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The influence of automation on employment in the South African manufacturing industry

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The influence of automation on employment in the South African manufacturing industry.

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A research report was submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business

Johannesburg, 2021

KEYWORDS

Automation, Employment, Job losses, Manufacturing industry, and South Africa.

ABSTRACT

Orientation: There are emerging uncertainties that automation causes job losses, especially in the manufacturing industry because it is a labour-intensive industry.

Motivation of the study: The beverage manufacturing sector is essential because it contributes to the GDP of developing countries, as it is one of contributors of job creation.

Purpose of the study: This study aims to identify the influence of automation on the South African beverage manufacturing industry, the objective is to investigate whether automation creates jobs, or it causes job losses.

Methodology: This was a qualitative study, where seven semi-structured virtual interviews were conducted to collect data. Purposive sampling was used, the population for this study were employees who are working in the beverage manufacturing industry in Gauteng and Mpumalanga provinces, South Africa. Thematic analysis was used to analyse and interpret collected data.

The key findings of the study: The results of this study shows that automation creates new jobs for skilled workers, however, the study revealed that low-skilled workers who do repetitive work are vulnerable to losing their jobs when automation is introduced in the beverage manufacturing industry. The findings of the study also show that, employers upskill and train low skilled workers and old aged workers as a retention plan to reduce job losses workers whenever automation is introduced in the industry .The results of this study show that automation increases production and revenue for beverage manufacturers.

Practical and theoretical contribution: Automation should be embraced in the beverage manufacturing industry because it creates jobs, and it increases production and revenue for beverage manufacturing firms.

Conclusion: Adoption of automation can be a threat to low skilled workers, although it is able to create new jobs for skilled workers in the industry.

Automation enables the beverage manufacturing industry to grow revenue as a result of an increase in production.

Recommendations: In accordance with the literature reviewed and the findings of this study, it is recommended that automation be embraced by the beverage manufacturing industry in South Africa since automation would lead to an increase in production and returns in revenue for the manufacturers.

It is further recommended that employees in the manufacturing sector be less anxious or less worried about the adoption of automation because automation presents new opportunities to learn new things and it creates new jobs.

Based on the findings of this study it is recommended that employers should continue to train and up skill workers whenever automation is introduced in the beverage manufacturing industry in order to preserve jobs across their human resource spectra and affect positively the South African unemployment statistics.

KEY WORDS: Automation, Employment, Job losses, Manufacturing industry, and South Africa.

DECLARATION

I, Ms Nkhensani Mathebula, confirm that this research report is my own unaided work. It is submitted in partial fulfilment of the requirements for the degree of Master of Management in the field of Digital Business at the University of the Witwatersrand, Johannesburg. I also confirm that it has not been submitted before for any degree or examination in this or any other university, and that cited work is acknowledged through referencing

Name: Nkhesani Mathebula Signature:

Signed at: University of Witwatersrand Business School

Date: 05th August 2022

DEDICATION

I dedicate this work to my late mother, Deliwe Lilly Malamule who forced me to love school, I will be forever grateful.

To my family, colleagues, and friends, I could never thank you enough for your unwavering support through this journey.

ACKNOWLEDGEMENTS

I would like to acknowledge the Almighty God for the privilege to be able to complete my Master's programme and to do my research project at the Wits Business School, I am really blessed and thankful.

I would like to appreciate my supervisor, Dr Monnamme Tlotleng.I am grateful for your unwavering support and leadership throughout the project, I do not take it for granted. I appreciate your patience with me, when the going got tough.

I would also like to acknowledge all the beverage manufacturing firms that welcomed and allowed me to collect data from their employees which was critical in order for me to complete this project.

This study would not have been possible without my sponsor, who provided funds to pursue my studies with the Wits Business school for the last two years.

To the MMDB class of 2020, special thanks to Tsholo, Nthabi and Tshepiso. I am thankful for the major role that you played in my life since the beginning of our journey of conducting our Masters together. May the almighty God bless you and your families abundantly.

To my family, friends and acquaintances thank you for the love, support and encouragement.

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CHAPTER 1. INTRODUCTION

The manufacturing industry plays a vital role in the national economy because, it is a great source of employment. The manufacturing industry create one in every ten jobs for individuals in the South African workforce (Brynjolfsson & McAfee, 2014; Statistics South Africa, 2018). In 2018, the manufacturing industry had employed about 1.7 million people in South Africa, and contributed 15.3% to the Gross Domestic Product (GDP) (Deloitte, 2013). Due to the decline in production, the contribution of the manufacturing industry towards South Africa's GDP dropped to 14% in 2019 (Deloitte, 2013).

The South African manufacturing industry comprises of food and beverages (at 26%), followed by petroleum and chemical products (at 24%), Basic iron and steel (at 19%), and then water products, papers, and printing (at 11%). The smallest players are motor vehicles, parts and accessories at 7%, followed by glass and non-metallic mineral products at 4%, furniture and other manufacturing at 3%, textiles, and clothing at 3%, electrical machinery at 2% and lastly Communication and professional equipment at 2% (Statistics South Africa, 2018). This information is summarised in Figure 1.

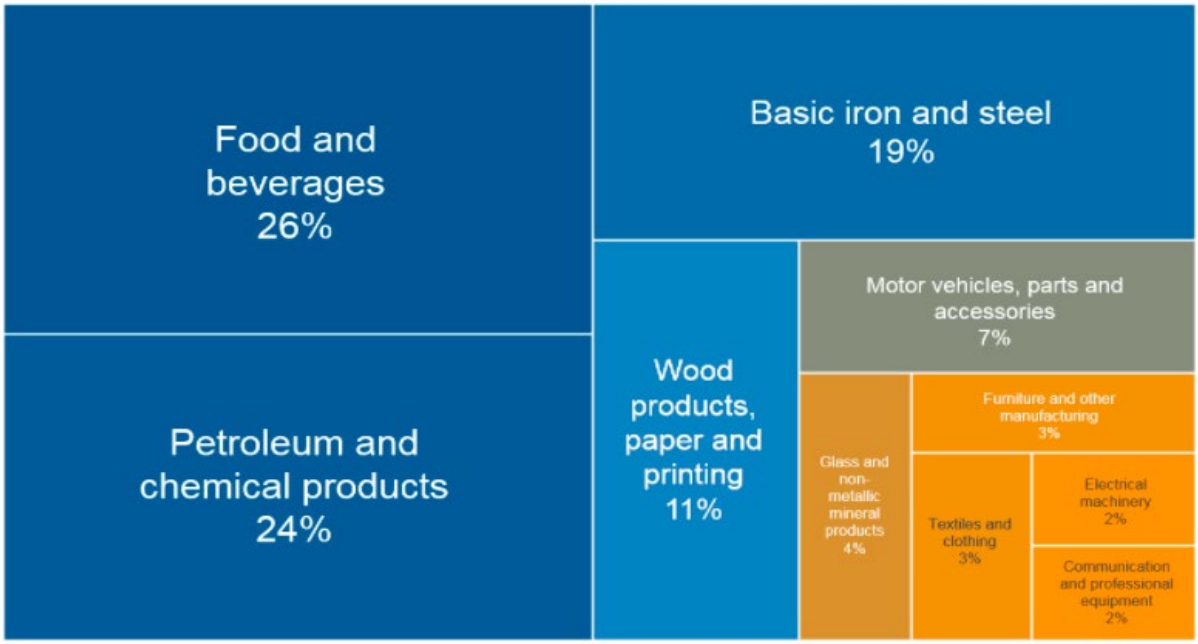


Figure 1: Summary of the manufacturing industry in South Africa Source: (Statistics South Africa, 2018)

1.1 Purpose of study

This research aims to identify the influence of automation on employment in the South African beverage manufacturing industry. This study aims to investigate whether the influence of automation is beneficial to the beverage manufacturing industry or not, in terms of job creation. This is a case study that will focus on the beverage manufacturing industry based in Gauteng and Mpumalanga Provinces of South Africa. The beverage manufacturing sector was chosen because it is a prime contributor of job creation in South Africa.

1.2 Context of study

Performance of the manufacturing industry

According to Deloitte (2013), the manufacturing industry experienced inconsistent waves of growth in production from 2002 to 2017. Figure 2 shows manufacturing growth yearly against GDP.

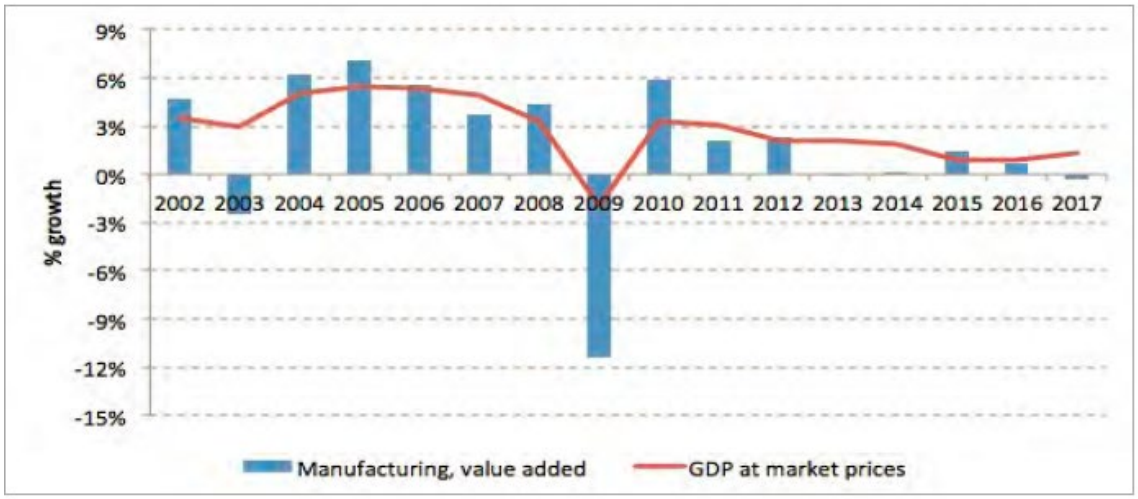


Figure 2: Growth of the manufacturing industry against the GDP in South Africa, Source: (Deloitte, 2013)

Figure 2 shows that in 2003 the manufacturing industry took a nearly 3% knock-in production growth, followed by 11% in 2009 while in 2014 there was almost 0% growth. The last loss in production was in 2017 which was about 0.5%. Despite production losses in different years, the industry experienced almost 7% production growth in 2005.

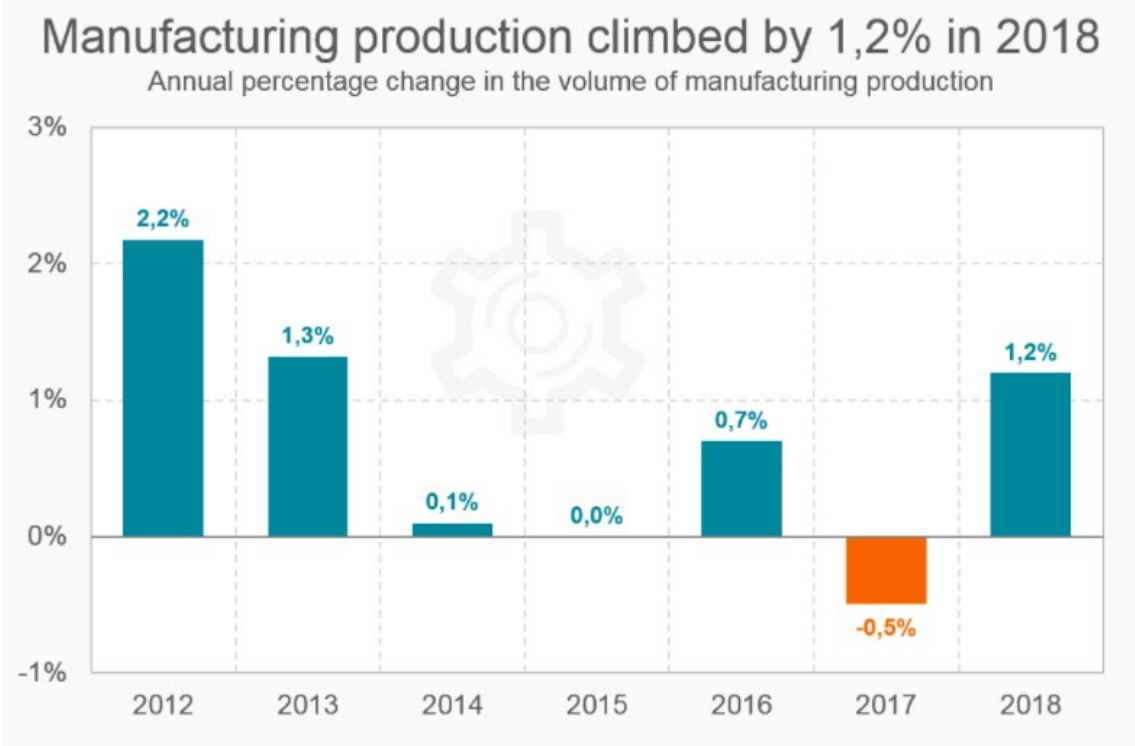


Figure 3: Increase of production in the manufacturing industry in 2018, Source: (South African Marketing insights, 2017).

Figure 3 shows that despite the decrease in production growth of 0.5% in 2017, the manufacturing industry experienced a 1.2% increase in production in 2018, which was followed by the highest growth of 2.2% in 2012 (South African Marketing Insights, 2017).

According to the Department of Trade and Industry (2019)(DTI), South Africa continued to record stable regressions in the manufacturing industry, from about 24% of GDP in the 1980s to 13% in 2017. The manufacturing industry has endured a substantial decrease of -11% in its impact on South Africa's GDP in 2009, the industry has since wriggled to recover (South African Marketing Insights, 2017).

Domestic demand within the South African manufacturing industry remains weak, due to unstable sales volumes since 2003 (Department of Trade and Industry,

2019). The decline in production has adversely affected employment and the GDP of the country. The total number of jobs that have been lost due to a decrease in production in the manufacturing industry from 2008 to 2017 is 420 000 (South African Market Insights, 2018). The following are plausible reasons for the observed decline in production of the manufacturing industry in South Africa:

1. Decrease in demand for manufacturing goods in the economy in recent years (Deloitte, 2013; South African Market Insights, 2018).
2. The lack of steady supply of electricity by Eskom impacted the South African manufacturing firm's industry (Deloitte, 2013; South African Market Insights, 2018).
3. An increase in the number of manufactured goods imported from countries such as China and Germany (Deloitte, 2013; South African Market Insights, 2018).
4. Growth in other industries budding comparatively more rapidly than the manufacturing sector resulting in a decrease in market share of the manufacturing sector (Deloitte, 2013; South African Market Insights, 2018).
5. An increase in the number of automated machines and equipment imported from China and Germany resulting in a loss in employment (Deloitte, 2013; South African Market Insights, 2018).

Therefore, the manufacturing industry is still struggling to recover from production losses due to several factors that have been highlighted above. The findings also show that introduction of automated machinery has contributed to a decrease in

demands for locally manufactured goods which has led to an increase in loss of employment.

The objective of the study is to investigate the influence of automation on employment in the South African beverage manufacturing industry with a particular focus on Gauteng and Mpumalanga Provinces.

1.3 Background of study

Automation has been around for centuries. The first automation in manufacturing was developed in 1785 by Olivier Evans, where an automated flour mill was developed (Andreoni, 2019; Parschau & Hauge, 2020). The anxiety of job losses, due to automation started in the early 19th century. This was met with the luddite protests in Britain where workers vandalized automated machines (Parschau & Hauge, 2020). The protests were justified because the introduction of automation in the manufacturing industry was affecting the labour demand negatively thereby increasing the unemployment rate (Manyika et al., 2011). However, (Parschau & Hauge, 2020) argues that the introduction of automation in the workplace did not necessarily mean that jobs will be lost as automation can create new jobs as well.

1.4 Research problem

Automation is perceived as a threat to employees in the beverage manufacturing industry thereby causing a decrease in demand for locally manufactured goods (Vermeulen et al., 2018). Therefore, automation is perceived to have an adverse influence on employment because it causes job losses/job displacement in the South African beverage manufacturing industry.

1.5 Research objectives

(i) To investigate how automation causes job displacement in the beverage manufacturing industry in South Africa particularly in Gauteng and Mpumalanga provinces.

(ii) To discover how automation increases productivity in the beverage manufacturing industry in South Africa particularly in Gauteng and Mpumalanga provinces.

1.6 Research questions

(i) How does automation cause job displacement?

(ii) How does automation increase productivity and revenue ?

1.7 Significance of the study

There are emerging uncertainties that automation causes job losses, especially in the manufacturing industry because it is a labour-intensive industry (Parschau & Hauge, 2020). The manufacturing sector is essential because it contributes to the GDP of developing countries Chang et al., (2009). Therefore, the purpose of this study is to identify the influence of automation on employment of the South African beverage manufacturing industry, the objective is to investigate whether automation causes job losses or not.

1.8 Delimitations of study

This study will be conducted in the beverage manufacturing industry of South Africa, with a particular focus in Gauteng and Mpumalanga provinces.

1.9 Assumptions of study

It is assumed that the response rate of the participants and their employers will be positive. It is also assumed the participants will respond to the questions with sincerity.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of literature pertinent to the understanding of the influence of automation in the beverage manufacturing industry. The scope of the review includes literature that looked at the influence of automation in the manufacturing industry. This section also includes the relevant propositions to the research questions and the formulation of the theoretical framework for this study.

2.2 The Fourth Industrial Revolution and Automation

The 21st century is on the border of the Fourth Industrial Revolution which consists of advanced technologies such as artificial intelligence, robotics, data science, quantum computing, internet-of-things to improve the efficiency of different industries in the global economy (Vermeulen et al., 2018).

Artificial intelligence is a type of technology that also consists of a family of technologies such as robotic process automation, virtual assistants, natural language, advanced machine learning, and computer vision which can be adopted by companies to contribute to global economic growth (Bughin et al., 2018).

Automation is a type of artificial intelligence technology which can be used to automate robots such as industrial arms, automated production lines and automated machinery which are used in the manufacturing industry to reduce the

time it takes to manufacture products (Bastiane, 2019). The automotive industry uses the highest number of automated industrial arms, automated production lines and automated machinery followed by the electronics manufacturing division, the plastic, and chemical manufacturing, then the food and beverage manufacturing (Bastiane, 2019).

Automation can be defined as the use of automated electronic or mechanical devices in the manufacturing process to save time and improve productivity (Frohm et al., 2008). Bessen (2016) articulates that automation happens when machines partially or completely perform duties that are usually done by human beings and reduce the time needed to complete that duty.

Brynjolfsson and McAfee (2014) argues that automation causes job losses because automation replaces human beings which creates technological unemployment and socio-economic inequality. Although automation causes unemployment as a result of displacement of some workers, automation increases productivity and creates demand for new or improved products and services which in turn creates demand for new jobs created due to automation (Vermeulen et al., 2018).

Automation has both an optimistic and undesirable influence on employment in the beverage manufacturing industry. The following section will address the influence of automation in the manufacturing industry.

2.3 The perceived influence of automation on employment in the beverage manufacturing industry.

2.3.1 *Automation causing displacement of jobs*

(i) Displacement of jobs for the less educated/less-skilled workers

Ghimire et al. (2020) submits that automation increases productivity and efficiency in the manufacturing industry however, low-income workers are more vulnerable to loss of jobs due to automation compared to middle- and high-income workers. This is because most jobs that are done by the low-income workers are repetitive and they can be easily automated (Shook & Knickrehm, 2018). Repetitive jobs in the beverage manufacturing sector such as warehouse packaging, data collection, inventory control, inventory documentation, office clerks, cashiers can be easily automated using automated machinery (Manyika et al., 2011).

Vermeulen *et al* (2018) argue that it's not only the low-income class that are vulnerable to automation but also the middle-income class because they also do routine duties which can be simply automated as well.

Occupations that require a college degree perform less routine work and are therefore less vulnerable to technological unemployment compared to occupations that don't require a college degree, therefore workers with degrees are less vulnerable to job losses (Bessen, 2016).

It is estimated that in the USA about 36 million jobs are likely to be automated by 2030, and 52 million jobs are facing a medium risk of being automated in 2030 (Vermeulen et al., 2018).

This means that automation is a threat to employment of the low-income and middle-income class in the next 9 years in developed countries. Job displacement of low–income class workers caused by automation, creates economic inequality because, the poor (low-income) end up being poorer because their duties can easily be automated compared to the middle and high-skilled workers (Rapanyane & Sethole, 2020).

(ii) Automation causing displacement of jobs due to lack of digital skills in adults.

55% of adults in the Atlanta, USA, who are older than 50 years are susceptible to job losses caused by automation because of the gap in digital skills that the younger generation has (Ghimire et al.,2020). Even in a case where the younger generation does not have digital skills, it is easy to upskill a younger person than an adult who is older than 50 years because the older age group capacity to learn new digital skills is comprised as they get older (Vermeulen et al., (2018).

Another adverse contributing factor to the older generation is that even if they have a college degree, they obtained the degree 20-25 years ago with the curriculum that was not digitally inclined, therefore even the educated older generation is exposed to unemployment because the current curriculum is more digitally inclined towards artificial intelligence (Ghimire *et* al., 2019).

The risk of job displacement due to automation is high in adults older than 50 years whether low or middle-skilled within the manufacturing industries in developed countries (Ghimire et al., 2020; Rapanyane & Sethole, 2020). Further to that, even graduates older than 50 years are exposed to job losses because of the difference in the current digital curriculum in higher institutions compared to the curriculum that was taught 20-25 years ago which was digitally informed (Ghimire et al., 2020; Rapanyane & Sethole, 2020).

Many jobs in developing countries, in comparison to developed countries, are more vulnerable to being replaced by automation (Millington, 2017). It is also common in developing countries to see jobs of blue-collar or low-skilled labours become automated first compared to white-collar or high-skilled labours. Just like in developed countries, the factor that determines which jobs will be automated is based on whether jobs or tasks are routine or not (Millington, 2017; Rapanyane & Sethole, 2020).

In Africa, the risk of jobs being replaced by automation is different for each developing country. In Nigeria it is expected about 65% of jobs will be automated, 67% in South Africa, and 85% in Ethiopia, which is higher than the 57% that was estimated by the Organization for Economic Co-operation and Development (OECD) in 2017 (Millington, 2017).

The rate of unemployment in South Africa is high, Covid-19 worsened the rate of unemployment, therefore job losses as a result of automation will harm the economy of South Africa (Rapanyane & Sethole, 2020).

2.3.2 *Proposition 1*

Automation causes job losses in the manufacturing industry in South Africa.

2.3.3 *Automation causing an increase in productivity.*

(i) Increase in productivity, revenue, and job creation.

Automation does not necessarily cause job losses in specific income classes because, automation increases productivity in the manufacturing industry (Vermeulen et al., 2018). High productivity leads to reduced prices of products/services which drives an increase in demand which also drives an increase in new occupations as a result of automation (Bessen, 2016). An increase in productivity allows the beverage manufacturing industry to be more efficient and reach more clients and tap into new avenues which also increases revenue (Rapanyane & Sethole, 2020).

This means that automation has a positive influence on the beverage manufacturing sector by increasing productivity and employment.

2.3.4 *Proposition 2*

(i) Automation increases productivity within the beverage manufacturing industry.

2.4 Conclusion of Literature Review

Automation has been perceived to have positively influenced the beverage manufacturing industry, by increasing productivity, revenue and creating employment. However, automation is also perceived to have negatively influenced the manufacturing industry by causing displacement of jobs for the less educated/less-skilled workers, displacement of jobs due to lack of digital skills in adults.

2.4.1 *Proposition 1*

(i) Automation causes job losses in the beverage manufacturing industry in South Africa.

2.4.2 *Proposition 2*

(ii) Automation increases productivity in the manufacturing industry.

Table 1. Consistency table: research questions and propositions

RQ #	State Research Question or Objective	Prop/ #	State Proposition or Hypothesis
1	Does automation cause displacement of jobs in the manufacturing?	1	Automation causes job losses in the manufacturing industry in South Africa.
1.1	Does automation cause the displacement of jobs due to the lack of digital skills in adults?		
2	Do automation increase productivity in the manufacturing industry?	2	Automation increases productivity in the manufacturing industry.
2.1	Does automation increase revenue and create jobs?		

2.5 Analytical Framework

The integrated overview of the theoretical and empirical concepts of this study is as follows:

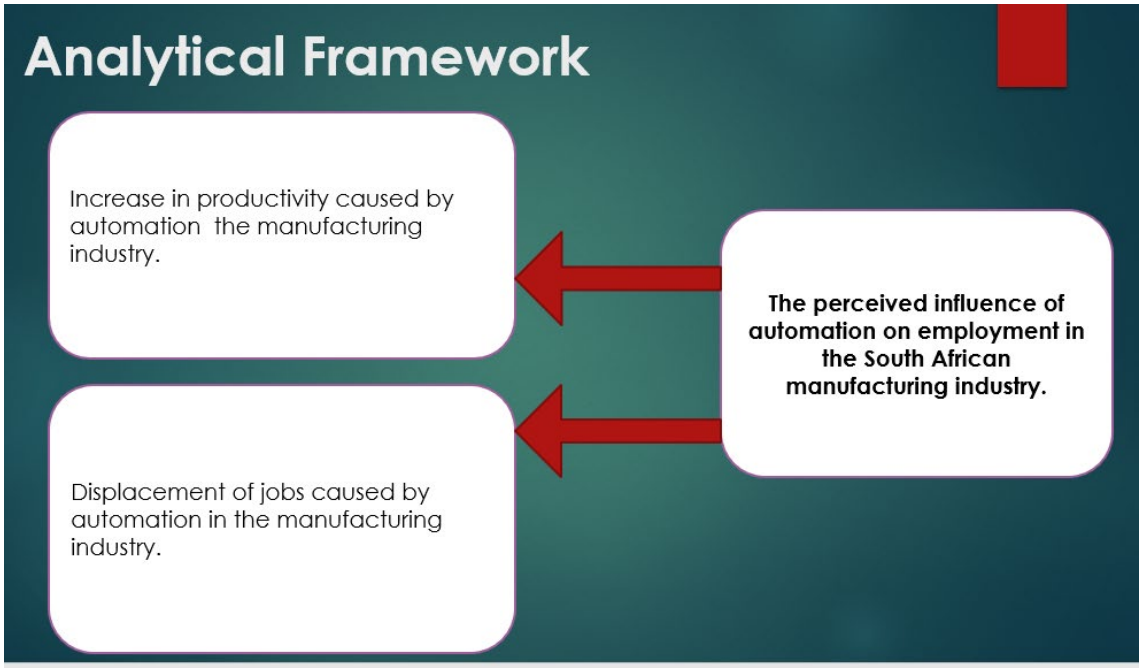


Figure 4: Analytical Framework

2.5.1 *Theoretical Framework*

Christensen's disruptive theory

This study is anchored on Christensen disruptive theory. This theory was found by Clayton Christensen in 1992. Christensen defines disruption as a theory of responding to competition in the market (Denning, 2016). Disruption is displayed each time a new innovative technology is used to produce new products or services that are under-offered by the main stream market to create competitive advantage (Denning, 2016).Disruptive innovation enables new organizations to

offer products and services that are cheaper, simpler or more convenient to use and this features enables organizations to grow (Ntimane, 2020).

There are two types of innovation that Christensen has identified, the first is Disruptive innovation, which is used to create or to produce products or services that are new in the market, and the second type is Sustaining innovation, that can be defined as improving the existing products or services in the market and the incumbents market share (Christensen et al., 2013).

Advantages of Christensen theory of disruption

- It allows new organizations to introduce a new business model (Ntimane, 2020).
- It allows organizations to create new markets by introducing new products or services (Christensen et al., 2013).
- Organizations can purchase products or services focusing on a targeted customer base (Ntimane, 2020).
- It can replace a leading organization in the market (Ntimane, 2020).
- It allows organizations to introduce products and services to be simpler, convenient and affordable (Christensen et al., 2013).
- It allows the innovative product or service to compete with established products or services from incumbent organizations (Ntimane, 2020).

Disadvantages of Christensen theory of disruption

- It allows disruptive innovation for products or services that are cheaper and low in quality (Ntimane, 2020).

- The performance of disruptive innovation is driven by the duration a new product or service has been in the market (Christensen et al., 2013).

Table 2. Characteristics of the disruptive innovation in disruptive manufacturing

No	Characteristics of the disruptive innovation in disruptive manufacturing	Applicable
1.	It allows new organizations to introduce a new business model (Ntimane, 2020).	X
2.	It allows organizations to create new markets by introducing new products or services (Christensen et al., 2013).	X
3.	Organizations can purchase products or services focusing on a targeted customer base (Ntimane, 2020).	
4.	It can replace a leading organization in the market (Ntimane, 2020).	X
5.	It allows organizations to introduce products and services to be simpler, convenient and affordable (Christensen et al., 2013).	

6.	It allows the innovative product or service to compete with established products or services from incumbent organizations (Ntimane, 2020).	X

The Christensen's disruptive model

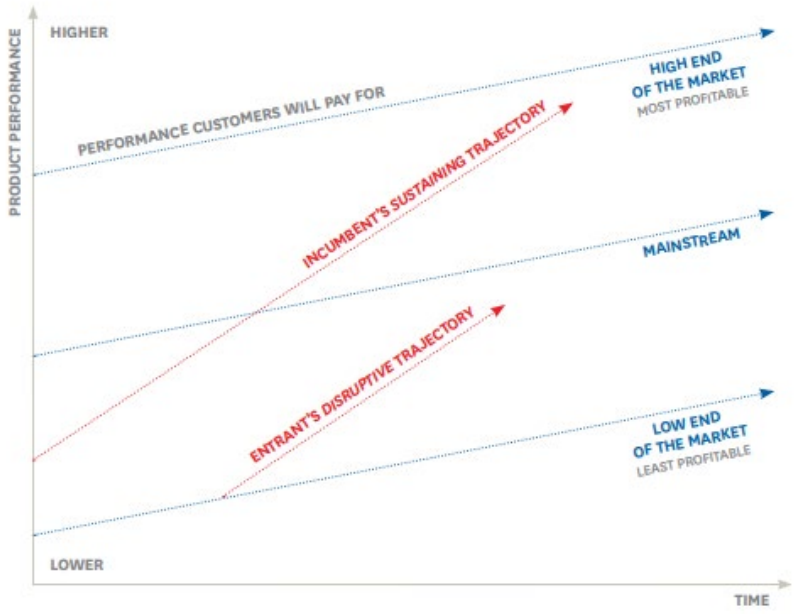


Figure 5: Christensen's disruptive theory model (Denning, 2016)

Figure 5 compares performance of products which are shown as red lines, the red lines also show how products or services perform and improve over time. The blue lines indicate the willingness of customers to pay for product or service based on the performance of that product or service in the market (Denning, 2016).

The bottom red line represents the performance of innovative entrants selling new innovative products or services, the top red line represents the performance of incumbent's organizations who are using sustaining innovation to sell mainstream and highly profitable products and services (Christensen et al., 2013).

As existing organizations introduce high-quality products or services to meet the needs of customers on the high end of the market, they exceed the needs of low-end customers and many mainstream customers (Denning, 2016).This leaves an opportunity for new comers to maximise the low-profitable sections that existing organizations are deserting (Christensen et al., 2013).

Disruptive entrants are represented by bottom red line to advance the performance of their products and services and move up to the highest profitable market and challenge the supremacy of the existing organizations (Christensen et al., 2013).

The Christensen's disruptive model on the South African manufacturing industry.

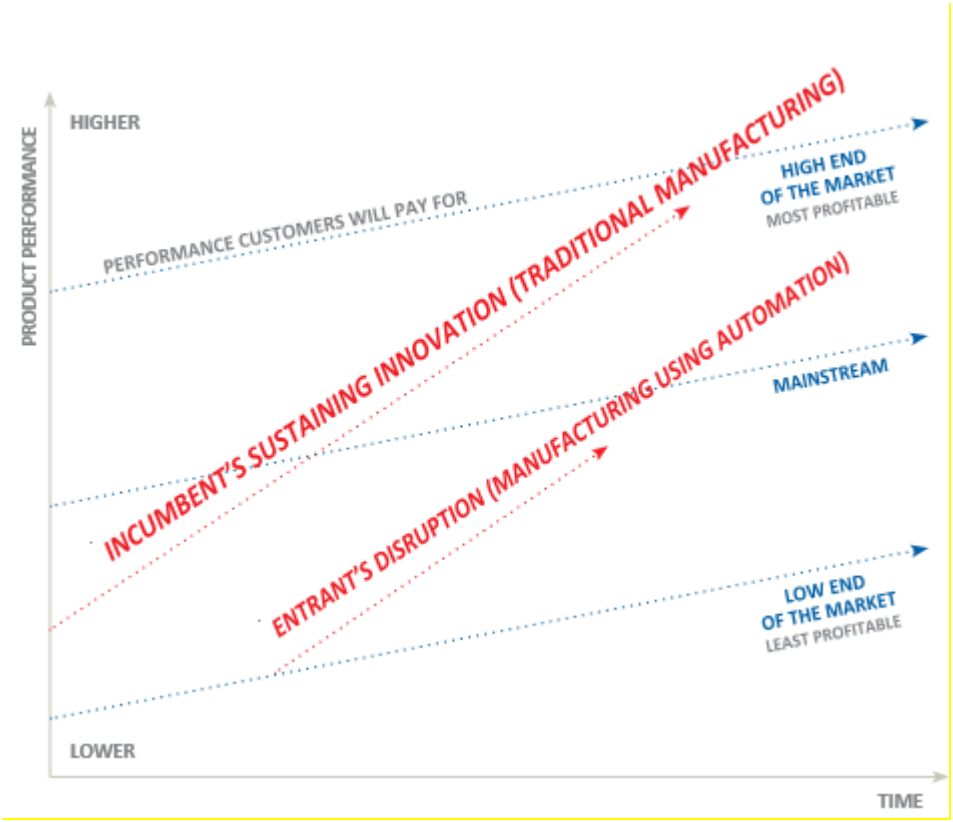


Figure 6: Christensen's disruptive theory model on the South-African manufacturing industry (Denning, 2016)

Figure 6 compares performance of manufacturing methods which are the red lines showing how manufacturing improves over time with manufacturing performance which are the blue lines showing customers willingness to pay for manufactured product (Denning, 2016).

The bottom red line represents the performance of new innovative manufacturing organizations which are using disruptive automation to manufacture least profitable and mainstream goods which require less labourers compared to conventional manufacturing (Christensen et al., 2013).

The top red line represents the performance of incumbent's that are also knows as conventional manufacturers which use sustaining innovation to manufacture mainstream and highly profitable manufactured products using more labourers (Christensen et al., 2013).

As incumbent manufacturers introduce high-quality products or services to meet the needs of customer on the high end of the market, they exceed the needs of low-end customers and many mainstream customers (Denning, 2016).This leaves an opportunity for innovative entrants to maximise the less-profitable segments that incumbents are neglecting (Christensen et al., 2013).Overtime disruptive manufacturing using automation will move up to the highest profitable market and challenge the authority of traditional manufacturers (Christensen et al., 2013).

The difference between traditional or conventional manufacturers and innovative manufacturers is their ability to identify and maximise opportunities in the market using disruptive innovation (Denning, 2016). Disruptive innovation is also referred to as efficiency innovation due to the following reasons when compared to sustaining innovation (Christensen et al., 2013):

Table 3. The difference between Disruptive and sustaining innovation table.

No	Disruptive innovation / Efficiency innovation (	Sustaining innovation (traditional Manufacturing)
1.	It enables manufacturers to produce more with less human resources (Denning, 2016).	Manufacturers produce more with more human resources (Christensen et al., 2013).
2.	It increases efficiency in business by using a combination of automation and human resources to manufacture products (Carbonero et al., 2020).	Limited efficiency by using labour intensive based manufacturing (Christensen et al., 2013).
3.	It can eliminate traditional manufacturers in the mainstream and high end market share.	It does not create growth from new consumption (Denning, 2016).
4.	Automation replaces some or all labour intensive tasks of workers, thus causing a negative influence on employment may (Carbonero et al., 2020; Conte & Vivarelli, 2011).	It doesn't generally create jobs create jobs (Christensen et al., 2013).
5.	It creates new market share using disruptive innovation	It sustains business by making manufactured products goods and better

		to promote economic activities (Denning, 2016)
6.	It increases profits	It keep profit margins attractive and competitive (Christensen et al., 2013).

Disruptive manufacturing using automation enables more production with less human resources thus causing a negative influence on employment in the manufacturing industry. It also clear that disruptive manufacturing increases efficiency, profits and productivity in the manufacturing sector.

This study aims to investigate the influence of disruptive manufacturing using automation on employment, to discover whether automation cause job losses. The further seeks to investigate how disruptive manufacturing using automation can increase productivity and profits within the South African manufacturing industry.

CHAPTER 3. RESEARCH METHODOLOGY

This chapter explains the methodology that was used to test the propositions to answer the selected research questions. This section discusses the research paradigm, research design, sampling method, the design of the research instrument, and data collection as well as the methods that will be utilized to analyse and interpret the collected data.

3.1 Research approach

This is a qualitative study to understand the propositions and theories generated from literature review. The qualitative approach is appropriate for this study because, it shows a profound understanding of the participant's behaviour and opinions, and it allows the research to be seen from the perspective of the participants and forms experiential information (Creswell & Creswell, 2017).

The assumptions for this approach are as follows:

• The participants of the interviews brought a deeper insight of the influence of automation on job creation in the manufacturing industry.

• The qualitative approach provided a clear indication of the current reality of the influence of automation on employment in the South African beverage manufacturing industry and was compared to what has been identified in literature review.

3.2 Research design

A qualitative generic design was used for this research because it focuses on gaining insight into the participants' subjective opinions, attitudes, beliefs, and reflections on experiences on the influence of automation on employees in the chosen manufacturing industry (William et al, 2015). The perception of the employees on the influence of automation was collected using semi-structured interviews and interpreted using the thematic analysis method.

3.3 Data collection methods

Data was collected through semi-structured interviews with sampled participants. Semi-structured interviews allowed participants to amenably share their experiences with the perceived influence of automation on employment (Creswell & Creswell, 2017).

Semi-structured interviews have the advantage of having a higher return rate as opposed to questionnaires, and they are also flexible which enables probing and additional questions to be asked of the respondents (Corbin & Strauss, 2014).

3.4 Population and sample

3.4.1 *Population*

The population for this study were workers of any race and gender between the age of 20 and 55 years that were working in the beverage manufacturing industry. The chosen age limit was chosen to test the theory from literature regarding

adults who are over the age of 50 years, because literature indicated that this age group is vulnerable to job displacement as a result of automation.

3.4.2 *Sample and sampling method*

Purposive sampling was used in this study because, it is used to select a fit-for-purpose sample that is relevant to the topic being researched (Corbin & Strauss, 2014).

Seven (7) semi-structured interviews were conducted via Teams to beverage manufacturing companies in Mpumalanga and Gauteng provinces, this was to ensure that purposive sampling provides the dependability of the study.

3.5 The research instruments

Semi-structured interviews with three main sections were used as the research instrument. The first section of the research instrument is the demographic questions for the participants, the second section included questions linked to the perceived influence on automation increasing productivity and revenue, and the third section covers the perceived influence of automation causing job displacement in the manufacturing industry.

3.6 Procedure for data collection

Data was collected through Teams. Semi-structured interviews were conducted via teams to beverage manufacturing employees of the firms based in Mpumalanga and Gauteng Provinces of South Africa. Human Resources managers of the selected firms were approached to follow ethics and to ensure

that respondents prioritize the interviews. Face-to-face interviews were not possible due to Covid-19 lockdown restrictions.

3.7 Data analysis and interpretation

The data collected from the semi-structured interviews was analysed using the thematic analysis method. According to Corbin & Strauss (2015) thematic analysis is suitable for interviews because patterns and themes of the study can be easily identified and analysed.

Steps that were followed:

- The semi-structured interviews were transcribed in order to analyse the collected data.
- Codes were generated.
- Similar codes were combined to identify themes.
- Themes and patterns were identified.
- Data was interpreted and discussed.

3.8 Limitations of the study

- The study focused on organizations that are manufacturing beverages only and the findings of the study might not be a clear indication for the other sectors in the manufacturing industry in South Africa.
- Conducting semi-structured interviews with respondents was time-consuming, and it affected the response rate of the study.

- Due to the pandemic, the interviews had to be conducted online, therefore the availability of resources to attend the interviews could be a challenge.

3.9 Transferability and dependability

3.9.1 *Transferability*

Transferability is the extent to which findings of a qualitative study can be moved into different contexts with different samples (Creswell & Creswell, 2018). There are two qualifying conditions for transferability, and they are, (i) a clear description of the context and (ii) purposive sampling of the research participants (Creswell & Creswell, 2018).

The context of this research is specific to workers in the beverage manufacturing industry that are affected by automation in Mpumalanga and Gauteng Provinces of South Africa. Purposive sampling is also applicable because the only workers in the manufacturing answered the interview questions.

3.9.2 *Credibility*

Credibility is the guarantee that can be placed on the truth of the research outcomes (Corbin & Strauss, 2015). Credibility defines whether the research outcomes are a true reflection of the participants' original data and if their views have been interpreted correctly (Corbin & Strauss, 2015). In this strategy, the researcher used peer briefing where the researcher was looking for feedback and support from other researchers to advance the quality of the findings (Corbin & Strauss, 2015). This research was also guided by a research committee and an

appointed academic research supervisor; therefore, this study should be able to maintain credibility through the correct leveraging of these bodies.

3.9.3 *Dependability*

Dependability can be described as the firmness of the research results as time progresses (Corbin & Strauss, 2014). Dependability involves the results of the study, how they are interpreted, and the recommendations derived from the data collected from the participants of the research (Corbin & Strauss, 2015). All transcripts of the interviews have been kept, and the actual responses guarantees the dependability of this research.

3.10 Demographic profile of participants

The most important demographics of the sampled population that are key to this research is the education, and their income level. This is because the second research question of this study sought to find the negative impact of automation on low skilled and low-income respondents. The second key demographic factor is the age, and the occupation of the participants because it was reviewed in literature that respondents older than 50 years are adversely affected by automation in the beverage manufacturing industry.

3.11 Ethical considerations

This study followed all the required ethical guidelines that have been given by the University of Witwatersrand. Participants were requested for consent before the

interviews commenced and the objective of the study was well explained to ensure that participants understand the aim of the research.

The study did not discriminate anyone based on age, gender (except where a need to check certain impact as per question 2 of this research) or race and lastly, the research will be conducted after obtaining ethics clearance approval from the University of the Witwatersrand.

Table 4. Consistency table: research questions, propositions, data collection, and data analysis method.

RQ #		State Research Question or Objective	Prop #	State Proposition	Data collection detail	Data analysis method
2.1		How does automation cause displacement of jobs for the less educated/less-skilled workers?	1	Automation causes job losses for the low skilled workers.	Interview guide question 10	Thematic analysis
2.2		How does automation cause the displacement of jobs due to the lack of digital skills in adults or age?	1	Automation causes job losses for workers who lack digital skills and are above the age of 50 years.	Interview guide question 12	Thematic analysis
2.3		How does automation create a rise in the economic inequality of workers?	2	Automation increases economic inequality.	Interview guide question 14	Thematic analysis
2.4		How does automation increase productivity and revenue?	2	Automation increases productivity and revenue.	Interview guide question 7& 8	Thematic analysis

CHAPTER 4. DATA ANALYSIS

This chapter presents the results of the study, data that was collected through semi-structured virtual interviews. The participants were employees, who are working in the beverage manufacturing sector in Gauteng and Mpumalanga provinces in South Africa.

Responses from all seven participants during interviews were recorded and transcribed for coding purposes. Initial data coding was done, and 28 initial themes were identified. Further analysis of the initial themes and sub - themes were performed, and six overarching themes were identified as a summary of the collected data.

This section presents the results of the overarching themes in relation to the propositions of the study. Table 5 shows the propositions that were developed from the objectives of this study.

Table 5. Summary of the propositions of the study

Number	State Proposition
1.	Automation causes job losses for the low skilled workers.
2.	Automation causes job losses for workers who lack digital skills and to old, aged workers.
3.	Automation increases productivity and revenue.
4.	Automation increases economic inequality.

4.1 Results pertaining to Proposition 2: Automation causes job losses for low-skilled workers.

The objective of the research question for this proposition was to investigate whether automation causes job losses for low skilled workers in the beverage manufacturing industry.

Responses from participants 1,2,4,5 & 6 indicated that automation does not cause job losses, because the use of automated machinery lead to increases in production and would therefore promote job creation or more workers being required in the sales department and IT department. The results also showed that automation creates more jobs for digitally inclined workers to operate the automated software and production lines. The responses also indicated that automation creates new positions in the industry because use of automated machinery, may result in upskilling of general workers to semi-skilled or skilled or professional workers and thereby being able to fill up new positions that require workers who are digitally skilled.

In contrast, to the responses from participants 1,2,4,5 & 6, participant 3 & 5 indicated that automation causes job losses for workers who are low-skilled and do repetitive manual work. Since automated machinery can do those jobs faster than the general workers/low-skilled workers this would lead to job displacement of such workers. Therefore, unskilled (general workers) are vulnerable to losing their jobs due to the nature of repetitive work that they do, whilst skilled workers are less vulnerable. The results also showed that temporal workers get retrenched compared to permanent workers when automation is introduced in the beverage manufacturing sector.

However, participants 3 & 5 acknowledged that although automation creates new jobs for skilled workers, the rate at which low-skilled workers lose jobs is higher than the jobs that are being created by automation.

4.2 Results pertaining to Proposition 3: Automation causes job losses for workers who lack digital skills and to old age workers.

The aim of this research question, as proposition 3, was to determine whether workers who lack digital skills and old aged workers, are susceptible to losing their jobs as a result of automated machinery in the beverage manufacturing industry.

The responses from participants 1,2,4,5 & 6, indicated that automation does not cause job losses for workers who lack digital skills or those that are old aged, because there are mechanisms in place to train such workers. Work instructions presented in a form of labelled pictures, watch and learn, and method are used to close the literacy gap in the workplace. Results also showed that employers use slow transition methods to introduce automation in the workplace to ensure that workers are able to familiarize themselves with the technological changes.

In distinction, participants 3& 7 indicated that work culture makes it harder to train old age workers given that they are commonly resistant to change, and also due to the lack of willingness to learn. This makes it harder for employers to retain such old age workers, as a result such workers are susceptible to losing their jobs due to implementation of automation in the workplace.

4.3 Results pertaining to Proposition 1: Automation increases productivity and revenue.

The objective of this study was to investigate how disruptive manufacturing using automation can increase productivity and revenue within the South African manufacturing industry in Mpumalanga and Gauteng provinces. Responses from participants 1,4,5 & 6 from the interviews, revealed that automation increases production and revenue in the beverage manufacturing sector because automated production lines enable workers and by translation the firm to produce more beverage within reduced time The results also showed that an increase in revenue is equally proportional to the rate of production of beverage, this was learnt when some participants indicated that they observed a drastic increase in production due to the use of automated production lines in the industry.

The responses also indicated that automation in the beverage manufacturing sector can be applied using automated production lines/automated machinery to increase production and revenue.

Participants 2, 3 & 7 indicated that automation increases the quality of beverage products, this means that using automated production lines improves the quality of produced beverage. The participants signposted that using automated production lines resulted in less spoilage of beverage which resulted in more or the bulk of the beverages leaving the production line with the required quality standards. This indicates that automation plays significant role in product quality control thereby leading to an increase in revenue.

4.4 Results pertaining to Proposition 4: Automation increases economic inequality.

The aim of the research question, for this proposition, was to determine whether automation increases economic inequality in South Africa. Six (6) participants out of seven (7) indicated that automation does not increase economic inequality, because the South Africa beverage manufacturing industry is not yet technologically advanced compared to other developing countries which have advanced in using automation.

However, the participants acknowledged that automation would lead to a disruption wherein skilled, or professionals will be employed. This means more jobs will be created by automation for skilled labours as opposed to unskilled or low-skilled workers.

In contrast, one participant from seven participants, said that automation is currently causing an increase in economic inequality, because automation benefits the middle/high income class, whilst the low-income or less skilled are vulnerable to losing their jobs and becoming poorer.

The main difference between both responses from the participants is that the six participants believe that automation will cause a disruption in a long run as the beverage manufacturing industry advances in using automated machinery, whilst the opposing participant believes that automation is already causing a disruption which is causing job losses for the low-skilled workers.

4.5 Findings.

The findings of the study in relation to the propositions have been presented in Table 6:

Table 6. Summary of the findings in relation to the propositions of the study.		
No	**Research proposition**	**Findings**
1.	Automation causes displacement of jobs for the less educated/less-skilled workers.	1.1 Automation does not result in job losses, because use of automated machinery increases production and requires more workers in the sales and IT departments. As a result, new jobs are created in the process. Moreover, it can be said that automation also create more jobs for digitally inclined workers to who are software savvy and therefore can operate the automated production lines. 1.2 Automation creates job losses for low skilled workers who do repetitive work that can be easily automated.
2.	Automation causes displacement of jobs due to the lack of digital skills in adults or old age.	2.1 Automation does not cause job losses for workers who lack digital skills or old aged employees, because there are mechanisms in place to train workers who lack digital skills and old aged workers. Work instructions presented in a form of labelled pictures, watch, and learn and method are used to close the literacy gap in the workplace. 2.2 It is difficult to train old-aged workers due to their resistance to change which is common amongst them.
3.	Automation increases productivity and revenue	3.1 Automation increases production and revenue in the beverage manufacturing sector because, automated production lines enable manufacturers to produce more beverage within a short period of time. 3.2 An increase in production causes an increase in revenue.

Table 6. Summary of the findings in relation to the propositions of the study.		
No	**Research proposition**	**Findings**
		3.3 Automation increases the quality of production. This is to say using automated production lines improves the quality of produced beverage.
4.	Automation creates economic inequality.	4.1 Automation will cause a disruption in a long run as the beverage manufacturing advances in using automated machinery. 4.2 Automation is already causing a disruption which is causing job losses for the low skilled workers.

CHAPTER 5 DISCUSSION OF RESULTS

5.1 Introduction

This chapter presents the discussion of the results of the study in comparison to the literature review. The discussion will be presented looking at a proposition at a time.

5.2 Discussions pertaining to propositions of the study

5.2.1 Discussion pertaining to proposition 2: Automation causes displacement of jobs for the less educated/less-skilled workers.

The finding of the study for proposition two (2) is that automation does not result in job losses, because the use of automated machinery lead to more workers being needed in the sales and IT departments, as result new jobs are created in the process. Automation therefore creates more jobs for digitally inclined workers to operate the automated software and production lines. This finding aligns with a study by Shook & Knickrehm (2018) that middle and high skilled workers are less vulnerable to job losses caused by use of automated machinery. This means that automation creates new jobs for workers who are skilled or are digitally skilled.

However, the second finding of the study indicated that although automation creates new jobs for highly skilled workers, it also caused job losses for low-skilled workers who do repetitive work that can be easily automated. This finding agrees with literature by Manyika et al., (2011),who concluded that low skilled workers, who do repetitive work are easily exposed and due to automation can be easily displaced from jobs by automated machines.

5.2.2 Discussion pertaining to proposition 3: Automation causes displacement of jobs due to the lack of digital skills in adults or age.

According to Ghimire et al., (2020) and Rapanyane & Sethole (2020) the risk of losing jobs as a result of automation is high in adults older than 50 years whether low or middle-skilled within the beverage manufacturing industry (Ghimire et al., 2020; Rapanyane & Sethole, 2020). Further to that, even graduates older than 50 years are exposed to unemployment because of the difference in the current digital curriculum in higher institutions compared to the curriculum that was taught 20-25 years ago which was digitally informed (Ghimire et al., 2020; Rapanyane & Sethole, 2020).

In contrast to literature stated above, the finding of this study indicated automation does not cause job losses for workers who lack digital skills or old aged employees, because there are mechanisms in place to train such workers. The finding of the study revealed that work instructions, labelled pictures and watch and learn method are mechanisms used to train older- workers and workers who lack digital skills.

Another finding of the study for this proposition showed that it is difficult to train older workers due to resistance to change which is common amongst their peers. This finding aligns with a study done by Vermeulen et al (2018),that states that it is easier to train younger workers compared to old aged workers because of the learning capacity between young and old aged workers.

5.2.3 Discussion pertaining to proposition 1: Automation increases productivity and revenue.

The findings of the study for proposition one revealed that automation increases production and revenue in the beverage manufacturing sector because, automated

production lines enable manufacturers to produce more beverage within reduced period of time. This finding aligns with literature that states that automation does not necessarily cause job losses in specific income classes, because automation increases productivity in the manufacturing industry (Vermeulen et al., 2018).

The second finding for proposition one is that an increase in production causes an increase in revenue. This finding corroborate study by Bessen (2016), which states that high productivity leads to a reduction in prices of products/services which drives an increase in demand, and also drives an increase in new occupations as a result of automation.

Another finding for proposition one is that automation increases the quality of the products. Using automated production lines improves the quality of the produced beverage. This finding agrees with Rapanyane & Sethole (2020) who argues that automation enables the beverage manufacturing industry to be more efficient. Improvement of produced quality of beverages speaks to efficiency, this means that automation allows manufacturers to be efficient and improve the quality of produced beverages.

5.2.4 Discussion pertaining to proposition 4: Automation increases economic inequality.

According Rapanyane & Sethole (2020),automation creates job losses for the low skilled workers and increases economic inequality amongst South Africans.

However, the finding of the study indicated automation will cause a disruption in a long run as the beverage manufacturing industries advances in using automated machineries.

5.3 Conclusion

Table 7. Summary of the Propositions, findings & literature review.

Number	Proposition	Literature review	Findings from collected data
1.	Automation causes job losses for the low skilled workers	YES	NO
2.	Automation causes job losses for workers who lack digital skills and to aged workers.	YES	NO
3.	Automation increases productivity and revenue	YES	YES
4.	Automation increases economic inequality.	YES	NO

Based on Table 7 above, it is evident that automation increases productivity and revenue for the beverage manufacturing organizations based in Mpumalanga and Gauteng Provinces of South Africa. However, the findings of this study, as per the collected data, suggests that automation creates new jobs for skilled workers. The findings of the study also showed that contrary to literature reviewed, beverage manufacturing companies

have mechanisms to train aged workers and workers who lack digital skills. The last finding that did not align with literature reviewed is that automation does not increase economic inequality.

CHAPTER 6 CONCLUSIONS & RECOMMENDATIONS

6.1 INTRODUCTION

This chapter will integrate the findings of the study and the original research questions. This section will present answers to research questions based on the findings from the collected data.

6.2 CONCLUSIONS REGARDING REQUESTION 2: How does automation cause job displacement in the beverage manufacturing industry?

The objective of this research question was to investigate how automation causes job displacement in the beverage manufacturing industry. Findings from the literature review showed that automation causes job displacement for low-skilled workers, because low skilled workers do repetitive work that can be easily automated. However, the findings from collected data showed that automation creates new jobs for skilled workers, because automation creates new jobs in sales and IT departments and other departments that require digital skills.

Findings from literature reviewed revealed automation causes job losses for the low skilled workers because they do repetitive work, however findings from this study indicate that more jobs are created because of automation when compared to the ones that are lost due to automation.

The last finding from previous studies showed that, automation causes job losses for workers who lack digital skills and for aged workers. Contrary to the previous studies, the findings of the study indicated that automation does not result in job losses for workers who lack digital skills because training and upskilling is provided. The findings

of the study also showed that automation does not cause job losses for aged workers because they can be retrained or re-skilled, however, due to their nature in resisting change, this can lead to their displacement.

6.3 CONCLUSIONS REGARDING REQUESTION 1: How does automation increase productivity and revenue in the beverage manufacturing industry?

The objective of this research question was to investigate how automation increases productivity and revenue in the beverage manufacturing industry. Findings from previous research showed that automation increases productivity because it enables manufacturers to produce more beverage through use of automated machineries. Automation enables beverage manufacturers to reduce the time it takes to produce more beverage, as a result increased production causes an in increase in revenue.

The finding from the collected data also showed that automation increases productivity and revenue within a short period of time when compared to conventional methods of manufacturing beverage in South Africa. The findings of this study, from collected data and previous studies, were aligned. This is to say there is no contradiction.

6.4 RECOMMENDATIONS OR PRACTICAL IMPLICATIONS.

In accordance with the literature reviewed and the findings of this study, it is recommended that automation be embraced by the beverage manufacturing industry in South Africa since automation would lead to an increase in production and returns in revenue for the manufacturers. Adoption of automation is also endorsed because the findings of the study show that automation also improves the quality of the beverage, as a result manufacturers experience less beverage wastage.

It also evident that automation would have a great influence on the economy of South Africa because it will enable more production that will result in more economic activities and increase in employment.

It is further recommended that employees in the manufacturing sector be less anxious or less worried about the adoption of automation because automation presents new opportunities to learn new things and it creates new jobs.

Based on the findings of this study it is recommended that employers should continue to train and up skill workers whenever automation is introduced in the beverage manufacturing industry in order to preserve jobs across their human resource spectra and affect positively the South African unemployment statistics.

6.5 SUGGESTIONS FOR FURTHER RESEARCH

Based on the findings of the study and literature reviewed more research should be done to determine, whether the number of jobs losses for low skilled workers as a result of automation are more or less than the number of jobs that are created by automation. The findings of this study showed that there is lack of literature addressing job losses as a result of automation specifically for low skilled workers in South Africa and in Africa.

It is further recommended that further research should be done to determine the stage of advancement in terms of adoption of the 4^{th} industrial revolution technologies in South African and African manufacturing industries. This study will be able to address whether adoption of automation in the beverage manufacturing industry is responsible for the increasing statistics of unemployment in South Africa and in Africa as well.

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ANNEXXURE A: SEMI-STRUCTURED INTERVIEW QUESTIONS



CONSENT FORM

Dear Sir/Madam,

Project Title: The influence of automation on employment in the South African manufacturing industry

Institution: The University of Witwatersrand, Johannesburg (Faculty of Law and Management)

I am a Master's student in Digital Business researching on the influence of automation on employment in the South African beverage manufacturing industry. Research is a logical process of collecting, analysing and interpreting collected data to understand the phenomenon of automation and its impact on the manufacturing industry.

This study aims to investigate the influence of automation on the South African beverage manufacturing industry, whether automation is benefiting the manufacturing industry or it is working against the industry in terms of job creation which has a direct effect on the economy of South Africa. The research is conducted for academic purposes in fulfilment of Master in Digital Business at the University of Witwatersrand Business School.

Thank you for agreeing to participate in the interview which will be used for our research. Please note that the information shared in the interview and questionnaire will only be used for the sole purpose ofour thesis as required by the University of Witwatersrand. You have the right to withdraw from the survey at any time. This consent form was drafted to ensure that you understand your purpose as wellas your involvement in our research.

Upon signing the consent form, the research participant/interviewee agrees to the following:

- Recording of the interview
- Agree to be quoted directly
- Usage of the recording for the sole purpose of research as required by WITS University
- Answers to the questionnaire will be used solely for the research as requiredby WITS University

Should you have any queries regarding the collected data of this survey, you are welcome to send arequest via email to 799081@students.ac.za.

Participant Consent:

I do hereby agree to participate in the above-mentioned study and have read and understood whatthe study entails and that my involvement in the study will be kept confidential. I agree that participating in this study will not result in any penalty, legal action, or loss of any nature.

_____ _____

Participant Signature Date

INTERVIEW GUIDING QUESTIONS

SECTION A: DEMOGRAPHICS

1. How old are you?

less than 30 years old	
30 - 40 years old	
40 – 50 years old	
Over 50 years	

2. What is your gender?

Male	
Female	

3. What is your race?

African	
White	
Indian	
Coloured	

4. What is your marital status?

single	
married	
divorced	
other	

5. What is your highest qualification?

Matric (Std 10)	
Diploma or post matric qualification	
Bachelor's Degree(s)	
Postgraduate degree(s)	

6. What is your income bracket per month?

0 - R10 000	
0 - R15 000	
R15 000 – R30 000	
Over R30 000	

SECTION B: AUTOMATION INCREASING PRODUCTIVITY.

7. Please tell me how the use of automated machinery or automated software increased productivity in yourworkplace?

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8. Please tell me how the use of automated machinery or automated software has increased revenue/profitfor your employer?

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9. Please tell me how has automation created jobs or new jobs at your workplace?

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SECTION C: AUTOMATION CAUSING JOB DISPLACEMENT

10. Please tell me if you are worried that you might lose your job due to some type of automation because youare low-skilled?

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11. Please tell me if you are worried that you might lose your job to automation because your work is repetitiveand can be easily automated?

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12. Please tell me if you are worried that you might lose your job to automation because you lack digital skills,or you are not inclined with the fourth industrial technologies like automation?

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13. Are you worried that you might lose your job to automation because you lack digital skillsand your age as a result you are not inclined with the fourth industrial technologies like automation? Please tell me more about that

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14. Do you think automation causes increase unemployment in South African and it increases economic inequality between the low–income class and the middle and high-income class?
Please tell me more about that

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