Gordon Institute of Business Science
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Adoption of job automation technologies in the fourth industrial revolution: A managerial perspective

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A research project submitted to the Gordon Institute of Business Science, University of Pretoria, in partial fulfilment of the requirements for the degree of Master of Business Administration.

11 November 2019

Abstract

The role of information technology in business has increased in prominence rapidly over recent years. The progression of technology has lead to increased anxiety amongst workers due to the anticipated unemployment that is associated with job automation technologies. It is therefore pertinent for business leaders to understand the impact that the construct of unemployment has on the adoption of such technologies.

This study explores the perspectives of senior and executive managers with regards to job automation technologies. The findings of the study were obtained by conducting seventeen in-depth semi-structured interviews with representation from eight different industries.

The study found that managers consider a multitude of factors when contemplating adopting job automation technologies that span across the internal and external environment as well as the technology domain. Additionally, the study found that jobs that are highly repetitive in nature are more prone to automation.

The findings of this study were mostly supportive of the extant literature. By utilising the existing technology models' new findings were discovered with regards to the negative impact of an unstable power supply, sabotage of the technology by employees as well as the current unemployment levels found in the country have on the adoption of technology.

The researcher found the current technology adoption models are indeed accurate but that they omit the impact that the current unemployment rate of a country has as a moderating effect on the model. This study coherently demonstrates the importance this variable has when managers consider the adoption of technology

Keywords

Job automation, Artificial Intelligence, Fourth Industrial Revolution, Technological Unemployment, Technology Adoption

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

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11 November 2019

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Chapter 1 – Introduction to the research problem

1.1. Introduction

This chapter frames the essential elements of the study that was carried out and provides background to the research by introducing the research problem.

In an era that is now frequently referred to as “the fourth industrial revolution”, this study explores managerial perspectives on job automation technologies within a South African context. Advancements in technology over recent years have generated a significant amount of uncertainty among the workforce. While the gains achieved in the field of technology development have created excitement, there remains a level of anxiety amongst employees around the potential for job redundancy through technological unemployment. Numerous discussions and forums have examined the potential for machines to replace humans in the workplace. This leaves managers with the challenge of understanding what future technologies could mean in real terms for their business and employees. The current rate of innovation is greater than during any other period in history, and a substantial amount of time is being invested by business and academics in trying to anticipate the potential impact on organisations as well as labour. It is necessary to ensure the impacts of these new technologies are addressed and that business leaders are prepared for the disruption of labour markets that tend to be associated with them.

An exploratory study was carried out to identify managerial considerations around the adoption of emerging automation technologies. The study identified several factors that could either promote or discourage adoption. A few of these findings were found to be uniquely South African in nature, owing to the environment in which the managers and their businesses operate.

The findings of this study should not be accepted as the organisational intent to substitute humans with automation technologies as the views expressed by the respondents cannot be viewed in isolation.

1.2. Background to the research problem

Over recent years the associated fields of artificial intelligence, machine learning and robotics have rapidly transformed the range of available job automation technologies. These developments have sparked a wide array of discussions around the role these

technologies may play in the business environment, with specific scrutiny around the potential impact on current and future jobs (Arntz, Gregory & Zierahn, 2017; Autor, Dorn & Hanson, 2015). While the potential effects of job automation technologies and the associated concerns are not confined to the present (Autor, 2015; Mokyr, Vickers & Ziebarth, 2015), the pace of recent developments has reignited the discussion.

For the purposes of this study, artificial intelligence, machine learning and robotics will collectively be referred to as "job automation technologies". It is commonplace at the present moment for artificial intelligence, machine learning and robotics to be grouped together and classified under the single term "artificial intelligence" ("AI"). The role of AI in information technology (IT) strategies has become more prevalent as developments gain traction and businesses explore ways to leverage these in order to remain competitive. IT is increasingly relevant to organisations keen to remain agile; it is perceived as an enabler that can help them achieve their objectives (Drnevich & Croson, 2013). Owing to this increased prominence, it is imperative that businesses ensure the correct technologies are adopted: those that are fit for purpose and will provide a competitive advantage.

Despite the rapid pace at which advancements in AI have occurred, the relative youth of the technology means it is still viewed as "emerging". It is common for managers to be hesitant to adopt technologies that are seen as being in their infancy, primarily due to the risks and high costs that traditionally are associated with emerging technology (Oliveira, Thomas & Espadanal, 2014).

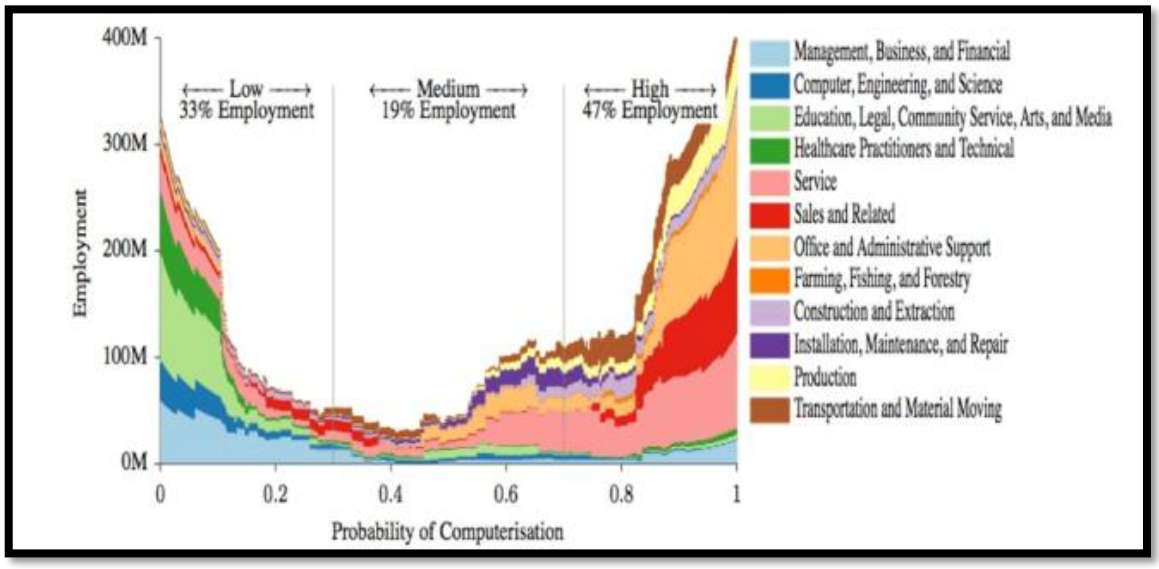
1.3. The research problem

Historically, industrial revolutions have been accompanied by disrupted labour markets and significant challenges relating to specific jobs and tasks (Feldman & van der Beek, 2016; Galor & Weil, 2000; Lafortune, Lewis & Tessada, 2019; Squicciarini & Voigtländer, 2015). The advancements in technology during each of the industrial revolutions have been well documented and date back as far as the 19th century (Rotman, 2013). Preceding revolutions increased productivity while creating jobs that previously did not exist through the change in demand for particular skills (Franck & Galor, 2015; Squicciarini & Voigtländer, 2015). However, this might not be the case in the current fourth industrial revolution (Autor, 2015; Huang & Rust, 2018). Huang

and Rust (2018) posit that the implications of technological advancements for jobs in the fourth industrial revolution are far-reaching and could be more severe than in previous eras.

According to a recent futures study carried out by Frey and Osborne (2017), the current workforce of the United States is highly susceptible to job automation, with up to 47 percent of jobs at risk of being automated within the next 20 years as depicted in figure 1 below.

Figure 1.1 – US jobs' susceptibility to automation



Source: Adapted from Frey and Osborne (2017)

While this study has been criticised for overstating the effects of automation (Arntz et al., 2017; Dengler & Matthes, 2018), the concern around whether jobs will be lost to automation remains. These concerns are further compounded by the ability of artificial intelligence, machine learning and robotics to perform tasks that prove a challenge to humans. These tend to be less expensive to maintain, are able to learn faster and are less likely to lose interest in tasks that are repetitive when compared to people. Essentially, these traits represent significant cost and efficiency benefits to organisations that adopt automation, as the technologies are able to carry out some tasks more accurately and at a lower cost than humans (Qureshi & Syed, 2014).

While the Frey and Osborne (2017) study focused on labour markets in the United States, similar market research was carried out by Accenture (Accenture, 2018) focusing on the South African workforce. Based on their analysis, the Accenture report (Accenture, 2018) found that 35 percent of jobs in the South African market are susceptible to automation. The effect of this would be felt across all skill sets that currently provide labour to business, at all levels. According to Statistics South Africa (2019), the current level of unemployment in South Africa is 29,1 percent. In a country with an unemployment rate currently among the highest in the world, the risk of shedding 35 percent of current jobs is a major concern. The potential disruption that these technologies pose is of concern at a national as well as an organisational level. According to Gilbert (2015), the disruption associated with automation has the potential to influence business processes and transform industries. This view was supported by Gans (2016), who suggested that disruption brings opportunity for organisations to gain competitive advantage by implementing innovative ways of addressing the disruption.

Though a considerable amount of information regarding the potential impact of job automation technologies already exists, the development of this impact is reliant on the actual adoption of the technology. Failure to adopt would mean maintaining the status quo for organisations and employees in terms of business operations but could result in sustainability risks for the organisation.

The need for this research was identified during an attempt to source literature on managers' perspectives regarding the adoption of job automation technologies in the fourth industrial revolution and how they envisage dealing with the disruption that might ensue. From an emerging market perspective there is insufficient literature discussing which elements play a role in the decision to adopt autonomous technologies and the implications thereof on the labour force. This is especially true in the scarcity of top quality (three- and four-star) journals examining the factors that affect the adoption of said technologies.

1.4. Research aims

The objective of this research is to explore how managers view the emergent automation technologies within their industries and functions. Further to this, the research aims to gain insights into the elements that managers consider when

considering adopting artificial intelligence, machine learning and robotics and what the key factors are that either promote adoption or are seen as being a barrier to adoption for their organisation.

In order to gain an understanding of these elements, the study makes use of the following models:

- Diffusion of Innovation (DOI) – (Rogers, 2003)
- Technology Acceptance Model (TAM) – (Davis, 1989)
- Technology-Organisation-Environment (TOE) – (Tornatzky, Fleischer & Chakrabarti, 1990)
- Bounded Automation (Fleming, 2019)

The aims of the study can be summarised as follows:

1. Understand the considerations that come to the fore when managers look to adopt job automation technologies within an emerging market context.
2. Of these considerations, identify which are seen as enablers of or barriers to adoption.
3. Determine which roles are susceptible to automation and how managers intend to deal with the potential technological unemployment.

By gaining insights into the above areas the research intends to build on the current literature by identifying the motivating and deterring factors to job automation as perceived by managers across various industries. The research intends to identify roles that will be required in the future and allow labour to understand which skills will be sought-after going forward.

The aim of this study is not to understand whether an organisation is intent on substituting human labour with machines but rather is concerned with the elements that play a role in the technology adoption process. A further objective of the study is to evaluate how organisational leaders perceive these technologies and intend dealing with the disruption they bring about.

1.5. Scope of the research

The research scope will encompass the views of managers regarding the adoption of job automation technologies. The study aims to understand managerial views on adoption and therefore the scope of the research will be confined to perspectives around adoption at individual and organisational levels. The research sample therefore will be limited to managers who have decision-making powers regarding the adoption of automation technologies. Further to this the research will aim to understand how managers perceive the available technologies and how they plan to address possible disruptions to the labour force.

It is important to note that the scope of the research is limited to the views expressed by the managers and these should not be read as the strategic intent of the organisations to which they belong. The views expressed by the participants should not be viewed in isolation and should not be considered the official position of any organisation with regard to adopting new technologies.

1.6. Significance of the research

IT has moved from the periphery of business operations and is increasingly playing a significant, if not a central, role in business. According to Wu and Chiu (2015), businesses that leverage IT systems and the advancements therein are more likely to gain advantages over their competitors. As most organisations look to gain advantages in competitive markets, this study seeks to gather insights into the perspectives of managers on adopting automation. By understanding the factors that either promote or hamper adoption, the study aims to provide further material in a field that currently lacks high quality literature, as discovered by the researcher at inception. The findings of the research also may contribute to understanding whether, in the South African context, managers are looking to embrace automation, and the potential implications for employees active during the fourth industrial revolution.

1.6.1. Business rationale

According to Frey and Osborne (2017) and a localised report by Accenture (Accenture, 2018), some jobs are at risk of being replaced by machines. It would benefit business to understand how the adoption of job automation technologies could provide competitive advantage while also gauging whether managers are embracing these technologies and what the deterrents to that may be. The fourth industrial revolution is viewed as having a significantly greater negative impact on the labour market than previous revolutions (Autor, 2015; Huang & Rust, 2018) and resultant technological unemployment (Schwab, 2016). From a South African perspective, it would be of interest to understand what role, if any, high unemployment in the country plays in these considerations (Statistics South Africa, 2019), by examining the factors related to bounded automation (Fleming, 2019).

1.6.2. Academic rationale

According to Graetz and Michaels (2018), as the costs of automation stagnate, organisations increasingly are able to afford to adopt job automation technologies. From a theoretical point of view, there is a dearth of literature focusing on these concerns in developing economies such as a country like South Africa, and on how managers perceive job automation and the drivers of adoption across various industries. By gathering data within this field, the research will contribute to the understanding of factors that managers consider when embracing or discarding automation technologies such as artificial intelligence, machine learning and robotics. The results of the research may be used to identify tasks and jobs that could imminently be automatable from a managerial perspective. From a labour economics point of view this could prove beneficial in identifying prospective careers for the future workforce. The research will also provide insights into the construct of bounded automation (Fleming, 2019) and whether this relatively new concept is playing out in an emerging market context.

The considerations raised by the participants of the study will provide insights into the factors that influence the technology adoption process. By analysing these the study will aim to contribute to the literature surrounding the impact these technologies have on the workforce with a specific focus on the enablers and deterrents that managers consider prior to adoption. In recent years much has been made of the

implications of job automation technologies without sufficient literature being produced regarding the enablers of or barriers to adoption.

1.7. Conclusion

Authors have questioned whether machines will make the jobs of humans obsolete (Brynjolfsson & McAfee, 2012; Makridakis, 2017). The debate around technological unemployment is a seam that has run through all previous industrial revolutions (Clark, 2005; De Pleijt, Nuvolari & Weisdorf, 2018; Rotman, 2013), but the fourth industrial revolution has provided technological advancements at a pace far greater than any earlier iterations. These advancements once again have led to technological anxiety with regard to labour market disruption (Huang & Rust, 2018). This study seeks to explore how managers view job automation technologies within their industries in the current age and how these technologies are influencing their business operations. Further to this the research aims to gain insights into factors that influence the adoption of job automation technologies and whether bounded automation plays a role. The study seeks to identify jobs that are seen as imminently automatable by the managers who form part of the study. Additionally, the research will attempt to establish how managers intend to address the disruption brought about by job automation technologies.

This chapter has introduced the study by means of illustrating the problem from a business and academic perspective. The need for the study in relation to this problem was set out together with the objectives of the study. While the study will engage managers regarding their assessment of the job automation technologies available and the adoption thereof, it has been noted that the views offered should not be interpreted as those of the organisation or industry in which they operate.

Subsequent to this chapter the research paper progresses to chapter two, examining the available literature (which is limited to three- and four-star journals). The research questions are introduced in chapter three, which outlines the insights to be obtained. This is followed by chapter four, which details the framework of the research methodology for this study and the manner in which data will be gathered. Chapter five presents the findings of the data-gathering exercise, which is further analysed in chapter six. Chapter seven concludes the study and focuses on the key findings in relation to business and academia before suggesting areas for future research.

Chapter 2 – Literature review

2.1. Introduction

This literature review covers aspects of job automation and the adoption of job automation technologies. First the concept of job automation will be introduced and existing literature in the field of automation will be explored. The literature will set out contrasting views regarding automation and its possible effects on the labour market. A discussion on the various technology adoption models will follow, exploring the common adoption models of diffusion of innovation (DOI), technology acceptance (TAM) and technology-organisation-environment (TOE) and their relevance to this study. The DOI and TOE models deal with adoption at an organisational level, whereas TAM will be used to explore adoption at an individual level, in support of the research problem stated in the previous chapter.

The literature review also will discuss the three previous industrial revolutions and how the technologies introduced during these eras were viewed. The next stage of the literature review will cover the fourth industrial revolution and compare and contrast this with previous revolutions. Finally, the literature review will conclude by contrasting labour market disruptions due to technological advancements in previous eras against the present, fourth industrial revolution.

The literature review was carried out using three- and four-star rated journals to provide a quality review of the field of job automation and the available research around the potential impact of these technologies.

2.2. Job automation

Despite the significant benefits of AI and, by extension, automation to business, providing as it does stimulating, innovative solutions to organisational inefficiencies, the technology is fairly new and adoption levels are moderate. A recent study across 17 economies that included the United States, South Korea, Australia and 14 European countries found robotics used for industrial purposes in around one-third of the economies researched, while adoption of service robots was found to be in the initial stages (Graetz & Michaels, 2018). Nevertheless, the advancements in

automation are progressing at a rapid pace. These provide significant opportunities for organisations over the medium to long term. Major advancements in technology are often accompanied by technological anxiety, and in the age of automation this anxiety is related to potential job losses (Acemoglu & Restrepo, 2018; Mokyr et al., 2015).

This recent progression of technology has led to numerous academic studies being conducted around its implications for labour markets (Arntz et al., 2017; Autor et al., 2015). Technology progression has bred workforce anxiety throughout the ages; it is the pace of progression of these technologies in the fourth industrial revolution that has proved to be a catalyst for the discussions (Autor, 2015; Mokyr et al., 2015). The anxiety could also be attributed to the role that technology has assumed in business environments. As technology occupies a more prominent role in organisations that wish to achieve their strategic objectives, its impact needs to be considered (Drnevich & Croson, 2013). The importance of technology in business cannot be underestimated, however there are barriers to the entry of new technologies. According to Oliveira et al. (2014), risk assessment and cost analysis are of importance to managers contemplating adopting technologies that are seen to be in their early developmental stages. Managers are reluctant to deploy a technology where the risks are seen to be high and the costs at peak (Oliveira et al., 2014).

It has been argued that while robotics has the potential to progress the quality of human lives, it also could disrupt labour markets and productivity (Pratt, 2015). This lends further credence to the anxiety associated with automation. The study by Graetz and Michaels (2018) found that an increase in technology adoption provides organisations with benefits related to improved productivity and lowered production costs. Of significance to this research paper, the study found limited disruption to labour markets in terms of job losses, but also discovered that low-skilled workers were impacted considerably more than higher-skilled workers.

Automation historically has been viewed as machines performing mundane, repetitive and manual tasks along a production line. The advancements in artificial intelligence and robotics has changed the view that production line jobs and low-skilled workers are solely at risk of automation as tasks that require cognitive skills

are also at risk of being automated by intelligent, deep-learning machines (King, Hammond & Harrington, 2017). The professional services industry was also found to be at risk of automation if the functions are compartmentalised and services become more standardised (Susskind & Susskind, 2016). This provides further evidence for the notion that as further technological advancements are made the risk of more jobs being substituted by non-human capital increases.

It is indisputable that artificial intelligence technologies, together with the growth of other technologies, will influence the management of organisational operations and possibly affect employment requirements. One of the key objectives of the revolution of artificial intelligence is to replace, enhance and augment the tasks that are presently being done by humans, thus competing with humans in the labour market (Makridakis, 2017). Graetz and Michaels (2018), offer an alternative view that suggests the decline in the cost of job automation technologies allows organisations to adopt automation to complement humans in the tasks they are required to execute. This in turn results in greater efficiencies and provide productivity benefits and output cost reduction.

The advances being made in the disciplines of human-machine interaction, artificial intelligence, automation and associated fields are bound to bring about remarkable changes in how we interact with these technologies on a daily basis (Janssen, Donker, Brumby & Kun, 2019). While human-machine interaction will be of importance as we progress through the fourth industrial revolution, managers will be dealt a challenge in determining which tasks should be executed by humans and which should be automated (Janssen et al., 2019). It is therefore important for managers to allocate tasks in a manner that enables human-machine interaction to be utilised optimally.

It is thought that the effects of the artificial intelligence revolution will be felt more strongly in developing countries than in developed ones. Primarily this is due to large numbers of the workforce in developing countries comprising the semi-skilled and unskilled components of the labour market, which could easily be substituted by machines. Should this be the case, the cost of labour will decrease significantly, and the gains achieved by making use of cheap labour in developing countries will no

longer be realised. This will lead to developed nations making use of artificial intelligence technologies within their borders to produce similar or better products at approximately the same cost, or even cheaper, of outsourcing to developing countries (Virgillito, 2017). It is therefore necessary to address the skills that will be required in the fourth industrial revolution to mitigate the impact on people whose existing skills are at risk of being automated.

Advancements in automation tend to prompt employees to pivot away from roles that require repetitive actions and are routine in nature, and pursue jobs that are manual but non-routine in nature (Cortes, Jaimovich & Siu, 2017). This may prove to be a challenge if one takes into consideration the view of Autor (2015), who posits that job creation may be hampered by automation which would lead to insufficient new jobs replacing the old ones. While he recognises that in the past changes in technologies led to increased employment, he insists that this is not always the case. He further expands on possible issues that could result in lower employment due to automation: employees who are in a position to provide complementary activities to automation will see an increase in their worth, while the opposite holds true for employees whose tasks are substitutable by automation. However, the resultant gains of the complementary relationship between labour and automation will be diluted by the upsurge in the total supply of labour (Autor, 2015). The potential of a job to be substituted by automation increases where the tasks it involves are manual and repetitive, which a machine can be programmed to perform. Owing to recent advances, machines are able to carry out these tasks easily once they have been coded to do so. By contrast, jobs that require high levels of skill are less at risk of substitution (Decker, Fischer & Ott, 2017).

A further outcome of this scenario is job polarisation due to the relative declining costs associated with automating routine jobs that can be programmed into a machine (Autor & Dorn, 2013). This view is challenged by Susskind and Susskind (2016), who state that highly skilled jobs are at risk of being automated where the required skills tend to be repetitive in nature. Where these contradictory views overlap, it is evident that when it comes to automation the level of skill is less fundamental to the use of the technologies than the repetitive nature of the task.

Frey and Osborne (2017) further support the view that jobs that require low levels of skill, as found in industries like logistics and transportation or office work, are highly susceptible to automation. However, the learning capability of the technologies allows more professional jobs such as doctors, lawyers and auditors to be automated once the tasks that these jobs comprise are compartmentalised (Susskind & Susskind, 2016). It is therefore noteworthy to understand that the technologies driving the fourth industrial revolution have the potential to affect both the blue- and the white-collar worker (Latham & Humberd, 2018; Susskind & Susskind, 2016). By way of example, an artisan such as a plumber could have a lower risk of disruption in comparison to a skilled legal professional (Latham & Humberd, 2018).

To overcome the risk of automation, Frey and Osborne (2017) propose that employees pursue skills that allow them to perform tasks that require social skills or creativity. This was echoed by the World Economic Forum Report (2018), where the top five skills were identified as the ability to solve complex problems, the ability to think critically, the ability to be creative, management of people and collaboration.

Latham and Humberd (2018) state that skills which are practical and have direct applications, together with problem-solving in real time, are more secure against being automated. Agreeing with Susskind and Susskind (2016), they posit that the skills that doctors, lawyers and accountants possess are vulnerable to automation while also highlighting the loss of call centre jobs due to automation. While this view is shared by numerous academics, an alternate view concerns itself with a scenario in which job automation does not necessarily lead to a decline in employment, but rather to an increase where human capital and machines perform complementary tasks. Inferring from the outcomes of the industrial and digital revolutions, this view reflects a case of technology creating a larger number of jobs than it erodes (Deloitte, 2015).

Artificial intelligence and machine learning rarely supplant entire job, process or business model functions; rather they complement the activities carried out by human capital by providing further value adding processes (Brynjolfsson & Mcafee, 2017). To achieve the value-add of adopting automation, employers need to address the displacement of human workers by machines. It is therefore necessary to explore

the possibility of reskilling workers to deploy them in more efficient ways or areas. Latham and Humberd (2018) recommend that reskilling be carried out rapidly, with a focus on skills, qualifications or certifications that can be achieved over a short period of time as opposed to the drawn-out process of pursuing formal qualifications. Essentially this translates into a need for organisations to be agile when dealing with job or task displacement.

It is important to note that the criticism of the Frey and Osborne (2017) study, which used O*NET data, centres around the fact that it focuses on occupations rather than tasks, and assumes the same occupation across industries and geographical regions carries out the same tasks. However, Autor and Handel (2013) have previously found that tasks vary not just between different occupations but even within a single occupation. It is necessary to consider the specific task being executed rather than to take a generic approach to a job or occupation when discussing job automation technologies.

In a study conducted by Lacity and Willcocks (2016) where humans were partnered with robotics the groupings resulted in high performance teams. This is further supported by a local study carried out by Accenture, which found that the more rapidly South African organisations are able to gain the skills required for human-machine collaboration the lower the impact of job losses to machines will be (Accenture, 2018). A further finding of the first (Lacity & Willcocks, 2016) study was that for automation to be successful and provide competitive advantage, the support of senior management is essential.

According to Acemoglu and Restrepo (2018), the adoption of job automation technologies is dependent on the cost of automation versus the cost of human capital. Adoption will occur where the cost of automation is lower than that of hiring an employee to execute a particular task. They posit that the ability of the technology to automate tasks is irrelevant and organisations will adopt the technology on the basis of the financial benefits that can be reaped. From this it can be inferred that managers will consider the cost-benefit relationship prior to adopting technology. Whereas Graetz and Michaels (2018) suggest that the adoption of job automation technologies is driven by an increase in efficiencies and productivity, Acemoglu and

Restrepo (2018) opine that the adoption process is driven by the cost-benefit relationship for organisations with a key focus on the cost of labour versus the cost of automation.

The review of the existing literature indicates the need for research to be conducted that can uncover the views of management regarding job automation adoption in a South African context.

2.3. Industrial revolutions

2.3.1. First industrial revolution, mid-18th century to c. 1830

The first industrial revolution was driven by the transition to new manufacturing processes enabled by the introduction of machinery, steam and water power and the mechanised factory system (Schwab, 2018).

From a human capital perspective, the first industrial revolution was driven by high-skilled and knowledge workers, not by lower-skilled or less educated workers. It was the rise to prominence of these skilled individuals that drove economic development during this period. While the improvement of workers' skills increases efficiency, when adopting technology advancements it is the high-skilled and well educated individuals who are able to adopt these technologies in a beneficial way by utilising innovative methods of implementation to achieve positive results (Squicciarini & Voigtländer, 2015). This view is further supported by Nelson and Phelps (1966) who claim that rapid technological advancements benefit from superior skill sets among workers.

Clark (2005), however, argues that knowledge did not play a prominent role in England during the industrial revolution. He explains that accomplished specialists during this period were supplanted by technology without significant changes being seen in the labour market for skilled and unskilled workers. A number of recent studies have challenged this view, particularly that of Franck and Galor (2015), who argue that during the industrial revolution in France there was a demand for skilled labour.

Technological advancements during the industrial revolution are also seen as the catalyst for the progression of worker skills during this period (Galor & Weil, 2000). The ushering in of innovative technologies in the first industrial revolution resulted in new skills being developed that were not limited to the implementation of the technology at the time, but included those that utilised and supported the technologies (Feldman & van der Beek, 2016).

An alternative view is that the advancements in technology coupled with the adoption of machinery during this period influenced the labour market with an explicit impact on highly skilled workers. The changes brought about by technology rendered obsolete some of the skills offered by these workers. The introduction of these technologies was seen as having the purpose of replacing or substituting worker's skill sets (De Pleijt et al., 2018).

This view is shared by O'Rourke, Rahman, and Taylor (2013) who emphasise that the impact of technological advancements on some industries is more favourable to unskilled than to skilled labour, while negatively impacting the demand for skilled labour. They further mention that while certain industries could be negatively impacted by technology, technological advancements could serve the purpose of being skill-demanding as well as concurrently skill-saving.

2.3.2. Second industrial revolution, late 19th to early/mid 20th century

The second industrial revolution was driven largely by mass production. New technologies that characterise the era (and which helped kickstart the process of globalisation) include the telegraph, railroads, electrical power and the telephone (Schwab, 2018).

The second industrial revolution is generally characterised as a period of skill replacement amongst the workforce. The technological change that took place during this period is unanimously described in previous research as being a substitute for skilled jobs. It has been argued that the introduction of factories had a negative impact on the demand for skilled labour while increasing the demand for

lower-skilled labour (Lafortune et al., 2019). However, Goldin and Katz (1998) argue that while certain jobs such as those of artisans, which were highly skilled, were replaced during this period, they were not entirely replaced by unskilled labour but rather by a combination of unskilled operators and engineers that were highly skilled.

The disruption of the labour market that accompanies technological change can lead to organisations cutting jobs that are occupied by average-skilled workers in favour of jobs that require a mix of unskilled and highly-skilled workers (Acemoglu, 1999). During the second industrial revolution the demand for highly-skilled engineers and unskilled operators increased, while the incumbent technology replaced average-skilled workers, such as sailmakers, which impacted the labour market (Acemoglu, 1999). The technology during this period was therefore both skills-biased and skill-replacing.

Chin, Juhn, and Thompson (2006) argue that technology introduced during the second industrial revolution did not develop the skills that were present at the time, but rather created a demand for new skills to be developed. The greatest impact of this was felt by the average-skilled worker who was supplanted by low-skilled workers under the supervision of high-skilled workers. This view is shared by Gray (2013), who suggests that workers who occupy jobs that require an average set of skills suffer from job polarisation during times of technological advancement.

Lafortune et al. (2019) suggest that capital was seen as a substitute for skilled labour during the period prior to the second industrial revolution. However, the introduction of technology during the second industrial revolution allowed for capital-intensive tasks to be substituted by cheaper, low-skilled labour, thereby displacing a number of skilled jobs. Lonigan (1939) suggests that at the time there was no relationship between technological innovation and the increase in unemployment. The rise in unemployment was attributed to the exorbitant cost of labour during the period, which restricted the number of employment opportunities created.

2.3.3. Third industrial revolution, 1969 to c. 2000

The third industrial revolution followed the invention of the microchip. Computing technology drove the revolution, fostering the ubiquity of personal computers and introducing automation (Schwab, 2018).

Whereas the previous two industrial revolutions had elements of skill-biased and skill-saving characteristics, the third industrial revolution is mainly characterised as skill-biased, resulting in an excessive demand for skilled labour during this period (Liu & Grusky, 2013). The accelerated computerisation and technological changes during this period played a significant role in the disruption of labour markets (Autor, Katz & Kearney, 2008). The high demand for their skills, i.e., the ability to operate computer technologies, provided skilled workers with a sense of job security.

A seminal piece of work by Krueger (1993) argues that the technology that accompanies computerisation could either supplant or complement skilled workers. He posits that the rate of adoption is greater among higher-skilled workers than less-skilled workers. This has led to a demand in the labour market for workers who possess the skills to operate, and perform tasks using, the available technologies.

In an opposing view, DiNardo and Pischke (1997) argue that job security and the demand for skills during the third industrial revolution were exaggerated. They further posit that the introduction of new technologies did not necessarily disrupt the labour market, but that these were rather introduced into jobs already occupied by skilled workers (rather than unskilled workers). The technologies prevalent at the time thus provided greater benefits to the portion of the labour market that happened to be more in tune with the incumbent technological advancements. While the adoption of these technologies was more profound among skilled workers, the impact on less-skilled workers was negligible and did not disrupt the execution of their jobs.

This view is supported by Symeonidis (2014), who argues that the disruption caused by technologies during the third industrial revolution was significantly less than during the previous two. The technological advancements during this period provided

opportunities for new organisations to flourish, rather than drastically impacting existing organisations and their labour force.

2.3.4. Fourth industrial revolution, 2000 to present

The fourth industrial revolution has seen the introduction of smart technology, 3-D printing, genome editing, artificial intelligence and the internet of things (Schwab, 2018). More and more people are online at home and at work, and advances in nanotechnology, quantum computing and biotechnology are made every day.

As demonstrated in the previous sections, the labour market has been confronted with industrial revolutions brought about by technological advancements throughout the ages and can be traced as far back as the 1700's (Rotman, 2013). The current revolution and associated technological advancements are moving at a pace that has not previously been seen. A number of studies have highlighted the potential negative impact the fourth industrial revolution could have on labour markets in terms of technological unemployment (Schwab, 2016).

Historically, previous industrial revolutions resulted in higher productivity and a shift in the labour market to new jobs that were a side effect of the incumbent technology. Autor (2015) opines that this might not be the case in the fourth industrial revolution, as the available technologies seem to be a barrier to the creation of new jobs rather than a stimulus to the labour market.

Whereas previous industrial revolutions impacted specific manual skill sets, the technologies developing in the fourth industrial revolution have the potential to replace skills that were previously believed to be secure against technological unemployment (Susskind & Susskind, 2016). The rapid advancements occurring in the current technological age pose a risk to jobs that require cognitive skills, which could result in impacts on the labour market that have not previously been encountered (Huang & Rust, 2018).

While the above explains the potential that technologies possess, their limiting factor is related to adoption. The widescale negative implications associated with artificial

intelligence, machine learning, automation and robotics are dependent on technologies being deployed at an organisational and industry level. Whereas the potential disruption these technologies might initiate cannot be denied, it is necessary to contextualise the environment wherein they exist. Consideration needs to be given to the regulatory as well as the socioeconomic environment, and whether these permit the adoption on a large scale and as such influence the impact that could result (Arntz, Gregory & Zierahn, 2016; Kim, Kim & Lee, 2017).

In a recent study by Fleming (2019), he introduces the construct of bounded automation. Bounded automation encompasses the elements that play a role in influencing the diffusion of technological adoption from a socioeconomic point of view. Fleming (2019) theorises that three factors impede the adoption of job automation technologies:

- The pricing of labour
- Organisational power relations
- The nature of the task

The price of labour relative to the cost of automating a job influences the decision to adopt automation or utilise manual labour. Where labour is cheap and abundant in supply the cost of adopting expensive autonomous technologies cannot be justified and organisations would rather make use of manual labour.

Organisational power relations are related to the industrial relations that organisations encounter in their business operations. In industries that are highly unionised, employees have significant power with regard to wage negotiations and labour practices. The adoption of automation eliminates the power of employees in such an industry and returns power to the organisation. In an emerging market context, like South Africa, this might not be easily attainable as unions wield significant power in the labour market.

Lastly, the type of task plays a role in whether it is automated or not. Despite technology being available that could provide an autonomous solution, many tasks still require a human constituent in the value chain, especially in the services

industry. Customers do not necessarily want to deal with autonomous technologies when faced with an emergency or an urgent requirement; they still want to interact with a human. However, Fleming (2019) notes that these jobs are characterised by low pay and difficult working conditions.

2.4. Technology adoption models

2.4.1. Diffusion of Innovation (DOI)

Diffusion of innovation theory, developed by Rogers (1995), is the most common theory used when conducting research in the field of IT adoption (Fichman, 2004). DOI theory is concerned with the trajectory of new technology from inception through to adoption with specific emphasis on how innovative technologies progress through a system. The theory examines the rate at which new technologies are embraced at both an individual and an organisational level (Oliveira & Martins, 2011). It is used extensively when in studying the implementation of innovative technologies (Wang & Wang, 2016).

According to DOI, the organisational level of adoption is influenced by three factors: characteristics of the individual or leader; characteristics of the internal organisational structure and characteristics of the external influences on the organisation (Rogers, 1995). In the context of this study it is these three factors that are most salient to the research conducted. The characteristics of the leaders will provide insights into the viewpoints of the managers around the adoption of automation technologies, while the role of the internal organisational structures and external influences will be analysed to determine their contribution in the framing of these viewpoints.

Rogers (1995) goes on to discuss the lifecycle of adopters, comprising of early adopters, early and late majority, and laggards. Within each of these categories the members have varying levels of disposition to adoption.

While this study is not focused on the organisational intention to adopt the technology, it is necessary that the participants frame their responses with regards to the role they fulfil at their organisation. It is therefore pertinent that they consider

the environment that they operate in. Due to the time constraints of this study, the characteristics of the managers will be limited to their attitudes toward the incumbent technologies, with a focus on their perspectives around adoption.

2.4.2. Technology-Organisation-Environment (TOE)

The Technology-Organisation-Environment theory was established in 1990 by Tornatzky, Fleischer, and Chakrabarti (1990). The TOE model pinpoints three elements that play a role in the adoption of technological innovation within an organisation, the technological context, organisational context and environmental context. The internal and external technologies of relevance to the organisation are encapsulated within the technological context, while the organisational context is associated with the traits of the organisation that could influence the adoption of technology. The environmental context relates to the macroeconomic environment in which the organisation operates (Oliveira et al., 2014). The TOE model has been used widely owing to its flexibility in application of the contexts proposed (Cao, Jones & Sheng, 2014). This flexibility permits the model to be applied across a multitude of technological, organisational and environmental contexts (Gutierrez, Boukrami & Lumsden, 2015).

While the usefulness of the TOE model is well established, there are limitations associated with it as well. For one, the model assumes that the making of decisions within an organisation follows a rational process and discounts the possibility of individuals responding irrationally when confined to limited sets of information (Stephen & Judge, 2013). A further limitation of the model relates to the application of the contexts individually as opposed to collectively and the potential resultant outcomes that the collective application could yield (Chen, Preston & Swink, 2016). Taking these limitations into consideration, this study will seek to address these shortcomings when conducting the research to mitigate them. Furthermore, the organisational context will not be expanded on as the research is focused on the views of the individual and not the organisation at large. Where organisational context is referred to this will be used at an aggregated level upon presentation of the results.

2.4.3. Technology Acceptance Model (TAM)

The Technology Acceptance Model was born out of the Theory of Reasoned Action (TRA), which is more generic in nature. The TAM was developed by Davis (1989) to accommodate the need for a model within the information systems (IS) arena (Legris, Ingham & Collerette, 2003). TAM comprises two concepts that are used to judge the intention of an individual to make use of a new technology: perceived usefulness and perceived ease of use. These concepts are utilised to determine behavioural intentions with regard to the adoption of a technology (Gangwar, Date & Raoot, 2014).

The technology acceptance model, in contrast to the technology-organisation-environment model, deals with the realm of the individual level where perceived usefulness is a fundamental element of the usage intentions of an individual (Venkatesh & Davis, 2000). Through empirical research it was found that TAM is responsible for roughly 40 percent of the processes that influence the adoption of technology (Legris et al., 2003).

For the purpose of this study, TAM is seen as a useful and relevant model for gauging the perceptions of managers around job automation technologies. The research aims to understand whether managers perceive the adoption of job automation technologies in a positive light and whether they foresee any benefits if they adopt the automation.

2.5. Conclusion

The literature review introduced the concept of automation by covering artificial intelligence, machine learning and robotics – the key inputs to job automation technologies. An analysis was then done to suggest models that are of relevance to the adoption of job automation technologies. It became apparent that while a number of adoption models exist, there is a lack of automation adoption models that considers managers as individuals and their perceptions regarding the adoption of job automation technologies. The technology acceptance model and technology-organisation-environment models, together with the diffusion of innovation theory,

are of relevance to this study.

The literature then reviewed the first, second and third industrial revolutions and the implications of the new technologies introduced during those periods. Essentially the foregoing industrial revolutions shifted the labour market in a positive manner and resulted in increased growth and productivity (Trew, 2014). This trend is seen across previous industrial revolutions despite job security fears and the impact that automation could have on employment (Pratt, 2015). Pratt (2015) notes that the current pace of technological advancements could prove to be significantly more detrimental to the labour market than previous revolutions owing to the ability of robots rapidly to develop and learn. He further postulates that this will result in a negative impact on the labour force across various industries.

While innovation could result in jobs being created, the adoption of new technologies and automation may increase unemployment (Castro Silva & Lima, 2017). The rapid pace of the development of technologies such as artificial intelligence, coupled with the skills and capabilities of the labour force in current times, presents managers with the opportunity to transform organisations (Colbert, Yee & George, 2016). Fleming's work regarding bounded automation (Fleming, 2019) introduces a new wrinkle to the adoption of autonomous technologies and how the macroeconomic environment influences adoption. While significant amounts of literature have covered the fourth industrial revolution and the potential impact on the labour market, the literature review set out above shows that technological anxiety was prevalent throughout all previous industrial revolutions. The researcher aims to provide a conceptual model based on the findings of the research that integrates the constructs of job automation and the adoption thereof while determining the key factors that promote or hamper adoption by managers in a South African context.

Chapter 3 – Research Questions

3.1. Introduction

Following the presentation of the existing literature in chapter two, chapter three sets out the research questions of this study as guided by the literature. Chapter three puts forward three research questions, devised by taking into consideration the research problem in chapter one and influenced by the existing research presented in chapter two. The purpose of the research questions is to gain insights into how the technologies available in the fourth industrial revolution are perceived by business with regard to their adoption and impact.

3.2. Research question 1

Understand which key factors play a role when managers consider job automation technologies.

RQ 1 – this question seeks to establish what the critical factors are that managers consider when considering adopting job automation technologies. This question will be analysed using the technology acceptance (Davis, 1989), technology-organisation-environment (Tornatzky et al., 1990) and diffusion of innovation (Rogers, 1995) models. The findings will subsequently be validated against the recently-introduced bounded automation theory (Fleming, 2019).

3.3. Research question 2

Of these factors, which are considered to be important in enabling or hampering adoption? Does bounded automation play a role in influencing the adoption of automation?

RQ 2 – this question seeks to identify potential patterns across various industries and among managers when identifying the factors that promote or disincentivise adoption. The question is also expected to identify in which aspect of the three models being applied these factors reside. The bounded automation theory will be factored in where it is found to be appropriate.

3.4. Research question 3

Which jobs or tasks are seen as the most likely/least likely to be automated within the next five years?

RQ 3 – the purpose of this question is to identify whether there is consistency between the literature review with regard to the jobs that are highly susceptible to automation and the perspectives of managers on jobs that are going to be automated. The question will seek to gain insights from the interviewees regarding the characteristics of the jobs that are mentioned. A sub-question of this would be "*how do managers intend to deal with the workers whose jobs they feel are imminently automatable?*"

3.5. Conclusion

Chapter three has posed the research questions that the study will aim to address. As stated in the research problem, in the midst of the fourth industrial revolution the growth of technological anxiety has increased due to the capabilities of technology. By gaining insights into the research questions this study presents an opportunity to address certain anxieties that currently exist. Chapter four will set out the research methodology to be utilised for this study.

Chapter 4 – Research methodology

4.1. Introduction

As established by the literature review, this field of study remains somewhat narrow and the academic literature available regarding the adoption of job automation technologies is limited. The foundation of the research design and research methodology is based on this review. The method of research selected is of importance: it must enable an informed research design decision. It assists with determining the strategy and choice best suited to the research and the researcher (Saunders, Lewis & Thornhill, 2016). This study follows a qualitative and exploratory approach, supported by the research method, research design, data analysis and data sampling as laid out in this chapter.

The data was collected via semi-structured interviews with managers within the sample. An analysis and categorisation of the data was subsequently carried out using ATLAS.ti software. This chapter concludes by addressing any concerns around reliability and validity, as well as the limitations of the study.

4.2. Research design

The research questions are central to deciding whether to pursue a quantitative or qualitative study (Marshall, 1996). This view is supported by Sarker, Xiao and Beaulieu (2013): “How the problem is formulated directly impacts a study’s design, data collection, and analysis” (p. vi).

According to Zikmund (2000), qualitative and exploratory research is defined as “Initial research conducted to clarify and define the nature of the problem” (p.102). This study was conducted via an exploratory approach, since its aim was to gain insights into the managers’ perspectives relating to the adoption of job automation technologies and the constructs that influence adoption decisions. It therefore uses a mono-method, as the data was obtained solely via a qualitative process (Saunders, Lewis & Thornhill, 2016). Exploratory research is most applicable when the study seeks to examine an area within a field of study with which the researcher is not well acquainted (Saunders & Lewis, 2012). Furthermore, qualitative research appropriate for fostering a meaningful understanding of an activity while focusing on the aspects

of discovery and exploration (Bloomberg and Volpe, 2012). A qualitative approach permits a meaningful study of an intricate environment to be carried out with the aim of providing answers to the “why” and “how” of the study subject (McCusker & Gunaydin, 2015).

Saunders et al. (2016) describe exploratory research as a method that allows one to gain an understanding of a problem and obtain insights in a manner that is flexible and can be adapted, which at inception is far-reaching but is gradually refined to produce a narrow context.

This study occupies the interpretivist paradigm as the research was conducted to obtain the views of managers across industries about automation adoption and which elements are considered to be influential when such decisions are made. The managers were prompted to provide their views and ideas, which tend to be subjective in nature. The researcher interacted with the managers to gain a deeper insight into their outlook on the subject. The interpretivist paradigm tends to produce qualitative data by using small samples.

Because there is a lack of overarching theory around job automation adoption, an inductive approach was used to allow for the development of patterns that could lead to a theory emerging from the data that was gathered. As the time available in which to conduct this research was limited, it was necessary to conduct a cross-sectional study as opposed to a longitudinal study (Saunders & Lewis, 2012; Zikmund, Babin, Carr & Griffin, 2013). The researcher conducted semi-structured, in-depth face-to-face interviews with all participants in the study. The researcher initially anticipated having to use digital tools such as Skype or WhatsApp to conduct at least some of the interviews, but thanks to the availability of the participants and access to the researcher’s networks this proved not to be necessary. The interviews conducted with each respondent were once-off with no follow-up engagement taking place. This research will therefore represent only a set of findings uncovered over a specific period.

4.3. Population

Saunders & Lewis (2012) define the population as all members of a group. Saunders et al. (2016) further expand on this definition and state that the population comprises

the set of cases in its entirety wherein a sample may be obtained. The cases possess similar characteristics which are of relevance for the purposes of the research (Zikmund et al., 2013). Zikmund (2003) states that in order for the research questions to be answered adequately, it is of paramount importance that the data is obtained from the correct sources.

As such, the population for the purposes of this study is identified as managers who occupy decision-making roles with regard to job automation. The population will include both executives and senior managers who are closely aligned to the implementation mechanisms of technology adoption in their organisations.

The researcher opted to exclude middle managers from the study on the basis that a population comprising executive and senior managers lends the study more credibility. Furthermore, the researcher imposed the criterion that each manager interviewed must belong to an organisation with a minimum of 200 employees. The purpose of this limitation was to ensure that the views expressed by the participants have applicability to scenarios involving job automation technologies.

4.4. Sampling

Because the researcher lacked access to the total population of all executive and senior managers across industries, a non-probability sampling technique was used (Saunders & Lewis, 2012). Respondents were sourced via the researcher's current organisation, where qualifying managers were approached to participate in the study as interviewees. The researcher also used purposive sampling, exercising their own judgement to select managers who met the selection criteria and were deemed accessible for interview. The researcher also requested referrals from managers being interviewed for colleagues who might be available to participate, thus making use of snowball sampling. The researcher also leveraged personal and professional networks to obtain interviews with managers within organisations that met the criteria.

As mentioned above, in order to lend credence to the data the researcher sought to interview managers of organisations with no fewer than 200 employees. As this research is an inductive qualitative study, non-probability purposive sampling is the method best suited (Kohler, 2016). The researcher intended to conduct interviews across industries to ensure diversity and dissimilarity, which will contribute to the

depth of perspectives gathered (Saunders & Lewis, 2012). The researcher engaged each prospective interviewee prior to arranging an interview session to establish their availability and provide background to the research.

The prospective interviewees were also notified of the need to record the interview. In the event that the interviewee declined to be recorded, the researcher would not pursue an engagement with the respondent. In the event that an interviewee opted out of the study post the completion of the interview, the researcher would delete the recording and the findings related to the specific data collected. Neither of these scenarios played out: all participants agreed to be recorded and none requested to opt out of the study at any point.

According to Mason (2010), 20 is an acceptable sample size for a qualitative study. Saunders et al. (2016), however, state that for a qualitative study that utilises non-probability purposive sampling there are no prescriptions in terms of the sample size. The researcher therefore set out to engage between 15 and 20 managers to obtain their perspectives on the adoption of job automation technologies, or fewer if the study approached data saturation.

Saturation occurs once the data being gathered ceases to provide any additional insights into the study being undertaken (Flick, 2014; Saunders, Lewis & Thornhill, 2016). Saturation can be categorised into two components – meaning saturation and code saturation. Meaning saturation relates to the understanding of the items highlighted during collection whereas code saturation is associated with the array of issues that are raised during the data collection (Hennink, Kaiser & Marconi, 2017).

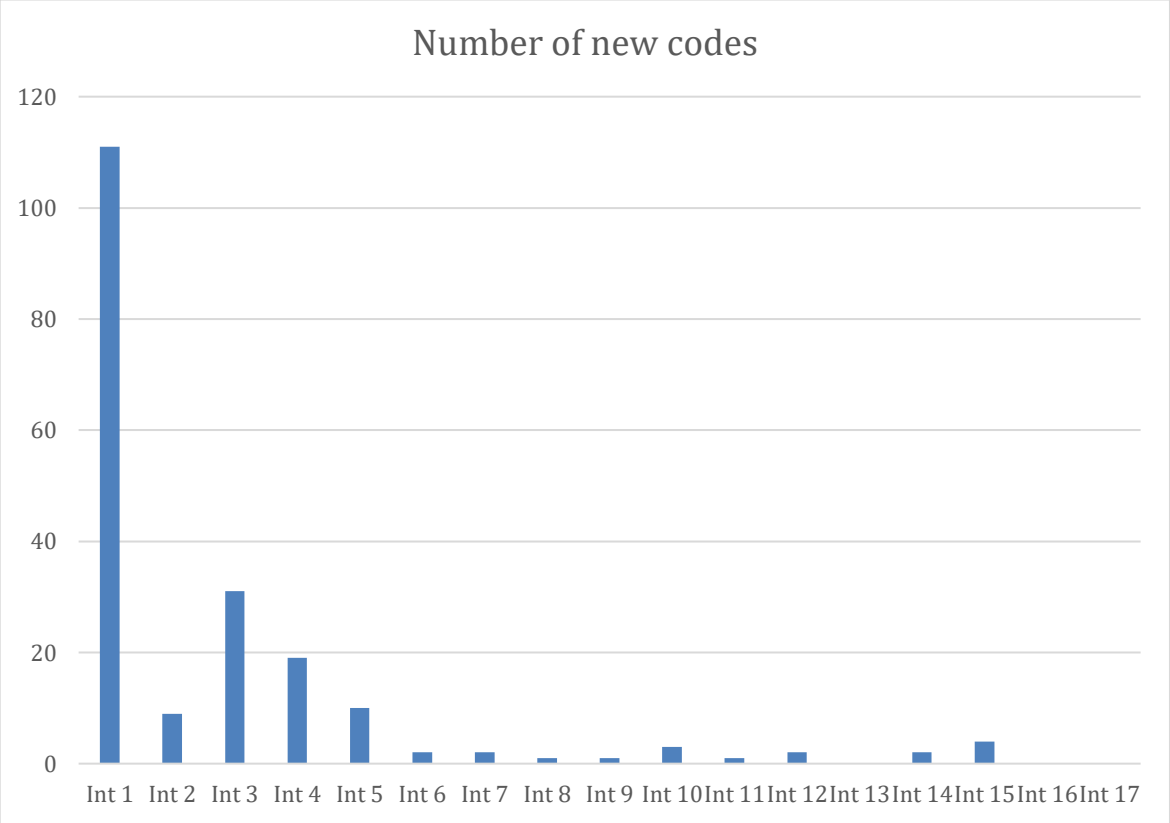
Saturation was identified at interview 13, with no new codes being generated. During interview 14, conducted to confirm saturation had been reached, the interviewee offered two new codes which resulted in further interviews being scheduled. Saturation was then re-approached at interview 16 and confirmed by interview 17, as both engagements produced no new codes.

It is worth noting that after interview five, no more than four new codes were generated per interviewee. From the 12 remaining interviews conducted, interviewee 10 produced three new codes and interviewee 15 four new codes. All other participants generated a maximum of two new codes – it could therefore be argued that saturation was approached at interview six. The researcher however opted to

pursue the interviews in order to gain a deeper learning of managers' perceptions across a diverse range of industries.

The researcher utilised the method described by Guest, Bunce, and Johnson (2006) and recorded a code as it was introduced to the study and illustrated as per the figure below. The codes were managed using ATLAS.ti software.

Figure 4.1 – Number of New Codes



4.5. Unit of analysis

The unit of analysis for this study is the perspectives offered by individual managers in the sample. This refers specifically to the factors that are considered when faced with the adoption of job automation technologies and their perceptions thereof.

4.6. Interview schedule

According to Saunders and Lewis (2012), semi-structured interviews provide an advantage in that the interviewer may probe the interviewee when necessary while still being able to move easily between questions. Using similar questions during

each interview process improves the analysis of the data from a comparability perspective (Flick, 2011). Following this process, any variances in the data collected can be credited to distinctions between respondents, and this phenomenon makes it necessary for one to employ an interview guide to steer the interview. The literature review set out in chapter two informed the interview guide with the aim of addressing the research questions raised in chapter three.

4.7. Data collection

The researcher's decision to conduct semi-structured, face-to-face interviews was further informed by Saunders and Lewis (2012), who state that an effective technique for carrying out exploratory research is to use academic literature and in-depth interviews. The in-depth nature of the interviews allowed the researcher to gain significant insights into respondents' views. The interviews were scheduled according to the respondents' availability. Where necessary the interview was either shortened or extended to accommodate the interviewee while ensuring each got their salient points across to ensure a rich set of data was gathered (Rowley, 2012).

The researcher is based in the Johannesburg area, and all 17 participants were interviewed within this region. Thirteen of the interviews were conducted at the respondents' premises, two at the Gordon Institute of Business Science campus, one at the researcher's organisation and the last at a professional workspace in the Sandton CBD. Each of the interviews was carried out in a secluded room at the respective venues to minimise potential disturbances (Saunders & Lewis, 2012). The interviews were recorded, once consent was received, on a mobile device and subsequently loaded to Google Drive.

The data collection phase spanned a period of three weeks, during which the 17 interviews were conducted with managers from across eight industries. The managers were categorised into executive or senior management based on their job titles. Where a job title was unclear (interviewees 13, 15 and 17), the researcher requested clarification from the interviewee as to where their role was categorised within their organisational structure. The shortest interview lasted 13 minutes and the longest 47. The average duration was 30 minutes.

Table 4.1 – Research interview subjects

Interview	Industry	Position	Management categorisation
1	Mining	Information Systems Manager	Senior Manager
2	Mining	Chief Information Officer	Executive Manager
3	Information and communications technology	Operations Director	Executive Manager
4	Mining	Information Systems Manager	Senior Manager
5	Legal	Director for Litigation	Executive Manager
6	Telecommunications	Senior Manager: Operational Finance	Senior Manager
7	Telecommunications	Executive Head of Department	Executive Manager
8	Manufacturing	Executive Director	Executive Manager
9	Telecommunications	Executive Head of Department	Executive Manager
10	Telecommunications	Managing Executive: Finance	Executive Manager
11	Telecommunications	Executive Head of Department	Executive Manager
12	Mining	Head of Group Treasury	Senior Manager
13	Petrochemicals	Improvement Manager	Senior Manager
14	Manufacturing	Global Transport Manager	Senior Manager
15	Energy	Senior Manager	Senior Manager
16	Information and communications technology	Senior Manager	Senior Manager
17	Banking	Head: Banking Collections	Executive Manager

4.8. Data Analysis

A qualitative data analysis was used to bring meaning to the data collected in the interviews. The research model developed by Saldaña (2015), which groups codes with similar meanings and categorises them accordingly, was utilised in the data analysis process. Saldaña's (2015) code-to-theory model advocates the grouping of codes to enable thematic analysis. The audio recordings were transcribed and loaded into ATLAS.ti for further analysis. Because the data was of a qualitative nature, quotes from the interviews were used to emphasise or support specific concepts (Lewis, 2015). A thematic analysis was performed on the data by coding the interview transcripts, combining these codes, and categorising them into themes.

Thematic analysis is a method for identifying, analysing, and reporting patterns or themes within data (Fugard & Potts, 2015). A theme represents a concept that emerges from an identified pattern of responses or meaning within the data set. It is important to note that the frequency with which a theme recurs does not necessarily define its significance.

Each interview was coded relatively shortly after it had been concluded, as recommended by Merriam and Tisdell (2016). This allows for subsequent interviews to be informed by the findings. According to Bloomberg and Volpe (2012), the researcher should absorb the data so as to be acquainted with the information and to facilitate the process of detecting patterns. They further state that the researcher should be flexible when analysing the data and avoid forcing information into existing categories. This was taken into consideration throughout this study, as evidenced in the number of interviews and the occurrence of limited new codes from interview six onwards.

4.9. Researcher bias, reliability and validity

When assessing a measurement, the two critical aspects are reliability and validity (Saunders & Lewis, 2012; Zikmund et al. 2013). Reliability relates to the dependability of a measurement where it is able to be applied over different periods and return consistent results. Validity relates to the aspect of accuracy and whether the measurement is fulfilling the purpose of the intended measure (Zikmund et al. 2013). The nature of qualitative research means there is a risk that data could be contaminated through interviewer or interpreter bias (Saunders et al., 2016). It is also generally understood that the fruits of qualitative research tend to be subjective.

This subjectivity can raise concerns around the validity and reliability of the data collected (Zikmund et al., 2013). To mitigate these concerns Creswell & Miller (2000) advocate utilising validity procedures to produce results that may be seen as authentic and trustworthy.

In order to mitigate the concerns around validity and reliability, the researcher sought an independent party to engage in the study. Throughout the data analysis process snippets of the data were shared with this individual and the researcher's findings tested against those of the external party. While the sheer volume of information did not permit sharing the complete set of data with the independent party, the key areas

and findings deemed to be important were validated with this individual to ensure that the researcher's interpretation was not biased.

4.10. Limitations

As discussed, the qualitative nature of this study suggests the data gathered will most likely be subjective. The researcher is not formally trained to conduct interviews, which may have an effect on the interviews and the data these gather (Agee, 2009). That it is impossible to engage the entire population for this study could lead to sampling bias on the part of the researcher. The researcher has attempted to address these possibilities by conducting interviews across various industries and different levels of management seniority. The results of this study cannot be generalised across all industries based on the small sample of 17 interviewees who were engaged during the short period over which the study was conducted.

Most important for this study is the limitation around the interpretation of managerial views on the adoption of automation. These do not reflect the organisational view and thus cannot be viewed in isolation as being the sole driver of job automation. The sample for this study resides within the borders of South Africa and consequently the macroeconomic environment and many other factors need to be considered prior to job automation technologies being adopted.

This study is focused on automation and adoption thereof and is therefore limited to the perspectives offered by managers with regard to these. The study does not aim to research any additional levers that play a role in the adoption of automation or the strategy of the organisations to which interviewees belong.

4.11. Delimitations

The researcher sought to engage senior managers and executive managers for the purposed of this study. It was thought that the seniority of this management sample will provide deep insights into the views around job automation technologies and the adoption thereof.

4.12. Ethical considerations

Prior to the data collection phase, it was necessary for the researcher to obtain ethical clearance from the Research Ethics Committee. Once this had been granted the researcher set out to collect the data. Each of the participants was asked to agree to the interview and a signed informed consent form (Appendix A) was obtained as proof of their consent before the interview started. All participants were assured confidentiality and anonymity, regarding both their identity and that of their organisation (Bloomberg & Volpe, 2012). No organisational data has been disclosed and the names of the participants have not been revealed. Of importance to the study were the participants' job titles, which demonstrate that they occupy positions that involve decision-making.

Chapter 5 - Results

5.1. Introduction

This chapter presents key findings from the semi-structured interviews conducted with the 17 participants in this study. The participants were drawn from a heterogeneous group of organisations and held different positions. The key findings are presented as they relate to the research questions posed in chapter three. The presentation of the results set out below are based on the themes that emerged from qualitative analysis of the interviews, and in relation to the research questions.

During analysis of the interviews, codes were categorised into code groups which subsequently informed the themes that emerged from the data analysis. These were used to answer the research questions where relevant.

This chapter begins by presenting a description of the participants in the study, followed by a presentation of the results from the qualitative analysis.

5.2. Description of participants and context

Table 5.1 – Interviewees in order of interview conducted

Interviewee	Industry	Position	Number of employees	Interview length (minutes)
1	Mining	Information Systems Manager	+/- 6000	27
2	Mining	Chief Information Officer	+/- 15 000	13
3	Information and communications technology (ICT)	Operations Director	+/- 40 000	43
4	Mining	Information Systems Manager	+/- 8000	40
5	Legal	Director for Litigation	+/- 1000	35
6	Telecommunications	Senior Manager: Operational Finance	+/- 5000	37
7	Telecommunications	Executive Head of Department	+/- 4600	34
8	Manufacturing	Executive Director	+/- 250	27
9	Telecommunications	Executive Head of Department	+/- 5000	20
10	Telecommunications	Managing Executive: Finance	+/- 5000	23
11	Telecommunications	Executive Head of Department	+/- 3000	49
12	Mining	Head of Group Treasury	+/- 4000	23
13	Petrochemicals	Improvement Manager	+/- 30 000	24
14	Manufacturing	Global Transport Manager	+/- 2000	37
15	Energy	Senior Manager	+/- 7000	27

16	Information and communications technology (ICT)	Senior Manager	+/- 1000	19
17	Banking	Head: Banking Collections	+/- 900	47
			Average	30
			Total	453

The names of the participants and their respective organisations are not disclosed to preserve their anonymity. Furthermore, this study aimed to obtain managerial views on the research topic and therefore the organisational details of the respondents were deemed irrelevant, other than their job title. It was important to ensure the respondents' roles are of relevance to the research, that is, decision-making roles in terms of the conventional responsibilities associated with such positions. As mentioned above, respondents were drawn from a diverse set of industries that were accessible to the researcher. The purpose of the varying set of industries selected was to allow the researcher to gain a heterogenous view of the subject and enable collection of a rich set of data.

Seventeen semi-structured interviews were conducted with senior and executive managers across eight industries. The telecommunications industry had the greatest representation with five respondents, followed by the mining industry with four. The information and communications technology (ICT) and manufacturing industries were represented by two respondents each, followed by the legal, petrochemical, energy and banking industries, each being represented by a single respondent.

To ensure the respondents views display significant relevance to the adoption of job automation technologies and the potential impact on the labour force, the researcher was careful to exclude managers from organisations with fewer than 200 employees. The organisations from which the sample was drawn range in size from approximately 250 to 40 000 employees across eight industries.

The 17 interviews were conducted via face-to-face engagements within the Johannesburg region, 13 at the premises of the respondents, two at the Gordon Institute of Business Science campus, one at the researcher's organisation and one at a professional workspace in the Sandton CBD, all in a secluded room at each venue. All respondents were introduced to the study by the researcher and furnished with the interview questions prior to the interview. Several respondents requested

clarity on the concept of organisational power prior to the interview. Prior to the recording of each interview the researcher assured respondents that their identity, and that of their respective organisations, would not be revealed as part of this study.

Upon commencing each interview, the researcher opened by reiterating the guarantee of anonymity of both respondent and organisation and explaining that the research sought specifically to gain insights into the respondent's own views. The results of this study should not therefore be extrapolated to any specific organisation or industry as the data cannot be viewed in isolation when considering organisational or industrial intentions to adopt job automation technologies.

5.3. Results: research question 1

RQ. 1. Understand which key factors are taken into account when job automation technologies are considered.

The purpose of this research question was to gain insights into which elements are of relevance when managers consider the available technologies for adoption.

5.3.1. How managers perceive job automation technologies

5.3.1.1. Positive emotions towards technologies

In most cases the respondents displayed high levels of positive inclination towards the technologies currently available in the midst of the fourth industrial revolution. The main consideration around this positivity was the ability of the technologies to offer efficiencies and optimise business processes.

> Interviewee 3: "*Personally I've seen a lot of great things being able to take place because of things like machine learning and AI*."
>
> Interviewee 4: "*I would say I am very for them*."
>
> Interviewee 7: "*I have a very positive view of these technologies. I think that the technologies can be used in business to make it more efficient, save money and also produce better insights for the organisation as a whole*."

While a lot of recent discussions have centred around the possible negative outcomes of the fourth industrial revolution, the majority of respondents expressed excitement in relation to the revolution and its technologies.

> Interviewee 1: "*It is an exciting space and I do see some traction, you know*."
>
> Interviewee 2: "*So, like I said in the beginning, I think they are very exciting*."
>
> Interviewee 6: "*In my view, particularly in my organisation, we are very excited about the fourth industrial revolution…*"

These positive inclinations were not restricted to any one industry; positive perceptions were shared across industries and across both senior and executive management roles. It therefore can be said that the technologies that are available and that continue to emerge during the fourth industrial revolution are seen in a positive light by senior and executive managers.

5.3.1.2. Negative emotions towards technologies

While the majority of participants displayed positivity towards emerging technologies, an alternative view was offered by respondent five:

> Interviewee 5: "*We don't seem to be there at all, we experience these solutions, but they always deliver less than what is promised.*"

This view was further corroborated by interviewee 13, who elaborated on the expectations of the technology versus its actual functionality:

> Interviewee 13: "*Currently at this stage I feel that a lot of these technologies don't necessarily play within the sphere of what technologies could be doing. If I think of a lot of the automation technologies, I think a lot of them are either old type or robotic automation or it is programming of a lot of if statements. So, it is not necessarily always new, so I believe that we currently are in a bit of phase of a bit of buzz word, that a lot of consulting firms are selling and stalling to figure out exactly what to do…*"

The views expressed by these two participants seemed to be based on the expectations created by service providers in the course of selling technologies to the respective organisations. The overselling of the technologies' ability to resolve business issues has resulted in these respondents' viewing them in a negative light.

Interviewee 3, who held an otherwise positive attitude towards the technologies, did raise a concern:

> Interviewee 3: "*As technology gets more and more advanced my concern personally is we are creating digital footprints that is going to define us. It is something that can harm you in the future without you even knowing… So, personally, I am quite concerned about, one, how the data will be managed. Two, with the fact of artificial intelligence and machine learning is on the rise that we will become beholden to the actual sort of manufacturers, but also just the applications that drive that*."

This sentiment was echoed by interviewee four, who had a positive inclination towards the technologies but also held reservations around the privacy of data:

> Interviewee 4: "*I mean if you look at that thing, what was that Cambridge Analytica how with the data gathered they actually manipulate people. I think that's something to be very cautious of. Who is going to watch these people that that doesn't happen? I mean it has already happened now that the info generated is being used for… yes to generate money but for the wrong things… I mean there was some stat that said in like five years' time there is going to be like 17,000 points that they can analyse a person on. That's hectic!*"

Thus, managers with an overall negative view of emerging technologies formed these attitudes in response to the unrealistic expectations created by service providers when selling the technologies to organisations, rather than the technology itself. It is interesting to note that two respondents who generally viewed the technologies in a positive light raised concerns around the data generated and stored by these technologies. In the age of Big Data and data analytics, the management and security of data in the fourth industrial revolution is of paramount consideration.

5.3.2. Organisational considerations

5.3.2.1. Industry impacts decision to adopt technologies

Industry category can play a role in whether an organisation will adopt emerging technology during its early stages or be prompted to respond to a technology that is disrupting its market.

Two interviewees from the mining sector shared the view that the nature of the industry does not necessitate being a first mover or an early adopter of new technologies. Interviewees 1 and 4 shared similar views with regard to the mining industry.

> Interviewee 1: "*We are never going to be cutting edge. That is probably because we're mining and don't have to go out and find business. It is very much… it is a very fixed industry I suppose*."

> Interviewee 4: "*I do think it is very industry specific as well.*"

The cyclical nature of the mining industry also played a role in deciding whether or not to adopt a technology due to the availability of funds during a commodity price high or low cycle.

> Interviewee 1: "*Being in the commodity space we go through these cycles where there is money and then there is not money*."

> Interviewee 4: "*We need immense amounts of capital to automate stuff and it is not that capital is just freely available, especially in these times. I mean, we're very cyclical*."

Interviewee 16 hailed from the information, communication and technology (ICT) sector, providing digital offerings to customers. This respondent felt it was necessary that their organisation be at the forefront of available technologies and adopt new technologies in order to provide their customers with a cutting-edge experience.

> Interviewee 16: "*I think we are also one of the front leaders in all the digital spheres and automation around you know, being a leader in providing point of views to clients. So, for our organisation it's important to apply it internally because we are supposed to be giving it out to clients as well, and then implementing it there*."

A distinction became apparent between the perspectives of the mining and information, communication and technology (ICT) industries around the need to be at the forefront of the available technologies. A possible reason for this difference between the sectors was offered by interviewee 13:

> Interviewee 13: "*I think a lot of the organisations haven't necessarily been disruptive enough for the burning platform to be clear, and to actually… I think you see in the financial sector where there is a lot of adoption, because they are being disrupted, and I think a lot of other industries aren't necessarily disrupted significantly enough yet for a lot of the technologies to be adopted*."

When technologies are considered for adoption, the nature of the industry plays a significant role in deciding whether to be a first-mover or an early adopter of the technology. Furthermore, the level of disruption an industry is undergoing clearly can impact the decision for or against adopting a technology. In the case where an organisation offers autonomous solutions to customers it was deemed necessary to be an early adopter of the technology in order to instil a level of comfort in potential customers.

5.3.2.2. Organisational authentication of technology offering

Two of the interviewees said they would need first to have evidence of the technology working as expected before adopting it in their area.

> Interviewee 1: *"… we would like to see proof that these technologies work before outlaying that kind of cash to build these automations or technologies…. We want to see proof almost before we invest the money*."

> Interviewee 9: "*I think in finance, where I work actually, it is to see the implementation of it*."

Prior to adopting a technology, these respondents required evidence of the successful application of the technology to ensure that it functions in a manner that warrants the outlay of funds.

5.3.2.3. Organisational readiness for technology adoption

Five of the respondents mentioned considering their organisation's state of readiness prior to adopting a technology:

> Interviewee 4: "*Your business almost needs to be geared for the technology that you're going to implement... you think for example, okay it is easy you just go and drop a technology in there and the robots will be there. No! … something has to change. It is not just dropping the technology in there*."

> Interviewee 10: "*… you have your early adopters, then you have your mainstream, then you have your mass and then your tail – which are typically the last to get on board a new technology. And that happens in an organisation. So your management, you may have certain areas in your management where your managers have just finished an MBA and they are fully aware of all the latest technology and are ready to go, but the first barrier they will face is that they will be out of sync with the rest of the organisation, because the rest of the organisation is probably a couple of generations behind in terms of their thinking; technology adoption takes a long time in a big organisation because as I said it has to go through a procurement process, you need to understand who your suppliers are going to be, you need to test multiple products. Then that has to be embedded in the fabric of your organisation's IT and infrastructure. So as…. You know, two generation previously's policy or decision reached maturity and we decided to take a course of action, it only really gets fully embedded operationally after a period of time, and at that point in time is when the new technology is starting to excite all the new managers*."

> Interviewee 14: "*Also the business itself's readiness and digital maturity. So, we talk about maturity in our first… you know it is that whole cave man… and it all depends on where your business or organisation you are working in, where is there maturity for digitalisation and technology in the business itself?*"

Interviewee 4 mentioned organisational readiness from an infrastructure perspective, that is, the organisation must have the correct infrastructure in place before it can support the adoption of new technology. The technology cannot be deployed if the organisation does not have the necessary structures in place to support its implementation.

Interviewee 10 spoke about the importance of organisational readiness from an alignment perspective. The respondent mentioned that there is a need to ensure that managers are aligned in terms of the technology to be adopted. Reference was made to the varying levels of support across management teams, and how the adoption of the technology can be incremental in its early stages until management alignment is obtained. The need for the correct infrastructure for the technology was also stated.

Interviewees 14 and 17 spoke about the maturity of the organisation and whether the organisation was sufficiently mature to accept the deployment of a new technology. These participants highlighted the internal structure and the organisation's appetite for change as important considerations.

The importance of organisational readiness was raised in reference to physical infrastructure, management alignment, organisational maturity and the organisation's appetite for technological change. The successful adoption or deployment of technologies hinged on these elements being considered prior to the technology being rolled out to the business at large.

5.3.2.4. Process considerations

In order for automation technologies to be adopted, a review of current business processes is required.

> Interviewee 7: "*Something else that one needs to consider in this instance is do you just put these into… you know, you have to consider your processes or your current ways of working. If you don't consider these and you employ these technologies on a process that doesn't currently work it will be to the detriment of your business in the long term*."

> Interviewee 13: "*I also think that in a lot of cases you are dependent on the maturity of processes to be able to use technologies to enable the processes; and I think a lot of organisations don't necessarily have the mature processes to adopt these technologies.*"

These participants' responses suggest that organisations need to carry out a process review to ensure alignment between the process being automated and the technology being deployed. The respondents spoke about the need for having the correct processes in place to support the technology being deployed.

5.3.2.5. Technology must align to business requirements

When considering whether to deploy job automation technologies, the technology needs to fit the requirements of the organisation. The technology has to address the current needs of the organisation and is driven by a business requirement.

> Interviewee 1: "…*look Company X is always open and I've always shared that with the team that if they've got any ideas and there is scope and we can definitely prove the business case then Company X is open to it, to look at these.*"

> Interviewee 2: "*Normally it will come from a business need. So, there must be a business need*."

5.3.2.6. Alignment of technology to organisational strategy

Six of the interviewees spoke of the decision to adopt new technology being made on the basis of its alignment with overall organisational strategy.

> Interviewee 6: "*So how does this tie in with our overall company strategy? Where does this take us over the next five or ten years, what happens next? How does this technology evolve as the business evolves?*"

Interviewee 7: "*So I think the first port of call is to understand your business; understand where it can be employed and strategically employ such technologies in order to get that benefit. Don't just take a plug and play approach to this…*"

It was evident from the responses that when considering job automation technology, the decision to adopt is based not on short-term wins but rather on the incumbent strategy and how the technology will align to the organisation's strategy in the long term.

5.3.3. Cost considerations

5.3.3.1. Cost of technologies

When exploring job automation technologies, the cost of the technology is a fundamental consideration in deciding whether to adopt. This was evident in the responses of the participants in the study: nine of the 17 mentioned the cost of the technology as a key consideration.

Interviewee 2: "*So one, first of all, will always be cost*."

Interviewee 8: "*I think the cost of anything is always a first consideration when it comes to running a business. You know, one is measured on financial performance amongst other things and you need to be able to motivate your reasons for doing certain things. So cost is certainly a challenge*."

5.3.3.2. Cost-benefit of implementing technologies

While the cost of new technology was of critical importance, more significant to the respondents was not its cost in isolation but rather the cost-benefit ratio it might represent. This was raised by 11 of the respondents:

Interviewee 6: "*I think we can break it down into two things which if you want you can look at it as one: I think cost is a very important thing. You have got*

to be able to afford the technology that you implement, and it goes one step further: if you can afford it, after putting down millions for a particular technology, how does that millions translate into return? Look, at the end of the day business is business, business is about generating returns and I think that is the first priority. Sorry to say, some people may deny it, but that is priority number one. So how does that cost generate returns? How long does it take to generate those returns? How certain are you to generate those returns?"

Interviewee 12: "*I think the two biggest factors when it comes to this kind of technology would be time and money. So, the cost implications are obviously at the forefront because when presenting this to any board, or any similar products in terms of automation to any committee for approval, the first question you will get is a cost benefit analysis. What is it costing and what do we get out of it*?"

The respondents noted that emerging technology is currently expensive and, while the costs might be high, the trade-off between investing in the technology and reaping the associated benefits over a defined period was the top consideration. The cost-benefit aspect was raised by respondents across a range of industries, which highlighted the importance of viewing the technologies in light of the benefits adopting them might offer.

5.3.3.3. Technology costs are high

Numerous participants noted that automation technologies are expensive to adopt.

Interviewee 4: "*To implement a technology is expensive. It is not a cheap thing*."

Interviewee 7: "*I think at the moment, because the technologies are not widely used within the SA context… it is being used, it is being trialled and tested, however, it is still expensive*."

While the majority of respondents alluded to the high costs generally associated with adopting these technologies, interviewees 9 and 10 took a different view. Interestingly, these came from the telecommunications sector and conflicted with the view of interviewee 7 – who belonged to the same sector.

> Interviewee 9: "*I don't think the price of setting up an RPA team, the price of paying for AI's and bots etc – the price is not a main consideration because it's cheap. I don't think we are limiting ourselves in the company because of the price of automation. It certainly is very affordable, and I don't think that is a barrier to entry*."

> Interviewee 10: "*What I have seen is that price is surprising, they are cheap – they are very cheap. So, from the perspective of big organisation that has a long history of technology procurement, these things are very cheap*."

5.3.3.4. Technology costs are decreasing

The general view of the respondents is that the cost of automation technology currently is high. However, five of them noted that these costs are likely to drop over time as the rate of innovation and technological development increases.

> Interviewee 3: "*So the barriers to entry is quite high, but if we look at the rate of innovation those costs are coming down… So, you know, the cost will come down dramatically, but for us, right now, what we do is we evaluate the space that we want to play in and the areas that are of high priority, we invest in.*"

The current cost of the available technologies poses a barrier to adoption at the moment. The respondents also noted, though, that as these costs are driven down the rates of adoption are prone to increase over time.

5.3.4. Government intervention is necessary

5.3.4.1. A country strategy is required

The need for government to play a role in the fourth industrial revolution was highlighted by numerous respondents. Among the government interventions that respondents felt were warranted was a strategy by which the country could realise the opportunities associated with the technological age. The respondents felt that the need to have a strategy is critical for the sustainable future of the country.

> Interviewee 1: *"I think South Africa needs almost like a master plan that these things fit into, but nothing is forthcoming yet. It is almost left up to business and the private sector and people to come up with this*."

> Interviewee 7: "*I think South Africa needs to think of, how do we strategise in the long term, at say fifteen/twenty-five years or a fifty year period, to skill the youth today so that one day they are going to be employing this technology and it won't be such a hindrance in the long run*."

> Interviewee 15: "*If we do not adopt [automation] as a society, as a country, we are going to be in big trouble because the world is not going to wait for us, and we need to identify where can we play and what do we have – so what skill can we teach people, and what can they then do, and how can they then play a role?*"

5.3.4.2. Government needs to enable an environment conducive to adoption

Respondents also looked to government to create an environment that promotes the adoption of new technologies.

> Interviewee 3: "*From a South African context I think because of the political landscape the motivators are very different in terms of how simple things like municipality – I say simple, but it is more complicated, you know – how municipalities are run; the police services; the traffic services; the emergency services; hospitals. We have amazing solutions that can help everyone, but it gets stonewalled when it comes to any sort of parastatal*."

Interviewee 16: "*In a local context I do think we are hindered by our government not rolling out and not supplying enough funding to get out to the people in the rural areas and applying these technologies*."

5.3.4.3. Country politics are a consideration

The current political climate was a cause for concern among respondents. The political environment was seen as playing a negative role in the adoption of the technologies within a South African context.

Interviewee 3: "*I think inhibitors in South Africa specifically is the political environment and the climate that we're facing.*"

Interviewee 13: "*If you look at, for example, mining: elsewhere in the world you see fully autonomous mines. In the South African context, you cannot fully automate a mine because it provides employment and you need employment. So, in those areas I see that a political appetite can be a restrictor to the adoption of the technologies*."

Several participants highlighted a need for government to enable and promote the fourth industrial revolution and the technologies encompassed thereby. The respondents noted that in order for South Africa to remain relevant within a global context, the government needs to play a more prominent role with regard to these technologies.

5.3.5. Unemployment in South Africa

While the respondents looked to government to assist in advancing the country into the fourth industrial revolution, they also considered the country's current employment crisis when contemplating new technology adoption.

Interviewee 8: "*The last thing that you do want – and I am very aware of the fact that one can talk about the adoption of AI, AI can be universal and used*

in a generic perspective, but you know what works in a westernised country where there is very little, or very low unemployment, doesn't necessarily work for a country like we are in, where the unemployment is high. We need to, as much as we need to adopt and consider the benefits of the fourth industrial revolution, one needs to also consider the realities that we face here from an economic perspective."

The level of unemployment in the country was raised by eight of the respondents as a key consideration when looking to adopt new technologies. This was reflective of the 29,1 percent unemployment rate as released at the third quarter of 2019 (Statistics South Africa, 2019). The view offered by interviewee 8 reflects the general feeling among the other respondents. While the need for adoption was clear among the respondents, they were also cognisant of the current state of the labour market and that the country could not afford to shed more jobs through automation.

5.3.6. People considerations

5.3.6.1. Impact of adoption on people

For this study, the senior managers and executive managers considered what the impact of adopting job automation technologies would be on the workforce.

Interviewee 10: *"… then you have to think about your digital fallout; in other words, what happens to the human being after the implementation or adoption of the new technology*."

Interviewee 12: *"… something that we have noticed already is when you go around to a few other organisations you see this catch line saying, 'what will be doing your job in ten years' time or fifteen years' time?' And I think it's well and good to say technology, where are we going to with technology, all in its place, but what happens to the people? That is then the big question mark."*

Within the South African context, it was evident that managers across various levels and industries were concerned about employees and what the ramifications for them

of adopting job automation technologies would be. The overall sense that emerged was of a human-centric approach in which the well-being of employees is taken into consideration.

The views expressed by the respondents displayed high levels of concern for the human element and the impact on workers of which managers need to be cognisant when considering implementing job automation technology.

5.3.6.2. Mindsets need to change

Eight of the respondents stated that for adoption to occur on a large scale and be successful, people would need for to pivot away from their current ways of thinking.

> Interviewee 7: "*Change in the sense that people need to change their mindset in how they see these technologies as not a hindrance but a benefit to the organisation and to themselves. I think you're going to have to consider the mindset of the individual utilising such technologies*."

> Interviewee 8: "*And I think the mindset around robotics, AI and all the rest needs to change too, because people automatically picture a robot that talks back to you in certain instances, whereas it is not, it is software – and we have used software for many, many years now*."

The respondents put forward the need to address the cognitive biases that people hold with regards to job automation technologies. The adoption of these technologies is dependent on how people perceive the technology being deployed. If the technology is viewed in a negative light, this will affect adoption.

5.3.7. Skills considerations

5.3.7.1. Skills need consideration before technologies can be adopted

The interviewees felt that the skills currently available, and how the current skill set might have to change with the adoption of automation technology, bore consideration. On the other hand, they believed the impact that automation might have on the organisation's existing skill set also was of importance.

> Interviewee 1: *"Do we need to reskill and upskill? What does it take to get these technologies going?"*
>
> Interviewee 7: "*Another one to add is definitely skills. I think skills play a vital part in this adoption of technology*."

The importance of skills and their relationship to technology adoption was mentioned across industries and management levels and seems to be a common preoccupation among respondents.

5.3.7.2. The correct mix of skills is important

While the skills that are available to organisations are important, a few of the participants also believed that the success of automation technology is dependent on having the right mix of skills amongst the workforce to ensure the optimum benefit for the business.

> Interviewee 9: "*So I think you are going to need this healthy balance of new breed of people who can actually really utilise the latest technology but also working with more experienced people. I think if companies get that wrong, they are going to maybe in a couple of years regret how they implemented. So, I think that is going to need a lot of thought going forward – that part specifically*."
>
> Interviewee 17: "*I also believe that these things are not going to be kind of implemented and then leave, especially the machine learning and stuff. In my mind I need to start looking at what internal capacity do I have to build, to continuously improve this as the business grows. So, it is not here in five years' time, ten years' time. Do we have the internal capability to do so?*"

As explained by interviewees 9 and 17, organisations need to find the correct balance of skills to amplify the benefits brought by technologies. While certain skills may be considered to be in demand in the fourth industrial revolution, such as the ability to implement these technologies, organisations prefer that the technology not be deployed by specialists with no understanding of the underlying business model and how these technologies may be leveraged to maximum benefit.

The respondents said a collaborative effort is needed to ensure that the technical skills of the fourth industrial revolution are intertwined with the business skills required to ensure the business continues to operate sustainably.

5.3.7.3. Local availability of skills

Several participants mentioned the availability of skills within South Africa in their responses. Not all were in agreement, however; there were conflicting opinions among the sample.

Some of the respondents felt that the country has insufficient available skills and is losing skills to other parts of the world.

> Interviewee 1: *"We've got huge amounts of brain drain and we see it, especially in our space where we specialise in SAP for example*."

> Interviewee 7: "*A lot of brain drain happens in South Africa, so a lot of skilled people are now moving because of the political atmosphere*."

The above views are in contrast to those offered by two other participants, who both felt that South Africa has the necessary skills for the advancement of the fourth industrial revolution.

> Interviewee 3: "*So I think South Africa is in a very unique position. I say this because we have many companies that provide world class services that*

were born and bred out of South Africa. So, in terms of there is no shortage of innovation and there is no shortage of skill in order to deliver."

Interviewee 13: "*I think the immediate thing that comes to mind is skills. We have the skills and abilities within organisations but also within the economy to be able to support and address this*."

Despite these conflicting views on whether the country has the necessary skills to deliver successful results in the fourth industrial revolution, it was apparent that the availability of skills is a key consideration when managers contemplate the implementation of job automation technologies.

5.3.8. Technology considerations

5.3.8.1. Autonomous technologies are not entirely new

During the current technological period much has been made of the available technologies and the capabilities they offer. The rapid technological advancements made in recent times are undeniable, and the disruption of which these technologies are capable across industries is the reason this phase is referred to as the fourth industrial revolution. Although this is generally accepted to be the case, a few of the participants held a slightly different view of these technologies:

Interviewee 3*: "I think the first thing that we've got to recognise is that we've labelled it recently but these types of what we're referring to as technologies or machine learning ability, these things have been around for a very long time."*

This respondent pointed out that the technologies currently available and viewed as emerging have actually been available for a number of years. They felt the hype around the current technological age has led to technologies which in fact have been utilised for many years being grouped under the umbrella of the fourth industrial revolution. The excitement around these technological developments has led to job automation technologies gaining more prominence now than before.

5.3.8.2. Technology is gaining prevalence

Four of the respondents spoke about the prevalence of job automation technology and how its popularity is driving its adoption. As the technology becomes more common – and thus more familiar – so too do levels of adoption as the technology becomes better understood.

> Interviewee 13: "*Having said that, I do believe that even with all the menial programming or technology usage, you could be able to solve a lot of problems just because people are aware of the technology and people have the appetite in a lot of instances to implement it…*"

> Interviewee 15: "*… there is a heightened awareness of these things because of popular media releases, and that we have actually embraced a lot of this within our organisation already*."

The interviewees believe that adoption levels will increase as these technologies become more mainstream and awareness around them gains traction. It is therefore necessary that organisations and their labour forces have an understanding of what these technologies entail to enable engagement with the technologies and increase adoption rates. The participants' views suggest a positive correlation between the prevalence of technology and adoption rates – the higher the prevalence of the technology, the greater the adoption.

5.3.8.3. Usability of technology

The participants of this study displayed high levels of awareness of the technologies currently available. However, numerous respondents expressed doubts about the practicality and suitability of deploying the technologies within their organisations.

> Interviewee 2: "*Then I am struggling in some of the new technology, I'm struggling to find use cases that will actually fit us as a business, so also there must be a very clear use case for our specific business*."

Interviewee 4: "*Is it actually practical? Yes: you can automate whatever you want but is it actually practical to automate it?*"

Interviewee 11: "*I mean given where we are now, and all the talk that has been happening, maybe I am sounding a bit more pessimistic about it, but I don't really see how this… I haven't seen it practically in action, how it can make my life easier.*"

Seven of the interviewees said the technology needed to be fit for purpose prior to deployment. The respondents displayed signs of hesitance when discussing the adoption of these technologies within their own organisations owing to unknowns around their practical application. This view was shared by both senior and executive managers and across industries. The adoption of job automation technologies is heavily influenced by whether managers perceive its functional application and usability as applies to their business, rather than only the abstract, conceptual offerings that these technologies represent.

5.3.9. Summary of research question 1 findings

The findings related to question one showed that senior managers and executive managers consider a multitude of factors before adopting job automation technologies. While the majority of responses indicated positive feelings towards these technologies, a few had salient negative connotations with them. Interestingly, the main considerations focused around organisations, technology, people and government.

It emerged that these considerations are multi-faceted in nature and apply across industries. The respondents reflected on the need for a strategic approach to adopting job automation technologies, as highlighted by references to organisational strategy as well as the need for a national strategy to embrace the fourth industrial revolution. It also emerged that the feasibility and practicality of the technologies are of importance.

5.4. Results: research question 2

RQ. 2. Which factors are considered to be of importance when determining enablers of and deterrents to adoption? Does bounded automation play a role in influencing the decision to adopt automation?

This research question sought to gain an understanding of the enablers of and deterrents to the adoption of job automation technologies. The aim was to identify what would motivate or prompt the participants towards adoption or deter them from implementing these technologies.

5.4.1. Enablers of adoption

The respondents were asked the reasons why they might adopt job automation technologies (or already had done so). In the context of this study, the benefits associated with these technologies during the interview process were classified as enablers of the technology.

5.4.1.1. First mover advantage

The benefits associated with being a first mover in adopting job automation technologies was seen as a motivator for managers. Organisations that are first movers in the job automation technology space are able to differentiate themselves from slower-moving or reluctant competitors and gain advantage over them.

> Interviewee 5: *"…being able to say to the market, 'We use this fancy suite of software, look at how amazing we are and how it differentiates us in terms of the comparison with our competitors.'"*

> Interviewee 10: "*The macro environment is going to constrain your companies that have the legacy whereas your new start-ups are not going to be constrained, they are going to be able to work around it and it is going to create some very interesting competitive dynamics and I think there is going to be casualties*."

The new entrants into a market have the opportunity to implement job automation technologies at business's inception, as do existing organisations that are early adopters. These organisations are able to reap the benefits of these technologies and set themselves apart from their competitors by offering solutions built around the latest technological trends in their respective industries.

5.4.1.2. Competitive advantage and organisational relevance

Seven of the interviewees deemed the need to gain competitive advantage, or simply remain relevant within industry, a motivator to pursue adoption of these technologies.

> Interviewee 6: *"… one needs to look at where the world is going because if we don't adopt certain technologies and our competitors do, our competitors will then have a competitive advantage over us and we won't have a business anymore and all of our employees will be left jobless*."

> Interviewee 15: "*I think another driver is that other people are going to do it, so if you are not going to be able to reinvent yourself, you are going to become irrelevant which means you are going to lose your workforce in any case; you are going to become non-competitive based on the adoption of new technologies that exist in the specific market.*"

The responses took into consideration the competitiveness of the interviewees' business environments. The participants highlighted the need to adopt new technologies to gain competitive advantage, business relevance and long-term sustainability.

5.4.1.3. Embracing global trends

The importance of embracing current global trends around automation was raised by a number of participants. While the South African context will be explored later on, it is worth noting at this point that South African organisations, along with the country in its entirety, operate within a global environment. The notion of global

competitiveness and the acceptance of global trends were raised by the respondents.

> Interviewee 1: "*You also then have to consider that the world is moving towards this fourth industrial revolution and the automation*."

> Interviewee 6: "*I think… we are living in a global economy and as such, if we want to stay relevant, we need to be able to communicate globally, and the communication in business currently is not English, it is technology. If we can't embrace technology, we are going to fall behind as a country*."

The interviewees were aware of automation technologies' growing prevalence on a global scale and as such expressed the view that South Africa and the organisations that operate within its market will inevitably be impacted by these technologies. This was deemed a motivator for adopting them.

5.4.1.4. Deployment of people

The inefficient use of human resources within organisations and the functions that they execute was seen as an enabler towards adopting technology to carry out these functions.

> Interviewee 3: "*The other piece is around our business where we provide support and if we look at the traditional call centre businesses, right, we've got… you know it is employed by some highly skilled people and when we look at the time and effort and energy that goes into resolving very basic queries it is not good use of these people's time.*"

> Interviewee 10: "*The reason why I would do it is that I think that the technology at the moment is of sufficient maturity to be able to take these tasks on at least 80%. What that allows me to do is do away with all the administrative heavy lifting that the team has to do and put them more into a position where they are managing these bots, which then means that they can do more work*."

Nine of the respondents spoke about adopting the technology to help make better use of their people by reassigning their employees to more value-adding tasks. The ability of the technology to take over time-consuming tasks currently performed by people was a key enabler for the adoption of the technologies.

5.4.1.5. Repetitive tasks

The multitude of repetitive tasks carried out within organisations was identified as a key driver of job automation technology adoption among respondents. No fewer than ten of the respondents raised the automation of such tasks, indicating that the benefits offered by technology in this regard were viewed as a key driver for adoption.

> Interviewee 7: *"… one of the things that we do is a month-end report, before we analyse to extract the information to put it into a table in order to see where there are variances or not. I think for me that is a very repetitive task… If I can get a robot to just pull the data… it would make a lot more sense for me as a contributor in finance to my business unit. For me that is a starting point in order to automate repetitive tasks*."

> Interviewee 17: "*What we started looking at was, which are the common processes? We called those 'rails'. Okay, so we said let's build a rail to say irrespective of what product you are asking for, we always are going to need this set of information. And then what we started looking at is how can we apply a first stage of automation in terms of simple robotics, that would mimic a user, a man, a warm body interaction. So, we did that. Benefits of that scaled down kind of operation costs by about forty percent in the first year and about seventy percent in the second year and by the third year literally we were close on ninety-eight percent of cost reduction. And that was significant. We are talking typically around a cost base of about two hundred million*."

The capability of job automation technologies to reduce reliance on employees for performing repetitive tasks proved fundamental to supporting decisions to adopt. The automation of such tasks has the potential to provide cost reduction benefits and alleviate employees' workloads. The managers who referred to repetitive tasks as menial or mundane clearly articulated the need to adopt technologies to relieve the burden of this work on their employees.

5.4.1.6. Data analysis

In an age when big data and data analytics are viewed as critical to organisations, the participants of this study perceived the ability of automation technologies to aid in analysis of data as a motivating factor to adopt them.

> Interviewee 4: "*Once implemented, the value gained from them is immense from the sense of the data can be analysed and used in ways that could never have been possible without these sorts of things*."

> Interviewee 7: "*I think as professionals we learn to be analytical, but you spend a lot of time just looking at data and trying to mine data. I think if you have certain technologies like a robot that can pull the data combined with some sort of machine learning at the background that can… and also can do these reports better or faster you can pull out more insight and then you can actually analyse the data, analyse what is happening in the ecosystem or the environment… economy rather, and use these to generate more profits for the business*."

The potential of job automation technologies to analyse the huge amounts of data being generated within organisations encourages their adoption.

5.4.1.7. Decision-making

As discussed above, the capability of automation technologies to process and analyse data reduces the amount of time taken for raw data to be transformed into information useful to businesses. The outcome of this analysis puts managers in a position to make improved business decisions.

> Interviewee 2: "*I do think they give us now the capability to make more informed decisions and start spending time on things that is actually value adding*."

> Interviewee 3: "*From a business point of view, just in my particular space, understanding… or being able to have access to information quicker gives*

me the ability to make better decisions or spend more time in terms of the analysis that I provide back to the board."

Since participants in this study all held decision-making roles within their organisations, it bears significance that seven of them pointed to the capacity of automation technologies to facilitate better-informed decisions as a motivation to adopt them.

5.4.1.8. Improved productivity

Nine of the respondents said the benefits associated with improved productivity are a driver of technological adoption. The speed with which these technologies are able to operate and the significantly reduced timelines in which results are produced offers clear productivity gains for organisations.

> Interviewee 8: "*It becomes about how can we, through the adoption of automation, become better at what we do, generate more revenue through those efficiencies, and become more productive*."

> Interviewee 16: "*The first motivator would be productivity. So, you would get more out of it, where a machine can do something far quicker, and you can get results easier*."

5.4.1.9. Quality and accuracy

Seven interviewees saw automation technologies as capable of providing a higher quality of output with greater accuracy than humans would be able to deliver. Two of the respondents provided insights into how their organisations already have reaped the benefits through adopting the technology.

> Interviewee 6: "*… we have implemented something like this about a month back, um about a year back, and where we had a team of about eight people working non-stop for a month, that same task gets done with better accuracy*

in just over four hours. And what's even better, that is not four hours in terms of your normal eight-to-five or if you want to call it, working hours; those four hours can be at any time you choose it to be. It can be in the middle of the night, you set the time and it provides: it provides exception reports, it provides information in the way that you want it, it is consistent…"

To mitigate risks associated with human error and produce results of consistent high quality, the respondents indicated an inclination to adopt the technologies.

5.4.1.10. Improved service offerings

The ability of an organisation to offer an improved offering to the market in which they operate by adopting available technologies was seen by some of the respondents as a reason to embrace them.

Interviewee 17: "*… so, you know we are in the banking sector and are quickly realising I think that it is not so much of the products that you have or the price points that you kind of selling your products at – those are much of a muchness between the banks – but where you have got to win this game is around the customer experience and customer service that you can provide customers, on a consistent basis... Now, no matter what you try to do within standardising training, etc, recruitment processes and that – it is very hard to deliver a consistent customer experience and service through that channel. So that is another area where you connect to say, 'how do we…' – there are certain parts of that continuum that we can deliver through a more automated kind of process*."

In highly competitive markets the adoption of the available technologies allows organisations to differentiate themselves from competitors and provide superior products and services to their customers. This was a motivator for adoption.

5.4.1.11. Identification of trends

A number of respondents gave the technologies' ability to identify patterns and trends as a reason for adoption. In the participants' roles, the potential to gain insights into their business allows them to take corrective action where necessary and address any potential threats or shortfalls experienced within the organisation.

> Interviewee 3: "*When we look at being a data-driven society, I mean, there's tonnes of data that is out there, compliance is a big thing and we find that this is where machine learning can help us to be able to pick up trends, anomalies and then also address any issues that may come up*."

> Interviewee 4: "*They're going to show us things that we don't know. They won't tell us the 'why', but they will show us trends and analysis… well, trends that we can't even perceive*."

The implementation of these technologies provides managers with the information necessary to address areas of concern or exploit areas of opportunity for their organisations.

5.4.1.12. Employee safety

The opportunity to improve workplace safety, specifically in mining, was raised by participants from the mining industry as well as others.

> Interviewee 1: "*I mean, the gold mines; South Africa has got some of the deepest mines in the world so why send people down 2km or 3km into the earth when there is a machine. If there is an issue that happens you can lose a machine*."

> Interviewee 2: "*Also it gives us huge opportunities to increase safety – that is a major concern in our environment*."

While interviewees 1 and 2 worked in the mining industry, interviewees 3 and 13 from other industries also raised safety in mining as a motivator for the adoption of automation technologies.

Interviewee 3: "*What we're finding is that, more and more in the mining space, some of our clients in places like Australia starting to investigate robotics… One, from a health and safety perspective because it is quite dangerous*."

Interviewee 13: "*… I think of manufacturing, if I think of mining, I think there is a lot of technologies that you actually take people out of the way of risk, that definitely has a clear social business value*."

Replacing people with machines in high-risk jobs and industries such as mining allows organisations to limit employees' exposure to risky or adverse environments. The safety and well-being of workers was considered sufficient motivation for managers to adopt job automation technologies in appropriate industries.

5.4.1.13. Process improvements

Across several industries that formed part of this study, mention was made of using technologies to achieve process improvements. Participants from five different industries were in favour of adopting automation technology based on its capability to enable process improvements in their organisations.

Interviewee 5: "*Operationally, often we run masses that require a very large volume of work from a small number of people or we have something that has to happen over an extremely short space of time. So in both those cases a technology that will help me to deliver the large volume of work or the small volume of work, but very quickly within the deadline, will always be something that I would be more than willing to take on and do in my daily practice*."

Interviewee 7: "*You are doing it to gain efficiency from both a process point of view and a cost point of view*."

5.4.2. Disincentives to adoption

5.4.2.1. Issues related to change management

A number of respondents raised the issue of change management as being important when considering whether to adopt job automation technologies.

> Interviewee 3: "*The challenge that we have, and the thing that is constantly bothering me is are we… do we have the right sort of change capability inside the organisation to make sure that the current staff will be ready for this when it comes through*."

> Interviewee 7: "*So the change management is quite important*."

> Interviewee 8: "*The very first thing that comes to mind before cost, before price, is… is people become very stuck in their ways and become very difficult to change*."

The data gathered in interviews highlighted the importance of change management when considering whether to implement new technologies. Should an organisation's change management initiatives or capabilities be insufficient, this would negatively impact chances of technology adoption.

5.4.2.2. Lack of understanding

Five of the respondents raised the lack of understanding of these technologies by employees as a disincentive to adoption.

> Interviewee 10: "*And then the second issue at the moment is just that we are still by and large, still in the very early days of these technologies, and the work force maturity, where people are at, they don't understand it; they don't have a good intuition around how technology works, or how to manage the tools. So often your implementation is not as effective as the promise of the implementation. So that is also a hindrance to the adoption*."

This may be linked to the change management initiatives raised in the previous point – it is necessary to educate the workforce around the functionality of the technology, and a lack of communication could prove to be a barrier to adoption.

5.4.2.3. Cost of technology

The costs currently associated with automation technologies were viewed by some of the respondents as negatively impacting adoption rates.

> Interviewee 1: "*Disablers is obviously the cost of these technologies and being at the forefront of these technologies*."

> Interviewee 7: "*I think price at the moment does slow down the adoption*."

While interviewees 1 and 7 focused on the cost of the technology, interviewee 2 drew a comparison between the technology cost and the cost of labour in the market.

> Interviewee 2: *"…South Africa's labour cost is extremely low, compared to the rest of the world, so at this stage there is still a case to say labour will be cheaper than technologies – I do think that will be tipped in a few years from now*."

Many respondents believed adoption rates were adversely affected by the costs of these technologies, significantly more than the cost of manual labour. It was noted, however, that these technology costs are expected to drop significantly over the coming years as adoption rates increase and the technologies gain prevalence.

> Interviewee 11: "*So I think studies out there are showing especially with the sort of exponential growth-thinking stuff, they say that the moment a technology is adopted and there is demand for it, costs tend to come down, like, exponentially*."

5.4.2.4. Cultural barriers

Five of the participants suggested culture as a deterrent to adoption. The issue of culture was discussed in the context of organisations but also in the context of South Africa as a country as well.

> Interviewee 5: *"Perhaps there's even a cultural barrier, when I used the example of the law firm, there might be a cultural resistance to adoption of the technology*."

> Interviewee 6: "*South Africa is a different context altogether. I think SA people, culture plays a role, the culture is very different, they are very resistant to change…*"

It was apparent the respondents felt that the culture within organisations and the country at large was an impediment to adoption of job automation technologies. The resistance due to cultural barriers requires a pivot in the thinking of the workforce and a mindset change on the part of people.

5.4.2.5. Government policy

Respondents saw the government as playing a negative role in the adoption of job automation by deterring organisations from implementing such technologies.

> *Interviewee 10: "Then on the other edge the macro environment in SA is one at the moment where the social political landscape is very heated and because of the pressure and the fact that people do not have financial security, there is policy political pressure for large organisations to retain and look after their workers – almost to the extent that it flies in the face of what would be considered standard private company practices. You know?"*

> *Interviewee 17: "I think if we take our current context we have got a lot of instability, I think we have instability in terms of overall government policy and I think our lack of direction depends on that policy and is creating a lot of stress in the industries."*

Government's attempts to protect jobs in the private sector could be construed as government interference, and the overall economic policy of the country and sustained low economic growth is a contributing factor to limiting the adoption of new technologies.

5.4.2.6. Infrastructure

Technologies can only be deployed successfully in an environment that promotes their use, as discussed above. Furthermore, it is necessary to have the supporting infrastructure in place for the technology to be implemented.

> Interviewee 5: *"… just in terms of deploying technology in a place which has no infrastructure. How do you do that*?"

> Interviewee 16: "*Also, implementing these technologies means you need an infrastructure in place in SA and once again we don't have that platform where, in a global platform, they have the perspective to do that very easily. I think locally we are really hampered, especially in our rural areas, to implement proper machine learning and AI technology; it is just so hard to do things in real time and almost apply the pace where these technologies are going*."

The lack of infrastructure was identified as a barrier to automation technologies being adopted. While it was deemed necessary that the country participate in the fourth industrial revolution, it was seen as lagging behind in creating an environment that promotes and enables adoption.

5.4.2.7. Electricity supply

Surprisingly, the stated-owned power utility was mooted as a disincentive to adopt automation technology. Four of the interviewees mentioned the need for a stable power supply is these technologies were to be adopted.

Interviewee 7: "*Another big factor is, our power supply is uncertain. Eskom is a big challenge at the moment, and I think that is also hindering some of the adoption because it is great to adopt the technology but if you don't have the power to run it you have a problem.*"

Interviewee 12: "*So to bring it back home, I would think that there are challenges. I mean a simple challenge if you look at dependability on electricity, when it comes and that is a basic, it comes to connectivity*."

The respondents were forced to consider the uniquely local challenge posed by a lack of a stable power supply. Similar markets that are often grouped with South Africa, such as Russia and China, do not seem to encounter such a challenge which negatively impacts on local adoption of technologies.

5.4.2.8. Education

The education system in South Africa was viewed as a hindrance to the adoption of automation technology. This was highlighted by five of the respondents, who mentioned that the country's levels of education did not meet the requirements to effectively deploy fourth industrial revolution technologies.

Interviewee 1: "*As a country I think South Africa will probably lag [behind] the world for some time until we sort out our education system…*"

Interviewee 5: "*So definitely just plain literacy, South Africa has a shocking literacy rate that prevents people from adopting technology…*"

The participants' responses emphasised the need to address and improve the nation's education levels to permit scalability of adoption. The inherent challenge in a country with large numbers of under-educated people is that the time needed to address this at a national level leaves the country far behind in reaping the benefits available from these technologies. The fourth industrial revolution is playing out now and will not wait 20 years for a sound educational policy to be implemented.

5.4.2.9. Skills

Closely related to the education challenges raised above is a skills shortage three of the respondents mentioned:

> Interviewee 1: "*The difficulty in the South African context is people's skills. South Africa's skills are not geared towards the jobs that are going to come out in the fourth industrial revolution*."

> Interviewee 7: "*Also, not many people have the knowledge or the basic skills within a South African context to go into tertiary education. I think that is one thing that as a country we need to look at how we upskill these children or these youth to actually, in the long term, utilise them in order to deploy such technologies. You're going to need people to know how to build the technology. You're going to need people to know how to deploy the technology and how to maintain these technologies, it is not self-maintaining, in the near future*."

In these respondents' view, South Africa is not equipped for the fourth industrial revolution, and the lack of available skills in the country hampers the adoption of job automation technologies. If local organisations are to gain benefits from the solutions currently on offer, the requisite skills need to be in place for them to adopt this technology.

5.4.2.10. Fear of job loss

The majority of the respondents highlighted the fear of job loss as a barrier to adoption. Nine of the 17 respondents mentioned this factor as a disincentive to automating certain jobs.

> Interviewee 7: "*From a hindrance point of view I think people do play a part… people's behaviour or people's perception towards accepting such technologies within an organisation could play a hindrance because some people may consider this a potential threat to their current position, to their current knowledge base and what keeps them in the organisation*."

> Interviewee 10: "… *you are asking the team whose jobs are at risk to do the implementation themselves and do the adoption themselves and demonstrate that they can make themselves redundant – and people are insecure about that, there is no maturity in thinking let's all work towards working ourselves out of a job. So that is a significant barrier*."

The sheer number of respondents who mentioned job security and the fear of unemployment testifies to this particular issue's level of importance. The resistance of employees to new technologies owing to anxieties around job loss is therefore a critical obstacle that needs to be circumvented if organisations are to adopt job automation technologies.

5.4.2.11. Implications on people

The human impact of job automation technologies was raised by 12 of the 17 respondents. While almost all the respondents spoke about deriving benefit for their organisations by implementing these technologies, as set out previously, the possible negative impact on their employees was viewed as the greatest barrier to adoption.

> Interviewee 3: "*The people component is a very big component of this. One of the things that we look at is how many lives are going to be affected*."

> Interviewee 8: "*And you know, sitting where we are sitting, you have #@!%&*! got to put yourself almost into a humanity perspective as well; you have got to say to yourself 'what happens to these people if they are impacted by what you do?'…*"

The view that the human impact of automation technologies acted as a barrier to adoption was shared strongly across industries and by both senior and executive managers. This responsible leadership outlook around technology adoption may specifically be related to the South African context where the unemployment rate is among the highest in the world for an emerging market (Statistics South Africa, 2019).

Interviewee 17 spoke about the trade-off between organisational benefit and the potential loss of jobs brought about by implementing automation technologies. The financial benefits, while undeniable in certain instances, is seen as secondary to the cost of people losing their jobs. Upon deeper analysis of this particular disincentive, it could be argued that the managers themselves pose a barrier to adoption owing to their strong desire to protect employees' jobs.

5.4.2.12. Sabotage of technologies

A number of contributors to this study brought up the potential for deliberate misuse of technology by employees hoping to ensure adoption is not achieved at scale. Possible sabotage by employees was seen as a disincentive to the adoption of job automation technologies.

> Interviewee 3: "*Then you'll get people who are set in their ways, who see this as a threat and don't see this as an opportunity, and they would dig their heels in and ensure that whenever they interact with the system, make it fail to show that the system doesn't work, or what we're introducing will fail*."

> Interviewee 4: "*I'm just thinking, autonomous haul trucks work in the Australian mines. They will be sabotaged here; I'll tell you that categorically*."

> Interviewee 7: "*They may have a specific knowledge base that senior management relies on, however, by placing such technology in an organisation or a function may actually make their current job role redundant. They may actually sabotage such adoption. So, for me that is one of the biggest hindrances*."

The respondents foresaw deliberate action being taken by employees to force a failed response from the technology, driven by resistance to change and fear of job loss. They were concerned that employees may act maliciously either to circumvent the technologies or to disrupt their functioning to create the impression that the technology was inadequate of non-functional, thus preventing adoption. Interviewee 4 offered an example of such a scenario:

Interviewee 4: *"… I've been part of projects where as soon as controls are put in, they get sabotaged – purposely sabotaged to make them fail at all levels. I can give an example where a… and a very easy thing, automated leave process was put in where you are taking it from a book and computers were broken, scanners were broken. Then there was always an excuse and a reason why the thing would not work; why it would fail; why you needed the tea lady to take the book around from this office to that office to get approval. I think we… by putting in systems you're going to curb that, however, people will try find a way to get around it in certain areas where there is going to be immense resistance*."

5.4.2.13. Management buy-in

Respondents strongly felt that attempts to deploy new technologies were bound to fail without senior management support. Failure to secure their approval tends to hamper technology adoption.

Interviewee 5: "*Although I'm a director there are many other directors. Some are fairly young like me; others are fifty, sixty, seventy years old. Now that senior practitioner has practised in a very particular way for forty or fifty years. So, they are wholly disinclined to agree to a massively expensive tech rollout for a product that they will not use because, as things stand today, they don't read an email from the screen – they print it and then read it. So that person is not going to suddenly turn around and use an advanced AI product. So how do you get them across the line to approve this budget? It's a much flatter hierarchy in a law firm than in most other organisations, which makes that sort of thing difficult*."

In cases where those in senior management positions do not see the value in new technologies, the chances of the organisation adopting them tend to be negatively affected. Whether or not the value can be proven to management, cognitive biases often prove a challenge to overcome.

5.4.2.14. Unions

Within the South African context, unions have been identified as a barrier to adoption of job automation technologies. This was echoed by interviewees from a range of industries and management levels. Nine of the respondents considered unions to be hindering adoption.

> Interviewee 5: "*Just generally, if people are going to lose their jobs the trade unions will fight against it tooth and nail*."

> Interviewee 7: "*In terms of organisational dynamic, at the moment in South Africa, in most organisations, there is a large low-skill labour force and the power sits with the labour force, with the unions… this actually causes a lot of challenges with many organisations, such as mines with the mining strikes or transportation with the logistics strikes that are happening at the moment. This actually hinders this country and slows it down economically*."

The role that unions play in the South African labour market has a direct influence on the adoption rates of job automation technologies. The respondents viewed unions in an extremely negative light. To promote these technologies, further dialogue is required to align unions and business to reap the benefits the fourth industrial revolution makes available.

5.4.2.15. Power dynamics

Questions of power elicited mixed views from the respondents. While some felt that organisations have power over employees, others felt the inverse to be true. Whatever each respondent's view, they agreed that the power holder could influence the adoption of automation technology.

> Interviewee 16: "*In SA, because we have all the unions and mostly have a labour force doing it at the moment, the power really sits with them because they will go on strike and they will cause disruption in productivity and they have the power, if they go on strike long enough, that they can close down an organisation. So, to that extent unfortunately in SA, the power doesn't sit with*

the organisation, to start applying all of these new technologies and taking advantage of all of that."

Interviewee 17: "*When it comes to this particular problem I think while unions are strong and do have a strong union base, I think we still dictate the power there. I don't think we are as industrialised as, for example, the mining sector. But it is coming, and I can see there are interventions. In just this coming week there is going to be strike action. So I think we still hold our… it is our ability to actually narrate and craft a story that says that we are still employers, and we don't see the banks becoming totally autonomous, and it is our ability to craft those into conversations that will allow us to maintain that power*."

The power dynamics in the South African context seem to be tipped in favour of the employees over the organisation. Although interviewee 17 spoke about the banking sector dictating power, the need to address the unions and relay a positive narrative reveals the power that resides within the workforce.

5.4.3. Summary of research question 2 findings

The findings related to question two revealed a multitude of enablers and deterrents to job automation technologies. Managers in the South African context considered the need to keep competitive pace with global markets an enabler to adoption. A number of the deterrents focused around national dynamics such as, among others, poor quality of education and a lack of a reliable electricity supply. In order for organisations operating within the South African environment to compete globally and stay relevant in the fourth industrial revolution, these country-specific challenges need to be addressed.

The benefits associated with automation technologies were seen as incentives to adopt the technology. These centred around operational gains for organisations and related to competitive advantage, productivity and efficiencies. The technologies were seen as allowing organisations to differentiate themselves from competitors by offering enhanced product and service offerings to their customers.

The deterrents to technology adoption highlighted by the respondents were generally human-centric in nature. According to the respondents, the key challenge hindering adoption is the potential impact the technologies would have on the labour force. A lack of the requisite skills, coupled with poor education levels and inferior infrastructure within the country, were raised as disincentives to adoption.

Most interestingly, the research found that when managers reflected on the enablers of adoption, they focused on the benefits that organisations can reap from these technologies. However, when considering the deterrents, they focused less on organisational constraints, and more on the human factor. A number of respondents spoke about resistance to adoption by employees due to fear of job loss or cultural indifferences towards technology. The role of unions in the South African market was also seen as a significant impediment to technology adoption. This was further discussed in terms of the power play that exists between organisations and the workforce. The impact of insufficient change management initiatives was raised as a barrier to adoption and, perhaps more crucially, the deliberate and malicious disruption or destruction of the technologies by employees to ensure failure.

5.5. Results: research question 3

RQ. 3.: Which jobs or tasks are seen as being the most likely/least likely to be automated within the next five years? How will managers deal with workers whose jobs are imminently automatable?

The purpose of this research question was to gain insights into the jobs or roles that managers see as being susceptible to automation. A great deal of anxiety has arisen, across industries, with regard to job security and the roles or jobs that could be eliminated due to the technological advancements of the fourth industrial revolution.

While it is irrefutable that some jobs are prone to automation, this question also aims to determine how managers intend to deal with the displacement of some jobs by technology in an environment of high unemployment.

5.5.1. Jobs at risk

5.5.1.1. Characteristics of jobs that are at risk

The respondents said jobs that are inherently unintuitive and lack creative rigour are predisposed to automation. Occupations whose execution require a process-driven methodology are at risk of being substituted by a machine in the near future, according to four of the respondents.

> Interviewee 2: "*So I think a lot of the jobs we know today that is not creative but actually just fetching data and comparing it to each other to actually make sense of it – will come to an end*."

> Interviewee 7: "*you're going to really impact jobs that are non-insightful and non-analytical in a way. People who do very processing orientated jobs will definitely get… or data input jobs will be the first to probably disappear*."

The machine learning capabilities of the technologies available in the fourth industrial revolution pose a significant threat to jobs that are procedural in nature. Jobs that are repetitive can be learnt by a machine and so remove the need for human labour.

5.5.1.2. Entry-level jobs

Five of the respondents mentioned the risk entry-level jobs face due to job automation technologies. The simplistic, repetitive nature of these jobs is easily automatable using available technologies.

> Interviewee 1: "*If anything, probably the entry level, which would be our master data administrators in our space would be areas that we can look at*."

> Interviewee 3: "*The point is, jobs like bank tellers; jobs like cab drivers; and if you look at… if I define, you know, service level 1-, 2- type functions that need to be provided for customers those types of functions will be automated*."

However, two of the respondents felt that entry-level jobs needed to continue to exist purely to ensure the ongoing sustainability of the organisation. Essentially, the proposition is that entry-level jobs need to be filled continuously in order to guarantee that future senior roles can be filled.

> Interviewee 5: "*So we've never had retrenchments in the history of this firm, but I can tell you that although the firm has tripled in size in the time that I have been with it we still employ almost exactly the same number of first years every year. The reason is that we are employing all these new technologies and stuff that makes for what they do, even in my practice I only employ the juniors because I need professionals in future*."

The respondents viewed call centre and helpdesk agents as the job categories facing the greatest risk of being automated. Ten of them mentioned the likelihood of one or both functions being supplanted by autonomous technologies.

> Interviewee 2: "*I think call centres will actually come to an end. I think most of the call centres will be replaced by bots, maybe speaking bots or bots that can just actually naturally respond on computers. So, call centres will come to an end*."

> Interviewee 15: "*Okay, let's talk about the ones that are highly susceptible: think about a call centre, there is repeating stuff that needs to be sent out there, we are going to lose those jobs…*"

Second to call centre or helpdesk agents, the role of data capturer was considered to be under threat of automation. This was mentioned by six of the interviewees.

> Interviewee 1: "*I think it would be jobs like data capturers...*"

The task of simply entering data into a system was seen as simplistic enough that a machine-learning tool could carry out the function more efficiently than a human. The need for a human to process data that does not require cognitive rigour could be substituted very easily with technology, according to the participants.

Three of the participants mentioned the role of bank teller as susceptible to automation by a robot that can service customers.

> Interviewee 17: "*Our tellers, they are going to be… I think it is almost time that we start bringing the ATM technology then into the branches themselves and start getting bots to work with consumers*."

According to three of the respondents, jobs in warehouse management are likely to be affected. Inventory administration can be managed by technologies and provide greater benefits to organisations.

> Interviewee 6: "*Our warehousing has been automated, so we have conveyor belts with machine hands that actually pick stock, place it in the correct place and ever since then – that was actually the first thing that we automated, was stock – and ever since then we have never had a misplaced item in our warehouse.*"

5.5.1.3. Traditional professionals

Professions that historically have been revered – doctor, lawyer, accountant, auditors and so on – were also foreseen as replaceable by technology. This was attributed to the repetitive nature of the jobs.

Eight of the participants mentioned the disruption that jobs in the medical sector may face due to advancements in technology.

> Interviewee 2: "*There is a lot of speculation on a lot of jobs that will come to an end, that are repetitive, and that includes doctors and lawyers*."

> Interviewee 17: "*I mean even the medical profession is under… I was at an AI digital conference in Miami last year and they had an interesting case: they took ten of the best dermatologists in the US, okay? They gave them ten sample cases of patients. They then developed this AI model that would be*

able to diagnose. They used two things, they used cost as the one metric, and they used diagnostic, like the degree to which they would diagnose the patient correctly. And on both matrices the AI out-diagnosed all ten dermatologists. And all they did was they fed this AI robot all the pictures that they could find on the internet... None of the doctors could, so they doctors were just relying on experience, etc. And this model out-diagnosed all the doctors and the recommended medical kind of regimen was much cheaper than what the doctors were going for. So, the programme of rehabilitation, pharmaceuticals that were required, etc, they came in at least about 40% cheaper than the specialists."

Intriguingly, while many areas of the medical profession were viewed as being under threat from technology, three of the respondents singled out radiologists as the profession most likely in the field to cease to exist due to technological advancements.

Interviewee 9: "*I mean one thing that comes to mind is something like radiology. I would think that is something that a bot could easy do because you could still get a doctor to interpret, but the actual even of having a radiologist for example, I suspect in future that could be in the medical field non-existent."*

Five of the interviewees spoke about the legal fraternity and how they envisaged the huge amounts of data associated with legal cases being done effortlessly by a machine with learning capabilities.

Interviewee 2: "*I think lawyers will definitely come to an end because the only thing that lawyers do is, they visit case studies, and there you can actually use a lot of machine learning to start measuring these*."

Interviewee 7: "*Sometimes even your legal… their jobs in terms of looking through legal… well all the laws and precedents that are set. Those types of law – skilled, repetitive, very manual type of jobs will go*."

The field of accounting and auditing will be impacted by technologies that are able to mimic tasks that traditionally would have been done by professionals.

Five of the respondents saw the role of the accountant diminishing due to technology.

> Interviewee 14: "*I think it comes back to the work that has got very strict rules around it, that repetitive work, and I mean then I start thinking, like no dig at accountants or anything, but that is like repetitive work, it is going through the same motion every month, you know?* "

The verification of information that is a cornerstone of the auditing profession could be done more efficiently and with greater accuracy by a machine than a human, according to three of the respondents.

> Interviewee 12: "*As well for me, something that you can easily do with technology, you don't need a whole team to come out and just to ask for documents and be ticking off invoices, to take a simple example; you could as easy as whatever, just up front put in your parameters, say what needs to be tested and let the system go in and do the entire audit and throw out the results... So that is another job that I think would be obsolete*."

5.5.2. Jobs that are secure

5.5.2.1. Characteristics of jobs that are secure

In the present age of ubiquitous technology, tasks that involved the need for human intervention and interaction were regarded as being immune to automation. The adoption of technology has negatively impacted communication and interaction between humans. This may be due to humans becoming over-reliant on technology and more inclined to interact with a technology or make use of a technological medium to interact with other people than to interact directly.

> Interviewee 10: "*Look, very simply my view is that the requirement for people is to become more like people in 4IR. The roles that I believe to be secure –*

if I can start with them – are going to be the roles that require human beings, and I think it is going to skew more towards the softer side."

Interviewee 12: "*People still need human interaction, not just machine interaction so, for me, it is something that we ought to consider while we move forward and while we embrace this technology, is not to forget this human element and how we are going to guard this value system of being humans, together with this technology as we move forward. Because if you look at times, clips of where people see the future, you see there are flying objects and people living on the moon and all those things (laughs) – well and good! But for me we should not oversee and overlook the human factor; we can't all just be stuck talking to each other via machines. We have to have the human touch, the human feel, the human emotion brought into this space as well*."

The respondents believed that owing to the behavioural habits of people in the fourth industrial revolution, the jobs that focus on interpersonal skills and provide human contact will innately be secure.

5.5.2.2. People-centred jobs

It transpired during the interviews that jobs in the human and social sciences fields tend to be more secure from automation thanks to the human factor that characterises such industries. Professionals such as psychologists, psychiatrists and coaches were seen to bridge the gap created by people's dependence on technology and enable them to be more human.

Interviewee 3: "*I think the jobs that will become more in demand, funnily enough in my view, will be psychiatrists and psychologists, because people are going to lack very basic skills that they would have otherwise picked up growing up playing with friends; interacting with people; understanding the human side of it. So, I think, you know, personal coaches… so coaches… funny enough, motivational speakers because people will need that… So, people like psychologists; people like motivational speakers; people like your personal coaches for business and own sort of development, those kinds of*

jobs I believe will be on the rise or will be more in demand because people are going to need that."

This perspective was shared by eight other respondents. The need to enable and support a more human society was a focal point.

Interviewee 16: "*So all the roles and jobs going forward where you work with people – your therapists, your psychologists, those type of people will definitely not be automated.*"

By identifying the jobs that focus on the human aspects of society in its current iteration, the respondents highlighted the importance of the skills that enable a cohesive social environment – human interaction – in the fourth industrial revolution.

5.5.2.3. Creative jobs

While repetitive jobs were viewed by the respondents as highly automatable, the reverse was true of the jobs that are seen as secure. Jobs that require distinguished levels of creativity are viewed as safe, currently, from being automated.

Interviewee 13: *"I think that in my view the clarification of what is not necessarily as easily under threat is where creativity comes to play, where pure professional design analysis on an ad hoc basis comes to play…*"

Interviewee 17: "*I think the jobs that are positively going to be preserved are creative jobs. The more creative side of things are possibly going to still be human-dependent*."

Among the jobs that the interviewees saw as immune to automation were those of artists, entertainers and sportsmen.

Interviewee 7: "*Entertainment such as movies, sports – those jobs will never go. Yes, there is a big play on e-sports, etc. however, I think in the long term*

people still love watching a person in Formula One or play a soccer match or play rugby or whatever the case may be."

Interviewee 14: *"I think it is probably the arts you know, to put it that way – in general. I think you can never replace arts and culture, the touchy-feely stuff…*"

Interviewee 16: "*And then anything in the world that a machine can't do repetitively like painting and coming up with new ideas and building sculptures – all those nice things can't be automated*."

The findings show that the cornerstone of job security seems dependent on creativity and agility. Entertainers, sportsmen and artists are able to improvise according to the situations they face. The respondents' views indicate that, currently, machines have limited capability to compete with human labour in these areas.

5.5.2.4. Management activities

Five of the interviewees raised management positions as secure roles in the fourth industrial revolution. The respondents viewed the management of people as relatively secure, as well as the management of technologies.

Interviewee 7: "*Positions that I think won't go or skills that are definitely needed in the future are, one, technical jobs that people can actually build these systems and utilise them; people who can actually utilise the system or the technology because you have to consider it as a tool and you need to know how to use that tool to create value for your organisation, for yourself or for your business unit. People who can teach these skills*."

Interviewee 10: "*If we distil that into… what does it mean for jobs, I think there is going to always be a role for management. Are there going to be as many? I don't think so*."

While the need for roles that manage technologies an organisation implements was clear, the management of people was viewed as important but not immune to the impact of the fourth industrial revolution. However, as stated by interviewee 10, the number of these roles is expected to decline over time. The findings thus indicate that roles directly involved in the implementation and maintenance of these technologies are assured.

5.5.2.5. Addressing the impact on employees

It has been established that most managers are considerate of the potential impact that these technologies could have on their employees. That said, it was also widely acknowledged by the respondents that automation technologies offer benefits and some jobs will be affected by their adoption.

The key finding was that managers do not seek to adopt automation and summarily replace people by eliminating their jobs. The assigning of certain tasks currently executed by people to robotics, artificial intelligence, machine learning and the like, creates an opportunity to upskill and redeploy those people to more value-adding functions.

> Interviewee 3: "*At the end of the day, having technology replace people is not the idea. Having technology replace functions is what I am focused on. The idea is that we need to be able to use the resources that are currently fulfilling those functions into providing a different kind of service*."

> Interviewee 8: "*If you take my example as an example, I don't necessarily want to replace what people are doing, even though it can in theory even… and we are not even talking about that from a job creation perspective, I am just saying that right now the process that we follow is sufficient for us, even though it might not be sufficient for somebody else*."

It is evident that the participants in this study do not envisage mass job losses if or when they adopt job automation technologies. Rather than making the employees redundant, the participants spoke about redeploying them.

Interviewee 3: *"If we're looking at our call centre businesses, they are investing huge amounts of money in terms of machine learning and AI in that particular space. What we're doing is we're skilling up the engineers on that side which also costs money because of the AI or machine learning investment in order to skill them up to bring them up to the next level and provide them with the skills that we'll need going forward*."

Interviewee 7: "*Also reskilling your teams, reskilling your people. Training is a very big consideration because sometimes employing these technologies doesn't mean that you're going to lose your people, it means that you're going to have different skilled people that will output at a different level or output different information or different value to the business*."

Interviewee 15: "*And I would say from a leadership point of view it is your role to train and develop and reskill and upskill those people into other roles…*"

Seven of the respondents emphasised the opportunity presented when job automation technologies are adopted to reskill staff to fill more value-adding functions. The respondents also felt that while some jobs may be lost to automation new jobs will be created as these technologies advance and are implemented.

Interviewee 1: "*It is not to say that… and I've had this debate with someone previously and I said that with the industrial revolution and the different revolutions we've gone through over the ages is that we might have taken some jobs, but it has created other jobs*."

Interviewee 6: "*What many people fail to see is that there are many jobs, there are many jobs around today that were not around fifty years ago, and that is because of technology, and the way I see it, twenty or thirty years from now, you will have jobs that don't exist today, but there will be new jobs, new industries, new responsibilities*."

5.5.3. Summary of research question 3 findings

The ability of artificial intelligence and machine learning to mimic a human carrying out a repetitive task poses a significant threat to many professions. However, the participants emphasised that while machines are capable of carrying out many tasks, creativity and talent, as in the case of sportspeople or artists, cannot easily be replicated by a machine. Similarly, the roles that are responsible for implementing and maintaining technologies are considered safe from automation.

Interestingly, managers in the South African context are inclined to reskill or upskill their work force in an attempt to improve efficiencies rather than allowing technology to supplant human labour altogether. By enabling the development of their employees' skills, these employers will be poised to take advantage of the new roles emerging during the fourth industrial revolution.

5.6. Conclusion

Chapter five comprises the findings of the research based on the research questions raised in chapter three. The results showed that a multitude of factors come into play when managers are considering the implementation of job automation technologies. These considerations span across the technology, organisation and environment.

It was found that the key considerations are mainly people- and environment-focused. The South African environment greatly impacts the decision whether to adopt job automation technologies. Whether this relates to the unemployment levels in the country or the role of trade unions, the respondents displayed high levels of empathy towards the labour force. While the majority of the managers viewed the technologies in a positive light and saw the need to embrace the technology to remain relevant and competitive in the fourth industrial revolution, the impact on people and the disruption associated with these technologies proved a major deterrent to adoption.

Among the unique findings uncovered during the process was the deliberate and malicious intent of employees to destroy technologies when they are implemented. It was found that fear of being supplanted by technology may lead employees to sabotage the technology to cause failure. A further unique finding was that the state-

owned power utility's inability to provide a stable supply of power to the economy is a serious barrier to adoption.

The "responsible leader" approach to job automation adoption emerged when managers discussed their desire to protect employees from job losses. Instead of implementing the technologies on a large scale and simply replacing humans with more accurate and better-quality technological tools, the respondents felt the need to secure jobs by reskilling employees to become players in the fourth industrial revolution.

Repetitive tasks faced highest risk of automation. The jobs mentioned, however, were not limited to low-skilled jobs; they included both entry-level jobs and professional jobs. The ability of the technologies to consume data allows both simple and highly complex repeatable tasks to be automated.

When it came to job security, while technology is evolving at a rapid pace, jobs that promote human wellness and interaction will be safe in the future. Creativity was viewed as a critical trait that could keep a job or role relevant.

The findings suggest that a close relationship should be fostered between business and government to address the challenges already being faced, as well as any future issues that may be foreseen based on the current trajectory of the country. One of these challenges relates to skills within the country; conflicting views were gathered regarding the availability of technology skills in the country. More importantly, it was noted that skill sets fit for purpose in the fourth industrial revolution are not being developed to allow economic participation for the future labour force.

The following chapter will proceed with a discussion of these results.

Chapter 6 – Discussion

6.1. Introduction

Chapter six is a discussion of the findings set out in chapter five above. This discussion is informed by the literature review presented in chapter two and the research questions raised in chapter three. This chapter seeks to integrate the findings of the semi-structured interviews with the literature review and the research questions.

Where appropriate, the discussion will highlight consistencies between the findings and the extant literature or, alternatively, where the findings deviate from the literature. Where new findings were discovered that are not covered by the current body of literature, the study will posit these findings as a contribution to the extant literature in the field of job automation adoption.

6.2. Discussion of research question 1

Understand which key factors play a role when managers consider adopting job automation technologies.

6.2.1. Purpose

The purpose of research question one was to gain insights into which key considerations come to mind when managers contemplate adopting the technologies available in the fourth industrial revolution. Furthermore, managers' perceptions were sought to inform an understanding of their attitude toward job automation technologies. The results obtained aligned with the components of the three technology models referred to in chapter three, as well as the bounded automation theory.

6.2.2. Managerial inclination toward technology

It was found that managers across industries take a positive view of the technologies now available in the fourth industrial revolution. The majority of participants displayed high levels of acceptance of these technologies. The Technology Acceptance Model as developed by Davis (1989) makes reference to two constructs that influence the acceptance of a technology: perceived usefulness and perceived ease of use. The majority of participants, who held a positive view of these technologies, confirmed their perceived usefulness. Two of the participants were less positively inclined towards the technologies. In particular, they perceived them as oversold by service providers and not capable of meeting the expectations.

As stated by Gangwar et al. (2014), the constructs developed by Davis (1989) help to confirm an intent to adopt a technology. The interviewees who took a positive view of the technology and its usefulness were already in a phase of adoption of the technology or were keen to adopt the technology. The limitations of the technology, as raised by the two interviewees, showed that at this point these managers did not plan to adopt the technologies.

While the results showed the value of the technology was undeniable, when the topic of ease of use arose the managers displayed signs of hesitancy toward adoption. This supports the existing literature around Davis's (1989) Technology Acceptance Model. The participants who considered the technologies useful showed signs of reluctance to adopt when discussing the practicality of deploying them. The results therefore showed that when managers consider the usefulness of the technology, they appear more likely to adopt it, and conversely, when they have concerns around the ease of use their keenness to adopt it declines. These findings bear out the literature by Davis (1989) and Gangwar et al. (2014).

The Diffusion of Innovation Model (Rogers, 1995) posits that the rate of technology adoption within an organisation is influenced by the attitudes of its leaders. While the interviewees responded mostly positively to the technologies, nevertheless the adoption and implementation were relatively low across the sample. While a positive perception may influence the decision to adopt, the managers considered a multitude

of factors, internal and external to their environment, when discussing job automation technologies (Oliveira & Martins, 2011)

6.2.3. Internal environment considerations

When focusing on the internal environment the participants of this study raised a number of considerations around the organisation and the elements that play a role in contemplating the adoption of job automation technologies.

6.2.3.1. Organisational considerations

The two prominent considerations were around the organisation and the cost of the technology. The findings of this research show that managers reflect on the traits of the organisation when considering job automation technologies. This aligns with the Technology, Organisation and Environment model as defined by Tornatzky et al. (1990), with a specific focus on the organisation component of the model. The literature mentions the limitations of the model, which this study sought to address by stipulating that the managers as individuals cannot be taken in isolation as the gatekeepers of technology adoption (Chen et al., 2016; Stephen & Judge, 2013).

It was found that key concerns emerge around the context of the organisation when technology adoption is contemplated. The industry in which an organisation operates is a key influencer of adoption. This finding is supported by Gilbert (2015), who states that the adoption of technology has the capability to transform industries. The impact of technology at an industry level is also supported by O'Rourke et al. (2013). By way of application of the Diffusion of Innovation model, Rogers (1995) posits that the adoption of technology involves early and late adopters as well as laggards. This was found to be true in the context of this study, as based on their industry organisations either were at the forefront of deploying automation technologies or currently had no intention to deploy them.

The study found that managers need to understand the practical application of the technology and how the technology actually works prior to adopting the technology.

This finding has a direct correlation with the Technology Acceptance Model where the use of the technology is of importance in determining the rate of adoption (Davis, 1989; Venkatesh & Davis, 2000).

The respondents felt it necessary that their organisation be geared towards the adoption of the technologies. Some spoke of their organisations having the necessary support systems in place to facilitate the adoption of the technology. This finding closely follows the theory of DiNardo and Pischke (1997), who posit that organisations whose internal environment is aligned to the technology are able to derive greater benefits from its deployment.

Another consideration the managers raised centred around the organisational processes in place. Six of them suggested that these would need to be reviewed when considering job automation technologies. This finding is compellingly supported by the literature surrounding the effects of automation technologies on organisational processes and their ability to alter these (Colbert et al., 2016; Gilbert, 2015).

The role of technology in current business environments cannot be overstated. Technology is seen as pivotal to organisations serious about achieving their goals. The results of this study confirm that technology plays a key role in the business environment of the fourth industrial revolution. However, the participants qualified this view with the observation that the technology being adopted must align with the business's requirements at the time and support the organisational strategy. The literature by Drnevich and Croson (2013) and Wu and Chiu (2015) speak to organisations deploying technology to reinforce their business and achieve their strategic objectives. This finding therefore is supported by the literature.

6.2.3.2. Cost considerations

The cost of technology adoption and related issues emerged strongly in the findings of this study. Numerous respondents cited cost as the primary consideration when deciding whether to adopt job automation technologies. The majority of interviewees regarded current technology costs as being exorbitant, but two respondents from the

telecommunications sector considered it relatively inexpensive. They noted, however, that the cost of technology is likely to decrease over time.

The managers' focus on the cost of technology supports the research of Oliveira et al. (2014), who state that managers display a level of reluctance to adopting technologies owing to the high costs associated with those that are deemed to be in their infancy.

While Oliveira et al. (2014) posit that the high cost of technology is a key influencer of the decision to resist adopting technologies, a number of academics propose that the cost-benefit relationship should be considered. First, Graetz and Michaels (2018) as well as Virgillito (2017) state that the cost of technology decreases over time, promoting adoption by organisations seeking to reap the associated benefits. Second, a direct correlation is drawn between the cost of adoption and the cost of labour by Acemoglu and Restrepo (2018). They write specifically about the cost-benefit relationship that prompts organisations to adopt technology as the price of human labour surpasses that of the technology.

The cost of labour was raised as a consideration in this study. It was suggested that as long as the cost of labour is less than the cost of technology, organisations are less likely to adopt it. This was particularly true within the South African context, as discovered in the findings set out in chapter five. The effect of the cost of labour on the adoption of technology is well grounded in the literature and is further supported by the findings of this study (Acemoglu & Restrepo, 2018; Fleming, 2019; Lafortune et al., 2019).

6.2.3.3. People considerations

By applying the TOE model (Tornatzky et al., 1990) with a specific focus on the organisation component, it was found that the impact of the technology on people was central to the views of the managers interviewed in the course of this study. Their views encompassed the impact of automation technology on the workforce and the attitude of people towards the technology. The findings illustrated that managers are cognisant of the disruption of which job automation technologies are capable and

of the degree to which they contribute to anxieties pertaining to technological unemployment.

The literature review in chapter two found extensive literature on the impact of technology on jobs and people. The impact of job automation on the workforce has been researched by many academics and the potential ramifications have been hypothesised in detail (Arntz et al., 2017; Autor et al., 2015). This study found that the impact of technology in the fourth industrial revolution has been a cause of anxiety, but this is not confined to the current technological age. Throughout previous eras the advancement in technology has been linked with potential disruption to labour markets (Feldman & van der Beek, 2016; Galor & Weil, 2000; Lafortune et al., 2019; Squicciarini & Voigtländer, 2015). The findings of this study further reflect those of previous studies around technological anxiety and disruption of labour markets.

While the participants of this study were cognisant of the need to consider the people impact of the technologies, the majority discussed the importance of having the right mind set when contemplating these technologies. It was found that in order for organisations to benefit from these technologies people need to alter their framing of them and attempt to consider the positive outcomes they offer. In support of the negative sentiment towards these technologies, Makridakis (2017) takes the view that they are deployed to supplant people. However, Graetz and Michaels (2018) emphasise the need for people to change their mindsets towards new technologies and embrace the complementary effects they have to offer.

6.2.4. External environment considerations

The environment component of the model proposed by Tornatzky et al. (1990) makes reference to environmental factors that play a role in the adoption of technology, in particular the factors that exist within the operating ecosystem of the organisation (Oliveira et al., 2014).

6.2.4.1. Government intervention

Participation of government was seen as key to the success of navigating the fourth industrial revolution. The findings suggest that managers believe it is the responsibility of the government to create an environment that is conducive to the adoption of new technologies by implementing policies that promote business improvements. Respondents felt that South Africa as a country needs to devise a strategy that enables not just the organisations that operate within its borders but the country at large to compete on a global scale.

The literature advises policy and socioeconomic reviews to create an environment that is sustainable and encourage the adoption of technology. The role of government and its policy decisions directly affect the adoption of technologies and can curtail or increase their impact as reflected in the current literature (Arntz et al., 2016; Kim et al., 2017).

6.2.4.2. Unemployment

Unemployment featured strongly in the findings of this research as a vital consideration for managers. Eight of the interviewees mentioned unemployment as central to contemplating adopting job automation technologies. The effect of technology on unemployment has been discussed at length in the extant literature and has been covered in this study. A number of studies have been conducted around technological unemployment in the fourth industrial revolution, as well as previous industrial revolutions as reviewed in this study (Autor, 2015; Castro Silva & Lima, 2017; Clark, 2005; Fleming, 2019; Huang & Rust, 2018; Lonigan, 1939; Schwab, 2016).

In the context of this research paper, unemployment was seen as component in the decision to adopt – and not solely as a result of adoption. The level of unemployment in South Africa in 2019 was a concern for managers prior even to the adoption of automation technologies. While the literature focuses on unemployment resulting from technological adoption, in the South African context it plays a major role outside of this deployment. This finding adds to the extant literature, as current unemployment levels in an environment with high unemployment plays a role in the

decision to adopt technologies as opposed to being an afterthought when adoption results in unemployment.

6.2.4.3. Skills

The findings showed that skills play a vital role in the consideration of new technologies. The interviewees emphasised the need to ensure people have the necessary skills to deploy, use and support the technology. It was further mentioned that in order to extract optimum value from these technologies, the correct set of skills is required within an organisation.

The role that skills play in the adoption of technology is addressed by the TOE model (Tornatzky et al., 1990). The availability of skills to deploy and support the technology was discussed in terms of the external environment and this therefore is categorised under the external environment for the purposes of this study. The importance of considering skills, and technologies' impact thereon, when looking to adopt technologies is supported extensively by the literature (Frey & Osborne, 2017; Nelson & Phelps, 1966; Squicciarini & Voigtländer, 2015).

Participants in this study believed that a mix of skills is required to allow new technology to thrive in industry. This supports the literature by Goldin and Katz (1998) and Acemoglu (1999), who discuss previous industrial revolutions adopting a hybrid model of skills that complement one another. The availability of skills and the impact of technology on skills, whether this be skills-biased or skills-replacing impact, has accompanied the advancement of technologies throughout previous periods (Clark, 2005; Cortes et al., 2017; Feldman & van der Beek, 2016; Virgillito, 2017). The consideration managers give to skills therefore confirms previous literature produced in this field.

6.2.5. Technological considerations

Some respondents spoke about how they perceive the technologies now available in the fourth industrial revolution. The technologies that are relevant to an organisation are divided in the TOE model into internal and external technologies

(Tornatzky et al., 1990). While the technologies are still considered emergent by some academics (Oliveira et al., 2014), the respondents referred to these rapid advances as not a completely new phenomenon. This was supported by segments of the literature and confirms that rapid technological developments have been occurring for many years (Clark, 2005; De Pleijt et al., 2018; Rotman, 2013).

The respondents also made mention of the technologies gaining prevalence over recent times as they move to the forefront of business environments and awareness of the technologies becomes heightened. This is mostly attributed to the technologies' ability to function at the same level as humans or to exceed these limits. This finding strongly supports the existing literature that speaks to the numerous discussions being held around these technologies and their capabilities (Brynjolfsson & McAfee, 2012; Graetz & Michaels, 2018; Makridakis, 2017).

6.2.6. Usability

The literature makes reference to technology's ability to provide a better quality offering to humans if adopted (Pratt, 2015). The study found that the managers agreed with this, stating that technology are able to provide benefits not previously envisaged. This view is also closely aligned to the literature of Janssen et al. (2019) who posit that use of and interaction with technology by humans will change the way we function in our daily lives. The findings therefore confirm the literature as managers view adoption of these technologies as able to improve people's quality of life.

6.2.7. Summary of the discussion of research question 1

The results of this study for research question one show that managers consider a multitude of factors when reflecting on the technologies available in the fourth industrial revolution, as found by Oliveira and Martins (2011). The considerations that were raised by the interviewees can be categorised into the following themes:

Theme 1: Inclination towards technology (Davis, 1989; Rogers, 1995)

Theme 2: Internal considerations (Rogers, 1995; Tornatzky et al., 1990)

Theme 3: External considerations (Tornatzky et al., 1990; Venkatesh & Davis, 2000)

Theme 4: Technological considerations (Tornatzky et al., 1990)

Theme 5: Usability (Davis, 1989)

Taking into account the findings in chapter two, five and six with regards to the research question one and the emergent themes, it may be stated that:

Theme 1: It was found that the literature by Davis (1989) and Gangwar et al. (2014) is confirmed by the findings of this study.

Theme 2: The study confirmed the existing literature with regards to organisational considerations (Colbert et al., 2016; Davis, 1989; Drnevich & Croson, 2013; Gilbert, 2015; O'Rourke et al., 2013; Rogers, 1995; Venkatesh & Davis, 2000; Wu & Chiu, 2015) as well as cost considerations (Acemoglu & Restrepo, 2018; Fleming, 2019; Graetz & Michaels, 2018; Lafortune et al., 2019; Oliveira et al., 2014; Virgillito, 2017).

The consideration of people and the impact of technology on people is strongly supported by the literature (Arntz et al., 2017; Autor et al., 2015; Feldman & van der Beek, 2016; Galor & Weil, 2000; Graetz & Michaels, 2018; Lafortune et al., 2019; Makridakis, 2017; Squicciarini & Voigtländer, 2015)

Theme 3: The external considerations that come to the fore align to a large extant with the existing literature. The technological anxiety that has accompanied previous industrial revolutions holds true for the current era too. The threat of potential job loss due to the adoption of technology has been felt throughout periods of technological progression, and is found to be true in the current technological age as well (Acemoglu, 1999; Arntz et al., 2017; Autor, 2015; Castro Silva & Lima, 2017; Clark, 2005; Cortes et al., 2017; Feldman & van der Beek, 2016; Fleming, 2019; Frey & Osborne, 2017; Goldin & Katz, 1998; Huang & Rust, 2018; Kim et al., 2017; Nelson

& Phelps, 1966; Oliveira et al., 2014; Schwab, 2016; Squicciarini & Voigtländer, 2015; Virgillito, 2017).

This study found that while technological unemployment as a result of the adoption of job automation technologies is widely discussed, the current unemployment levels in an environment with high unemployment has a direct influence on the adoption of the technologies in the first place. This finding contributes to the existing literature with regard to the effects of unemployment on the adoption of job automation technologies.

Theme 4: The discussion around technology focused on the advancements being made in the fourth industrial revolution and the impact these could have. The respondents noted that these technologies gain in popularity as awareness of them increases. These views align with the literature that suggests previous industrial revolutions were impacted by the attendant progression of technology (Clark, 2005; De Pleijt et al., 2018; Rotman, 2013). The findings are therefore supported by the literature.

Theme 5: The usability of technology that advances the way humans carry out certain tasks was raised by some of the respondents. This was mostly viewed in a positive light, which finding supports the existing literature by Pratt (2015) and Janssen et al. (2019).

6.3. Discussion of research question 2

Of these factors, which are considered to be important in enabling or hampering adoption? Does bounded automation play a role in influencing the adoption of automation?

6.3.1. Purpose

Research question two sought to ascertain which factors serve as enablers of job automation technology adoption and, conversely, what managers consider deterrents. The question aimed to establish whether Fleming's (2019) socioeconomic theory was of relevance to the South African environment.

6.3.2. Enablers of the adoption of job automation technologies

The participants in this study provided deep insights into the factors that promote the adoption of job automation technologies. For the purposes of this study the benefits put forth by the participants were analysed in the context of enabling the adoption of job automation technologies.

The benefit of early adoption was seen by the respondents as key to gaining advantages before the rest of the market and is supported by Gans (2016), who posits that technological disruption allows organisations to find innovative ways of dealing with business challenges. By embracing innovative technologies, the managers believed organisations are able to distinguish themselves from their competitors. A significant number of respondents mentioned the need to adopt the available technologies to gain competitive advantage and to ensure the sustainability of the organisation in the long term. The need for an organisation to adopt technology if it is to gain competitive advantage and achieve strategic objectives is theorised by Drnevich and Croson (2013) and Gans (2016) and was supported by the findings of this study.

While the scope of this study was confined to the South African context, there was consensus amongst the respondents that South Africa competes in a global economy and cannot be disconnected from the rest of the world when it comes to advancements in technology. The managers therefore considered it important for the country to adopt these technologies to keep pace with international trends and compete globally. The current literature makes mention of the implementation of these technologies across different geographies (Graetz & Michaels, 2018) and goes on to discuss the need for organisations to address external market forces (Oliveira & Martins, 2011) that seek to gain benefits from deploying these technologies (Lacity & Willcocks, 2016). The findings related to embracing global trends as an enabler of adoption confirms the extant literature.

The two leading enablers, according the interviewees, of job automation technology adoption were the abilities of the technology to provide benefits related to automating repetitive tasks and the utilisation of people, mentioned respectively by ten and nine

of the respondents. The benefits related to automating repetitive tasks and subsequently utilising people in a more efficient manner is strongly supported by the literature describing multiple studies (Autor & Handel, 2013; Brynjolfsson & Mcafee, 2017; Janssen et al., 2019; Lafortune et al., 2019; Latham & Humberd, 2018; Qureshi & Syed, 2014) and therefore the findings of this study further confirm the literature.

The respondents made reference to the capability of technologies to intricately analyse data and the related benefits of these analyses that are not humanly possible. The benefits of this information arose in the context of trend identification and the ability of the technology to enhance decision-making processes and in turn to improve the organisation. These capabilities are discussed in the studies conducted by Colbert et al. (2016) and Qureshi and Syed (2014). The findings of this study therefore support the existing literature in this regard.

Pratt (2015) postulates that the interaction between human and machine enables an opportunity for improvement of the quality of human lives. The managers of this study cited benefits of the adoption of technology such as increased safety, with a particular focus on the mining industry, and reducing workers' exposure to risk. The study by Pratt (2015) is thus confirmed by the findings of this research paper.

A further motivation for the adoption of job automation technologies is the benefit these technologies offer related to productivity gains. This view was shared by nine of the participants, which indicates a consensus that productivity benefits are a key enabler of adopting job automation technologies. The study conducted by Graetz and Michaels (2018) validates the views offered by the respondents of this research paper.

The results of this study found that managers consider job automation technologies to offer improvements in the quality and accuracy of tasks. They went on to mention the improvement in process that can be achieved by adoption of these technologies. Another key enabler they cited is the potential of the technologies to offer improved offerings to customers. While these three enablers were discussed separately from each other, parallels can be drawn between them. Essentially there is a dependency among the enablers, and it can be suggested that an improvement in the quality and

accuracy of a function carried out by automation technologies results in the organisation's processes being improved. Subsequently, this leads to better customer offerings by the organisation having adopted the technologies.

All three enablers can be found in the existing literature as discussed previously in this study. Qureshi and Syed (2014) make specific mention of the benefits that automation technologies can deliver in relation to the accuracy and quality of outputs. The relationship between automation technologies and the revision and improvement of processes is covered extensively in the literature (Colbert et al., 2016; Gilbert, 2015; Graetz & Michaels, 2018). The findings related to quality and accuracy improvements that these technologies offer, together with developing superior business processes by utilising the technologies and the resultant advantage of innovative customer offerings, are thus strongly supported by the extant literature.

6.3.3. Hindrances to the adoption of job automation technologies

This study found that managers in the South African environment consider a number of factors as barriers to the adoption of new technologies. These hindrances are discussed below in conjunction with the available literature (where it was found to be relevant).

The importance of change management was cited by the respondents as a challenge in the adoption of job automation technologies. The failure of insufficient change management initiatives was viewed as an impediment to adoption at scale. The deployment of automation technologies has the potential to bring about significant change in business operations and the manner in which tasks are executed (Janssen et al., 2019). As these technologies are relatively new to the markets, the managers mentioned a lack of understanding by workers as a challenge to implementing the technology and gaining acceptance for it in the workplace. It is therefore found that in order to deploy a technology within an organisation, managers need to institute effective change management processes that provide employees with a level of comfort that enables adoption of the technology. Failure to do so will be detrimental

to the rate of adoption of the technology, as described by the DOI model (Rogers, 1995). The findings of this research are matched in detail in the literature by Rafferty and Jimmieson (2017), who emphasise the importance of change management in mitigating the challenges related to employee resistance. Cultural resistance to new technologies at both an organisational and a country level was also raised by participants, which further amplifies the need for effective change management. Thus the study by Rafferty and Jimmieson (2017) is strongly supported by the findings of this research.

The cost of automation technologies was noted by the participants as a deterrent to adoption. The high costs associated with these emergent technologies were seen by the managers as a barrier to entry. A further disincentive related to cost was the access to cheap labour in South Africa; it is viewed as imprudent to favour an exorbitantly priced technology over cheaper human labour. These findings are completely aligned to the literature. The high costs are a deterrent to adopting new technologies (Oliveira et al., 2014) and the cost of human labour versus the cost of machine labour influences the adoption decision (Fleming, 2019).

The participants in this study mentioned government policy as a limiting factor to the adoption of job automation technologies. It was noted that the South African government seeks to limit job losses to technology. The regulatory environment and social impact of technology adoption is seen as important, as posited in recent studies. These studies refer to the effects of regulation and socioeconomic conditions on rates of adoption (Arntz et al., 2016; Kim et al., 2017; Oliveira et al., 2014). The findings of this study support the literature produced in this context.

The TOE model (Tornatzky et al., 1990) posits that the environment in which the organisation operates has an effect on the adoption of technology. This is expanded on by Oliveira et al. (2014), who examine the macroeconomic considerations that play a role in technology adoption. During this study it was found that the dynamics of the macroeconomy and the limitations thereof prove a deterrent to adopting job automation technologies. Specific mention was made of the lack of infrastructure that supports the implementation of the advanced technologies on offer in the fourth industrial revolution. This was further supported by the respondents in the context of

achieving mass-scale adoption. It was found that while some areas are equipped to adopt the technologies from an infrastructure perspective, there are vast areas that are precluded from adopting purely due to infrastructure constraints.

In addition to the infrastructure challenge experienced in South Africa, the current challenges around power generation and a stable electricity supply restrict the adoption of these technologies. Managers were hesitant to make large capital investments in technology due to concerns whether a stable source of power would be available to allow such technologies to function optimally. The findings around the infrastructure and power supply challenges discovered through this study are an extension of the previous literature by Oliveira et al. (2014) and Tornatzky et al. (1990).

Education and skills were seen as two impediments to technology adoption in a South African context. It was found that the poor education levels prevalent in the country, coupled with the need for specialised skills or the need to transform skills in the work environment to those more aligned to the technologies available in the fourth industrial revolution, are inhibiting factors to technology adoption. The effects of technological advancements on skills in previous industrial revolutions is covered extensively in the literature and the skills and abilities required in the fourth industrial revolution continue to be explored by academics (Chin et al., 2006; Cortes et al., 2017; Feldman & van der Beek, 2016; Franck & Galor, 2015; Frey & Osborne, 2017; Galor & Weil, 2000; Liu & Grusky, 2013; O'Rourke et al., 2013; Squicciarini & Voigtländer, 2015; Virgillito, 2017). Accordingly, the existing literature is strongly supportive of the findings of this study with regard to education and skills concerns.

This study discovered that the two greatest deterrents to the adoption of job automation technologies are the implications of the technologies on the workforce and the negative connotations associated with job loss anxiety. These technologies' impact upon people were raised by numerous respondents as a fundamental barrier to adoption. The adverse effects of technological unemployment has accompanied all of the previous industrial revolutions to some extent and the fourth industrial revolution is proving similar, with multiple academics exploring the potential consequences on people and jobs (Acemoglu & Restrepo, 2018; Autor, 2015;

Feldman & van der Beek, 2016; Galor & Weil, 2000; Huang & Rust, 2018; Lafortune et al., 2019; Mokyr et al., 2015; Squicciarini & Voigtländer, 2015).

This study confined its participants to senior and executive management, and a limited number of respondents mentioned that management buy-in is required to ensure adoption is successful, and its lack was a prohibitive factor. While this could be attributed to the perceived usefulness component of the TAM (Davis, 1989), it may be argued that in instances where management does not see any value in adopting the technology it will hamper adoption. However, the findings around management resistance to adopting technology is explicitly supported by a study conducted by Lacity and Willcocks (2016). This study confirms the existing literature that failure to obtain management buy in is a barrier to adoption.

The participants reflected on the South African labour market and the role that labour unions play in the economy. It was noted that unions exercise significant power in the South African market and may exert pressure on industries to prevent job automation technologies being adopted. This was viewed as a significant barrier to adoption as the actions of unions and their members can lead to violence and operational disruption of the affected industries. The recent theory around organisational power and the role it plays in technology adoption was strongly supported by this study (Fleming, 2019). While Fleming (2019) postulates that organisations attempt to gain organisational power by deploying job automation technologies, this study produced varied results. The respondents offered mixed views on where organisational power resides; some of the participants felt that organisations hold power and others that the unions and employees have the upper hand. This study found that the theory by Fleming (2019) has limited support within the South African environment as organisations are unable to fully adopt job automation technologies and regain organisational power due to the unionised workforce.

A contribution of this study to the existing literature deals with the sabotage of technology and its deployment. A number of respondents spoke about the intentional and malicious behaviour of employees seeking to cause technology to fail. The managers spoke about employees sabotaging new technology in order to disprove

its usefulness and thereby secure their positions in the organisation without having to compete with the technology. The sabotage was seen as a barrier to adoption and in light of this study contributes to extending the literature.

6.3.4. Summary of the discussion of research question 2

The results of this study for research question two illustrate the enablers and deterrents of job automation adoption. The results of the study are largely supportive of the existing literature around the factors that promote or hinder technology adoption. It is worth noting that the results of this study find that the enablers of the technology primarily centre around the organisation and the benefits to be achieved at an organisational level, and align to the model by Tornatzky et al. (1990).

In contrast to this, barriers to adoption tend to be people-focused as the participants articulated views regarding the impact on and behaviour of people toward the deployment of job automation technologies.

The findings of research question two discovered that sabotage of technology deployment by employees was a deterrent to adopting job automation technologies. This finding is deemed a contribution to the extant literature on the topic of barriers to job automation technologies.

6.4. Discussion of research question 3

Which jobs or tasks are seen as the most likely/least likely to be automated within the next five years?

6.4.1. Purpose

Research question three was posed to obtain insights into the jobs or roles that are viewed as highly susceptible to automation or, conversely, secure against being automated. A number of studies have been conducted recently in business and academia to establish the impact of fourth industrial revolution technologies on the

workforce (Accenture, 2018; Arntz et al., 2017; Dengler & Matthes, 2018; Frey & Osborne, 2017).

These studies have identified jobs that are at risk of being automated as well as those seen to be highly resistant to automation. The question explores the types of jobs that are considered to be low and high risk as well as the managerial implications of dealing with jobs that will be automated, and those people currently employed in them.

The research question aims to establish whether the views of the managers align with or contradict the literature around this subject.

6.4.2. Jobs that are highly susceptible to automation

6.4.2.1. Characteristics

Jobs that tend to be systematic and repetitive in nature are highly susceptible to automation, it was found. The respondents to this study mentioned that jobs which are performed with procedural consistency are imminently automatable thanks to the availability of technology that can mimic the actions of a human.

The interviews revealed that jobs that do not require high levels of creativity and are associated with mundane tasks will inevitably be substituted by machines. These findings agree with the current literature around the types of functions that may be performed at a higher level by technology than would be possible by a human. The study carried out by Frey and Osborne (2017) took a holistic definition of a job and analysed the level of threat to the job posed by automation. Arntz et al. (2017) refute this study, contending that Frey and Osborne were too focused on job titles rather than the actual tasks performed by people with the same job title. While their overarching approaches differed, the findings were aligned with their findings regarding the jobs and tasks that can be automated. Jobs or tasks seen as repetitive and non-analytical or which did not require problem solving skills were found to be at risk of automation. These findings are supported in literature by many studies that have been conducted and the findings of this study thus are confirmed by the current

literature (Accenture, 2018; Arntz et al., 2017; Chin et al., 2006; Dengler & Matthes, 2018; Frey & Osborne, 2017; O'Rourke et al., 2013; Susskind & Susskind, 2016)

6.4.2.2. Entry-level jobs

The respondents interviewed for this study concurred that jobs that are mundane and simplistic can be easily automated. This study has showed that entry-level jobs, which fulfil basic service level functions, are at risk of being automated. The jobs thus categorised by the interviewees included call centre agents, whose jobs were deemed to face the highest risk, followed by data capturers, bank tellers and data administrators, to name a few.

The jobs listed by the interviewees conform to the current literature around jobs that are imminently automatable. The straightforward and repetitive functions carried out in entry-level jobs are easily learnt by machine technology (Accenture, 2018; Fleming, 2019; Frey & Osborne, 2017; Graetz & Michaels, 2018; Latham & Humberd, 2018; Susskind & Susskind, 2016). The results of this study are fully supportive of the literature that exists with one caveat – some of the respondents spoke about the need to hire juniors and retain entry-level jobs for them to fill in order to develop them into senior employees. This was found to be true in the professional services industry where, for example, candidate attorneys may need to be hired to ensure the organisation has a supply of lawyers at lower levels, progressing through the organisation.

6.4.2.3. Traditional professionals

This study discovered that some jobs traditionally associated with high levels of skill, such as doctors, lawyers and accountants, were nevertheless at risk of automation. The respondents highlighted the ability of machines to provide a deeper analysis and greater accuracy than humans performing these highly skilled roles. It was noted that, again, the repetitive nature of these jobs renders them vulnerable to automation.

The views of the respondents aligned with the existing literature. Susskind and Susskind (2016) postulate that while some simplistic jobs are at risk of being

automated, some jobs are less at risk than the traditional professional jobs of doctors and lawyers. The threat posed by automation to the roles of accountant, lawyer, auditor and the like are covered in multiple studies that have become available recently (Accenture, 2018; King et al., 2017; Lafortune et al., 2019; Latham & Humberd, 2018; Susskind & Susskind, 2016). These studies are further confirmed by the results of this research paper.

6.4.3. Jobs that are secure from automation

6.4.3.1. Characteristics

The characteristics that were found to provide job security against automation centred around humanness. This study found that the ability to nurture human qualities and take a more human approach characterised the jobs likely to thrive in the fourth industrial revolution. These jobs will counter the alienating effects of the technology consumed by humans in their everyday lives, which respondents felt caused individuals' people skills and social skills to suffer.

The respondents agreed that jobs that focus on human interaction and promote social cohesion would be safe from automation. It was further discovered that the ability to be creative and innovative provides a level of job security. The respondents also felt that the management function enjoyed some level of job security.

The extant literature has focused on the need for skills that cannot be easily imitable by a machine (Arntz et al., 2017). According to Dengler and Matthes (2018) the jobs that machines cannot substitute for are those in the specialised human and social sciences field. Furthermore, Decker et al. (2017) suggest that jobs that require high levels of skill are less at risk of being automated. In terms of this study, it was found that there is close alignment between the results of the study and the available literature.

6.4.3.2. People-centred jobs

As mentioned above, the study found that jobs which focus on human well-being from a social standpoint are viewed as secure from automation. Some such jobs listed by the interviewees were those of psychologists, motivational speakers and life coaches.

While these jobs may be considered manual jobs, they are non-routine in nature and therefore are thought to be immune to automation (Cortes et al., 2017). Based on the study by Cortes et al. (2017) and that by Frey and Osborne (2017), which mentions the need to pursue social skills to mitigate the risk associated with automation, the findings related to this research are supported in the existing literature.

6.4.3.3. Creative jobs

The study found that jobs that require high levels of creativity will not face the risk of substitution by job automation technologies. Careers such as entertainer, sportsperson and artist were believed immune from technological unemployment.

The results of this study are confirmed by the literature, which makes mention of the skills of the future and lists creativity as an attribute of those jobs that will be secure through the fourth industrial revolution (Accenture, 2018; Cortes et al., 2017; Frey & Osborne, 2017).

6.4.3.4. Management activities

The respondents felt that managerial activities will probably withstand the technologies available for job automation. The management of people and of the technologies deployed were cited by the respondents as being relatively safe from automation.

The findings of this study conform to the literature. Managerial functions are seen as being less susceptible to automation than other roles as discussed in a number of academic and business reports (Accenture, 2018; Decker et al., 2017; Frey & Osborne, 2017).

6.4.4. Dealing with the displacement of workers

Participants in this study agreed that some jobs will be replaced by job automation technologies and provided insights into which these roles may be. The attendant shrinkage of the jobs pool thus would make it necessary for them to address the impact on affected employees. The results of this study showed that the managers interviewed do not intend to make workers redundant on a mass scale; instead a number of the respondents spoke about reskilling or redeploying their staff.

Technology adoption was seen not as a way to reduce headcount, but rather as an opportunity to redeploy employees in more value-adding roles. The study also found that the respondents anticipated new jobs being created due to technological advancements. This was seen as a mitigating factor to the potential disruption of existing roles, as impacted workers could be redeployed to new functions wherever possible.

The findings are strongly supported by the literature. The results of this study align with others carried out on past industrial revolutions, where the major focus was on skills – the need for new skills created by advancements made over those periods (Franck & Galor, 2015; Squicciarini & Voigtländer, 2015). The topic of new jobs coming into being is also supported by a study conducted by consulting firm Deloitte (Deloitte, 2015).

The demand for skills has always accompanied industrial revolutions (Feldman & van der Beek, 2016; Galor & Weil, 2000; Lafortune et al., 2019; Squicciarini & Voigtländer, 2015). The literature also makes reference to technology playing a dual role, supplanting some workers and complementing others (De Pleijt et al., 2018; Krueger, 1993). Latham and Humberd (2018) posit that the reskilling of workers when new technologies are deployed provides benefits.

The findings of this study are therefore found to be strongly supported by the literature.

6.4.5. Summary of the discussion for research question 3

The results of this study for research question three show strong correlations with the literature that has been produced about the various technological ages as well as the fourth industrial revolution.

Jobs that are repetitive in nature and do not require much variability in their required functions stand to be replaced by job automation technologies. Jobs that are less repetitive and require human analytical analysis and elements of talent, such as in entertainment or sports, will not be replaced soon.

The respondents of this study did not view the disruption these technologies pose to existing jobs and functions as an opportunity to reduce headcount. Rather this disruption is seen as an opportunity to address deficiencies in the current skill set and enable employees to provide more value-adding services to the organisation.

6.5. Conclusion

Chapter six provided a comparative analysis of the research results presented in the previous chapter against the existing literature on the subject covered in chapter two.

O'Rourke et al. (2013) posit that the first industrial revolution was concurrently skill-demanding and skill-saving in a similar manner to the second industrial revolution (Acemoglu, 1999). The third industrial revolution is viewed as having been skill-biased, as the demand for skilled labour increased during this period (Liu & Grusky, 2013). The fourth industrial revolution differs to the previous eras in that high-skilled, unskilled and low-skilled workers in certain categories are potentially at risk of being supplanted (Susskind & Susskind, 2016).

It is this significant difference that is the cause of much of the anxiety related to the adoption of job automation technologies. It is noteworthy that the results of this study reflect enablers of technology adoption as primarily centred around the organisation and the benefits that may be achieved at an organisational level, which aligns with the model proposed by Tornatzky et al. (1990).

In contrast to this, barriers to adoption were people-focused. The participants in this study took an interest in the impact and behaviour of people with regard to the deployment of job automation technologies.

The study results were closely aligned with the existing literature regarding adoption considerations, enablers of adoption and deterrents of adoption. It was also established that the theory of bounded automation (Fleming, 2019) is relevant in a South African context, but only to a limited extent due to its unionised workforce. The study further established that the jobs identified as at risk or secure from automation in terms of characteristics and job titles are the same as those discussed in the literature. The results also revealed the respondents' intention to harness the opportunity presented when job automation technologies are adopted to reskill and redeploy staff instead of solely reducing headcount.

There were three findings in this study that contribute to the existing literature, whereas research question three confirmed the findings of existing literature that mention the risk that is posed to repetitive tasks by job automation technologies:

1. Research question one discovered that while the present literature considers the potential unemployment post the technology adoption process, the respondents to this study consider the current unemployment level prior to adopting the technology. This study found that high unemployment levels are a barrier to adoption as the respondents did not consider the potential post implementation job loss acceptable.

2. Research question two discovered that the potential for sabotage by employees of technology and its deployment stood as a deterrent to adopting job automation technologies. This finding may be considered a contribution to the extant literature on the subject of barriers to job automation technologies.

3. Research question two found that the infrastructure and power supply challenges experienced in South Africa were hindrances to technology adoption, extending the previous literature by Oliveira et al. (2014) and Tornatzky et al. (1990).

Based on the findings of this study the researcher believes that the high unemployment in the current environment, coupled with the fear of job loss, as set out in the literature and confirmed by the results of this research, influences the decision of employees to sabotage technological deployments to ensure technological failure and secure their position in the organisation.

The tables below illustrate the relationship between the findings of the study and the existing literature for each research question as set out in chapter three.

Table 6.1 – Research question one

CODE GROUP	**EXISTANT LITERATURE**
POSITIVE EMOTION	Oliveira & Martins, 2011; Rogers, 1995; Gangwar, Date & Raoot, 2014; Davis, 1989
NEGATIVE EMOTION	Oliveira & Martins, 2011; Rogers, 1995; Gangwar, Date & Raoot, 2014; Davis, 1989
ORGANISATIONAL CONSIDERATIONS	Tornatzky, Fleischer & Chakrabarti, 1990
Industry impacts decision	Gilbert, 2015; O'Rourke, Rahman & Taylor, 2013; Rogers, 1995
Authentication of tech	Davis, 1989; Venkatesh & Davis, 2000
Readiness	DiNardo & Pischke, 1997
Process considerations	Gilbert, 2015; Colbert, Yee & George, 2016
Business requirements	Drnevich & Croson, 2013
Organisational strategy	Drnevich & Croson, 2013; Wu and Chiu, 2015
COST CONSIDERATIONS	
Cost	Oliveira, Thomas & Espadanal, 2014
Cost benefit	Graetz & Michaels, 2018; Virgillito, 2017; Acemoglu & Restrepo, 2018
Costs are high	Oliveira, Thomas & Espadanal, 2014
Costs are decreasing	Graetz & Michaels, 2018; Virgillito, 2017
Cheap labour	Acemoglu & Restrepo, 2018; Lafortune et al., 2019; Fleming, 2019
GOVERNMENT INTERVENTION	Tornatzky, Fleischer & Chakrabarti, 1990
Enable environment	Arntz, Gregory & Zierahn, 2016; Kim, Ki & Lee, 2017; Fleming, 2019
Country politics	Arntz, Gregory & Zierahn, 2016; Kim, Ki & Lee, 2017; Fleming, 2019; Oliveira et al., 2014
UNEMPLOYMENT	Schwab, 2016; Autor, 2015; Huang & Rust, 2018; Clark, 2005; Fleming, 2019; Castro Silva & Lima, 2017
PEOPLE CONSIDERATIONS	Tornatzky, Fleischer & Chakrabarti, 1990
Impact on people	Arntz, Gregory & Zierahn, 2017; Autor, Dorn & Hanson, 2015; Feldman & van der Beek, 2016; Galor & Weil, 2000; Lafortune, Lewis & Tessada, 2019; Squicciarini & Voigtländer, 2015
Mindset needs to change	Graetz & Michaels, 2018; Makridakis, 2017
SKILLS CONSIDERATIONS	Tornatzky, Fleischer & Chakrabarti, 1990
Skills must be considered before adopting	Frey & Osborne, 2017; Squicciarini & Voigtländer, 2015; Nelson & Phelps, 1966
Mix of skills	Goldin & Katz, 1998; Acemoglu, 1999
Availability of skills	Virgillito, 2017; Cortes, Jaimovich & Siu, 2017; Clark, 2005; Feldman & van der Beek, 2016

TECHNOLOGY CONSIDERATIONS	Tornatzky, Fleischer & Chakrabarti, 1990
Tech is not new	Clark, 2005; De Pleijt, Nuvolari & Weisdorf, 2018; Rotman, 2013
Gaining prevalence	Brynjolfsson & McAfee, 2012; Makridakis, 2017; Graetz & Michaels, 2018
USABLITY	Pratt, 2015; Janssen, Donker, Brumby & Kun, 2019

Table 6.2 – Research question two

ENABLERS OF ADOPTION	
First mover advantage	Gans, 2016
Competitive advantage and organisational relevance	Drnevich & Croson, 2013; Gans, 2016
Embrace global trends	Graetz & Michaels, 2018; Lacity & Willcocks, 2016; Oliveira & Martins, 2011
Utilisation of people	Janssen, Donker, Brumby & Kun, 2019; Brynjolfsson & Mcafee, 2017; Latham & Humberd, 2018
Repetitive tasks	Qureshi & Syed, 2014; Autor & Handel, 2013; Lafortune et al., 2019
Analysis and decision making	Colbert, Yee & George, 2016
Improved productivity	Graetz & Michaels, 2018; Lacity & Willcocks, 2016
Quality and accuracy	Qureshi & Syed, 2014
Improved service offerings	Gans, 2016; Brynjolfsson & Mcafee, 2017
Identification of trends	Qureshi & Syed, 2014
Employee safety	Pratt, 2015
Process improvements	Gilbert, 2015; Graetz & Michaels, 2018; Colbert, Yee & George, 2016
HINDRANCES	

Change management	Janssen, Donker, Brumby & Kun, 2019; Rafferty & Jimmieson, 2017
Lack of understanding	Rafferty & Jimmieson, 2017
Cost of tech	Oliveira et al., 2014; Virgillito, 2017; Fleming, 2019
Cultural barriers	Rafferty & Jimmieson, 2017
Government policy	Arntz, Gregory & Zierahn, 2016; Kim, Kim & Lee, 2017; Oliveira et al., 2014
Infrastructure	Oliveira et al., 2014
Electricity supply	
Education	Franck & Galor, 2015; Galor & Weil, 2000; Feldman & van der Beek, 2016; O'Rourke, Rahman, & Taylor, 2013; Chin, Juhn, & Thompson, 2006
Skills	Franck & Galor, 2015; Squicciarini & Voigtländer, 2015; Virgillito, 2017; Cortes, Jaimovich & Siu, 2017; Frey & Osborne, 2017; Chin, Juhn, & Thompson, 2006; Liu & Grusky, 2013
Fear of job loss	Autor, 2015; Mokyr, Vickers & Ziebarth, 2015; Huang & Rust, 2018; Acemoglu & Restrepo, 2018; Mokyr et al., 2015
Implication for people	Feldman & van der Beek, 2016; Galor & Weil, 2000; Lafortune, Lewis & Tessada, 2019; Squicciarini & Voigtländer, 2015
Sabotage of tech	
Management buy in	Lacity & Willcocks, 2016
Unions	Fleming (2019)
Power dynamics	Fleming (2019)

Table 6.3 – Research question three

CHARACTERISTICS OF AT-RISK JOBS	Frey & Osborne, 2017; Arntz et al., 2017; Dengler & Matthes, 2018; Accenture, 2018; Susskind & Susskind, 2016; O'Rourke, Rahman & Taylor, 2013; Chin, Juhn & Thompson, 2006; Gray, 2013
ENTRY LEVEL JOBS	Frey & Osborne, 2017; Accenture, 2018; Graetz & Michaels, 2018; Latham & Humberd, 2018; Susskind & Susskind, 2016; Fleming, 2019
TRADITIONAL PROFESSIONALS	Accenture, 2018; King, Hammond & Harrington, 2017; Susskind & Susskind, 2016; Latham & Humberd, 2018; Susskind & Susskind, 2016; Lafortune et al., 2019
SECURE JOBS	
CHARACTERISTICS	Arntz et al., 2017; Dengler & Matthes, 2018; Decker, Fischer & Ott, 2017
PEOPLE-CENTRED JOBS	Cortes, Jaimovich & Siu, 2017
CREATIVE JOBS	Accenture, 2018; Cortes, Jaimovich & Siu, 2017; Frey & Osborne, 2017; World Economic Forum Report, 2018
MANAGEMENT ACTIVITIES	Decker, Fischer & Ott, 2017; World Economic Forum Report, 2018
IMPACT ON PEOPLE - RESKILL NOT REPLACE	Arntz, Gregory & Zierahn, 2017; Autor, Dorn & Hanson, 2015; Franck & Galor, 2015; Squicciarini & Voigtländer, 2015; Cortes, Jaimovich & Siu, 2017; Deloitte, 2015; Brynjolfsson & Mcafee, 2017; De Pleijt et al., 2018; Krueger, 1993; Latham & Humberd, 2018
NEW JOBS WILL BE CREATED	Franck & Galor, 2015; Squicciarini & Voigtländer, 2015

7. Chapter 7 – Conclusion and recommendations

7.1. Introduction

This study was initiated in the hope of gaining insights into how managers perceive the adoption of job automation technologies. The study sought to explore the views of managers with regard to the factors they would consider when contemplating adopting the automation technologies of the fourth industrial revolution. The study aimed to identify the key enablers of and deterrents to adopting job automation technologies, as well as the impact on the workforce and on jobs that are seen to face a high or low risk of automation.

Owing to the widespread anxiety around technological unemployment, the study was conducted to understand the potential implications for jobs within an environment that has significant unemployment levels (Statistics South Africa, 2019) to establish the validity of the global discussions around local markets (Arntz et al., 2017; Autor et al., 2015). The literature establishes that the disruption associated with technology progression has existed throughout the ages (Autor, 2015; Mokyr et al., 2015) and this study provides further context to this by discussing the role of technology in previous industrial revolutions and contrasting this with the views obtained through interviews.

Chapter seven draws this study to a close by providing a summary of the research findings, followed by the consequences of these findings from an academic and business perspective. The limitations of this study are then discussed, and areas of future research are proposed as is customary.

7.2. Research findings

By means of an exploratory study this research paper has provided answers to the three research questions set out in the study. It was discovered that members of senior and executive management across industries and organisation sizes share similar views regarding the factors that play a role in the adoption of job automation

technologies. In the course of exploring research question one, it was found that the anxiety associated with the disruption these technologies cause does not affect the way managers perceive them. They aired positive attitudes toward the technologies and saw benefits and value in adopting them. The construct of perceived usefulness as posited by Davis (1989) was therefore confirmed by this study.

The considerations that came to the fore were multifaceted, as had been suggested by Oliveira and Martins (2011) and is supportive of the Technology, Organisation, Environment model (Tornatzky et al., 1990) as the views were easily classified into these three components. The key finding of research question one was the respondents' cognisance of the implications of the technology for the workforce. Although they reflected a positive attitude towards the adoption of the technology, the human impact was discussed in detail, highlighting the alignment between the findings of research question one and the extant literature on the impact of job automation technologies on the workforce (Arntz et al., 2017; Autor et al., 2015; Feldman & van der Beek, 2016; Galor & Weil, 2000; Graetz & Michaels, 2018; Lafortune et al., 2019; Makridakis, 2017; Squicciarini & Voigtländer, 2015).

The contribution of research question one to the literature centres around existing unemployment levels as an input to the decision to adopt job automation technologies, as opposed to the extant literature which focuses mainly on unemployment as a consequence of technology adoption.

The findings related to research question two were supportive of the existing literature around the enablers of and deterrents to technology adoption. The key finding of research question two was the difference in the approach of the participants, who spoke at length about the organisational benefits these technologies offer and why they should be adopted, but who when discussing barriers to adoption were more focused on the human aspects and the negative effects of the technology on people. In short, the findings showed that when managers reflect on the enablers of adoption, they focused on the benefits that organisations can reap from these technologies. However, when considering the deterrents, the focus was not on organisational constraints per se, but rather on the human factor.

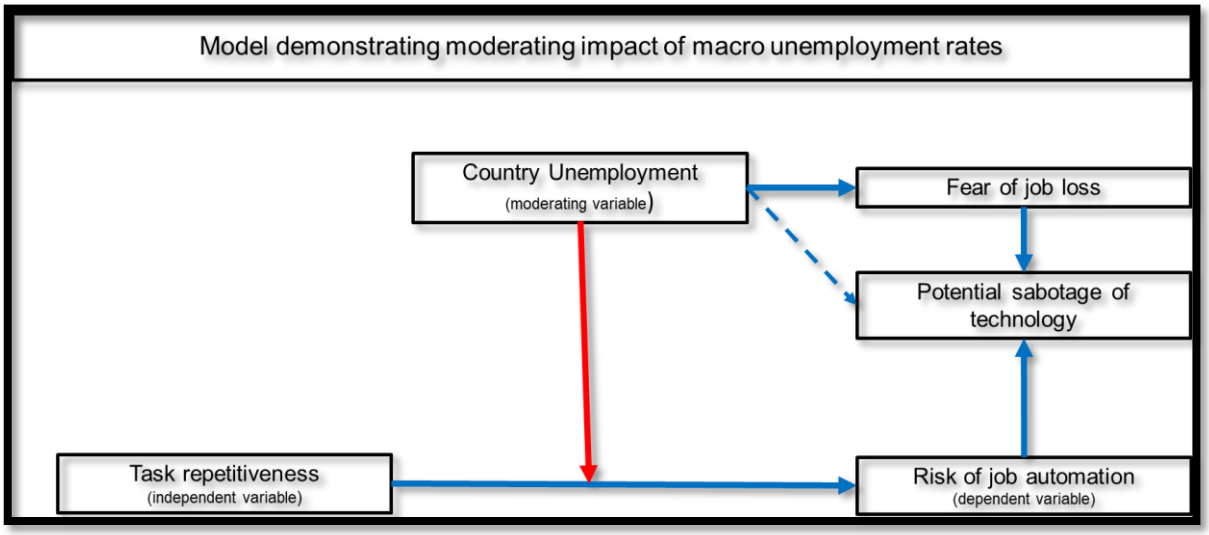
It was found that the bounded automation theory (Fleming, 2019) is of relevance to the South African environment. The role of unions was seen as a significant impediment to technology adoption. The problem posed by insufficient change management initiatives was highlighted, and the sabotage of technologies by employees was considered of critical importance. The contribution of research question two's findings relates to the sabotage of job automation technology as a barrier to its adoption.

Research question three did not provide any new insights into the question of which jobs are at risk of or safe from being automated, but rather confirmed the validity of previous research. The findings supported the existing literature around the importance of skills that are creative and analytical and have a focus on human well-being (Accenture, 2018; Frey & Osborne, 2017). These traits were confirmed by the respondents as being secure from automation. Further to this, the study provides support to the existing literature around the risks that repetitive tasks face due to automation technologies (Lafortune et al., 2019; Qureshi & Syed, 2014; Susskind & Susskind, 2016).

The collective findings of the three research questions show that South Africa as an emerging market faces the same challenges as other global markets to a large extent. The findings also brought to light the human-centric approach the respondents take when considering the people impact of fourth industrial revolution technologies. To an extent, the managers were willing to forgo organisational benefits that could be achieved by implementing the technologies in favour of protecting the jobs of their employees. While this might seem as irrational behaviour on the part of the managers, the context of an environment with such high unemployment levels counters this argument and shows the behaviour of the managers can be seen as rational while attempting to avoid further unemployment.

7.3. A proposed model

Figure 7.1



According to Bloomberg and Volpe (2012), the limitations of qualitative research can be addressed via the generalisability of the results of the study. The study confirmed previous research that states highly repetitive tasks are imminently susceptible to automation (Lafortune et al., 2019; Qureshi & Syed, 2014; Susskind & Susskind, 2016). The fear of job loss has been covered extensively in the extant literature and was found to be of significant relevance to this study (Autor, 2015; Mokyr, Vickers, & Ziebarth, 2015; Autor, 2015; Huang & Rust, 2018; Acemoglu & Restrepo, 2018; Mokyr et al., 2015).

An environment that has high unemployment levels was found to be a barrier to the deployment of job automation technologies. This study further discovered the malicious and deliberate behaviour of employees to prevent the success of technology deployment as a hindrance to the implementation of automation technologies. The study was found to be supportive of previous findings around repetitive tasks being highly susceptible to automation (Frey & Osborne, 2017; Arntz et al., 2017; Dengler & Matthes, 2018; Accenture, 2018; Susskind & Susskind, 2016; O'Rourke, Rahman & Taylor, 2013; Chin, Juhn & Thompson, 2006; Gray, 2013).

Based on these findings the researcher postulates that while the level of repetitiveness of a task should increase the rate of automation adoption, the unemployment rate of an environment is a moderating factor to the adoption of job automation technologies. Furthermore, the fear of job loss in an environment with high unemployment influences the decision to sabotage the technology deployment.

The proposed model by the researcher posits that the level of unemployment, where found to be high, negatively impacts the decision of managers to automate tasks. The researcher further postulates that as job automation increases and the fear of job loss intensifies, the risk of sabotage by employees will increase.

7.4. Implications for business

This research has provided insights into the elements that influence the decision to adopt job automation technologies. It was established through the study that organisations within South Africa, and the country as a whole, need to start gearing towards adopting technologies, as physical country borders are transcended through technology.

In order to remain competitive and relevant in the global market, business needs to address the challenges around unemployment and the skills needed for the future of work. Organisations, through their management teams, need to bridge the gap between the negative implications for the workforce and the benefits that are forgone when these technologies are not adopted.

It is critical for the future sustainability of organisations that the requisite skills be developed to promote and support the technologies of the fourth industrial revolution. If the unemployment problem that exists is to be addressed, the trade-off cannot be to forgo the clear benefits of these technologies in order to protect a workforce that soon will be redundant in comparison to other international markets, which are adopting the technologies. The findings of this study intensify the need for a collaborative effort between business, labour and government to address the shortcomings of the environment that prevents economic progression.

The proposed model illustrates the need for managers to address potential disruption to technology adoption due to employee sabotage. The high unemployment level of the operating environment plays a moderating role in the adoption of job automation technologies and it wold be prudent of managers to mitigate the risks associated with this moderating variable.

7.5. Limitations

Owing to the exploratory nature of this study, the results cannot be broadly generalised and are limited in their application. The researcher conducted the study by interviewing senior and executive managers only, which is a further delimitation of the study. The sample size did not include sufficient representation from all industries that operate within the South African market.

Most importantly, the views expressed by the participants of this study are not the official views of the organisations they belong to, and the study therefore makes no findings with regard to the strategic intent of organisations to adopt job automation technologies.

Qualitative research, by design, tends to be subjective in nature and conscious or unconscious biases on the part of the researcher may affect the research. The study is further limited geographically, in that the research was conducted in the Gauteng region and hence the results may not be replicable in other regions within South Africa or across its borders.

The model proposed was not empirically tested to ascertain its validity and test the strength of the variables.

7.6. Suggestions for future research

The findings of this study were mostly supported by existing literature. However, the new insights it uncovered present an opportunity for those findings to be researched in greater detail. The role of current unemployment levels can be researched to determine the extent this influences job automaton technology adoption.

A study on the intricacies of technology sabotage and the frequency of such a phenomenon may be conducted to understand the topic in greater detail. A study on the enablers of and deterrents to adopting job automation technologies may be

carried out using quantitative methods to provide a ranking of each of the considerations found in this study. Using the findings of this study as a basis, a similar study may be carried out with an industry-focused approach to validate the findings against industry-specific behaviours.

The model proposes that environments with high unemployed are prone to sabotage due to the fear of job loss. A proposed future study can be conducted to ascertain if sabotage occurs in environments with low unemployment rates.

7.7. Conclusion

The research has discovered new findings into the enablers and deterrents to job automation technologies. The exploratory study that was conducted via semi-structures interviews with seventeen participants across eight industries provided the researcher with rich insights into the factors that play a role in the process of adopting job automation technologies.

The researcher was able to develop a model based on the findings that considers the unemployment levels of an environment and the influence it has on the technology adoption process. It was also noted that managers within the context of this study display high levels of concern for the workforce and are generally protective of the jobs of the workers against technology adoption.

As set out in the introduction of this study, the views that were expressed and the associated findings of this study do not translate into organisational intent to replace humans with job automation technologies.

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Annexure A: Interview schedule and consent form

Adoption of job automation technologies: A managerial perspective.

Researcher: Naweed Abdulla, MBA student at the Gordon Institute of Business Science

I am conducting research into how managers view the emergent automation technologies within their industries and functions.

The interview is expected to last one hour and will hopefully provide me with insights into the elements that managers consider when looking to adopt AI, ML and Robotics and what the key factors are that either promote adoption or are seen as being a barrier to adoption for their organisation.

Your participation is voluntary, and you can withdraw at any time. The interview will be audio recorded, however you may choose not to be recorded. All information will be kept confidential and will only be reported on in combination with that collected from other respondents.

Should you have any concerns, you may contact myself or my supervisor.

Muhamed Naweed Abdulla
18370812@mygibs.co.za
082 840 6020

Simon Swanich
simon@swanich.com

Interviewee Name: _____

Signature: _____

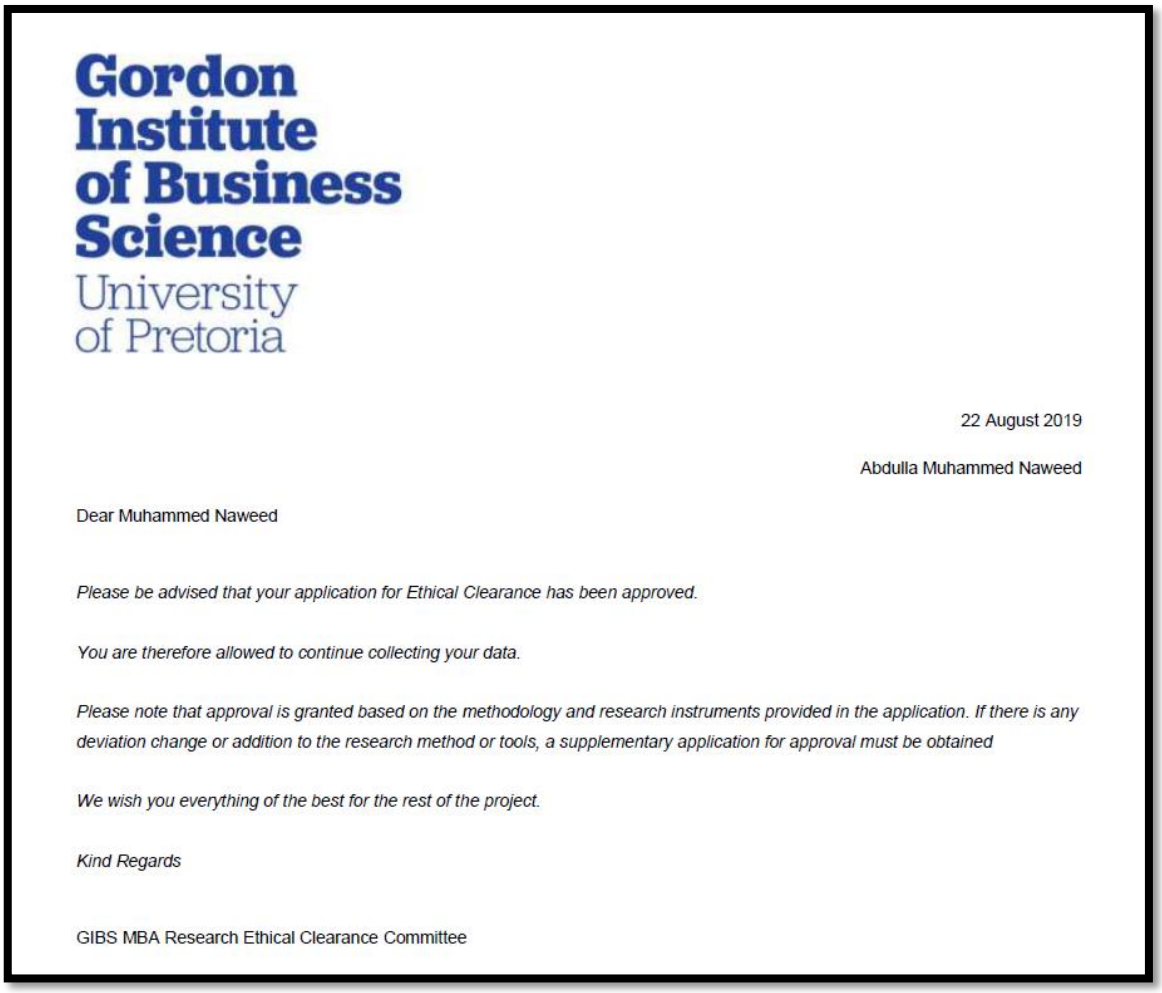
Date: _____

Researcher's name: _____

Signature: _____

Date: _____

Annexure B: Ethical clearance



Gordon Institute of Business Science
University of Pretoria

22 August 2019

Abdulla Muhammed Naweed

Dear Muhammed Naweed

Please be advised that your application for Ethical Clearance has been approved.

You are therefore allowed to continue collecting your data.

Please note that approval is granted based on the methodology and research instruments provided in the application. If there is any deviation change or addition to the research method or tools, a supplementary application for approval must be obtained

We wish you everything of the best for the rest of the project.

Kind Regards

GIBS MBA Research Ethical Clearance Committee

Annexure D: ATLAS.TI codegroups

Research question 1:

POSITIVE EMOTION

NEGATIVE EMOTION

ORGANISATIONAL CONSIDERATIONS

COST CONSIDERATIONS

GOVERNMENT INTERVENTION

UNEMPLOYMENT

PEOPLE CONSIDERATIONS

SKILLS CONSIDERATIONS

TECHNOLOGY CONSIDERATIONS

USABLITY

Research question 2:

ENABLERS OF ADOPTION

HINDRANCES

Research Question 3:

CHARACTERISTICS OF JOBS THAT ARE AT RISK

ENTRY LEVEL JOBS

TRADITIONAL PROFESSIONALS

JOBS THAT ARE SECURE

CHARACTERISTICS

PEOPLE CENTRED JOBS

CREATIVE JOBS

MANAGEMENT ACTIVITIES

IMPACT ON PEOPLE - RESKILL NOT REPLACE

NEW JOBS WILL BE CREATED