.328	.000	2.65	9.23
		Moderate perception	2.57*	.461	.000	1.43	3.71
Job disruption	Low perception	Moderate perception	-7.66*	1.501	.000	-11.38	-3.94
		High perception	-11.01*	1.496	.000	-14.72	-7.31
	Moderate perception	Low perception	7.66*	1.501	.000	3.94	11.38
		High perception	-3.35*	.519	.000	-4.64	-2.07
	High perception	Low perception	11.01*	1.496	.000	7.31	14.72
		Moderate perception	3.35*	.519	.000	2.07	4.64

Based on observed means.
The error term is Mean Square (Error) = 8.443.
*. The mean difference is significant at the .05 level.

Table 4.7 above contains the summary of the Scheffe Post Hoc tests which was performed in order to carry out multiple Comparisons between 4IR job disruption and human capital development. Scheffe Post Hoc results indicate that in relation to their human capital development, participants with low perception about the 4IR significantly differ from those with high perception but not moderate ones. However, in terms of job disruption, low perception significantly differ from both moderate and high perceptions.

It suffices from Tables 4.5, 4.6 and 4.7 to state that 4IR significantly affects both human capital development and job disruption in the University of Zululand. This finding agrees with several other scholars and reputable platforms such as Future of Jobs Report (2016), McKinsey Global Institute (2017), Xu, David, and Kim (2018), as well as Runde, Bandura, and Hammond (2019) and platforms that predicted that 4IR will have a far-reaching effect. Future of Jobs Report (2016) predicts that the 4IR will cause radical interruptions in the work domain. McKinsey Global Institute (2017) states that automation and advancements in AI will cause a disruption in the work environment and skill requirements. Xu, David, and Kim (2018) agree that the 4IR exceeds a mere alteration powered by technology because it is propelled by disruptive innovations that can unmistakably affect major industries and sectors like education, business and health. Meanwhile, Runde, Bandura, and Hammond (2019) opine that all countries will be affected by the 4IR inclusive of South Africa.

4.4 Conclusion

This chapter delved into the analysis of the data gathered via the FIRSAQ with the corresponding interpretation of the results and relevant discussions. The findings of the study from analysed data show that perceptions about the probable 4IR skill requirements is high, and the current level of awareness with regards to the effect of 4IR technologies on job disruption is high. Furthermore, the assessment of the significance of 4IR technologies on job disruption and human capital development in the University of Zululand indicated that 4IR significantly affects both job disruption and human capital development. However, findings also showed that the current human capital development approach in the University of Zululand is more formal than informal. The next chapter contains the summary, conclusion, and recommendations based on the findings of this study as well as suggestions for further studies.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATIONS

5.1 Introduction

In the previous chapter, the data that was gathered in this study was analysed, interpreted and discussed using relevant literatures. In this chapter, the summary of the study, findings and conclusion of the study are presented. Furthermore, recommendations of the study and suggestions for further studies are duly considered in this chapter.

5.2 Summary

This study aimed at exploring the perceptions of the academic staff on the effects of the 4IR on expected job disruption and on human capital development approach at the University of Zululand. In order to achieve this aim, four research objectives and questions were formulated with focus on perceptions about probable 4IR skill requirements, current level of awareness with regards to the effect of 4IR technologies on job disruption, perceptions about the current human capital development approach and assessment of the significance of 4IR technologies on job disruption and human capital development.

In order to understand the existing discussions in relation to the above-listed aim, objectives and questions, several articles were reviewed on the previous industrial revolutions, the 4IR technologies, framework, probable impacts on workforce and skills-need as well as need for human capital development. Furthermore, the researcher discussed the structure that was adopted in executing the research. In other words, the research paradigm, design, sampling and data collection were elaborately discussed. Subsequently, the required data for this study was gathered from the academic staff members of the University of Zululand. Thereafter, the data was analysed using SPSS version 25 and discussed vis-à-vis existing literatures.

5.2.1 Findings

5.2.1.1 Summary of Findings for Demography

The outcome of the analysis of the data gathered from the sample of this study reveals that there were more male than female participants in this study, more Lecturers than Senior Lecturers and Professors, and more Africans than Indians and Whites.

5.2.1.2 Summary of Findings for Research Objective One

The result of the analysis of the data gathered from the sample of this study reveals that perceptions about the probable 4IR skill requirements was high.

5.2.1.3 Summary of Findings for Research Objective Two

The analysis of the data gathered from the sample of this study reveals that perceptions about the current level of awareness as regards the effect of 4IR technologies on job disruption was high.

5.2.1.4 Summary of Findings for Research Objective Three

With regards to the perceptions about the current human capital development approach, the academic staff of the University of Zululand were highly of the view that the current human capital development approach in the University of Zululand is more formal than informal.

5.2.1.5 Summary of Findings for Research Objective Four

The assessment of the significance of 4IR technologies on job disruption and human capital development shows that 4IR significantly affects both human capital development and job disruption.

5.3 Recommendation: Need for change in the approach to human capital development in the University of Zululand

- This study recommends that the University of Zululand adopts the informal approach to human capital development than the formal approach in order to equip the University staff and by extension, the next generation of workers in the nation with the requisite 4IR skill.

The findings of this study shows that the academic staff members of the University of Zululand are highly aware of the technologies of the 4IR. This implies that the academic staff members of the University of Zululand are aware of the fast pace at which changes are occurring globally and in South Africa due to radical interruptions of 4IR technologies such as robotics, AI, and CPS amongst others. Furthermore, the findings of this study shows that the academic staff members of the University of Zululand are highly aware of the skill requirements of the 4IR globally and in South Africa.

This implies that the academic staff members of the University of Zululand understand that the changes occasioned by the 4IR technologies in the global and South African work environment has brought about an emphasis on high level of skills such as digital literacy, flexibility, creativity, active speaking and active listening amongst others. In other words, the academic staff members of the University of Zululand, as current workers, understand the need for an upgrade in their skills while as educators, they understand the need to impart the next generation of workers undergoing training in the University of Zululand with these same high level skills so as to ensure that they are relevant in the workplace of the future in South Africa especially and in the world generally.

However, further findings show that the approach to human capital development in the University of Zululand is still largely formal than informal. The major proposition of the 70:20:10 model reviewed in this study is that an organization that would be effective in developing its workforce in a technology driven environment would need to adopt a more informal than formal approach to learning and development. Therefore, with the current formal approach to human capital development in the University of Zululand, current workforce and by extension, the next generation of workforce would continue to lag behind in the national drive for workforce transformation as well as transition.

Von Tunzelman and Wang (2007) argue that for institutions to adapt to change, they need interactive capabilities which is an ability to be proactive in observing changes and adapting to the changes where needed. World Economic Forum (2017) adds that the approach to human capital development must be reviewed and upgraded to suit the dynamic needs of the current and next generation of workforce. Hence, in view of the probable changes of the 4IR, this study suggests that the training and development function of the University of Zululand considers adopting more of the informal than formal approach to human capital development so as to speed up the pace of lifelong learning, reskilling and up-skilling in the institution.

5.4 Suggestions for Further Studies

- This study focused on the academic staff members of the University of Zululand however, a replica study can be conducted focusing on the non-academic staff members only or both academic and non-academic staff members in the institution.

- A replica of the study in other higher institutions in South Africa may be necessary for Comparism between institutions, provinces and for valid conclusions to be made nation-wide.
- A similar study can also be conducted using different institutions in two or more developing nations. Conversely, two or more developing and developed nations can be explored in a similar study as well.
- A study can be done to review HR policies in general, around issues of the impact of 4IR and how they are addressed.

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APPENDIX I

UNIVERSITY OF ZULULAND
RESEARCH ETHICS COMMITTEE
(Reg No: UZREC 171110-030)

RESEARCH & INNOVATION
Website: http://www.unizulu.ac.za
Private Bag X1001
KwaDlangezwa 3886
Tel: 035 902 6731
Fax: 035 902 6222
Email: DlelanaM@unizulu.ac.za

ETHICAL CLEARANCE CERTIFICATE

Certificate Number	**UZREC 171110-030 PGM 2019/69**								
Project Title	**THE PERCEPTION OF EFFECTS OF THE 4IR ON EXPECTED JOB DISRUPTION AND ON HUMAN CAPITA DEVELOPMENT NEEDS AT THE UNIVERSITY OF ZULULAND**								
Principal Researcher/ Investigator	Samuel O. Taiwo								
Supervisor and Co-supervisor	Dr. M.F. Vezi-Magigaba								
Department	Business Management								
Faculty	Commerce, Administration and Law								
Type of Risk	Med Risk – Data Collection from people								
Nature of Project	Honours/4th Year		Master's	x	Doctoral		Departmental		

The University of Zululand's Research Ethics Committee (UZREC) hereby gives ethical approval in respect of the undertakings contained in the above-mentioned project. The Researcher may therefore commence with data collection as from the date of this Certificate, using the certificate number indicated above.

Special conditions:

(1) This certificate is valid for 1 year from the date of issue.
(2) Principal researcher must provide an annual report to the UZREC in the prescribed format [due date-27 October 2020]
(3) Principal researcher must submit a report at the end of project in respect of ethical compliance.
(4) The UZREC must be informed immediately of any material change in the conditions or undertakings mentioned in the documents that were presented to the meeting.

The UZREC wishes the researcher well in conducting research.

Mahlomaholo Geoffry Mahlomaholo

Professor Gideon De Wet
Chairperson: University Research Ethics Committee
Deputy Vice-Chancellor: Research & Innovation
28 October 2019

CHAIRPERSON
UNIVERSITY OF ZULULAND RESEARCH ETHICS COMMITTEE (UZREC)
REG NO: UZREC 171110-30
28 -10- 2019
RESEARCH & INNOVATION OFFICE

APPENDIX II

PRESIDENTIAL COMMISSION ON THE FOURTH INDUSTRIAL REVOLUTION

S/N	Title	Name	Surname	Race	Gender	Age	Criteria	Sector	Province	Institution	Qualifications	Expertise
1.	Prof	Tshilidzi	Marwala	A	M	47	Academia	ICT/Telecoms	Gauteng	University of Johannesburg	PhD (Engineering in Artificial Intelligence)	Theory and application of artificial intelligence to engineering, computer science, finance, social science and medicine.
2.	Mr	Leon Desmond	Rolls	C	M	43		ICT/Telecoms	Kwazulu -Natal Mzansi	ComNet NHDip (Software	Diploma (Business Analysis)	Software development,

										Development)		entrepreneurship
3.	Dr	Sibongiseni	Thotsejane	A	F	39	Academia	ICT/Telecoms	Eastern Cape	Walter Sisulu University	PhD, MSc, BSc (Information Systems)	Big data analytics; ICT policy; ICT technology innovation and development
4.	Dr	Prince Senyukelo	Jaca	A	M	47	Academia	Education and skills development	Eastern Cape	Walter Sisulu University	PhD, MSc (Maths + Ed), BSc (Ed)	Strategic Planning, Higher Education Sector
5.	Dr	Bernard Lewis	Fanaroff	C	M	72	SKA	Astronomy	Western Cape	University of Cambridge	PhD (Radio Astronomy)	Radio Astronomy

6.	Mr	Xolile Christopher	George	A	M	47	Public Sector	Local government	Gauteng	SALGA	MBA, Masters candidate (Development Economics)	Developmental Economics
7.	Mr	Thulani Humphrey	Dlamini	A	M	48	Research/ Public Sector	Science and Technology	Gauteng	CSIR	PhD Chemistry, MBL	Chief Executive Officer, CSIR
8.	Ms	Beth	Arendse	C	F	48	Private Sector	Creative Industry	Gauteng	Leaders in Motion Academy	NDip (Music), BMusic	
9.	Mr	Michael	Gastrow	W	M	40	Research/ Public Sector	Education and skills development	Gauteng	HSRC	PhD (Media studies), MA (English), BA (Hons)	Philosophy Chief Research Specialist in the education and skills

												development
10.	Ms	Nomso	Kana	A	F	34	Private Sector	ICT/Telecoms	Eastern Cape	Sun n Shield 84 Technologies		Nuclear scientist by trade and working as an entrepreneur in the broadband infrastructure sector
11.	Mr	Abdul Razak	Esakjee	I	M	30	Public Sector	Science and Technology	Gauteng	Transnet	MBA, M Eng., B Eng. (Mechanical)	Structural, geometric and functional design

												of rolling stock as well as plat equipment. Design and manufacture of a new generation timber wagon.
12.	Dr	Nompumelelo Happworth	Obokoh	A	F		Public Sector	Agriculture	Gauteng	CIPC	PhD in Plant Molecular Biology, MSc in Plant Biotechnology, BSc	Business strategy development, planning

											Hons, BSc	and implementation, organisational development, capacity building, Project budgeting, Intellectual Property Development and Protection, R&D

13.	Ms	Nomvula	Mkhonza	A	F	37	Women organisations	Agriculture	Gauteng	SA Women in Farming (SAWIF)	Diploma in Freelance Journalism	Entrepreneur in agriculture and mining.
14.	Ms	S'onqoba	Vuba	A	F	24	Women organisations	Finance	Gauteng	Perpetu8	BSc Hons (Actuarial Science)	Data scientist, financial services, research and analytics, SMME development, WEF Global Shaper, thought leader and advisor on

												4IR
15.	Prof	Chris Michael	Adendorff	W	M	53	Academia	Creative Industry	Eastern Cape	NMU	PhD (Development Studies), DBA, MCom, BCom, BTech	Futurist, life coach, entrepreneur.
16.	Mr	Mohamed Shameel	Joosub	I	M		Private Sector	ICT/Telecoms	Gauteng	Vodacom	BCompt Honours; AGA (SA); CFA (SA); MBA (Univ of Queensland); Finance & Business	Telecommunications & Finance

17.	Ms	Lindiwe	Matlali	A	F	40	NGO	ICT/Telecoms	Gauteng	Black Management Forum	Bcom (Economics and Statistics)	Digital innovation skills development
18.	Mr	Rendani Praise	Ramabulana	A	M	34			Limpopo		MEng. (Elect Eng.), NDip (IT)	
19.	Ms	Charmaine	Houvet	C	F	45	Private Sector	ICT/Telecoms	Gauteng	Cisco	MBA, Business Administration Degree	Telecommunications, research and development on Artificial Intelligence, Internet of Things and

												Skills. Broad knowledge of 4IR(Robotics,
20.	Mr	Baxolile	Mabinya	A	M	35	Private Sector	ICT/Telecoms	Gauteng	Deviare	MSc (Computer Science), MBA	Telecommunications strategy, data science and analytics, digital transformation thought leadership.
21.	Mr	Rendani	Mamphiswana	A	M	32	Private Sector	Energy	Mpumalanga	SASOL	PhD Candidate, MEng (Technology	Technical advisory and product development,

											Management), BSc Eng. (Chemical)	engineering, construction, project management, technology management and strategy development. Social innovation, process engineering and design
22.	Mr	Joseph	Ndaba	A	M	38	Private Sector	ICT/Telecoms	North West	Mahikeng Innovation	NDip (IT),	Corporate and entrepreneurial

										Hub	Marketing Diploma	development
23.	Mr	Calvo	Mawela	A	M	42	Private Sector	Audio-visual	Gauteng	Multichoice	BSc Engineering	Group CEO
24.	Ms	Marinda	Kellerman	W	F	50	Private Sector	Agriculture	Western Cape	SA Women in Farming (SAWIF)	B.Sc Agric (Hons)	Research, product development and advisory roles.
25.	Ms	Busisiwe	Mbuyisa	A	F	40	Private Sector	Banking	Gauteng	Standard Bank of South Africa	DPhil, Masters (IT), BCom (Hons) (informatics), BCom (IS)	Innovation and Technology Management, program and portfolio management, IT

												Consulting, systems design and development, financial planning and management.
26.	Mr	Andile	Ngcaba	A	M	62	Private Sector	ICT/Telecoms	Gauteng	Convergence Partners	Honorary DCom, MCom (Information Systems)	Policy & Regulatory expert, technology strategist, Chairman and founder of companies, former

												Director General in the former DoC.
27.	Mr	Gerhard Van	Deventer	W	M	43	Public Sector	Fintech	Gauteng	SARB	BCom, BSc, BA, BCom Hons, MA, MBA	Fintech Analyst, IT Risk Analyst, ICT Audit
28.	Mr	Tervern Liaan John	Jaftha	C	M	42	Public Sector	SMME	Gauteng	SEDA	BA Admin	Business and Technology Incubation
29.	Mr	Ben	Venter	W	M	51	Trade Union	Labour	Gauteng	COSATU	B. Com, BCom Hons, Post Graduate Diploma	Labour Law

											in Labour Law	
30.	Mr	Vukani	Mngxati	A	M		Private Sector	Business Consultancy	Gauteng	Accenture	B Com	Industrial Development

APPENDIX III

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	**290**	**165**	1900	320
50	44	**300**	**169**	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382

210	136	1100	285	1000000	384

APPENDIX IV

ORIGINAL INSTRUMENT

UNIVERSITY OF ZULULAND, KWADLANGEZWA, SOUTH AFRICA

UNIVERSITY OF ZULULAND

MCom. Business Management

Researcher: Mr. Samuel Oluwatobi, TAIWO (0832801027)

Supervisor: Dr. M.F Vezi-Magigaba

Dear Respondent,

INFORMED CONSENT LETTER

My name is Samuel Oluwatobi, TAIWO (student number 201830202); a Masters student in the Department of Business Management, Faculty of Commerce, Administration and Law at the University of Zululand. You are invited to participate in a research project entitled: **The Perceptions of Effects of the 4IR on Expected Job Disruption and on Human Capital Development Approach at the University of Zululand.**

I am hereby seeking your consent to provide responses for this project by attending to the statements in the questionnaire**.** The results of this study will contribute to knowledge by providing insights to various stakeholders in the education sector on the various issues bothering about the effects of 4IR on job disruption and human capital development in the University of Zululand.

Your participation in this project is voluntary. You may refuse to participate or withdraw from the project at any time with no negative consequence(s). There will be no monetary gain for participating in this research project. Confidentiality and anonymity of records identifying you as a participant will be maintained by the researcher. If you have any question(s) or concern(s) about participating in this study, please contact me at the numbers listed above. It will take you about 5 - 10 minutes to complete the questionnaire. I hope you will take the time to complete the questionnaire.

Sincerely,

Respondent's signature_____ Date_____

FOURTH INDUSTRIAL REVOLUTION SKILLS ASSESSMENT QUESTIONNAIRE (FIRSAQ)

Dear Respondent,

I am a Masters of Commerce student from the Department of Business Management and I am conducting a research on "**Perceptions of Effects of the 4IR on Expected Job Disruption and on Human Capital Development Approach at the University of Zululand, With a Focus on Academic Staff Members"** for which this instrument titled "Fourth Industrial Revolution Skills Assessment Questionnaire (FIRSAQ)" is designed to elicit relevant information on the afore stated research topic from you.

Please, note that the FIRSAQ instrument is purely for academic purposes and your responses would be treated with utmost confidentiality. Thanking you in anticipation for your favorable response.

Samuel Oluwatobi, TAIWO
Student Number: 201830202
Cell no: +27832801027
E-mail: 201830202@stu.unizulu.ac.za

SECTION A (PERSONAL PROFILE)

Please, respond by placing a tick (✓) where appropriate:

1. Gender: Male ☐ Female ☐

2. Rank: Lecturer ☐ Senior Lecturer ☐ Professor ☐

3. Highest Qualification: Undergraduate Degree ☐ Honours Degree ☐
   Masters Degree ☐ Doctoral Degree ☐

4. Race: African ☐ Indian ☐ White ☐

SECTION B

Selected below are statements that address some variables related to Fourth Industrial Revolution and its attendant effect on Human Capital Development. Carefully read each of the following under-listed statements**,** and respond by ticking (✓) the rating scale in the form of **Strongly Agree (SA), Agree (A), Indifferent (I), Disagree (D) and Strongly Disagree (SD)** that best suits your view of each of the statements.

S/N	Statement	SA	A	I	D	SD
Knowledge of Fourth Industrial Revolution Technologies						
1.	The Internet of Things (IoT) is a technological advancement in the fourth industrial revolution that allows any gadget with internet connectivity to communicate with one another.					
2.	Artificial Intelligence (AI) is a technological advancement in the fourth industrial revolution through which machines are programmed to think like humans.					
3.	Robotics is an arm of engineering wherein robots are developed to perform several tasks such as customer service, manual labour among others.					

4.	Cyber-Physical System (CPS) is a technological advancement in the fourth industrial revolution which refers to the mixture of physical and cybernetic systems.					
Fourth Industrial Revolution Skill Requirements						
5.	Beyond a book-based knowledge system, the fourth industrial revolution will require developing practical core competencies in humans.					
6.	In the fourth industrial revolution, complex problem-solving skills will be of more importance than physical abilities like manual dexterity.					
7.	In the fourth industrial revolution, broad social skills like persuasiveness, emotional intelligence and psychological teaching will override confined technical skills like coding or operating and controlling machineries					
8.	Content skills like ICT-related knowledge and active learning will be more functional in the fourth industrial revolution					
9	Cognitive abilities like creativity and mathematical reasoning are essential ingredients for fourth industrial revolution					
10	Process skills like active listening and critical thinking will be part of strategic skills for fourth industrial revolution					
11	Jobs in the fourth industrial revolution will require high level of human reasoning, social skills and flexibility in learning and unlearning.					
Approach to Reskilling and Up-skilling of Academic Staff in University of Zululand						
12.	The approach to re-skilling and up-skilling of workers in the University of Zululand is more formal than informal					
13.	As a staff member in the University of Zululand, I learn mostly from conferences, workshops and seminars					
14.	Most of what I know about my job today was learnt on-the-job					
15.	My training as a staff member of University of Zululand includes job shadowing, job change, and job rotation amongst others.					
16.	As a staff member of the University of Zululand, I often receive mentorship from my colleagues and executive coaching from the Management.					
Fourth Industrial Revolution Global Job Disruption						
17.	The radical interruptions that the fourth industrial revolution may cause to the work domain will include an increase in entirely new professions, new approaches to management of work, new skills needed in every profession and new equipments to enhance the abilities of workers					
18.	Notwithstanding the level of increase in productivity and economic growth by the fourth industrial revolution technologies, they will replace certain jobs of several people globally.					
19.	Professions in specified environments such as machine operators, legal assistants, and accountants are prone to automation and displacement from their jobs.					

20.	Professions in uncertain environments like landscapers, pipe fitters, and nannies may be less influenced by automation due to the technicalities and costs involved in their automation as well as their unattractiveness as a business proposal.					
21.	The impact of automation on professions involving management, expertise, and communication may be reduced as machines are yet to measure up with the productivity of humans in these areas.					
22.	Many more new jobs will be created to replace the few jobs that will be extinct due to the quick emergence of machines and algorithms in the work environment.					
23.	In South Africa, autonomous technologies may tend towards replacing the workforce than augmenting them as digital technology is being used to stimulate cost minimization, automation and enhancement of efficiencies.					
24.	In South Africa, the relationship between organisations and their workers in the fourth industrial revolution will be more of contract-based than permanent.					

APPENDIX V

Reliability Statistics

Cronbach's Alpha	N of Items
.882	28

Item-Total Statistics

S/N		Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
1.	The Internet of Things (IoT) is a technological advancement in the fourth industrial revolution that allows any gadget with internet connectivity to communicate with one another.	204.07	400.871	.555	.877
2.	Artificial Intelligence (AI) is a technological advancement in the fourth industrial revolution through which machines are programmed to think like humans.	204.03	409.596	.345	.880
3.	Robotics is an arm of engineering wherein robots are developed to perform several tasks such as customer service, manual labour among others.	203.97	408.728	.386	.879
4.	Cyber-Physical System (CPS) is a technological advancement in the fourth industrial revolution which refers to the mixture of physical and cybernetic systems.	203.77	408.101	.472	.879

5.	Beyond a book-based knowledge system, the fourth industrial revolution will require developing practical core competencies in humans.	203.86	403.795	.606	.877
6.	In the fourth industrial revolution, complex problem-solving skills will be of more importance than physical abilities like manual dexterity.	203.75	406.920	.503	.878
7.	In the fourth industrial revolution, broad social skills like persuasiveness, emotional intelligence and psychological teaching will override confined technical skills like coding or operating and controlling machineries	203.63	410.111	.529	.879
8.	Content skills like ICT-related knowledge and active learning will be more functional in the fourth industrial revolution	204.05	410.997	.347	.880
9.	Cognitive abilities like creativity and mathematical reasoning are essential ingredients for fourth industrial revolution	203.85	405.418	.519	.878
10.	Process skills like active listening and critical thinking will be part of strategic skills for fourth industrial revolution	203.86	403.097	.488	.878
11.	Jobs in the fourth industrial revolution will require high level of human reasoning, social skills and flexibility in learning and unlearning.	203.95	401.121	.662	.876
12.	The approach to re-skilling and up-skilling of workers in the University of Zululand is more formal than informal	203.85	406.312	.422	.879

13.	As a staff member in the University of Zululand, I learn mostly from conferences, workshops and seminars	203.89	401.647	.649	.876
14.	Most of what I know about my job today was learnt on-the-job	203.94	405.748	.453	.878
15.	My training as a staff member of University of Zululand includes job shadowing, job change, and job rotation amongst others.	204.21	398.848	.500	.877
16.	As a staff member of the University of Zululand, I often receive mentorship from my colleagues and executive coaching from the Management.	203.73	410.260	.447	.879
17.	The radical interruptions that the fourth industrial revolution may cause to the work domain will include an increase in entirely new professions, new approaches to management of work, new skills needed in every profession and new equipments to enhance the abilities of workers.	203.79	407.453	.468	.879
18.	Notwithstanding the level of increase in productivity and economic growth by the fourth industrial revolution technologies, they will replace certain jobs of several people globally.	204.08	409.281	.391	.879
19.	Professions in specified environments such as machine operators, legal assistants, and accountants are prone to automation and displacement from their jobs.	203.97	410.170	.361	.880

20.	Professions in uncertain environments like landscapers, pipe fitters, and nannies may be less influenced by automation due to the technicalities and costs involved in their automation as well as their unattractiveness as a business proposal.	203.85	411.635	.322	.880
21.	The impact of automation on professions involving management, expertise, and communication may be reduced as machines are yet to measure up with the productivity of humans in these areas.	203.85	407.635	.505	.878
22.	Many more new jobs will be created to replace the few jobs that will be extinct due to the quick emergence of machines and algorithms in the work environment.	203.82	404.198	.593	.877
23.	In South Africa, autonomous technologies may tend towards replacing the workforce than augmenting them as digital technology is being used to stimulate cost minimization, automation and enhancement of efficiencies.	204.07	401.026	.551	.877
24.	In South Africa, the relationship between organisations and their workers in the fourth industrial revolution will be more of contract-based than permanent.	203.94	403.531	.598	.877

APPENDIX VI

LIST OF CONFERENCE PRESENTATIONS

Parts of this research study have been presented in the following conferences listed below:

S/N	Authors	Title	Name of Conference	Institution
2019	Taiwo S.O. and Vezi-Magigaba M.F.	Fourth industrial revolution: A global and south African perspective	International Conference on Industry 4.0: A Global Revolution In Business, Technology & Productivity	SEGi University, Malaysia
2019	Taiwo S.O. and Vezi-Magigaba M.F.	Possible impacts of the fourth industrial revolution: A global and south African perspective	International Conference on Industry 4.0: A Global Revolution In Business, Technology & Productivity	SEGi University, Malaysia
2019	Taiwo S.O. and Vezi-Magigaba M.F.	Probable impacts of the fourth industrial revolution on human capital: A global and south African perspective	Management, Business, Administration And Legal Initiatives (MBALI) Conference	University of Zululand
2019	Taiwo S.O. and Vezi-Magigaba M.F.	Possible impacts of the fourth industrial revolution: A global and south African perspective	UniZulu 4th Teaching and Learning Conference	University of Zululand

Certificates as provided in some of the conferences is provided in Appendix VII and VIII.

APPENDIX VII

SEGi University

CERTIFICATE OF PARTICIPATION

This is to certify that

S.O. Taiwo, M.F Magigaba

have presented a paper entitled

Fourth Industrial Revolution: A Global And South Africa Framework

at the

International Conference on Industry 4.0: A Global Revolution in Business, Technology & Productivity (MYINDUSTRIES, 14th -16th October 2019)

Professor Dr. Bala Shanmugam
Conference Chair

APPENDIX VIII

SEGi University

CERTIFICATE OF PARTICIPATION

This is to certify that

S O. Tairo, M J Magigaba

have presented a paper entitled

Possible Impacts Of The Fourth Industrial Revolution: A Global And South African Perspective

at the

International Conference on Industry 4.0: A Global Revolution in Business, Technology & Productivity (MYINDUSTRIES, 14th -16th October 2019)

Professor Dr. Bala Shanmugam
Conference Chair