IMPACT OF AUTOMATION TECHNOLOGIES ON EMPLOYMENT

By

Loyiso Dukashe

Submitted in fulfilment / partial fulfilment of the requirements for the Masters in Business Administration to be awarded at the Nelson Mandela University

April 2021

Supervisor: Mr L Mahlangabeza

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SURNAME, INITIAL: **LOYISO DUKASHE**

STUDENT NUMBER: **215317238**

1. Has this treatise been submitted with your knowledge and support?

YES X	

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2. Submission Recommendation:

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Ref: [H20-BES-DEV-173] / Approval]

2 December 2020

Mr L Mahlangabeza
Department: Graduate School

Dear Mr Mahlangabeza,

TITLE OF STUDY: IMPACT OF AUTOMATION TECHNILOGIES ON EMPLOYMENT (MASTERS)

PRP: Mr L Mahlangabeza
PI: L Dukashe

Your above-entitled application served at the *Faculty Ethics Committee of the Faculty of Business and Economic Science, (14 August 2020)* for approval. The study is classified as a negligible/low risk study. The ethics clearance reference number is **H20-BES-DEV-173** and approval is subject to the following conditions:

1. The immediate completion and return of the attached acknowledgement to Lindie@mandela.ac.za, the date of receipt of such returned acknowledgement determining the final date of approval for the study where after data collection may commence.
2. Approval for data collection is for 1 calendar year from date of receipt of above mentioned acknowledgement.
3. The submission of an annual progress report by the PRP on the data collection activities of the study (form RECH-004 to be made available shortly on Research Ethics Committee (Human) portal) by 15 December this year for studies approved/extended in the period October of the previous year up to and including September of this year, or 15 December next year for studies approved/extended after September this year.
4. In the event of a requirement to extend the period of data collection (i.e. for a period in excess of 1 calendar year from date of approval), completion of an extension request is required (form RECH-005 to be made available shortly on Research Ethics Committee (Human) portal)
5. In the event of any changes made to the study (excluding extension of the study), completion of an amendments form is required (form RECH-006 to be made available shortly on Research Ethics Committee (Human) portal).
6. Immediate submission (and possible discontinuation of the study in the case of serious events) of the relevant report to RECH (form RECH-007 to be made available shortly on Research Ethics Committee (Human) portal) in the event of any unanticipated problems, serious incidents or adverse events observed during the course of the study.
7. Immediate submission of a Study Termination Report to RECH (form RECH-008 to be made available shortly on Research Ethics Committee (Human) portal) upon unexpected closure/termination of study.
8. Immediate submission of a Study Exception Report of RECH (form RECH-009 to be made available shortly on Research Ethics Committee (Human) portal) in the event of any study deviations, violations and/or exceptions.
9. Acknowledgement that the study could be subjected to passive and/or active monitoring without prior notice at the discretion of Research Ethics Committee (Human).

Please quote the ethics clearance reference number in all correspondence and enquiries related to the study. For speedy processing of email queries (to be directed to Lindie@mandela.ac.za), it is recommended that the ethics clearance reference number together with an indication of the query appear in the subject line of the email.

We wish you well with the study.

Yours sincerely

Prof S Mago

Cc: Department of Research Capacity Development
Faculty Research Co-ordinator: Lindie van Rensburg

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Mr. L Mahlangabeza, for his guidance and understanding throughout the preparation and completion of this treatise.

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ABSTRACT

Throughout history, the introduction of automated technologies has an impact on on human labour. The current wave of technological advancement has expanded the scope of automation raising a concern about the future relevance of human labour. **Hence, this study** investigated possible futures on the effect of automation technologies on employment.

The study adopted a desktop research approach using secondary sources employing future studies methodologies. **The study identified a** need to transform employment, educational systems and social policy to proactively respond to future effects of automation technologies towards employment.

Key phrases: *Automation, employment, skills, futures studies, six pillars*

SIGNATURE PAGE

Supervisor's signature to state that this work has been declared relevant and has been accepted.

Name of supervisor: Mr L Mahlangabeza

Signature of supervisor:

Date: 18/ January / 2021

CHAPTER 1: BACKGROUND OF THE STUDY

1.1 Introduction

Automation technologies bear a profound impact on employment patterns. The ever-expanding list of automation technologies is becoming broad, based on scope; such technologies are critical in their capacity to change organisational activities and labour demands (Wisskirchen, Thibault, Bormann, Muntz, Niehaus, Soler & von Brauchitsch, 2017). Modern organisations are increasingly using robotics, computerised algorithms artificial intelligence (AI), unmanned vehicles and mobile sensors to optimise core business functions to upgrade their logistics, management of inventory and complete other business activities (West, 2015).

Technological innovations of today are creating a new dawn in automation from which smarter machines are introduced on a large scale to the workplace (Manyika, Lund, Chui, Bughin, Woetzel, Batra, Ko, & Sanghvi, 2017). This has happened most radically in manufacturing industries, where great numbers of human labour have been replaced by tireless, more precise, and more efficient automation systems. It is also increasingly a feature of service industries, with, for example, automated customer carelines, self-service checkouts and so on, becoming more and more prominent (Manyika,et al. 2017).

In many cases, automation technology, carries a positive impact of increasing productivity, economic growth, and create new employment opportunities. However, the impact can also be negative, as clusters of workers find that their form of labour is being displaced or becoming obsolete, as organisation opt for cheaper and more efficient technological analogues (Kim, 2019). Adendorff & Putzier (2018) support this as they identify technology as an important driver of revolution considering its potential transformative influence, with both positive and negative effects.

Industrial intellectuals have provided conflicting views about the implications of changing technology for employment, with some experts identifying recent automation innovations as having profound impact on employment and job security (West, 2015). Mark (1987) express a view that technological progression is beneficial for society,

changes are more evolutionary than revolutionary in nature, and that technology ultimately creates more jobs than it eliminates.

An important gap that exists for this type of research is to study the extent of which automation technologies will transform the workplace environment and the implications for employment. The study thus seeks to address this identified area by examining possible effects of automation towards employment.

1.2 Problem statement

Throughout history, automation technologies have displaced and substituted human labour (Vermeulen, Kesselhut, Pyka & Saviotti, 2018). Economists have provided conflicting views about the recent performance of labour markets across advanced economies, with some scholars identifying the adoption of automation technologies as one of the possible explanation for the recent declining labour growth (Frey & Osborne, 2013).

The uncertainty surrounding the implications of automation technologies on employment are well documented in literature. Various studies (Goodhart, Llewellyn, Hartmann, Rojas-Suarez, & Weisbrod, 1998) and (Jaimovich & Henry, 2012) claim that automation is the main cause of on-going decline of employment rates. Frey and Osborne (2013) reported a shift in labour supply, with large numbers of workers moving labour supply from routine intensive occupations to more cognitive occupations as a consequence will result in an increase in unemployment, income inequality and possible collapse of social order.

What is certain is that the effects of automation technologies are affecting labour market and societies. There is a need to understand these automation technologies and the implications thereof. There is also a need to review education and training requirements to better understand future employment possibilities and avoid situations where people train or are trained for occupations that will cease to exist in future.

It is from this context that the research problem of this study is identified: *As a result of increasing technological innovations, automation transforms employment and this has implications for the labour market.*

1.3 Research questions

The research undertaken aims to identify possible future on the effect of automation on employment. However, to successfully investigate the research objectives, the study seeks responses to the research questions listed below:

1. What are the effects of automation technologies on unemployment?
2. What factors affect the adoption of automation technologies?
3. What possible skills requirements can be considered for the future labour market?
4. What issues hamper the implementation of a plausible future?

1.4 Research objectives

1.4.1 Primary research objective

The *primary research objective* of this study is to investigate the possible and plausible futures of the impact of automation technologies on employment. The investigation of this research objective is largely against three dimensions: automation technologies impact on employment, productivity and skill requirements. In addressing the problem, an exploratory approach has been utilised, focusing on the research objective. Inayatullah (2004) stated that the causal layered analysis (CLA) methodology aims to combine different modes of knowledge by creating transformative spaces for the development of alternative futures. This has proven useful in creating long term policy, thereby creating shared discourses while opening an honest and open conversation (Inayatullah, 2004).

1.4.1 Secondary research objectives

a) To examine the effects of automation technologies on unemployment.

b) To determine factors that affect adoption of automation technologies.

c) To consider plausible skills requirements for the future labour market.

d) To assess issues that hamper the implementation of a plausible future.

The unpredictable nature of technological advancement limits human ability to accurately foresee the future effects of any technological advancement on employment demand (Stahl & Wakunuma, 2007). This is significant in the application of automation technologies that impact labour requirements in both capacity and areas of application across sectors and industries (le Roux, 2018).

The various stakeholders for the purpose of this study include:

- *Labour market;*
- *Educational institutions;*
- *Government/legislators; and*
- *Service providers.*

Stakeholders may, at times, have opposing or different views as to what the possible future entails. This shows that future works is important in this field to envision, model and explore alternative futures to assist in achievement of the best preferable future possibility within the global context.

1.4 Research methodology and framework

This study adopted an exploratory approach in researching the objective. The qualitative research approach aimed to respond to questions put forward towards a specific problem with the objective of unpacking and understanding the factors from different perspectives (Corti, 2000). This is supported by Rahman (2016) who states that one of the key advantages of the qualitative approach is the speed and effortlessness at which research can be conducted. It must be mentioned that such models are not assistive in constructing possible, probable and preferred futures and were deemed not useful for the objective of the study.

Inayatullah (2015) identifies four different dimensions of future studies, namely; interpretive, predictive, critical and participatory action learning. This study employed the critical dimension. The goal of critical research is to disturb the current force relations through making problematic current classifications and inspiring other future scenarios. It is through this past and future distance that the present can be influenced to become exceptional (Inayatullah, 2015). This opens opportunity for the possibility of new ideas to emerge. Hence, critical futures research assists in providing abundant

information to what is being investigated compared to common empiricist studies (Inayatullah, 2002).

The six pillars by Inayatullah (2008) were used as a guideline throughout this study and acted as a conceptual framework. The pillars of the six pillar framework are summarised below:

1. Mapping the future

The mapping phase entails scanning of the environment affecting automation and employment and mapping of the past, present and future. In this study, this was achieved by utilising the Futures Triangle.

2. Anticipating the future

This pillar entails the emerging issues analysis. This approach assisted in searching for new possibilities and opportunities while also identifying critical issues in advance.

3. Timing the future

This pillar searches for elements of sustainable change. In this study, this pillar aimed to identify the social and institutional structures required to promote change towards a preferred future.

4. Deepening the future

The causal layered analysis (CLA) methodology unpacks and deepens the future. In this study, the CLA layers (Litany, Systemic Causes, Worldview and Metaphor) method was utilised to construct transformative variables in order to create alternative futures.

5. Creating alternatives

In this study, creation of alternatives was achieved through scenario planning. This is acknowledged by Inayatullah (2008) as one of the most important techniques that can be utilised in this pillar. The research followed a double variable scenario method conducted by the identification of two key challenges and developing alternatives based on them.

6. Transforming the future

In the sixth pillar, the future is now transformed towards the most preferred scenario. In this study, this pillar aimed to find a win-win solution.

Inayatullah (2004) states that casual layered analysis may be utilised as a research methodology within this type of research and would be correctly placed in post-structural theory and critical futures research. It is from this position that this study embarked on the CLA methodology to deepen and unpack the future of automation (Pillar 5), while fortifying and supporting the advancement of more grounded scenarios (Pillar 6). The methodology is discussed in detail in the next chapter.

1.5 Study outline

Chapter one illustrates the purpose of the study, the rationale of why the study is conducted and the research method utilised.

Chapter two discusses in detail the research methodology utilised to address the research problem. This includes the research approach employed in the study.

Chapter three contains the literature study to understand the research question. Chapter three, therefore, discusses current automation innovations, impact of automation technologies on employment and productivity and factors affecting the adoption of automation technologies.

In Chapter four, an analysis of preferable future for stakeholders is done. This chapter attempts to identify automation factors and their direct and indirect impact on employment.

Chapter five presents a summary of the research problem, whereby outcomes of the methodological analysis are discussed and concluded. The chapter concludes with recommendations and discussion of the limitations future research.

1.7 Conclusion for Chapter 1

Chapter one presented the intent of research, defined the research problem and objectives, explained the research methods and gave an outline of the study

1.8 Chapter that follows

The chapter that follows is on research methodology utilised in the study.

CHAPTER 2: RESEARCH METHODOLOGY

2.1 Introduction

Chapter one illustrated the purpose of the study, the rationale of why the study is conducted and the research method utilised. This chapter explores the concepts of futures thinking, including techniques and methodologies utilised in studying of the future. The chapter provides a brief background on future studies and a detailed elaboration of the six-pillar approach, causal layered analysis and scenario planning technique, including their role in this research. This chapter is highly influenced by the work of Professor Sohail Inayatullah (Inayatullah, 2008).

2.2 Systematic mapping review

The study conducted a 'systematic mapping review' of published qualitative journal articles. The aim of systematic review is to categorize existing qualitative literature on a particular research topic (Bimrose, Barnes, Brown & Hasluck, 2007). The review includes a systematic database search for published articles and categorisation of its uses into the six pillars approach and theoretical framework of future studies.

2.3 Mapping review search strategy

The research undertook a manual search process of specific conference proceedings and journal papers since 2010, focusing on keywords related to the impact of automation on technology. Key search terms included: *automation, technology, employment, artificial intelligence, robotics, automate*. The study explored the following databases: EBSCOHOST, MANDALEY, SCIENCE DIRECT, ENDNOTE and GOOGLE SCHOLAR. Candidate articles were accepted based on the following criteria: studies reporting any impact or outcome related to the implementation of automation and its effect on employment; studies of experimental, observational and qualitative designs; and studies published between 2010 and 2020. Articles were excluded if they were: not qualitative research; not automated related; not a report of findings of empirical research (e.g. published protocol, methodological paper, editorial); not reported in English and not human research.

2.4 Aims of the literature review

The aims of this study, therefore, is twofold, with an aim to identify and review the research and evidence on two separate, but related, areas:

- The impact of automation technology on employment; and
- Possible skills requirements to be considered for the future labour market.

A systematic review of methodology, modified to allow researcher discretion, was utilised to search databases to ensure that the search across databases was consistent.

The table below presents the summary of the search strategy for the first and second review question. Publications were screened by abstract and title, and particular emphasis was given to publications presenting methodologies for which a sound evidence base has been, or is being developed.

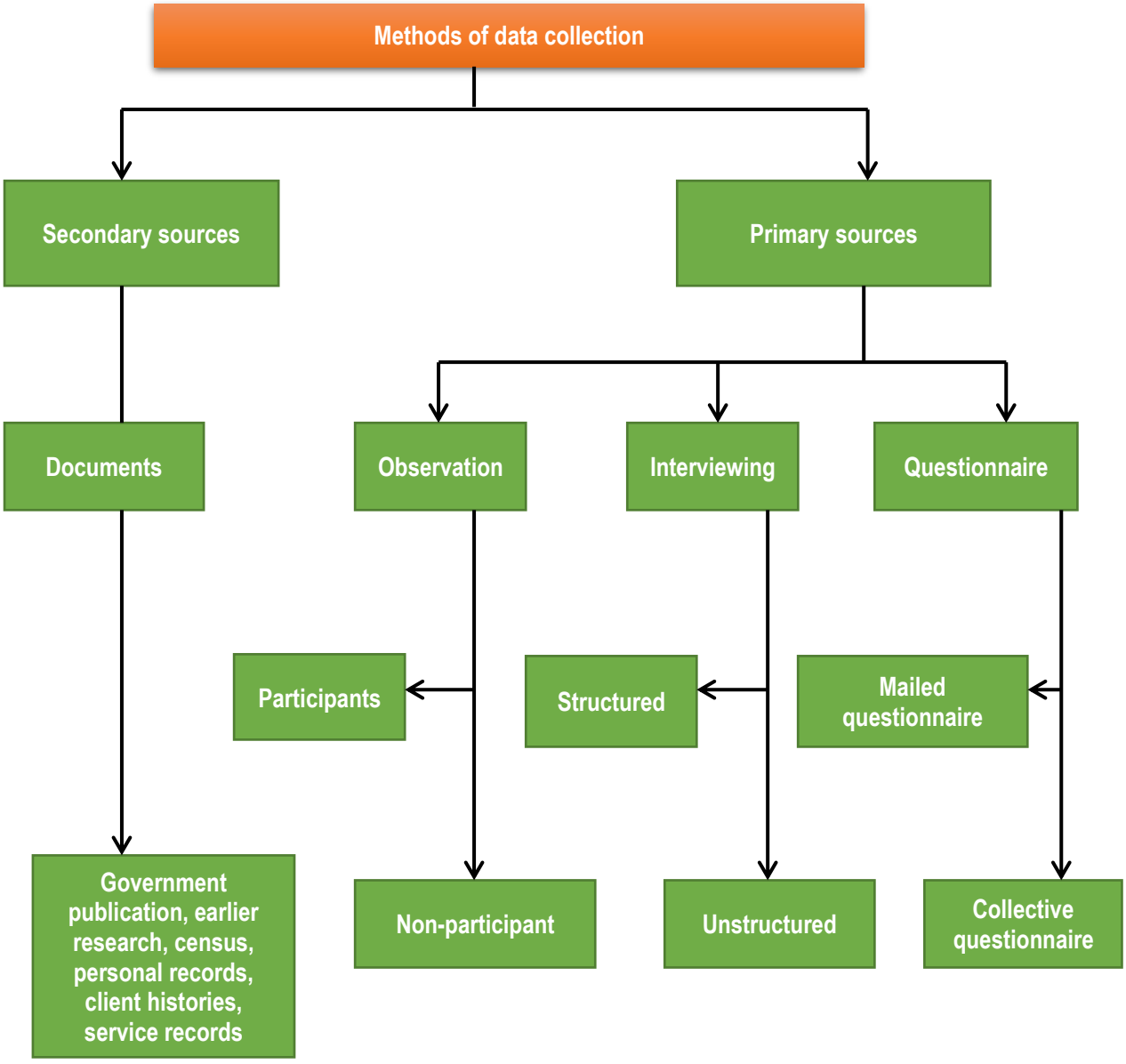
Review question	**Total hits**	**Screened by abstract and title**	**Considered studies**
The impact of automation technology on employment; and	19 677	379	29
Possible skills requirements to be considered for the future labour market.	21 455	264	40

2.1.1 Exploratory and secondary sources

This chapter adopted an exploratory approach in examining relevant literature to the research objective. Exploratory studies provide a means of identifying the current situation and pursuit of new understandings to enquire and asses issues opposingly (Swedberg, 2018). The methodologies utilised in such studies are identified as opportunity-orientated and explore possible futures without considering the desired outcome (Adendorff, 2013).

Qualitative research can use primary data or secondary data, best illustrated diagrammatically in Figure 2.1 below, which puts the two types of data collection into perspective.

Figure 2.1: *Major approaches to information gathering*



Source: Kumar, (2019)

Wiid and Diggines (2015) inform us that the aim of exploratory studies is to obtain insight and develop understanding rather than to collect replicable data; therefore, this

type of study often involves using sources. The methods for conducting exploratory studies include an analysis of secondary data.

A secondary source is a survey of existing relevant literature (Cant, Gerber, Nel, Kotzé, 2012; Kumar, 2018; Wiid & Diggines, 2015) and is referred to as a secondary source because it is material produced elsewhere or by someone else (Dane, 2018; Kumar, 2018; Nardi, 2018) and provides descriptions, summaries, analysis, commentary, perspectives, evaluation or conclusions about the primary source (Devlin, 2018).

To investigate the impact of automation technologies on employment, the study utilised literature to meet the research objectives and address the research question. Here, the research made use of nine steps of working with secondary sources, as suggested by Cohen, Manion and Morrison (2018:591). Secondary data was used due to its many attractions (Ashley, 2017; Durdella, 2019). These include the reality that data had already been collected and already exists, so the researcher did not have to worry too much about challenges of data collection such as time to collect data (Cohen *et al.,* 2018; Wiid & Diggines, 2015), nor worry about access to people and permissions from gatekeepers (Cohen *et al.,* 2018).

Secondary data for this study came at a low-cost, even free of charge, convenient and it saved time and money. Access was quicker, even immediate (Cant *et al.,* 2012; Cohen *et al.,* 2018), and it enhanced the collection of primary data and provided for deeper competition of data for a broader interpretation of primary data (Cant *et al*., 2012; Wiid & Diggines, 2015). Since it came from different sources, it was combined to yield a robust analysis. As the secondary data was already in existence, the research was unconstructive and respected ethical issues of privacy, confidentiality, anonymity, non-traceability and leaving people alone (Cohen *et al.,* 2018).

The secondary sources used in this study were relevant textbooks, peer-reviewed journal articles (Delvin, 2018; Wiid & Diggines, 2015), official legislative documents, published reports (Delvin, 2018; Wiid & Diggines, 2015), subject dictionaries (Ashley, 2017), subject encyclopaedias and the internet (Hammersley, 2017).

According to Hofstee (2015), although librarians are among the under-rated people of the world, they can really help a researcher a lot. Accordingly, doing secondary

research becomes easier if you make friends with a good librarian (Hofstee, 2015). Using the assistance of the librarian at the university, the researcher was able to undertake an investigation of applicable documents and literature across electronic information database and the world-wide web. These are expatiated hereunder:

- **The internet:** Internet-based information collection tools can be a cost-effective and productive approach to contemplate. The internet is proven to be an effective technique for data collection, and website utilised are recorded on the reference list.
- **Library Search engines:** Library search engines such as university repository, dissertations and theses, EBSCOhost, JSTOR, NEXUS, books, and a number of theses and dissertations provided the researcher with a vast number of relevant articles on the subject.

- **The internet**: In utilising the internet, particularly google scholar.com to access scholarly articles and reputable websites, the researcher was able to expand the sources of documentation.

2.1.1.1 Steps in searching for secondary data

Wiid and Diggines (2015) and Cant *et al*. (2012) provide steps for searching secondary data. Table 2.1 below provides a comparison of steps for searching secondary data.

Table 2.1: *Steps in collecting secondary data by different authors*

The six steps in collecting secondary data by Wiid and Diggines (2015)	The five steps in collecting secondary data by Cant *et al*. (2012)
• Step 1: Specify data requirements • Step 2: Determine which data would be obtainable from internal sources • Step 3: Seek external sources of secondary data • Step 4: Obtain secondary data • Step 5: Scrutinise the validity of data • Step 6: Identify data that must be obtained from secondary sources instead	• Step 1: Identify what is known • Step 2: List the key terms • Step 3: Search using secondary data • Step 4: Compile literature and evaluate findings • Step 5: Approach somebody who knows something about research

Source: Cant *et al*. (2012) and Wiid and Diggines (2015)

Having identified the two different data analysis methods by Wiid and Diggines (2015) and Cant *et al*. (2012), the researcher utilised the data analysis steps presented by Cant *et al*. (2012). These steps are identified as:

Step 1: Identify what is known.
Step 2: List key terms and names.
Step 3: Search using secondary data.
Step 4: Compile literature and evaluate findings.
Step 5: Approach somebody who knows something about the research.

2.1.1.1 Evaluation of secondary data

According to Wiid and Diggines (2015), data obtained from different sources has to be evaluated in terms of content, usability, presentation, cost and quality. Since secondary data is not collected specifically to solve a particular problem, researchers do not always know how reliable it is. Therefore, external data must be evaluated carefully before using it for decision making (Wiid and Diggines, 2015).

***a)* Six fundamental aspects to be considered when evaluating secondary data**

In this study, the researcher used Wiid and Diggines' (2015) six fundamental aspects when evaluating the data. The steps are discussed below:

(1) Purpose: In this investigation, secondary data was not collected for the examination at hand but for other purposes. The information was, thus, assessed to perceive how it relates to the current investigation.

(2) Accuracy: The researcher recalled what was investigated and assessed the speculation of the information. The researcher assessed the sensibility of the information, regardless of whether or not it is material to the investigation objective.

(3) Consistency: When assessing secondary data, the researcher examined multiple sources of the same information to confirm consistency.

(4) Credibility: The researcher scrutinized the creditability of the source. The quality of the information source, including the institution that gathered the information, was assessed.

(5) Methodology: The quality of the information is only as good as the methodology utilized. Defects in the methodology can create invalid results, not usable past the research investigation. The researcher considered the following:

- The qualities of the data-collection techniques and the way in which the information is presented;
- The definitions and terms utilized in the different sources;
- The inspecting technique utilized;
- The freshness of the information, as secondary information dates rapidly in a dynamic climate;
- The measure utilized in the different sources;
- The research techniques and information assortment strategies utilized; and
- The general confirmation that the information was deliberately gathered, broke down and introduced.

(6) Bias: The researcher determined the reason why the data was collected.

2.2 Futures studies

Inayatullah (2004) defines futures studies as the systematic study of probable, possible and preferred futures and worldviews and myths that underlie them. Inayatullah (2008) further stated that by mapping the past, present and future; by anticipating future issues and their consequences; by being sensitive to the patterns of change; by deepening our analysis to include worldviews, myths and metaphors; by creating alternative futures; and by choosing preferred and backcasting ways to realise the preferred, we can create the world we wish to live in

Futures studies takes into consideration the reformulation and analysis of the current understanding of the world (epistemology), social constructions of reality and worldview (Ramos, 2002). Future studies' application of critical thinking assists in the identification of hidden assumptions and what has been taken for granted (Inayatullah, 2008). Schultz (2012) described futures studies as the study of inquiry that involves a

systematic thinking approach, based on distinctive perspectives that clarify the future, thus, increasing the ability to have control.

The objective of futures studies is not to predict future events but assist with the development of strategy and ensure effective decision-making of the present time. (Glenn & Gordon, 2009). This statement is supported by Roux (2018) who identifies the purpose of futures study as one that systematically explores, constructs and measures both possible and desirable futures to improve decision-making. For Schultz (2012), the three main purposes of futures studies are to seek an understanding of the past and reposition the present to incorporate information, ideals and principles for planning social action, communicate and advocate for a particular image of the future.

2.1.1 The six pillars approach

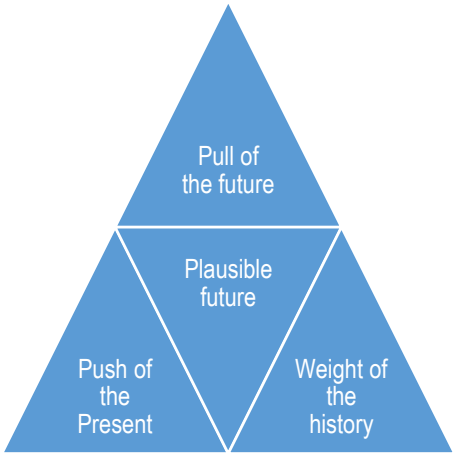
The six pillars approach provides for a theoretical framework of future studies linking different methodologies and techniques through praxis (Inayatullah, 2008). The theory was developed by Inayatullah (2008) who identified the pillars as:

Pillar 1: Mapping the future;
Pillar 2: Anticipating the future;
Pillar 3: Timing the future;
Pillar 4: Deepening the future;
Pillar 5: Creating alternatives; and
Pillar 6: Transforming the future.

Pillar 1: Mapping the future

In this pillar, the images of the past, present and future are analysed. Inayatullah (2008) states, *"by mapping time, we become clearer on where we have come from and where we are going".* It is through this perspective that Inayatullah (2008) identifies The Shared History and Futures Triangle methods as crucial techniques in this pillar. Figure 2.2 illustrates this.

Figure 2:2: *The Futures Triangle*



Source: (Inayatullah, 2008)

The "Shared History" method seeks to identify continuities and discontinuity in history, thereby providing a framework from which to move to the future. The "Futures Triangle" method maps present views of the future through three dimensions: The push of the present, the pull of the future, or the weight of the past (Inayatullah, 2008). Inayatullah (2008) identified the reality that each institution or organisation has a different view of their future and identified five archetypal images of the future. Table 2.2 tabulates Inayatullah's (2008) five images of the future.

Table 2.2: *The five images of the future*

Evolution and progress	The belief of rationality and considering humans as the center of the universe.
Collapse	A belief that limits of humankind have been met and a collapse in inevitable.
Gaia	The belief that the world is a garden, and we require social advances to fix the harm we have caused to ourselves, to other people and nature, turning out to be increasingly more comprehensive to what is significant. Partnerships between people of both genders, humans and nature, and humans and technology are new evolutionary milestones.

Globalism	International barriers separating cultures and nations can be eradicated by the introduction of an unrestricted global economy system. The sharing of technology and progression of capital can greatly benefit the global majority. Technology and free progression of capital can carry wealth to all. Conventional beliefs and creeds are barriers preventing attainment of a new world.
Back to the future	The belief is that change is overwhelming, and there is a need to re-visit simpler times, when rules and hierarchy were clearer and technological innovations were less destructive.

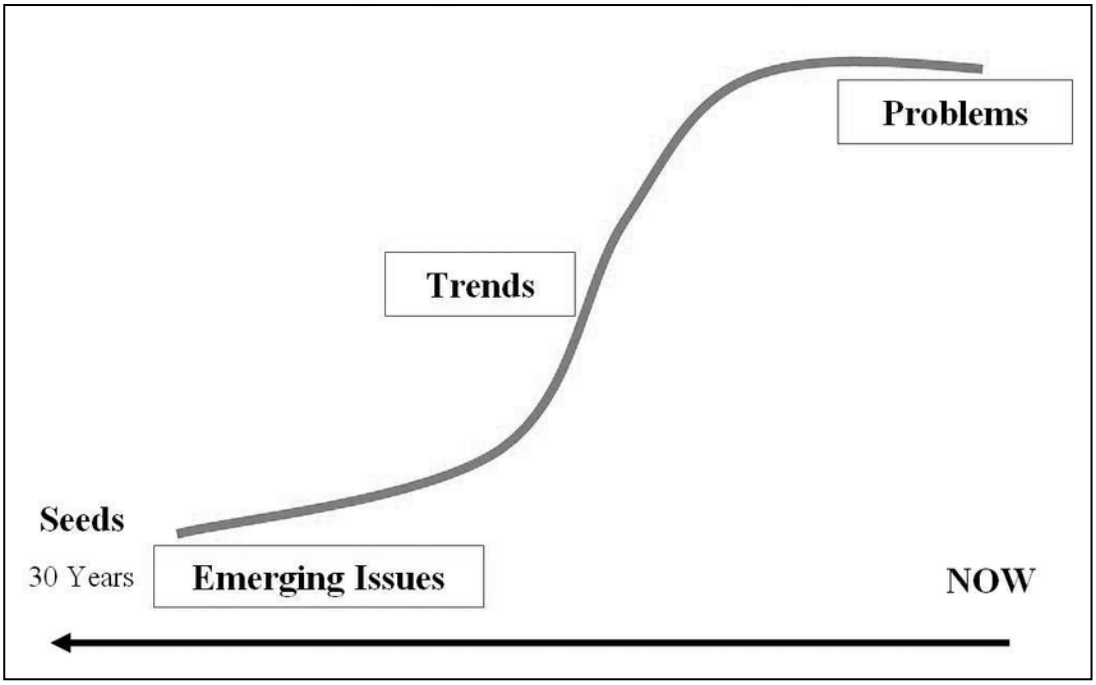
Source: (Inayatullah, 2008)

Along with images of the future are pushes of the present. They are identified as quantitative trends promoting changes in the future. These drivers can be identified as climate change, internet accessibility, ageing population, etc. By examining the interaction of factors of the futures triangle, we can create a preferred future (Inayatullah, 2008).

Pillar 2: Anticipating the future

Anticipation is the second pillar of future thinking. Inayatullah (2008) identified the "emerging issues analysis" as the main method in this pillar. The Emerging issues analysis consists of identification of three core issues: 1) identification of bell weather regions, the start of new social innovations; 2) identification of perceived challenges before they become unmanageable and costly and; 3) to search for new opportunities and possibilities. The method aims to identify and analyse social disrupters such as: will artificial intelligence result in robots having legal rights? Will technology such as the smart toilet help with early diagnostics? Will smart bots redefine employment, *etc*? Although the analysis and solving of tomorrow's problems leads to little benefits, Emerging issues analysis can assist to minimise harm and make organisations and individuals more aware and respond far more swiftly to emerging challenges (Inayatullah, 2008).

Figure 2:3: *Emerging issues analysis*



Source: (Inayatullah, 2008)

Important questions concerning automation and employment are posed during this phase. These are:

- What does this mean for the automation and employement ?
- What can be done currently?
- What are the issues that affect attainment of the desired future?
- What are the perceived implications for the stakeholders?

Pillar 3: Timing the future

Pillar three seeks to identify patterns and models of change in history to shape the future (Inayatullah, 2008). In order to time for the future, Inayatullah identifies the following primary patterns summarised as follows:

- The future is linear, progressive and good, only through hard work and commitment will we achieve a good future;

- New futures are, in most cases, developed by the creative minority in the population. This group challenges the status quo and in doing so, promote

political, social, technological trends, conditions or advancements and advancement;

- The future is repetitive; the future comprises of good and bad times and those at the top will one day end up at the base. As a result of their positions, they cannot adjust to evolving conditions. Their prosperity depends on the authority of past obsolete conditions;

- There have been periods in the past where actions of a couple invoked a dramatic effect, bringing about a change. In these periods, customary techniques are not effective; and

- The future is a spiral. Foresighted leadership can stimulate positive influence and acceptance, while interrogating the past can help build the ideal future.

The pillar identifies the world as complex, so it focuses on the astute use of the drivers for change to better influence and understand social reality.

Pillar 4: Deepening the future

Deepening the future is the fourth pillar. The Casual Layered Analysis (CLA) is considered as one of the decisive techniques in this pillar. There are two methodologies that are considered critical during this phase: the CLA developed by Inayatullah (2008) and the four quadrant mapping method developed by Slaughter and Bussey (2012).

Inayatullah (2008) identified the (CLA) as a sophisticated method of categorising different concerns and views about the future, and then using these to assist groups to think more effectively. The methodology has been identified to assist individuals organisations to understand the current reality through gaining a deeper and border understanding of alternative futures (Inayatullah, 2008).

Pillar 5: Creating alternatives

The fifth pillar focus is on creation of alternatives futures. Inayatullah (2008) identifies scenario planning as a vital method to reveal the extent of uncertainty, the present

state and presenting alternatives for the future. Scenario planning in this context can, therefore, be defined as planning based on the observation to develop a strategy to implementation across several probable futures to identify driving forces that will influence the future in different directions (Inayatullah, 2008).

Pillar 6: Transforming the future

Transformation is the sixth and last pillar. In this pillar, the aim is to narrow the future to the preferred. Three methods are identified as important in this pillar: Visioning, Backcasting and Transcending. Visioning is fundamental in futures thinking as visions help pull people by giving individuals or groups a sense of the possible. Backcasting works by moving individuals and groups into the preferred future; the method fills the gaps between the present past and future and in doing so, makes the future achievable. Transcending is identified as a method to resolve conflict between visions through a win-win resolution. Conflict between visions is resolved through a process of interaction and creating alteratives; the aim is to find new ways to develop an integrated vision (Inayatullah, 2008).

2.2 Deepening the future with the CLA

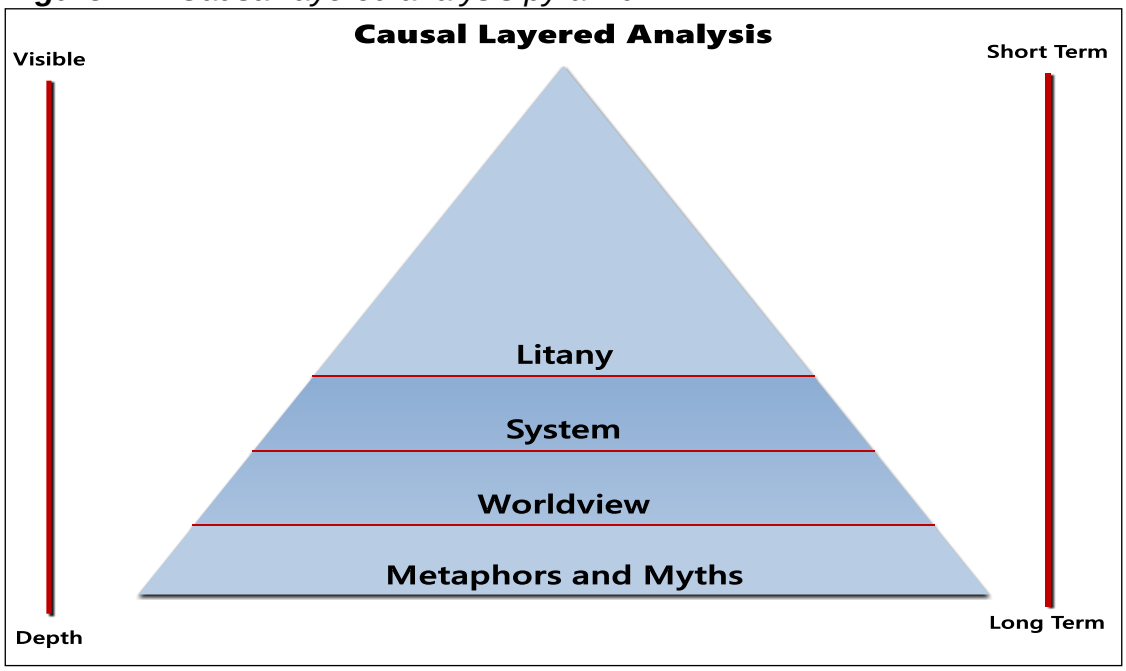
Inayatullah (2008) identifies the Causal Layered Analysis (CLA) as a sophisticated method of categorising different concerns and views about the future, and then using these to assist groups think more effectively. The methodology has been identified to assist individual and organisations understand the current reality through gaining a deeper and border understanding of alternative futures (Inayatullah, 2008).

Jackson (2013) claims that the CLA intends to distinguish between the main impetuses and perspectives supporting assorted viewpoints about the future and what it means to groups and organisations. The method encourages scrutinizing customary thinking to create a shared perspective on conceivable future outcomes that can break existing standards of reasoning (Jackson, 2013). The CLA provides a futures methodology that assesses the present and past to identify alternative futures. Its aim is not in foreseeing the future but in creating transformative spaces for the development of alternative futures (Inayatullah, 2008).

CLA consists of four distinct layers:

1. Layer 1: The litany;
2. Layer 2: Social causes;
3. Layer 3: Discourse or worldview; and
4. Layer 4: Myth or metaphor.

Figure 2.4: *Causal layered analysis pyramid*



Source: (Inayatullah, 2009)

2.2.1 Layers of casual layered analysis

The first layer of the CLA is litany. Inayatullah (2004) identifies this layer as quantitative patterns, issues, regularly exaggerated, frequently used for political purposes publicised by the media news. Occasions, trends and issues are not associated, and seem discontinuous. The result is often a feeling of helplessness, apathy or projected action. The litany layer is the most apparent and does not require much analytical expertise. The layer is also identified as conventional and can create politics of fear as it is easily accepted and rarely questioned. With regard to this research study, the first layer of the CLA, deals with the impact of automation technology on employment (Inayatullah, 2004).

The second layer of the CLA focuses on systemic causes that affect society. These include historical, political, economic, social, and cultural factors. Interpretations are provided in quantitative data, technical explanations and academic analysis. In this layer, data is normally disputed but the line of dispute does not question the paradigm in which the issue is formed (Inayatullah, 2004). In this layer, the research focuses on internal and external factors affecting the adoption of automation technologies that strengthen participation, willingness and usage from affected stakeholders.

The third layer, at a deeper level, as explained by Inayatullah (2004), focuses more on structure and the discourse/worldview that supports and legitimises it. The objective of this layer is to acquire deeper social, linguistic and cultural structures that are independent of influence. The understanding of deeper assumptions behind the issue is vital at this stage, as are efforts to review the problem (Inayatullah, 2004). The worldview layer consists of additional four other layers (Inayatullah, 2004):

1. Stakeholder: In this layer the different interests of various stakeholders are expressed;
2. Ideological layer: the layer refers to the viewpoints on how the world should appear and how it currently appears;
3. The third layer is civilizational, as expressed through worldviews; and
4. Epistemic: The ideology is that every challenge that needs to be resolved invokes a particular discourse or a combination of a few.

According to Inayatullah (2004), there is a fourth layer that manages the examination of myth and metaphor. These are the profound stories, aggregate models, the oblivious, frequently emotive, measurements of the issue or paradox (considering populace to be no factual, as local area, or considering individuals to be innovative assets, for instance). This level gives a gut/emotional level experience to the perspective under request. The language utilized is less specific, more concerned about inspiring visual images, with touching the heart, as opposed to perusing the head. This is the root level of questioning. However, questioning itself discovers its limits since the frame of questioning should enter different frameworks of understanding the mythical, for instance. Causal layered analysis requires an individual to go past regular outlining from issues.

Inayatullah (2004) concludes on the scenarios at each different level. Litany type scenarios are more instrumental, social levels are more arrangement-orientated and discourse/worldview scenarios intend on capturing key contrasts. Myth/metaphor type situations are similarly discreet, yet this articulates through poem, a story, an image. At each level, it is frequently asked: who will be responsible to take care of the issue? The obligation consistently changes at each level. For example, at litany level it is the obligation of the government or enterprise, and at social level, it is various groups shaping a partnership. However at the worldview level, voluntary affiliation and individuals accept accountability and at the myth/metaphor level, its leaders or artists.

CLA does not support a specific truth but seeks to discover how a discourse becomes favoured, who benefits and who loses when a specific truth becomes prevalent (Inayatullah, 2008). The CLA aims to distinguish the main driving forces and perspectives supporting assorted viewpoints about the future and what it means to organisations and groups. The technique empowers scrutinizing of customary intuition to deliver a shared perspective on conceivable future results that can break existing standards of reasoning and working (Jackson, 2013). Jackson (2013) recognizes a portion of the advantages and drawbacks of the CLA in Table 2.1 below.

Table 2.3: *Advantages and disadvantages of CLA*

Advantages	**Disadvantages**
Can work with different foresight methodologies	Requires individuals partaking in conversations to be open to sharing of perspectives and question their presumptions and assumption for activities in an organisation.
It can support the formation of better future scenarios	Should be connected with other foresight techniques to concoct future scenarios.
Provides an important confirmation framework to ensure that created scenarios are robust across varied standpoints.	It is important for participants to acknowledge the fundamental CLA hypothesis

Constructs visions that are shared by many regarding preferable organisational future	May coincidentally decrease creativity by individuals
Potential for issue transformation	May constrain action through paralysis
Connection of long, medium and short-term strategic thinking	

Source: Jackson (2013)

2.2.1 Creating alternatives with scenario planning

Scenarios are identified as a combination of hypothetical occasions set in the future, built to explain a potential chain of occasions as well as reasoning for their decisions (Amer, Daim & Jetter, 2013). Lindgren and Bandhold (2009) identified scenario planning as an important aspect in the creation of alternative futures due to its close relation to strategic planning (Lindgren & Bandhold, 2009b). The utilization of scenario planning has expanded significantly in recent years, with research connecting the adoption of scenario planning procedures with vulnerability, unpredictability and instability of the organisational environment (Amer et al., 2013). Expanded vulnerability has amplified the benefit of perceiving future patterns and anticipated organisational landscape (Amer et al., 2013). The utilization of scenario planning by organisations has thus expanded because of more prominent unpredictability and vulnerability in the environment.

Scenario planning enhances decision-making ability through illustrating and uncovering conceivable future occasions and circumstances, resulting in improved planning and assisting an organisation to be more adaptable (Lindgren & Bandhold, 2009b). Kosow and Gabner (2007) propose four scenario models from their study on alternative futures:

1. Continued development, with a future where it is normal that most recent patterns and conditions are advanced further;

2. Steady state, with a future that looks to capture development and discover an equilibrium in the economy and with nature, underlining a safe and non-prejudicial society;
3. Collapse, with a future that is the result of failure of continued growth and emergence of great contradictions;
4. Transformation, with a future that attempts to change essential assumptions of the other three situations through exciting creative or spritual change (Kosow & Gabner, 2007)

This methodology encourages scenario planners' abilities to identify and cast their own thoughts and concerns and their potential for change (Inayatullah, 2009). As recently expressed in Chapter one, scenario planning is utilized to create alternative futures. Inayatullah (2015) states that the twofold factor scenario planning technique is excellent for strategy improvement. This technique is utilized to lay out key vulnerabilities dependent on the CLA results in this study. This is to reveal the present and establish the range of uncertainty. The uncertainties recognized can, therefore, provide the basis of four possible futures.

2.3 Conclusion of chapter 2

As the world turns out to be progressively different and as occasions from distant places drastically sway on how, where, when, why and with whom we live and work, future studies can assist us with recovering our agency (Inayatullah, 2009). Through mapping of the past, present and future, the assumption of future issues and their results, consideration of grand patterns of change, deepening our examination to incorporate worldview, metaphors and myths, formation of alternative futures and the selection of a favoured route forward, the world we aspire to live in is created.

The study assumes that an optimistic future can be formed. It focuses on examination and mapping of different alternatives to improve uncertainty planning. The industry needs to establish a scope of adjustment and alternatives accessible, and figure out the outcomes of sure decisions in forming the ideal world, in which they aspire to flourish. It is from this explanation that this research disclosure uses the six pillar approach to deepen and unpack the future of automation technologies (Pillar 5), while fortifying and supporting the improvement of more grounded research disclosure.

2.4 Chapter that follows

The chapter that follows is on literature review.

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

The previous chapter dealt with research methodology. This chapter reviews literature on the impact of automation technology on the workplace. This is achieved by discussing matters relating to effects of automation technologies on the workforce. This addresses factors affecting the adoption of automation technologies and relativity of education and training in automation effected environment.

According to Efretuei (2005), literature reviews for any scientific investigation are to conduct in-depth evaluation of existing literature that depicts direct relevance to the objective of the study, to relate and assess the present status of knowledge in the subject sub-field, and distinguish irregularities and gaps to legitimize a specific object of an academic inquiry. This chapter takes an in-depth exploration of the following:

i. Definition of literature review;
ii. The necessity of review of literature for this study;
iii. Steps followed in literature review;
iv. Literature used for the study;
v. Sources of literature used for this study;

3.1.1. Definition of literature review

According to Smit (2018), literature review can be defined as the selection of available documents both published and unpublished on the topic; these contain information, ideas, data and evidence written from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and effective evaluation of these documents in relation to the research being proposed The necessity of literature review is discussed hereunder.

3.1.2. The necessity of literature review

Creswell and Plano Clark (2018) declare that in an academic research, literature study needs to be engaged in for the researcher to understand different research practices in the field being studied. This study embarked on a literature review aimed at

contributing towards a clearer understanding of the nature and meaning of the problem that has been identified (De Vos *et al.,* 2018).

Therefore, some background information obtained mainly from what has been published as relevant to the research topic was conducted by the researcher as part of the review of literature. This was followed by acquainting with models that were deemed necessary for this study. In order to conceive the topic of this study, guidelines for the review of literature as presented by Bless, Higson-Smith and Sithole (2018), Marshall and Rossman (2016) and Vithal and Jansen (2010), were followed in order to: demonstrate mastery of literature in the field, discuss the proposed study in relation to the current, lay the foundation for this research, offer a syndissertation of what has already been written on the topic, examine what has been written on the topic, show that the researcher has identified some gaps in previous research and that the proposed study will fill a demonstrated need, place the study in context and identify gaps in knowledge as well as weaknesses in previous studies. This implies determining what has already been done and what is yet to be studied or improved.

3.1.3. Steps in conducting literature review

Steps suggested by De Vos *et al.* (2018) were followed by the researcher in the execution of the literature review for this study. Only relevant sources of literature were cited and commented upon. These were grouped into different categories related to particular variables and included subheadings. Other types of background information were also presented (Bless *et al.,* 2018).

In conducting this study's literature review the three broad issues were kept in mind: the purpose of the review, literature sources, and reviewing techniques (Bless *et al.,* 2018). The four steps involved in conducting literature review, according to Kumar (2018) include:

(1) Step 1 in conducting a literature review: Searching for existing literature in the area of study;

(2) Step 2 in conducting a literature review: Reviewing the literature selected;

(3) Step 3 in conducting a literature review: Developing a theoretical framework; and

(4) Step 4 in conducting a literarture review: Developing a conceptual framework.

Since literature review provides a theory base, a survey of published work and journals that pertain to the topic being researched (Nontshokweni, 2011), the researcher engaged in literature review to gain an overarching understanding of the research around the topic being researched.

3.1.4 Literature used for the study

Walliman (2006) is of the view that the researcher should be able to obtain the information required to complete the research. Kumar (2018) strongly supports this point by clarifying that if the researcher's topic entails collection of information from secondary sources, the researcher should ensure that data required is available in the required format before finalising the research topic. Both writers' views were taken into consideration by the researcher before embarking on this study. This was done by collecting as much information as possible from different sources.

3.1.5 Sources of literature

According to Mouton (2001), literature review refers to scrutiny of all relevant sources of information. However, not every source of data qualified for inclusion in the literature. Only credible sources that provide data on the research question and about the research problem that enabled the researcher to draw conclusions were used in this study (De Vos *et al.,* 2018).

Mouton (2001) and Neuman (2014) recommended that most relevant sources can be reduced to the following in order of credibility and scientific verification. Taking this recommendation, the researcher's literature review considered definitions and elaborations of learning environments because these definitions provided the basis for this study. The researcher used secondary sources such as books, dissertations and theses, policy documents, government documents, internet, journals and articles. More on secondary sources is in Chapter 2.

3.2 Automation

The Britannica Encyclopedia (2020) defines automation as use of machines on assignments once performed by individuals or, progressively, on tasks that would be impossible in any other form. In spite of the fact that the term *mechanisation* is regularly used to refer to basic substitution of human work by machines, automation generally implies the integration of machines into a self-governing system. Frey and Osborne (2013) explain similarly by defining automation as technology concerned with the application of electronic, mechanical or computerised system to control and operate production. Frohm (2008) confirms that the definition of automation focuses on the integration of machine/human interaction; therefore, automation can be defined as a self-regulated process that utilises programmable machines to conduct a series of tasks. The difference between automation and mechanisation is that mechanisation only introduces a machine to a process, whereas automation goes further by controlling the behaviour of process machines (Kamaruddin, Mohammad & Mahbub, 2016).

3.2.1 Automation technologies

Current developments in automation are becoming more elaborate and are having a major effect on the workforce. Technological innovation in areas such as Robots, algorithms, 3-d printing and machine-to-machine communication have the ability transform labour and business practises (Kuder, Kaye, Zimmerman, Abhishek, Satymurthy, Krishnamurthy & Madupali, 2017).

Table 3.1 hereunder presents a list of some of the most recent technological advancements in operation that facilitate the automation of a variety of work activities.

Table 3.1: *List of automation technologies*

Artificial intelligence	Artificial Intelligence (AI) is a computer science that specialises in development of computer systems that display intelligence.	
	Machine learning	AI specialising in advancing systems that have the ability to learn. i.e., systems are trained to perform functions rather than programmed.
	Supervised learning	AI that programs a computer system to respond to interaction by giving a set of test input and wanted yield sets.
	Transfer learning	AI that creates systems that collect information acquired while addressing an issue and relating it to an alternate but related issue.
	Reinforcement learning	Subfield of machine learning creating systems programmed to receive simulated rewards or punishments for behaviour rather than supervised learning on correct input-output pairs.
	Cognitive computing	Alternative word for AI.
Neural networks	**Artificial neural network**	AI systems based on re-enacting connected “neural units,” loosely modelling neurons interaction of the brain.
	Deep learning	Use of neural networks that have many layers (“deep”) of a large number (millions) of artificial neurons.
	Convolutional neural network	Artificial neural networks in which the connections between neural layers are inspired by the organisation of the animal visual cortex, the portion of the brain that processes images, well suited for perceptual tasks.

	Recurrent neural network	Artificial neural networks whose connections between neurons include loops well-suited for processing sequences of inputs. It is a system based on recurrent neural.
Robotics	**Soft robotics**	Robots constructed from deformable, soft materials that can change items of varying shape, weight and size with a single device.
	Swarm robotics	Synchronised multi-robot systems, normally comprising large numbers of robots
	Tactile/touch robotics	Robotic limbs with ability to touch, sense, have dexterity and perform a variety of tasks.
	Serpentine robots	Serpentine looking robots with many internal degrees of freedom to freely thread through compact areas.
	Humanoid robots	Robots built to resemble human beings that incorporate a range of technologies and are able to perform a different human tasks.
Automation product categories	**Autonomous cars and trucks**	Unmanned wheeled vehicles capable of operating without a human driver automatically and remotely.
	Unmanned aerial vehicles	Flying vehicles with ability function without a human pilot.
	Chatbots	AI systems developed to re-enact conversation with human users, particularly those integrated into messaging apps.
	Robotic process automation	Class of software “robots” that copies actions of a human being interacting with user interfaces of other software systems. Enables the

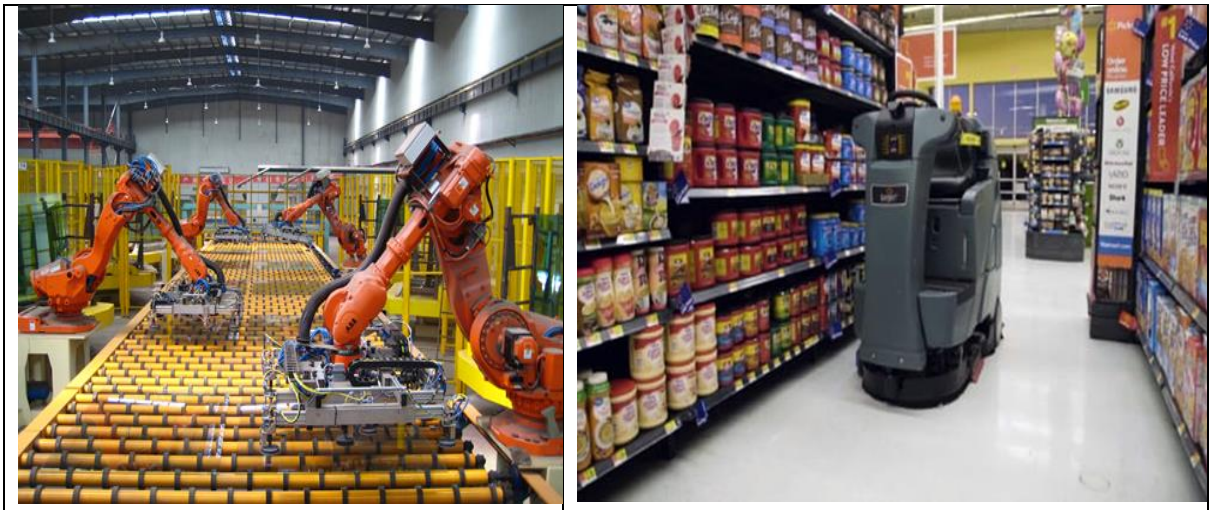
		automation of many “backoffice” (e.g., finance, human resources) workflows without requiring expensive IT integration. For example, many workflows simply require data to be transferred from one system to another.

Source: (Manyika, et al. 2017**)**

The list of automation technologies grows every day. Current developments in artificial intelligence, robotics and algorithms allow for automation in cognitive activities, intruding on areas previously assumed to require human experience and judgement (Manyika, et al. 2017).

The images below present examples of automation technologies replacing human labour in various sectors.

Figure 3.1: *Automation technologies performing work activities in manufacturing and retail industries*



(Source: https://thecanvasartgallery.com/shutterstock-image/automation-587205803/)

Figure 3.2: *Automation technologies performing work activities in agriculture and service industries.*

(Source: https://www.cgdev.org/publication/automation-and-ai-implications)

3.2 Impact of automation on employment

Smith and Anderson (2014) conducted a study investigating possible effects of emerging technologies on employment. The results revealed that 48% of the sample foresees a future where technology replaces a number of both white and blue collar occupations, with many concerned that this may contribute towards to rise in unemployment and inequality, thus leading to collapse in social order (Smith & Anderson, 2014).

The concern over technological innovations displacing and destroying jobs is hardly a recent phenomenon. Some of the early examples can be traced to the Luddite movement experienced during the Industrial revolution where textile mill workers destroyed automated loom machines in protest against the automation of textile production, which they feared would endanger their livelihoods (Manyika, Lund, Chui, Bughin, Woetzel, Batra, Ko, & Sanghvi, 2017). Employment losses and displacement from technological advances have proven to be an integral effecting productivity in the economic process. For example, as technology replaces human labour, growth is generated through enhancement of skills of the remaining labour force and allocation of liberated resources into new income activities. However, previously, workers could transfer from one routine job to another in a different industry, but this option may no

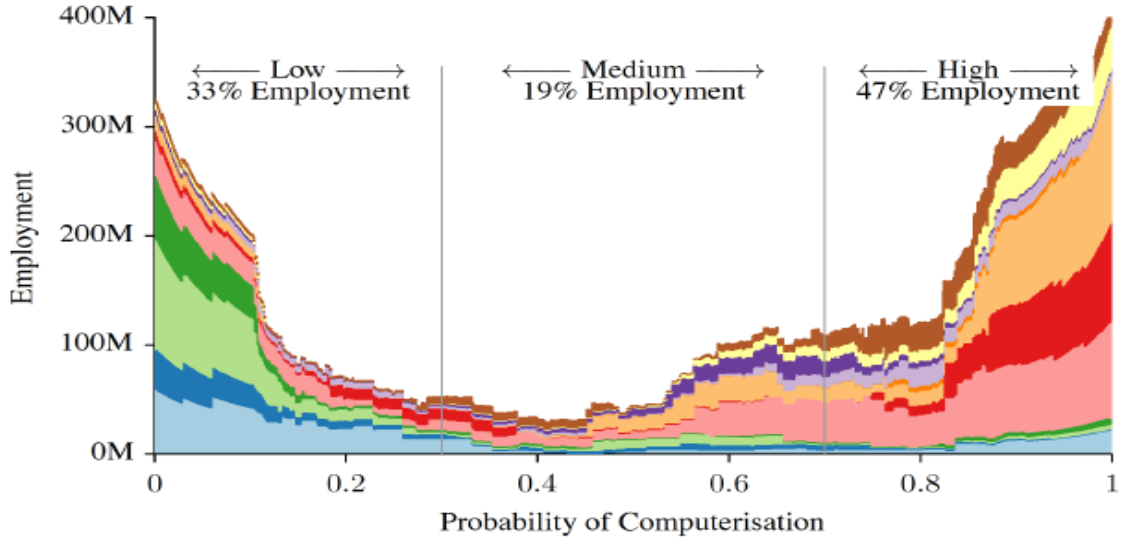
longer be available in the future as these alternatives will also be automated (Hirsch-Kreinsen, 2016).

Wisskirchen et al (2017) issue an equally strong warning and argue that as technology accelerates, machine automation may ultimately penetrate the economy to the extent that wages no longer provide the bulk of consumers with adequate discretionary income and confidence in the future. If this issue is not addressed, the result will be a downward economic spiral. Wisskirchen et al (2017) warn that at some point in the future, machines will be able to do jobs of a large percentage of the 'average' people in our population, and people will not be able to find new jobs.

The acceleration of automation technologies may eventually disturb the economy to the point where salaries and wages will no longer provide consumers with sufficient income, resulting in a downward economic spiral (West, 2015). West (2015) further warns that if machines perform jobs of a large percentage of the population, these individuals will not be able to get alternative employment.

A study on how susceptible jobs are to computerisation was conducted by Frey and Osborne (2013) who studied the probability of computerisation of 702 occupations in the United States. The results revealed that just below 50% of total US occupations was at risk of computerisation and that educational and wages attainment shows a negative relationship with the occupations' probability of computerisation (Arntz, Gregory & Zierahn, 2016).

Figure 3.3: *Probability of employment computerisation in the USA*



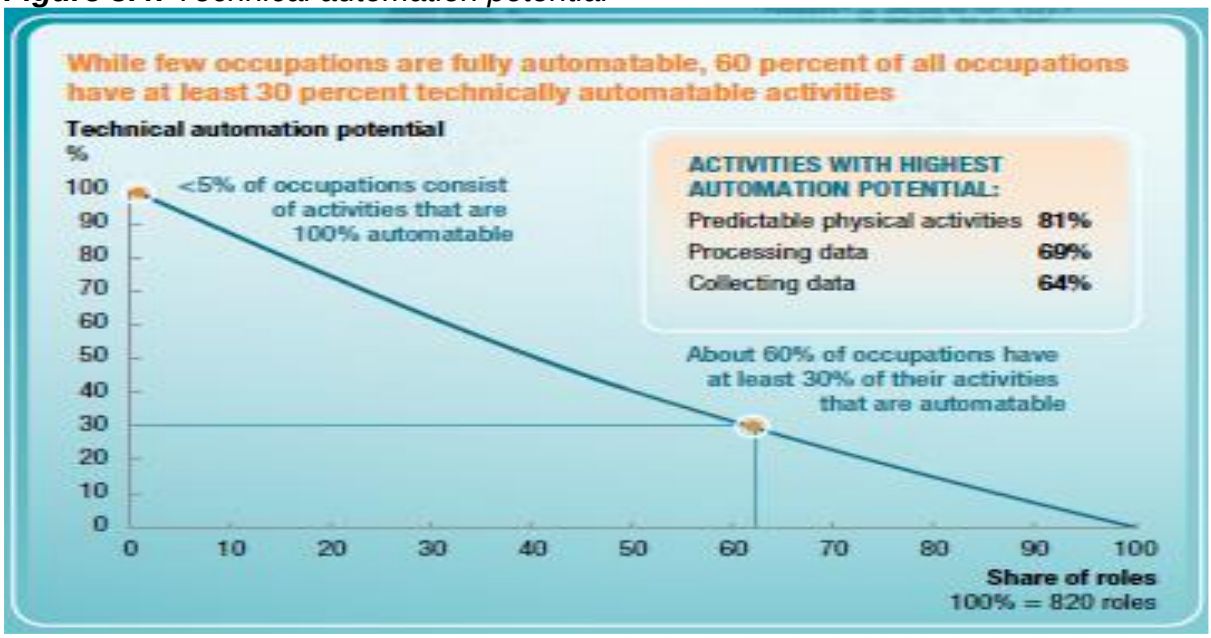
Source: Frey and Osborne (2013)

The analysis by Frey and Osborne (2013) reveals that occupations such as library technicians, tax preparers, account clerks, insurance underwriters, watch repairs, cargo agents, telemarketers, title examiners, mathematical technicians, hand sewers, data-entry specialists and photographic process workers have a near 100 percent probability of having their jobs computerised. On the other hand, occupations such as occupational therapists, mechanic supervisors, mental health social workers, recreational therapists, oral surgeons, dieticians, emergency management directors, audiologists and health care social workers have a less than 1 percent probability of having their occupations computerised. Their analysis was based on the educational requirements of different fields and improving levels of computerisation and wage levels (Arntz, Gregory & Zierahn, 2016). However, authors such as Deker (2017) believe such assessments exaggerate the potential negative side effects of automation by putting emphasis on the physicality of substituting labour by capital. Therefore, they overlook economic aspects (Decker, Fischer, & Ott, 2017a).

A recent study conducted by Mckinsey Global Institute (2018) estimates that sixty percent of occupations will have, at least, thirty percent of their related activities automated by the year 2030 (Mckinsey Global Institute, 2018). The study further estimated potential work displacement at 15% and occupational shifting between 3 to 14 percent. Thus, while there may be new opportunities created to compensate for redundancy due to technological advancement, the fulfillment of these opportunities

is dependent upon guaranteeing that workers can and will be willing to transfer to these newly created opportunities (Manyika et al., 2017).

Figure 3.4: *Technical automation potential*



Source: (Manyika et al., 2017)

Figure 3.4 above illustrates an instance whereby there was an expected decrease in unemployment in an industry (weaving industry) due to automation; instead, the opposite happened, and the number of jobs increased against the expected decline. The introduction of automation in this industry decreased the price of cloth, and thereafter increased demand, resulting in employment growth in spite of the less labour-intensive technology (Bessen, 2018). Similar incidences have also been observed in France, whereby growing dependence on the internet and computers was said to have caused an approximate 500 000 job losses in different occupations within 15 years, yet conversely, it was responsible for the creation of an estimated 1.2 million direct and indirect jobs (Manyika et al., 2017).

One of the reasons presented forward to explain the increase in labour due to automation is that automation creates a demand for new tasks and occupations associated with the automation system and largely creating employment within the automation sector. Therefore, though automation might cause work displacement in labour intensive sectors, the automation system will bring spinoffs such as jobs of its own that will, in the long run, even out the initial job losses. In the future, work will be

transformed but human interaction will still be required to manage the digital world (Bessen, 2018).

This leads to follow-up questions such as whether the automation of work activities will decrease the workforce, or the leftover, remaining tasks will be broken down and shared among the remaining workforce. Decker et al. (2017a) answer this question by stating that this is dependent on the distribution of work in the stated workplace and on whether duties that are not easily automatable can be pooled together to create a new job.

Fleming, Clarke, Das, Phongthiengtham and Reddy (2019) state that the automation of work activities should not present an 'all or nothing" scenario in the workplace. They point towards work-sharing arrangements that were implemented in some countries during the recent global financial crisis as a plausible solution. At the moment, automation does not seem to have led to a significant increase in unemployment (Fleming *et al*., 2019).

Given uncertainties surrounding employment predictions, it is not surprising that academics offer contradicting views over the effect of technologies advancement. For instance, Brynjolfsson and McAfee (2014) contend that technology is delivering significant changes in the labour force. As a result of these uncertainties, some scholars are in disagreement over the lasting effects of new, emerging technologies. These scholars maintain that, *"technological progress is going to leave behind some people, perhaps even a lot of people, as it races ahead."* They stress that workers in the present day need to possess distinct skills or the right education to be of value in their workplaces and that workers with regular skills and aptitudes will be worse off because robots, computers, and other digital technologies are obtaining human like skills and abilities (Brynjolfsson & McAfee, 2014).

Bessen (2018) expresses reservations that automation could lead to unexpected changes in total employment. Similarly, Freeman (2017) is sceptical that technological advancements would disrupt a large number of sectors to explain recent job numbers.

Gordon (2017) is even more sceptical about the adverse effects of automation on employment. He argues that recent progress in automation and computing is not as transformative as cars, wireless communication, electrification and perhaps even

indoor plumbing. He further states that advances that enabled people to effectively travel rapidly over long distances and improve communication will be more significant to society's advancement. Gordon (2017), therefore, does not expect major effects on the labour force from emerging technologies even though many other experts have observed the substitution of technology for labour.

3.3 Factors affecting the adoption of automation technologies

Embracing and adoption of automation technologies is born out of various choices; most common is the weighing of positives and negatives of integrating automation technology in the workplace (Salim, 2018). There are theoretical models and frameworks that have been created to determine the outcomes of automation technologies adoption. The Technology Acceptance Model (TAM) developed by Rodgers (1983) introduces factors that result in implementation of new technologies (Woodside & LaPlaca, 2014).

Del Aguila-Obra and Padilla-Meléndez (2006) further added to the TAM framework and established that the adoption of new technologies is influenced by internal and external factors. They further identified internal factors as: culture, innovation, management and human capital in an organisation. External factors include: the role of government, competition and the image of the new technologies to companies (Salim, 2018). The findings of Del Aguila-Obra and Padilla-Meléndez are further supported by El-Gohary, (2012) asserting that adoption decisions of new technologies are affected by both external and internal factors.

3.5.1 Internal factors

3.5.1.1 Culture

The term *culture* is defined as preferences, rituals, values, assumptions, beliefs, skills, knowledge and behaviours common within a specific social group of society (Woodside & LaPlaca, 2014). In recent years, academics have recognised the relationship between corporate culture and successful implementation of automation technologies. In many instances, corporate culture has been cited as a hindrance in the implementation of automation technologies. Corporate culture has long been described as shared practices, beliefs and values that members of an organisation

have jointly built up together (Salim, 2018). Kamaruddin *et al* (2016) stated that organisational decisions are greatly influenced by its decisions of the past, thus contemplation of new technologies adoption can be dependent on the decisions taken in the past. The introduction of new technology is likely to be considered only if other technology were previously introduced beforehand. Therefore, organisations that embrace change management have a high possibility of the acceptance of new technology (Salim, 2018). In this respect, the culture within a workplace has some influence on the successful adoption and implementation of new technologies.

3.5.1.2 Innovation

Innovation plays a vital role in adoption of new technologies (Decker *et al*, 2017a). Corporations are utilising innovation as a competitive advantage to remain ahead of competitors. Rogers (2003) identifies innovation as a systematic approach to dealing with new ideas from conception, adoption and execution, leading to the development of different products and enhancement of the production methods. Authors such as Bellgran and Säfsten (2010) identified innovation as the constant improvement of productivity and operation processes leading to enhanced productivity. Innovation in an organisation is greatly influenced by the creativity of the organisation its members (as it involves creation of ideas that enhance new products and production processes.

3.5.1.3 Management

Management can also be identified as a hindrance to the adoption of new technology (Edensor, 2015). Mapulanga and Saladi (2016) stated that managers displayed a fear of new technologies and concluded that the managerial approach to automation technologies has an effect on the adopting innovative technologies (Mapulanga & Saladi, 2016). Management carries the responsibility to define and implement organisational goals. Organisational goals must be visibly supported by top management as this will influence adoption of new technologies (Millington, 2017). Management should articulate a clear vision and strategy, about the organisation’s operational procedures, including how to effectively communicate the adoption of new technologies and how employees will be skilled and trained (Mapulanga & Saladi 2016).

Management should consider automation policies or strategies as part of adopting and implementing automation technologies (Decker, et al., 2017a). When an organisation has an automation strategy, management will be in a position to evaluate their investment on automation. Successful automation technologies are usually made in tandem with an organisation's long-term goals and taking into consideration the manufacturing strategy, along with its current production capacity (Mapulanga & Saladi, 2016).

3.5.1.5 Human capital

Human capital can be defined as skills and knowledge acquired by individuals from investments in on-the-job-training, education and other experiential exposure (Salim, 2018). Venter (2014) identifies training and education as key components of human capital as they assist in the acquisition of knowledge that provides skills that are functional to the workforce. From this view, it is important to carefully consider first level operational employees in the organisation as in most cases, they interact more regularly with automation technologies (Faed, Alireza, Radmand, Pedram, Talevski, Alex, 2010). Capabilities of the workers to handle new technology must be given much consideration when adopting new technology. The possibility of adopting new technology in an organisation is reliant on management having confidence in capabilities of the labour force (Ariss, Sonny, Raghunathan, Kunnathar, Anand, 2000).

Another factor to be considered is the response of the workforce in relation to the new technology, for example, if the new technology is perceived to result in job losses or creation of new employment opportunities (Blasi & Puig, 2002). At this point, communication and relations between management and workforce become vital. If poor relationships exists, there may be resistance in the adoption of new technology. This type of resistance from employees results from many factors such as expected work displacement, losing of status, poor organisation climate and loss of power (Edensor, 2015).

3.5.2 External factors

3.5.2.1 Country laws and regulation

Countries have a great influence on introducing new technologies within their borders through passing of relevant laws and policies (Maluleke, 2017). Government laws can affect utilisation of new technologies in areas such as insurance, environment, market structure, etc. Regulations carry a direct impact on the utilisation and adoption of most technologies, and regulations can allow or prohibit utilisation of certain technologies or production methods (Maluleke, 2017). For example, if a law is passed on environmental regulations, then pollution-saving technologies will be adopted within the country and subsequently, many industries will receive incentives for new innovative technologies that will be specifically invented and designed to reduce pollution (Mapulanga & Saladi, 2016).

Government laws can influence utilization of new advancements in regions, for example, market structure, environment, insurance etc. Regulations on the environment directly affect utilization and selection of some technologies; some regulations will prohibit or advocate for use of specific technology or production method (Hall & Khan, 2004). For instance, if a law is passed on environmental regulations, then pollution-saving technologies will be embraced within the country; subsequently, many industries will receive investments in new technologies explicitly intended to create less pollution (Mapulanga & Saladi, 2016).

3.5.2.4 Competition

The global consumer market has grown more competitive than ever before, and companies have to increase their performance output through adoption of innovative production process and product development methods through automation. This has led to enhanced productivity and creation of a sustainable competitive advantage for organisations (Tait, McKetin, Kay-Lambkin, Carron-Arthur, Bennett, Christensen & Griffiths, 2015). With automation becoming a competitive advantage, it is now viewed as a decisive factor of whether a company can be competitive or not. Automation has the added advantage of being more cost-effective and as such, reduces the cost of

products, thereby making the company more competitive (Yan, Li, Chen, Zhong, Li, Jiang, & He, 2015).

3.4 Automation, training and education

The impact of automation requires a review of the current educational system. Eichhorst (2017) identifies education as a vital area of public policy and investment in human capital imperative in job creation and productivity in the future. Authors such as Ivanov and Webster (2017) identify the need to provide potential labour with means to improve their knowledge and skills levels to meet the changing developments of technology (Ivanov & Webster, 2017). Job-holders also share this insight. The Pew Research Centre conducted a study in 2016 on the state of American jobs. It found that 87% of workers felt it is important to obtain new skills throughout their careers to keep up with technological changes affecting the workplace. Jobholders further identified the need to bring about change that will better suit the developing technological scope in the content and format of education (Chang, Rynhart & Huynh, 2016).

A study conducted by Asatiani, Penttinen (2016) 1.1 million students found that 286 000 students are in programs that will not exist in the future (Asatiani & Penttinen 2016). The study further identified uncertainty around the required skills of the future. The World Economic Forum (2015) confirms this uncertainty identifying changes of work techniques, as well as the balance between industries as factors making it difficult to predict skills needs (World Economic Forum, 2015).

The argument is that if characteristics of an automation resistant occupation require human emotion, non-repetitiveness and ambiguity, we need to strongly develop skills that fit these occupations. Academic curricula should be structured to encourage creativity and experiential learning accompanied by digital development literacy and computer science learning (West, 2015).

3.6.1 Designing a future-ready curriculum

A curriculum can be defined as a design or planning of an institution or country that encompasses a wide variety of meaning that covers the entire planned programme. The development of a curriculum must consist of at least implementing strategies, content, aims and a method of assessment that requires empirical data through academic research studies (Siraj & Abdullah, 2011).

The investment in human capital must aim to not only develop skills needed for the present, but also skills that will be needed to leverage technological advances of the future. The development of such future skills requires encouragement of creativity, critical thinking, emotional intelligence, cognitive flexibility as opposed to rote learning with a view to match the way people will increasingly work (Samans & Zahidi, 2017)

In 2014, Emory University developed a degree programme mixing statistics and maths with traditional liberal arts subjects. Emory University argues that the developing world of technology requires graduates to obtain enhanced data management skills to improve their chances of employment. Denison and Dartmouth University have also developed similar programs of mixing traditional liberal arts and data science (Ivanov & Webster, 2017). Authors such as Hooley and Borbély-Pecze (2018) agree to this approach, identifying the importance of technology supporting a curriculum with a blend of Science, Technology, Engineering and Maths (STEM) disciplines.

Although not everyone can be an engineer or data scientist, employers are increasingly expecting many job opportunities to require basic and more advanced STEM literacy. Therefore, much is to be gained by increasing the overall future-readiness in the STEM field (Samans & Zahidi, 2017).

Integrative approaches, for example, STEM may better mirror the adaptable reasoning and transdisciplinary nature of genuine problems, real-life problem-solving and enhanced student participation by giving them various approaches to engage in STEM learning (Subotnik, Tai, Rickoff, & Almarode, 2010). For integration to succeed, suitable educator preparation is expected to plan instructive practices that work and successfully react to requirements of individual students (Freeman, 2017). The

association between STEM qualifications and occupations may be looser than often recommended; current evidence identifies numerous pathways towards STEM occupations other than STEM qualifications (National Science Board, 2015).

Fitzgerald (2014) argues that humanities studies are equally as important as STEM disciplines, and that humanities studies assist graduates to gain cultural perspective, critical thinking and communication skills. These are skills that are not easily automated (Fitzgerald, 2014).

van Deursen, Helsper & Eynon, (2016) investigated digital skills required to navigate the changing world of automation technology. The results showed that focus on creative, social, operational and information navigation skills would serve as a good starting point in rethinking education programmes.

Aoun (2017) promotes a model of learning, termed “humanics” which has an emphasis on the following aptitudes:

- Experiential learning: Helps improve the competitive human edge. The application of knowledge to unique, real world situations;
- Human literacy skills: Enhancing skills such as creativity, communication problem solving, conflict resolution, and the ability to working in groups and teams; and
- Lifelong learning: Creating a growth mindset through promoting re-learning and advancement of knowledge on an ongoing basis.

Aoun (2017) further advocates that to attain the correct alignment between technology and employment, collaboration between the government, institutions of higher learning and industry are necessary. Such collaborations are useful and necessary to develop less costly and adaptable programmes that speak to current demands of industry. An example of this would be offering accredited programmes endorsed by industry (Pieterson, Ebbers & Madsen 2017).

Such inter-sectorial collaboration is necessary to ensure that businesses and economies are adapting to the changing business environment while employee skills remain relevant and competitive (Ivanov & Webster, 2017).

3.7 COVID-19 and the Future of Work

COVID-19 is a severe acute respiratory syndrome caused by the SARS-CoV-2 virus. Covid-19 is easily transmissible and exerts extreme pressure on the healthcare system because of its high infection rate. As of February 2020, the World Health Organization (WHO) declared Covid-19 a global pandemic (World Health Organization, 2020).

The COVID-19 pandemic is an unprecedented global health pandemic that has led to losses in economic activity and employment. Due to the contagious nature of the COVID-19 virus, the pandemic is contributing to accelerated adoption and deployment of automation technologies. This acceleration could move across sectors and cause disruptions in employment (World Bank, 2020).

The International Monetary Fund (2019) estimated that the economy will contract by 2.7 percent in 2020, and global unemployment is expected to rise to 5.8 percent.

Figure 3.5: APEC GDP growth 2000 -2020

Source: International Monetary Fund (2019)

In order to better navigate the possible economic scenarios where pandemic-related unemployment levels are influenced by organisational decisions to automate, there is a need to develop a deeper understanding of underlying factors that contribute to the adoption of automation technologies during and after the pandemic.

3.6 Conclusion of Chapter 3

Literature review was aimed to investigate automation technologies and the impact on employment. This was conducted through investigating current automation innovations, impact of automation technologies on the employment, factors affecting adoption of automation technologies and skill requirements. The literature presented a different view to traditional job losses anticipation, but one where automation creates employment and business. Pandemic-related unemployment levels are compounded by decisions to avoid contact human (social distancing), thus opting to automate. Literature has also identified a need to review education and training requirements through obtaining a balance between arts, data science and lifelong learning to enable employees to meet changing advances in technology to remain employable in automation affected environments.

3.7 Chapter that follows

An analysis of the ideal, realisable future of automation technology and how this affects employment is undertaken in the next chapter. This chapter utilizes futures methodologies to identify these factors and their impact on employment and makes practical recommendations for stakeholders.

CHAPTER 4: EFFECT OF AUTOMATION TECHNOLOGY ON EMPLOYMENT: PATH TO THE FUTURE

4.1 Introduction

Chapter three reviewed literature. In the current chapter, an in-depth analysis of automation technologies and how they affect employment is conducted. The six pillars approach is designed to assist people to question, map, anticipate, deepen and create alternatives to transform the present to a future that they envision (Inayatullah, 2015), and this is applied to establish the effect of automation technologies on employment.

4.2 Mapping the future: Futures Triangle

The mapping of the future is identified as the collection, collation and summarizing available information, including trends and expected developments, which ultimately results in the creation of foresight knowledge (Horton, 1999). Lindgren and Bandhold, (2009b) support this by calling it the 'tracking'' stage due to how it tracks progressions within an environment that may affect the focal inquiry concerning the identification of drivers, trends and uncertainties that should be considered since they impact the focal inquiry.

In this study, the Futures Triangle is utilised to map today's view on the impact of automation on employment through three dimensions: the images of the future, pushes of the present and weights. Inayatullah (2015) identifies five standard images of future:

1. **Evolution and progress:** The belief of rationality that considers humankind as the centre of the universe;
2. **Collapse:** The belief that limits of mankind have been met, and collapse in inevitable, basically going towards a worsening future;
3. **Gaia:** The belief that the world is a garden requiring social advances to fix the harm caused to an individual, other people and nature, turning out to be increasingly more comprehensive to what is significant. Partnerships between people of both genders, humans and nature and humans and technology are coming evolutionary milestones;

4. **Globalism:** Barriers between cultures and nations could be eradicated once the world moves to an unrestricted economy system. Free progression of capital and technology can carry wealth to all. Conventionalisms and creeds are obstructions preventing people from achieving a new world; and
5. **Back to the future:** The belief is that change is overwhelming, and there is a need to re-visit simpler times, when rules and hierarchy were more clear, and technological innovations were less destructive.

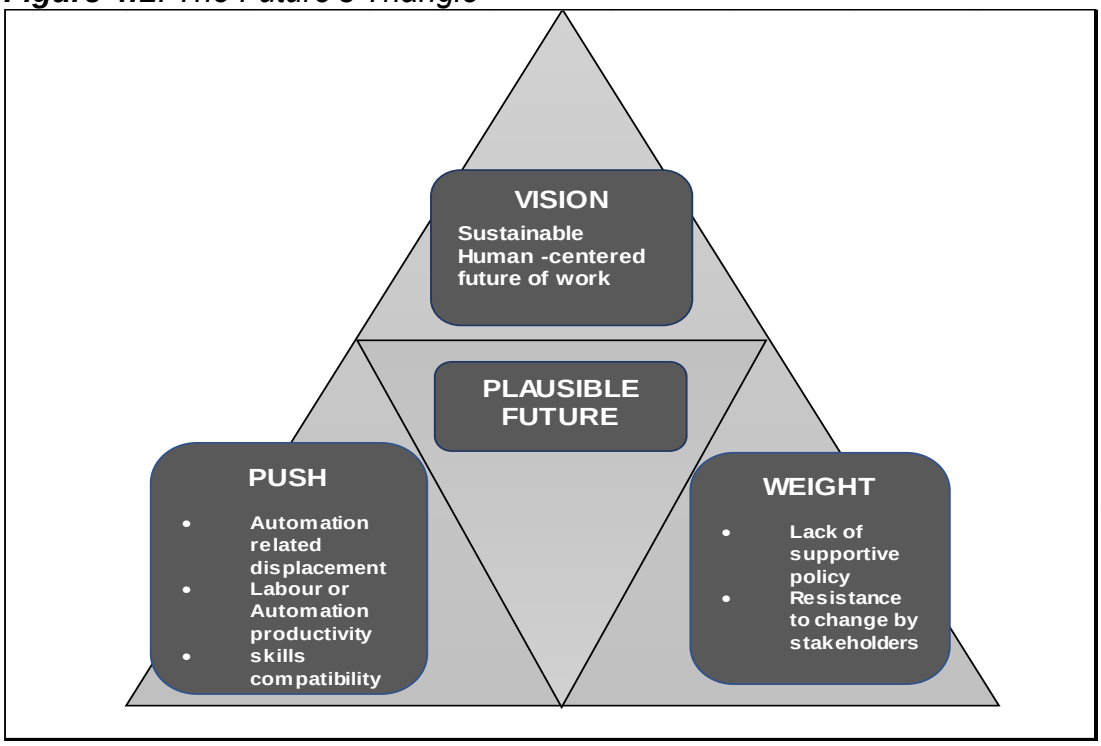
Inayatullah (2015) also refers to trends and drivers that influence the future, together with barriers hindering attainment of the preferred change. This study considered the image of the future of work, as contained under Goal 8 in the United Nations 2030 Agenda for Sustainable Development, which goes thus:

*"**Goal 8**: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all"*

Goal 8 of the Sustainable development agenda 2030 recognises the importance of sustained economic growth and high levels of economic productivity the creation of well-paid quality jobs, as well as resource efficiency in consumption and production. It calls for providing opportunities for full employment and decent work for all while eradicating forced labour, human trafficking and child labour, and promoting labour rights and safe and secure working environments (UN, 2015).

Figure 4:1 portrays the Futures Triangle utilised to map today's view on the impact of automation on employment through three dimensions: the images of the future; pushes of the present and weights of the past.

***Figure 4:1**: The Future's Triangle*



Source: Adapted from Inayatullah (2008)

In additional to the Futures Triangle, an **environmental scanning** of factors affecting automation and employment will be performed to detect present forces, exposing some of the vital trends and drivers that exist and may have an impact on future employment. Vudzijena (2015) defines environmental scanning as monitoring, evaluating and disseminating information for strategic or tactical purposes. This is further supported by Albright (2004) by describing environmental scanning as internal communication of external qualitative data about issues that may influence an organisation's decision-making process.

Cornish (2004) created the term "Great Transformation" identifying global interconnectedness and interlinking in changes in the environment, creating an all-inclusive transformation. Effects of interconnected global trends disrupting the commercial and economic landscape have been witnessed in the past. Global trends are the driving forces in cultural development that most likely impact the future in all aspects (Darrel & Larsen, 2006). These trends represent knowledge-plausible future. As such, mapping seeks to describe several plausible futures. Based on the weights and pushes of the futures triangle, it is important to identify some of these trends to

assist in mitigating and unpacking uncertainties and issues that shape automation and employment in future.

4.2.1 Productivity

One of the main advantages of technological/automation innovation is its progressive impact on productivity enhancement. Productivity can be explained as an increase in output achieved per unit of labour input (Kenton, 2019). Various studies (Brynjolfsson & McAfee, 2017; Frey & Osborne, 2013; Sabadash, 2013) conducted in different industries have consistently concluded that technological advancements in automation lead to increased productivity output. Effects of the relationship have not necessarily had any positive impact on labour since historical trends have witnessed technological progress (development of automated machinery), thus accounting for a decrease of over 80% and 60% in US steel and agriculture labour sectors, respectively (Rifkin, 1995). Such statistics have proven common in labour-intensive industries where the introduction of new technologies enabled corporations to increase productivity and economic gains (Sabadash, 2013).

Recent technological strides like the introduction of artificial intelligence has widened possibilities of technological progress with the ability to perform tasks previously believed to belong exclusively to human workers (Brynjolfsson & McAfee, 2014). However, the development of such technology is only a one-dimensional of the effects on labour. The knowledge centre definition of technological progress illustrates this point as it also considers the acquisition of new knowledge as a productivity-enhancing factor (Kenton, 2019). The knowledge centre definition argues that technical progress could still be possible without the inclusion of new updated technological products. For example, the implementation of a new production process could possibly unlock the ability to increase productivity while utilising the same labour and equipment input (Le Roux, 2018)

4.2.2 Displacement

Automation displacement refers to situations where technological developments in automation account for decrease in demand of labour or eradication of occupations (Salim, 2018). Such displacement has become a common trend with the introduction

and adoption of automation technologies throughout history (Le Roux, 2018). However, despite the number of global displacement, employment levels have relatively stayed constant (Maddaremmeng & Panennungi, 2015). Brynjolfsson and McAfee (2012) provided a reason for this, identifying that new technology may cause displacement but at the same time, new technology creates new labour markets. The balance between creation and destruction of labour demand should be maintained to ensure that labour levels stay unaffected by technological advances. Labour market information suggests that, in the course of history, the job-creation effect of technological progress has counter-balanced its job-destruction effect (Manyika et al., 2017).

Skills requirements

One of the key challenges of automation progress and employment is the uncertainty around skills requirements. There is a need to provide potential labour with the means to improve their knowledge and skill capabilities to meet the changing developments of automation technologies (Frontier Economics, 2018a). The introduction and adoption of new technologies increases the demand for certain skills while decreasing the demand for others (Maddaremmeng & Panennungi, 2015). This trend was experienced with the introduction of the industrial machinery in the US steel industry where the machinery decreased demand for human intensive labour but increased the demand for skills associated with maintenance, production and operations (Manyika et al., 2017).

The same was experienced with the introduction of Automated Teller Machine (ATM) in the late 1970s, where the demand for tellers decreased but the demand for marketing and service skills increased (Pethokoukis, 2016). What could be observed from both instances is that the demand, together with the incentives for low skilled labour, decreased while the demand and incentives for the technically oriented increased (Frey & Osborne, 2013). What is certain is that technological progress presents a skills challenge for the labour market. Workers will constantly need to update their skills sets to remain relevant in the labour market (Frontier Economics, 2018a).

4.2.3 Anticipating the future: Emerging issues analysis

In anticipating the future, data collected during the mapping phase is interpreted through an analysis of emerging issues and drivers to identify regions where social innovation begins (Inayatullah, 2008). The process seeks to identify issues before they become unwieldy and unmanageable and identify new opportunities and possibilities. As mentioned in the research methodology chapter, the objective of the research process is to respond to a few vital questions, important for the creation of foresight. These include: What can be done about it in the present? What are the issues that challenge the attainment of autonomous future? What does this all mean for the labour market? (Conway, 2015).

The following questions may be asked:

- How will workers whose jobs are automated transit to new opportunities?
- Why must individuals, organisation and governments consider automation technologies and their effect on employment and productivity?
- Are the current education systems effectively adapting to the developments in automation technology?

The international labour organisation global commission of 2019 investigated the future of work. The following were identified as key issues that need to be understood in order to construct different views of the future:

- **Economic:** Does the adoption of automation technologies contribute to economic growth? Can economic growth be achieved without the implementation of automation technologies?
- **Technology:** What are the new technological developments in automation? Will artificial intelligence ultimately result in complete automation? How can policy makers stimulate automation development?
- **Social contract:** How can social policy support automation affected employees? Can public funding be used to support the workforce? How can public policies protect employees through work transitions?
- **Labour market:** How will labour markets deal with rapid technological developments? Which occupation and tasks are more prone to automation?

Which occupations will be lost to automation? What type of new employment opportunities will be created? Will employees be willing to change occupations?

- **Human capital:** What type of skills will be required? Are education systems aligned with the changing technological environment? What are the necessary educational requirements? How can lifelong learning be achieved to skill, upskill and re-skill employees/workforce?

4.3 Timing the future

The third pillar includes looking for the patterns in history and recognizing every single one of the models of progress. This phase involves considering issues such as individuals' activities that have an effect on the future and the posibility of planning mitigation around such activities.

Inayatullah (2008) alludes to a few fundamental thoughts (detailed in Chapter 2) which are associated with timing the future. One of these thoughts are that there are key periods in mankind's history where actions and activities of a couple could bring about change. Established methods of behaviour are not effective during these periods. The world is most likely in this phase currently.

4.4 Deepening the future

Inayatullah (2008) defines CLA as a sophisticated method of categorising different concerns and views about the future, then uses these to assist groups to consider issues more effectively. Inayatullah further considers the CLA methodology as the method that attempts to deepen the future and develop transformative areas for the creation of alternative futures.

The CLA adopts four levels of analysis (Inayatullah, 2008).

Table 4.1: *Layers of the CLA*

Litany Layer	Representing data and usually acknowledged headlines of the way things ought to be.

Systemic layer	Concerned with social causes such as political and economic causes of the identified issue.
Worldview layer	Obtaining a deeper understanding on assumptions behind the issue as crucial as are efforts to review the challenge.
Metaphor layer	Represents the narrative and often the vehicles of myths

Source: Inayatullah (2008)

The table below reflects the application of CLA on identified issues confronting Automation technologies and employment:

Table 4.2: *Application of the CLA*

CLA level	Issue
Litany	Uncertainty about automation technologies' future effect on employment Uncertainty about future skills requirements
Systemic causes	Effects from loss of income and employment due to automation, legislation and regulations detrimental to adoption of automation technologies.
Worldview	Automation technologies are of critical importance to the economy as they improve quality, production and efficiency.
Myth / Metaphor	Automation brings about job losses and economic inequality.

Source: Inayatullah (2008)

At the litany level is the view of automation technologies as presently seen. The main issue put forth is the uncertainty regarding automation ultimately ending employment. This level represents quantitative trends and challenges that require minimal diagnostic abilities.

It is widely acknowledged that the dynamic nature of technological advancement negates our ability to accurately predict the future impact of any specific technology on labour demand (le Roux, 2018). This is especially applicable in the case of

Automation technology which, firstly, impacts labour requirements in diverse ways across industries and sectors and, secondly, continues to rapidly accelerate in both capacity and areas of application (Jaimovich & Henry, 2012). Recent studies have yielded different results to the effect of automation. Chang, Rynhart, Huynh and Phu (2016) estimate that close to 56% of jobs in Asia are at a risk of automation by 2036 (Ae-heeChang & Huynh, 2016). The World Bank (2017) predicted that over half the jobs in the developing world are at risk to automation (The World Bank, 2017). The McKinsey Global Institute (2017) estimated that close to 60 % of all occupations have at least 30% of activities that can be automated (Manyika et al., 2017). Results from Maddaremmeng and Panennungi (2015) found that an average of 9 per cent of jobs are at high risk of automation and 50% to 70% of jobs will have most of their tasks automated, transforming the very nature of the jobs.

What is evident from literature is that automation technologies will carry perpetual effect on employment. One of the major issues, therefore, remains: will employees affected by automation technologies be able to transit to new opportunities? Probable solutions proposed are:

- The development of effective and well targeted lifelong learning opportunities for re-skilling and up-skilling workers in sectors prone to automation; and
- Aligning educational systems to changing requirements brought by technological innovation and capacitate learners with skills that will enable them to take advantage of opportunities brought by automation.

At the systemic level, the challenge is uncertainty around the regulatory environment and loss of employment and income. It is broadly accepted that technological innovation is a critical driver of economic development. Utilisation and invention of new technologies is likely to be affected by different components that may include social, institutional and economic conditions (Crafts, 2010).

- **Economic Conditions**: An example of this can be in how the economic conditions of 18th century England led to the adoption of automation technologies in the first industrial revolution. Allen (2009) explained that low-energy costs against high-labour costs led to the development and adoption of automation technologies of the period;

- **Institutions:** Institutions that implement property rules, thus constraining power to the ruling class, may stimulate technological advancement, molding both the invention and dissemination of new technologies. Under these institutions, benefits from technological advancement gains would not only be extricated by the elites but could directly benefit broader society more than other institutions (Frontier Economics, 2018a); and

- **Social Factors**: The use of automation technologies not only affects the natue of work but also relationships between employees. Allen (2009) suggested that technological development is closely linked to social and technical factors. For example, choices around specific technical solutions depend on whether those solutions will be accepted by a relevant social groups (Allen, 2009);

The sytematic view is concerned with causes that affect society, these social causes include historical, legal and political factors, The proposed solutions at this stage are:

- Invesing on re-skilling of the workforce to create employment opportunities in other industries and formulating strategies to accommodate the imminent displacement of labour due automation in the industry; and

- Challenge resource governance structures to focus on long-term benefits that provide adequate labour protection, including tailored income support and re-employment assistance.

At the worldview and myth levels, automation brings about job losses and economic inequality. Recent adoption of automation in the manufacturing industry has been connected with rising unemployment levels for employess with a low and medium level formal education. Be that as it may, overall employment levels affected by industrial automation have regularly stayed consistent, as employment losses in the manufacturing sector were offset by rapid creation of employment in the service industry, thus leading to a rise in employment (Frontier Economics, 2018b).

Overall, the same was experienced with the introduction of ATMs as this provided bank tellers with more time to utilise on productive tasks such as individual customer service and marketing, leading to an overall increase in the demand of labour.

Employment opportunities are likely to be developed from the invention, maintenance and utilisation of automation technologies (Maddaremmeng & Panennungi, 2015). The third level relates to structure and its supporting worldview**,** while the level of metaphor represents deep stories, unconscious and often emotional dimensions of the dilemma or of the problem.

Proposed solutions at these levels include:

- Respond to a comprehensive, rational position of the creation of sustainable employment demand through development of lifelong requalification programmes reinforced by social policy; and
- Develop measures in support of income protection against automation, stressing the importance of creating sustainable re-employment and ultimate long-term contribution to the economy.

4.5 Creating alternatives

Inayatullah (2015) defines scenario-mapping as the most important method in this pillar. According to Inayatullah (2008), the future of the effects of automation on employment is extended during this phase, assisting in outlining what can be done to further enhance progress within an industry. The objective of this phase in creating alternatives is to apply the scenario method by studying probable scenarios to address key uncertainties of CLA outcomes. This is to enable persuasion of industry and policy to avoid undesirable futures and rather aim to achieve the ideal future. To investigate the main forces, basic vulnerabilities are utilized to outline the future landscape (Inayatullah, 2015). From the Futures Triangle and from emerging issues investigation, a range of situations can be inferred to introduce the ideal future (Inayatullah, 2015). As laid out in Chapter 2, the twofold varible strategy can be utilized by choosing two key factors or drivers. This technique is an excellent strategy development although it is important to debate these key variables (Inayatullah, 2015).

Bezold (2009) outlines four scenario archetypes; these are articulated as follows:

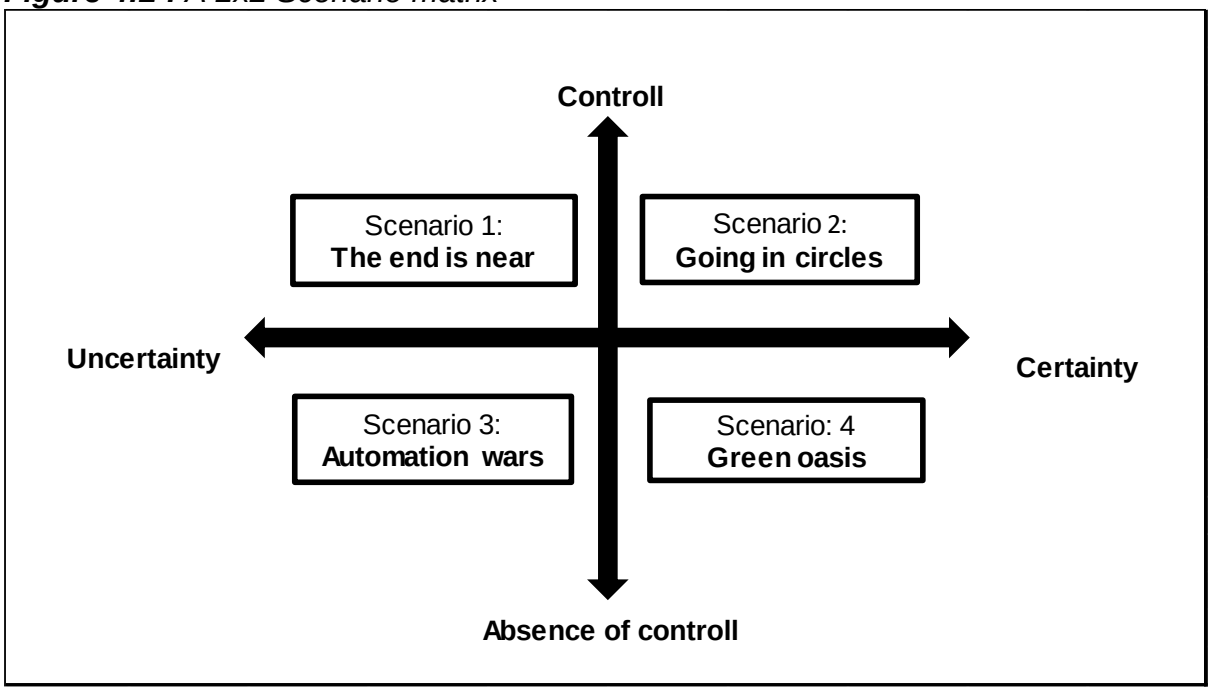
Table 4.3: *Four scenario archetypes*

Continued Growth	is where current conditions are enhanced. This is where employment rate is high, with a growing population, an increase in innovative technology and more products are developed. This is the official view of most countries where the economy is growing in all respects.
Collapse	emerges from failure to achieve continued growth, where contradictions between nature, technology, the economy are too sensitive and drastic. It should be mentioned that the scenario depicted should not portray the "worst case scenario".
Discipline	is where the future aims to achieve growth and strike a balance between the nature and economic activities. This usually arises when continued economic growth is considered to be unsustainable or undesirable.
Transformation	this is a future that looks to change fundamental assumptions of the other three scenarios. This stage centers around the transforming force of technology – especially advanced AI, space exploration and settlement, teleportation, unlimited energy sources, nanotechnology, and the rise of a "fantasy society" as a replacement to the "informative society". It envisions and invites the transformation of all life, including mankind from its current position into another "post human" position on an artificial Earth, as the expansion of intelligent life to beyond the solar system.

Source: Bezold (2009)

This method does not cater for what Inayatullah (2015) refers to as an *"outlier scenario."* For the automation effected labour market, this is shown in Figure 4.4, where two variables have been created from emerging issues investigation. The variables yield four situations below.

Figure 4:2 : *A 2x2 Scenario matrix*



Source: Prepared by the researcher

Presented below is a description of the above-mentioned scenarios for automation technologies and employment (Inayatullah, 2015).

1. **The end is near:** This scenario depicts a future where automation technologies are retained on the status quo and do not adapt to the progression of time, arising innovations and trends. In this scenario, there are no inventions, social and skilling consideration for the economy or the future of work;
2. **Going in circles:** In this scenario, alternative modes other than automation technologies are used, for example, human labour. This results in improved employment, but also a drastic reduction of innovation and productivity and social living standards;
3. **Automation war:** This scenario is where everything becomes automated. Systems like Artificial Intelligence are successfully implemented and operate with minimum or no human interference. This is where automation accounts for most, if not all industries;
4. **Green oasis:** This scenario sees a human-centred approach for the future of work where the individual and labour are placed at the centre of social and economic policy. In this scenario, social policy plays a vital role in the promotion of employment demand, together with availability of lifelong learning

programmes. This would result in high levels of employment and productivity, leading to economic prosperity.

The four scenarios can also be presented in the following four dimensions, as illustrated in Schwartz's scenario model (Inayatullah, 2015).

Table 4.4: *Schwartz's scenario model applied: Effect of Automation technologies on employment*

Scenarios	Preferred	Disowned	Intergrated	Outlier
Litany	Automation technologies creating sustainable business opportunities and employment demand. Targeted lifelong learning programmes	Automation displacement, No alignment between labour demand and automation requirements	Technology focused training and programme.	Fully automated systems
System	labour supportive policies	Economic inequality Unemployment	Integrated economic, labour and social regulations	Non human factories and workplaces
Worldview	Automation technologies dependent on human labour for growth and sustainability	Intelligent automation systems independent of human labour.	Integration	Employment wars (Man vs Machine)
Metaphor	"Moving forward"	"Moving backwards"	"Moving together"	"Moving parallel"

Source: Inayatullah (2015)

Inayatullah (2009) warns of trying to find the most likely future outcome as that can be mistaken as predicting the future. When the future is predicted, it removes the contributors from the scenario. Use of the scenario matrix is practical when investigating the impact of automation technology on employment (Inayatullah, 2009).

4.6 Transforming the future

Transformation is the sixth and last pillar. In this pillar, the aim is to narrow the future to the preferred. The search for solutions to address challenges of automation, should not seek to slow the adoption of these technologies. Governments, corporations and individuals should rather embrace automation technologies to benefit from enhanced productivity, performance and social benefits. In achieving this objective, it is important that the correct policy options are adopted to achieve the preferred vision of the future.

Productivity growth alone is not the solution for challenges posed by automation technologies but a key requirement in employment growth (Le Roux, 2018). Productivity is a key growth contributor to the economy. Policies that embrace the adoption and utilisation of automation technologies for productivity growth will ultimately unlock employment demand and investment (Uguina, 2017). The investment in human capital is also important in developing sustainable employment. Displaced workers will, in most cases, have to be re-skilled to effectively compete in labour market (Frontier Economics, 2018a)

Setting up of lifelong learning initiatives enables the workforce to obtain necessary skills, reskilling and upskilling needed to benefit from opportunities offered by new technology (Chang, Rynhart, Huynh & Phu 2016). Social policies also need to consider displacement support to affected workers. As the nature of work changes, many workers will need assistance adjusting. Many best practice approaches to transition safety nets are available and should be adopted and adapted, while new approaches should be considered and tested (Frontier Economics, 2018a). Governments, educational institutions, employees and employers have complementary responsibilities in building effective and appropriate institutions such as skills development policies, employment services and training systems to provide workers with the support they require (OECD, 2016).

CLA can also be applied to enhance the richness of the discussion, as demonstrated in Table 4.6. This allows for the transformation of strategy from the current reality to a reality considered from other perspectives, and then to the integrative view (Inayatullah, 2015). This, therefore, creates a transformative and longer-lasting change – knowledge that serves.

Table 4.5: *CLA Applied – Integrated, vision of the future*

CLA level	Current	Transformed
Litany	Automation displacement Lack of required skills	Collaborated Lifelong learning programmes
Systemic	Economic inequality Unemployment	Social policy support for displace workers Technology embedded educational systems
Worldview	Improved productivity.	Sustainable technological employment opportunities
Metaphor	“Snail pace”	“rise of the machines”

Source: (Inayatullah, 2015)

4.3 Conclusion for Chapter 4

This chapter focused on an in-depth analysis of how automation will impact and affect jobs in the future. Inayatullah's (2008) six pillar framework was used to dissect this. Within this framework, various tools were used to further explore this impact. Firstly, the Futures Triangle was used to outline the push and pull factors towards visions identified. This is detailed in the first pillar. Secondly, the future is anticipated by using the Emerging Issues Analysis within the second pillar, while timing the future highlighted in the third pillar. This is where questions are posed about effects of automation in the economy, and trends are outlined. Thirdly, the future is deepened using the Casual Layered Analysis, and alternatives of the plausible future are constructed using scenario planning. This is done in the fourth and fifth pillars, respectively and where the strategic output is constructed. Finally, in the sixth pillar, the future is transformed and the preferred future is presented.

4.4 Chapter that follows

The next chapter presents a summary of the research problem and findings or outcomes of the methodology. The chapter concludes with recommendations and identification of limitations of the study for possible future research.

CHAPTER 5: CONTRIBUTIONS, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

This chapter presents an overview of the study chapters, evaluates the research, discusses contributions of the study, the study's limitations, provides theoretical and practical considerations, makes recommendations and concludes the study.

5.2 Overview of the study chapters

The dissertation was developed based on the following structure:

Chapter 1 illustrated the purpose of the research, the rationale of the study and the research methods utilised.

Chapter 2 identified and justified the methodological approach used in this study. It also presented the research paradigm, design and techniques, limitations as well as tools and instruments utilised in the study of the future. Chapter 2 also provided the background on future studies and detailed elaboration of the six-pillar approach, causal layered analysis and scenario planning technique, including their role in this research.

Chapter 3 focused on the literature study aimed to understand the research questions. Chapter three also discussed current automation innovations, impact of automation technologies on the employment, factors affecting the adoption of automation technologies and skill requirements.

The emphasis of **Chapter 4** was on data presentation, analysis and discussion of the findings. In this chapter, an in-depth analysis of automation technologies and how they affect employment was done. The six pillar approach, emerging issues analysis, CLA and scenario planning were applied to establish the effect of automation technologies on employment.

Chapter 5 gives an overview of the study chapters, evaluates the research, discusses the contributions of the study, makes recommendations, discusses the study's limitations and concludes the study. This chapter aims to reflect and provide a vision, while providing recommendations and conclusions to the questions raised by this research.

5.3 Evaluation of the research

The preceding chapters aimed to analyse possible future regarding the effect of automation technology on employment. The Futures Triangle was utilised to map the future by isolating the vision of “United Nations goal 8 of the 2030, sustainable development goals”, push towards this vision and the weights or restrictions from attaining this vision. Afterwards, an Emerging Issues Analysis was conducted to anticipate factors that could influence or affect this vision from coming to pass. Effort was also made to suggest workable solutions to address various research questions raised and ultimately address research objectives. The future is then narrowed down to the transformed, with a focus on revealing win-win solutions for the adoption of automation technologies and employment without concession.

Table 5.1: *Derivations from research objectives*

Objective	Outcome
1. To examine the effect of automation technologies on unemployment.	Automation technologies ultimately lead to job creation and economic growth.
2. To determine factors affecting adoption of automation technologies.	The decision to adopt automation technologies is affected by various external and internal factors (Literature review).
3. To consider plausible skill requirements that can be considered for the future labour market	Labour force needs to develop digital/data management skills accompanied by lifelong learning to remain competitive in the labour market
4. To assess issues that hamper implementation of a plausible future	Lack of relevant skills and potential labour displacement hamper attainment of an integrated future

Source: Prepared by the researcher

5.4 Recommendations

The outcome provides an opportunity to make submissions on possible recommendations that can be applied by various stakeholders. From this point, the following issues can be highlighted:

- ✓ How to promote lifelong learning in the labour market;
- ✓ How to ensure development of social protection and labour transition policies for automation effected workers;
- ✓ How to ensure sustainable productivity and employment demand; and
- ✓ How to attain the right alignment between educational and technology requirements.

- **Productivity:** What has been established from the study is that technological innovation creates long-term economic growth, productivity and improvement in living standards (Chang, Rynhart, Huynh & Phu 2016), although technological innovation has been identified to decrease employment in the agriculture and manufacturing industry. Technological innovation has led to increased productivity as it has improved output in these sectors. As tools improve, technology magnifies our leverage and increases the importance of human expertise, judgement and creativity. As automation technology frees time, it increases the scope of what is possible, people invent new products, new services that capture people's attention, occupy time and spur consumption. In other words, automation technologies are essential to create economic growth by allowing workers to achieve more in less time.

  As changes in technological advancement grow, it is evident that the labour market of the future may be completely different to what it is at present. However, in order to maintain productivity growth while also reducing the displacement of human capital, the following are required:

  - ✓ Creative innovation that is adaptable to latest technological advancement;
  - ✓ Effective collaboration amongst relevant stakeholders;
  - ✓ Collaborated technology and human effort environment; and
  - ✓ Stimulation of technological innovation to create new industries.

- **Displacement:** The implementation of new automation technologies displaces workers in affected industries but creates employment. Research by the OECD (2016) found that technological innovation creates employment through development of new industries and requirements for new skills. Historically, this process has led to net job creation, as new

industries replace old ones, and workers adapt their skills to changing and expanding demand (OECD, 2016).

In order to deal with the effect of automation displacement in the workforce, the following strategies can be employed:

- ✓ Development of policies that provide adequate labour protection, including tailored income support and re-employement assistance policies;
- ✓ Organisational job restructuring to accommodate automation;
- ✓ Stakeholder support in the creation of new industries;
- ✓ Implementation of lifelong learning initiatives for workforce; and
- ✓ Implemetation of re-skilling and upskilling programmes.

- **Skill requirements:** Automation technologies present a skills challenge for the labour market. New technological advances in automation require workers to constantly update their skill sets to remain capacitated in the labour market; strategies that can be implemented include:
  - ✓ Alignment between technology and educational systems; and
  - ✓ Stakeholder engagements and consensus on market and educational requirements.
- **Strategic issues:** Hough, Thompson, Strickland and Gamble (2011) stated that the creation and implementation of strategy is the mechanism for ensuring sustainability and value creation. This sentiment is supported by Morris, Webb, Fu, and Singhal (2013), who identified three characteristics of a good strategy. These include:
  1. A view that incorporates all the risk factors;
  2. An effective approach to the management and analysis of data; and
  3. Strong partnerships with stakeholders to ensure a common goal, a clear plan and responsibility.

- **Collaboration in the development of Future-Oriented Curriculum:** The labour market is constantly evolving, and the skill requirements are rapidly changing. It is, therefore, important that the government, academic institutions and business leaders anticipate these changing requirements and ensure that

individuals receive appropriate skills and support. Developments in the labour market necessitate close collaboration between the government, business leaders and educational institutions. Qualifications issued at academic institutions should assist graduates to be employable. Collaborative curriculum development will ensure that graduates are afforded the right skills and are well-educated to optimally contribute to economic growth and job creation. Governments, academic institutions and businesses should pursue the following strategies in order to develop a future-ready curriculum:

- ✓ Establishing systems that offer information on learning measures. These systems will assist in identification of suitable learning objectives and enable informed decisions by stakeholders;
- ✓ Preparing for innovations and obtaining clear understanding of the impact of technology on learning;
- ✓ Developing close partnerships with employers and labour market to provide support in achieving skills and business objectives. This will assist in ensuring provision of a competitive learning and business market; and
- ✓ Preparing for the adoption of continuous disruptions of established business models and income streams created by the marketisation education.

The study has, therefore, attempted to analyse the impact of automation technologies on employment to develop strategies for advancement and progress of human capital.

4.4 Key contributions of this study

The study has contributed through considering various literature resources in reckoning the future about the effect of automation technologies on employment. The application of Inayatullah's (2008) six pillars framework was utilised, while incorporating analysis tools such as the emerging issues analysis and the futures triangle. The CLA method was also utilised to deepen the future, which produced scenarios relevant to future effects of automation technologies on employment and attainment of a preferred future. The creation of different scenarios enables

stakeholders to gain insight through exploring alternative futures, thereby providing the basis for stakeholders to take advantage of opportunities offered by automation technologies to attain sustainable employment and economic growth.

5.5 Limitations of the study

The literature review conducted to investigate the impact of automation technologies on employment, focused its efforts on its effect on general employees, adoption factors and education and training systems. However, literature review did not portray opinions of a significant number of industry experts. Consulting such experts would have enhanced the information-gathering process and provided deeper empirical evidence.

5.8 Recommendations for future research

The research aimed to build confidence and create awareness and collaboration amongst stakeholders. This can be achieved through creation and implementation of more effective social and labour policies, including re-evaluation of educational and training programmes. It is from this principle that it is recommended that new policies and strategies be developed for further value creation plans/initiatives towards the future. Further research opportunities include:

- Research to improve strategies for attainment of the proposed future;
- Research on educational and skills requirements; and
- Creation of stakeholder think tanks for collaborated solutions.

5.9 Recommendations for practice

The results of the study can be consulted in practice by Government legislators, Educational providers, labour market and service providers (Human Resource department) in dealing with the effect of automation technologies on employment.

5.10 Conclusion of the study

The research identified a genuine concern in the labour market about automation technologies replacing human labour. Different studies have concluded that

automation bears profound impact on employment and skills requirements. General occupations that require creative knowledge and innovation are least at risk of automation. In short, if a job is predictable, the risk of automation is much higher. If a job does not require innovation or creativity, then the return on investment for companies is higher on machines than employees. A brief analysis of current automation technology was conducted and revealed that current innovations like AI and machine learning have widened possibilities of automation technologies. Such automation systems will soon be able to conduct cognitive activities believed to belong exclusively to humans, thus posing challenges for employment. The research also found that the historical trends of automation adoption ultimately led to overall increase in employment as automation creates a demand for new skills and occupations associated with the new automation system. Therefore, even though automation might cause work displacement, the automation system itself will bring spinoffs such as jobs that will, in the long run, even out the initial job losses.

The research identified that governments, business and the general public need to be educated on the forthcoming skills gap. Alignment between education and technological requirements is essential. The developing world of technology requires the labour force to develop data management skills to remain competitive in the labour market. Educational systems should be structured to promote traditional arts together with data science subject. Continuous learning for the labour market must be promoted through lifelong learning initiatives that would enable the labour force to consistently update their skills sets.

Social policy was also identified as an important option to assist displacement and unemployment in automation effected industries. Policy support for automation-affected industries is necessary to provide adequate social protection for displaced workers. Such initiatives could include income support and tailored employment assistance policies.

The results of the analysis of the future studies theory confirm a need to transform employment, educational systems and social policy for the future effects of automation technologies and employment. Exploring and accepting uncertainty will enable the stakeholders to see familiar themes when moving towards the future and be able to

develop new insights. Through the application of futures studies, wisdom in this sphere will then be created.

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