Gordon Institute of Business Science
University of Pretoria

The impact of socio-materiality and AI technology adoption within the manufacturing Industry.

Student Number: 23036461

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.

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Abstract

Artificial intelligence (AI) embedded technologies are becoming a trend in the fourth Industrial revolution. These technologies are known for bringing groundbreaking efficiencies and superior quality to the products being produced in South Africa's manufacturing industry. With evidence of South Africa's high unemployment rate and low skilled workforce the operationalising of this AI embedded solutions strategy has become a challenge. The researcher aims to collect qualitative data through semi-structures interviews from the manufacturing sectors leadership to understand their challenges and use this data to form strategic actions to ease the implementation of these AI embedded technologies.

The researcher will start with desktop research to understand the existing literature and structure this research to solve the gaps that may exist and focus the data collection within the South African Context. The researcher will then find leaders who meet the criteria of possessing experience with these AI embedded technologies. The researcher will then collect the open codes of data from the interviews and fine the axial and selected codes which will allow the themes to emerge.

The research will then analyse these themes to understand the effect that the workforce has on the implementation of AI embedded technologies and use this data to form strategic actions to mitigate these risks.

Keywords and terminologies

<u>Artificial Intelligence (AI), Embedded technologies:</u> Technology that can collect data from repetitive processes, big data, and the Internet of things, to self-teach and assist Humans and organizations to improve the efficiency of their processes and gain competitive advantages through new capabilities and improved quality.

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.

Nishen Naidoo

04 November 2024

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Chapter 1: Introduction to Research Problem.

1.1. Introduction

The construct of modern society and the organisation commonly accepts both in academia and business that we exist in an age of discontinuous fast-paced change and this change is driven by the paradox of modern technologies within the construct of the fourth industrial revolution(4IR). Across the different horizons of technology revolutions, the first industrial revolution started around the 1760s and lasted till roughly 1830, the second industrial revolution started in the mid-19th century till the 20th century (Inc., 2024). The third industrial revolution started around the 1970s and transitioned to the fourth industrial revolution around the 2010s (Inc., 2024). The fourth industrial revolution officially transitioned over from the third industrial revolution around 2010 and there is already speak of the incoming fifth industrial revolution (Inc., 2024). The transition from the first to the second took around 70 years then from the second to the third around 40 years. Similarly, from the third to the fourth revolution, it also took 40 years. It has now only been 14 years and we are already hearing talks of moving towards the fifth industrial revolution. This acceleration of technological advancement is making it difficult for emerging countries to keep up. The explosion and perforation of Artificial intelligence (AI) has grown from 0-100 in one year. The year 2023 was considered the year of generative AI. All global economies, advanced and emerging are struggling to understand the impacts of this, even though these technologies are still in their relative infancy. Emerging economies are falling behind in the attempt to keep up with the acceleration of these technological advancements. If emerging economies do not adapt their approach to AI-embedded technology, then these countries will have higher manufacturing costs and low product quality, which will result in a loss in investment. The research will intend to better understand human behaviour regarding adopting AI-embedded technologies in emerging economies such as South Africa. Globally, there are excellent studies conducted but little to no research has been conducted in emerging economies. South Africa has a multi-cultural population if compared globally and will contribute a great deal of knowledge on this topic.

With the manufacturing industry constantly becoming more competitive every day, companies are looking for innovative ways to be cost-effective but remain profitable whilst keeping their market share (Gillani, 2020). This is currently a complicated task with companies that have a large workforce, as this brings the excessive cost of overheads into the top line (Economy, 2024). Manufacturing is said to be one of the top five industries impacted by AI-embedded technologies due to these technologies replacing manual processes or legacy processes (Forbes, 2023). The Mining industry could increase its revenue margins by 15%, retail could increase by two percentage points and banking could increase by ten percentage points on average (Mckinsey, 2019). These AI-embedded technologies are coming in and disrupting the model of the manufacturing industry in emerging markets to drive up cost-effectiveness. The aim is to improve the EBITA margin, increase revenue and reduce the direct cost. The researcher aims to find a construct between the readiness of the environment and the willingness of the workforce to accept this technological advancement without competing in the workplace.

1.2. Research problem background.

It may seem paradoxical as emerging economies are said to catch up with advanced economies through AI-embedded technologies, but research suggests that emerging economies such as South Africa are struggling to keep up with the speed of the advancements made in the manufacturing environment (News, 2024). It may seem far-fetched that South Africa would be on the verge of major investment into AI-embedded technologies. However, according to the African Development Banks, South Africa is one of four African countries that are placing high investments in AI technologies (Exchange, 2024). The Financial Sector seems to be leading the push towards AI technologies with an estimated 14.9 billion ZAR by 2025 (Exchange, 2024).

The manufacturing industry used to be a stronghold for South Africa's economy as it held a contribution of around 25% towards the GDP. The latest numbers as of 2022 show a decrease of 12% which is an alarming downtrend for the industry (Villiers, 2024). It is known that South Africa has three major stakeholders in the manufacturing sector, employers, shop floor workers, and the trade unions. There is a strong belief that the biggest threat to jobs is the move of this industry towards automation through AI-embedded technologies. Manufacturers have an opportunity to prove the opposite and use the technology to link humans to a more efficient and productive process (Villiers, 2024). Leadership within the business needs to communicate the position towards the business and capacitate the people to understand that the use of AI-embedded software solutions can drive up productivity in a business, improve wages and open up the opportunity for training and development of new skills in the industry (Villiers, 2024). The Unions then need to understand the importance of AI and communicate the long-term benefits for the sector.

Research suggests that Africa is next in line to become the centre of manufacturing focus for the world (Mathenjwa, 2023). A McKinsey report predicts that Africa can double its manufacturing output by 2025 says Mathenjwa in his 2023 article (McKinsey, 2019). This will be due to Africa's drive to localize its production to allow the continent to meet the local and export demand. It is estimated that 70% of emerging markets are still using analogue technology hence Africa can grow into the AI space (Mathenjwa, 2023). South Africa needs to ensure that they do not fall behind in the race of African countries to capture the Manufacturing sector through AI innovation. South Africa faces intense competition from Ghana, Ethiopia, Kenya, and Nigeria in the race to be the leader in the AI space (Mathenjwa, 2023). South Africa will need to ensure that the people of the country are ready to embrace the move to AI-embedded solutions through strong leadership. Leadership will need to understand the perception of their people to mobilize the resources correctly. This is what the report aims to achieve through qualitative analysis.

1.3. Purpose statement

This research aims to investigate the impact of AI embedded technologies on workforce readiness in South Africa’s manufacturing sector, which aims to identify strategies for smoother adoption. Through exploring employee’s perspectives and readiness, the study seeks to offer actionable insights that address skills gaps and enhance organizational alignment with the AI-driven transformation.

A key factor that will link the constructs is to determine if there is resistance toward AI-embedded technology in the manufacturing sector. For a country like South Africa, it is important to understand the multicultural thinking of the Fourth Industrial Revolution(4IR) to help set the foundation for creating a model for operationalizing AI-embedded technologies in the environment of business.

The researcher further aims to understand the underlying issues and causes of emerging economies with a focus on South Africa and why the country is falling behind. The top two major antecedents for the slow adoption rate could be linked to South Africa's high unemployment rate and the current level of education. The latest statistics released in mid-May 2024 show a further increase in the unemployment rate by 0.8% to 32.9% (SA, 2024). In an article on AI in education systems the author states that "the education system lacks teachings on AI literacy and the educators lack the skills to prepare the next generation for the implementation of AI in the workplace" (Desk, 2023).

The constant creation of technology will inspire the youth and bring about cultural change by creating a demand for AI as part of the educational curriculum. This will be crucial to prepare them for the incoming AI-embedded environment.

1.4. The Business rationale

From a business perspective, beneficial aspects can be used in this type of study to support businesses in crafting a strategy towards AI-embedded technologies. The key factors such as human understanding will be a key factor as to the perception of AI technology in the workspace. Data has shown that there could be an increase in jobs to 1.2 million by the year 2030 with the adoption of AI embedded technologies (Mckinsey, 2019). The researcher also seeks to help leadership in an organisation understand the key insights into how employees perceive AI-embedded technology and how can the organisational structure with a communication plan be used to sensitize the employees on the future of the business through technology. Product development for solutions in the manufacturing sector has had a history of always being developed in silos. There is no attempt made to involve the users in the design solutions which eventually leads to resistance to implementation not because they are afraid of being replaced, but rather because they are not part of the solution. Communication with the employees is a key strategic activity to ensure a smooth integration towards a new vision.

Understanding the politics within the workforce is a vital component in structuring the communication plan and will ease the journey of the new strategy. Customer experience should be the primary factor in the design of solutions as technology and humans need to form a common solution. With South Africa having such a large workforce, there needs to be a combination of people-based innovations and training & development to create a new set of skills within the industry. The competitive advantage is the end effect of AI-embedded technology and should be able to add long-term benefits to the business through big data and profitability. Technology should add efficiency and sustainability to the strategic pillars within the business and allow employees to embrace innovation as a culturally safe space.

1.5. The Academic rationale

As previously mentioned, the research that exists on the effects of AI-embedded technologies in organizations seems to be paradoxical as some reports show extensive improvements to the organization and some articles highlight minimal organizational benefits (McKinsey, 2019). Furthermore, these technologies are still nascent hence the lack of studies that are conducted in emerging and complex economies. A McKinsey report shows that whilst AI-embedded technologies may disrupt the business environment it will create a market for new skills which will create new higher-paid jobs (Mckinsey, 2019). On the other side, there are articles from the same publisher that states that AI can also be hugely dangerous from a privacy and discrimination perspective (McKinsey, 2019). So, the paradox remains due to the limited research available, and the researcher is aiming to close that gap. This added to the fact that there are no studies conducted in the South African context and compounded by the lagging AI Policies that are currently in place. The policies that exist are vaguely defined, unlike advanced regions which have strong policies which guide the implementation of modern technologies. The Minister of Communications & Digital Technologies of South Africa has mentioned in a report that “most nations have already developed policies to drive economic growth” whilst South Africa is still developing policies to guide AI implementation.

He also quoted Nelishia Pillay Head of Computer Science at the University of Pretoria that "with the right mix of policies is the only way Africans can benefit from AI" (Ntshavheni, 2021). So, if South Africa is still trying to develop policies the country will always be one step behind.

Furthermore, from an academic perspective which is the drive behind this research, there is a multitude of benefits from retrieving insight from human perception towards AI-embedded technologies which include, Culture within an organisation that can make or break the drive for new innovative strategies. Traditional organisational structures are hard to change without understanding the people within the organisation. The semi-structured interviews will help attain data into the ways of working and the personality of the people within the business. Social studies are an academic direction that this research may touch on, the questions will try to understand the social and psychological thinking of the workforce and can form the baseline for the development of an academic framework of technological implementation in the region of emerging economies through the manufacturing sector. Educational awareness as to why an environment may reject the implementation of AI-embedded technology is the first step to understanding what needs to be done to implement key structures within a strategy to ease that implementation process.

1.6. Scope of Research

The scope of the research is to link the constructs of the Technology Adoption Model with the Model of Technological Organizational Environment and bring in the theory of Socio-Materiality to gauge to readiness of the manufacturing environment to accept AI-embedded technology in their workspace. It will use the aid of semi-structured interviews to analyse the feelings of the workforce towards how they feel AI-embedded technologies will affect their lives. The research will be focused on the manufacturing industry in an emerging economy such as South Africa.

Chapter 2: Theory and Literature Review.

2.1. The Introduction

Following on the purpose which provided the reasoning of the importance of understanding the impacts of this research, this section unpacks the key constructs in more detail. The events of the first industrial revolution moved Britain from being reliant on the agricultural economy to being reliant on the mass-producing mega factories (Inc., 2024). The major invention during this period was the invention of the steam engine (Inc., 2024). This also allowed the wealth of the British to be more widespread across the middle class (Inc., 2024). The second industrial revolution further evolved by advancing the use of machines and brought about the emergence of the Internal Combustion Engine (Inc., 2024). The third industrial revolution included the introduction of digital computers, Automation, robotics, and renewable energies (Inc., 2024). The fourth industrial revolution incorporated technology such as Artificial intelligence, advanced robotics and automation combined with the Internet of Things, big data and blockchain technologies (Inc., 2024). Advanced AI is now looking to be the major technology driver to kick-start the fifth industrial revolution.

President Cyril Ramaphosa was elected to office in 2018, his first order of business was to incorporate the fourth industrial revolution into the South African economic policy (Sutherland, 2019). South Africa has elevated levels of unemployment and inadequate infrastructure, which has not been an ideal location for the role of AI-embedded concepts. AI technologies are being developed on a large scale and are continuously self-learning. There is extensive analysis to be done on data security and privacy (Choi, Kumar, Yue, & Chan, 2022).

In the manufacturing industry, AI-embedded Robots are fast becoming the norm due to their ability to quickly learn and adapt (Pillai, Sivathanu, & Mariani, 2022). The common belief is that robots can perform repetitive human tasks better with more consistency (Pillai, Sivathanu, & Mariani, 2022). If we look at a similar environment to South Africa, like India's for instance the turnover is expected to grow to 283 billion USD by 2026 and the increase in the use of AI Robots is expected to increase the output of the manufacturing plants fast track development activities in the country (Pillai, Sivathanu, & Mariani, 2022).

The research is within the constructs of information systems where the technology adoption model (TAM) has been widely developed. The TAM is a proven framework to use but covers only perceived use and ease of use which only explains 40% of the AI systems being used (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). To cover the full perspective which includes internal and external factors there will be a need to use a combination of TAM and Technology Organizational environment (TOE) framework (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). The combined framework will link internal factors with external factors. These factors will then be linked to perceived usefulness and ease of use to allow us to understand the Intention of the user to adopt (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

The TAM is widely used to find acceptance in the age of AI innovations in the work environment. This model asks questions about how AI-embedded solutions support production efficiencies and promote safer working environments. In countries such as India, the adoption of AI-empowered robots is still in its infant stages and like South Africa is still an emerging market. The deployment of the TAM is not to merely assess for adoption but to also understand the factors that affect the adoption of a workforce. The TAM model looks to incorporate key factors around the working environment, the technology and social influences that guide the digital context.

PWC estimated in 2021 that there will be substantial investment across the industries to the tune of 200 billion USD. Researchers believe the social environment needs to adapt to technology development within their space or be left behind (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). There has been great emphasis on the adoption of technology and research has proven that there is huge economic gain from adopting innovative technology. There is substantial proof of this in the other BRICS nations such as India and China. (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Strong leadership is required to drive the technology with strong finance and resources management, this is to ensure that the organization benefits and there is minimum resistance from the workforce (HOEGL & MUETHEL, 2023). This is again where the TOE plays a strong role in identifying the factors that affect technology adoption and helps leadership understand how to mitigate these risks during implementation (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

2.2. Organizational investment in technology and Policy alignment.

To recapture the last 20 years emerging economy countries have grown through its phases of industrialization due to its ability to leverage on its strong manufacturing sector (Andreoni & Tregenna, 2020). Although there has been significant growth with the emerging economies only China among the emerging economies is able to break into the top industrialized countries (Andreoni & Tregenna, 2020).

The major reason for this lagging behind is due to the lack of development in its technology and these countries still dealing with the historic inequalities and weak political systems. This leads to countries falling into what is called “the middle-income trap” in which countries focus on implementing high technology solutions into their sectors but the work force is not prepared well enough to manage these new technologies.

The middle-income trap is a result of three serious issues, firstly is the inability for to scale and leverage technology as a competitive advantage which prevents the country from being competitive with the likes of China. Secondly, is the inability of companies forming global partnerships and being able to locally support the demand, finally the challenges of catching up with the pace of technology development. Countries need to take a deep dive into their policy construction and try to adopt policies from regions that face similar political challenges and work force demands.

If South Africa looks to catch up with the leading industrialized economies, the country will need to benchmark of countries such as Brazil and China. It will be key to look at factors such as the ability to expand their reach globally (Andreoni & Tregenna, 2020), at which point in their industrial transition did they implement their policies to address their weaknesses and how did they manage to keep up with the development and leveraging of new technologies (Andreoni & Tregenna, 2020).

To focus on this research topic which aims understand how technology can be leveraged to maintain a competitive advantage and how these technologies can be better received better in the manufacturing industry. Depending on the financial model of the companies in the manufacturing industry there are companies who seek finance to purchase these technologies. Within the constructs of the financial model there are factors that are looked at to verify financial viability and pay-back period. One of the factors looked at is the headcount reduction that can be used as a cost saving to pay back these financial loans which in the context of South Africa is a major weakness due to the high unemployment rate.

If South Africa looks to add value globally, businesses and the people of South Africa need to work hand in hand with the incorporation of new technologies into their working environment to be more effective and competitive. The two concepts that needs to be looked at is the development of several types of technologies and focus on the different stages of technology development (Andreoni & Tregenna, 2020).

Within the manufacturing industry, company needs to ensure they invest in technology that does not separate people development from technology implementation. Companies tend to want to implement high levels of technologies which are not readily available in the country, which lead them to importing technologies such as robotics and AI embedded technologies. During the implementation processes there will be all positive experiences, until the installers leave, and the technology is left for the local skill to maintain. This leads back to companies understanding their internal capabilities and installing technology that is within their skill level an maintaining this technology until the sector builds up its skill level to allow the company to scale up to higher level of technology (Andreoni & Tregenna, 2020). By doing this companies prevent themselves from falling into a phrase called the “Valley of death” translated into non-sustainable technology.

Companies should not separate the investment of technology and the investment in their work force. Ensuring that the work force is capacitated to maintain and use these new technologies will remove the resistance of acceptance of the technologies and introduce a feeling of inclusion into the future of the organization.

2.3. The Effect of Technology on Productivity and Employment.

Studying the environment of AI has shown major increase in interest in technological advancement along the path of machine learning, Automation, and internet of things to drive the age of AI embedded technology (Yang, 2021). The introduction of General-Purpose Technology (GPT) has proven that AI can revolutionize the manufacturing industry which has driven organizations to start investing in these technologies and focus on long term gain through quality and profitability (Yang, 2021). There also needs to be a consideration for the ability to make the work force within an industry redundant. At a high level the introduction of technology aims to add value to the organizations through the ability to produce good quality products consistently and more efficiently with less waste thus making the process more profitable (Yang, 2021).

The implementation of AI embedded technologies did not always show a positive in productivity gains with one of the major causes being learning adjustments. This can be translated with the user of this technology being unable to adapt to the new technology due to the lack of training and transfer of skills (Yang, 2021). This function as an enabling factor of resistance from employees which negates the original positive return of investment. The topic of job losses through technology implementation is a topic not spoken about enough due to the controversial nature of the discussion. This although is just the surface of the topic as if you delve deeper into the discussion there are positive outcomes which relate to the creation of a new job market and the increase in the wage scale of the sector.

AI can improve the productivity of plant processes but there are limitations of the current AI structure. Using AI in processes that involve automation and robotics and are repetitive in nature are strongholds of the AI embedded field. Processes that can be learned and programmed into machines using historic data through machine learning allows AI embedded technologies to hold the advantage over Human based processes. Processes that that require quality that the eye cannot see and is programmable such as vision systems are now becoming a tool in which the manufacturing sector is using to improve their quality to customers (Yang, 2021).

Alternatively, AI embedded technologies may not be a viable option due to the costly nature of the technology. With the fragility of the manufacturing sector making this type of investment could be profitable now, but a change could reverse the return of the investment such as change on market demand. Once a technology is purchased you will need to pay it off regardless of the state of the business finances whereas if volumes go down a company could invoke section 189 to reduce cost which is always the last resort (Yang, 2021). The success of AI embedded technology may have a long way to go in replacing the experience of employees with unique experiences and due to this getting the employees to adapt to new technologies will be a challenge due to the feeling that they may lose their jobs (Yang, 2021).

The research that exists suggests that in the USA that robotic innovations have had a negative effect on the employment within that region (Yang, 2021). Although this effect is on the lower skilled workers (Yang, 2021). Although if the data is analysed more holistically it shows that labour productivity increased through the introduction of AI embedded technologies and the data also shows a positive employment growth due to the ability of the sector to grow through the innovation of AI embedded technologies.

Due to the rapid growth of technology and its unpredictability it is challenging to predict the future effect on employment. Although with the data that exists it can be assumed that the implementation of AI technology can increase the productivity of processes but not without human intervention (Yang, 2021). The data also shows that due to the rapid growth of businesses due to the implementation of the technology this has a direct relationship with the increase in the employment rate. This however does not mean there will not be a loss of jobs, with the increase in employment rate comes the change in demand of the skills within the work force. This will lead to a demand in highly qualified individuals within the work force which is intended on increasing the educational level of the sector (Yang, 2021).

This then poses a chain reaction towards the educational level of the institutions across the country. Institutions need to partner with these AI organisations to ensure that the graduates that leave the campuses or technical universities are capacitated with the correct skills to manage the new environment of AI embedded technologies (Yang, 2021).

2.4. Work Force and the Struggle to bridge the skills gap.

The fourth industrial revolution is going to come regardless of if industries are willing to integrate their strategy or not to ensure competitiveness. The data is consistently becoming more evident that by the year 2025 more than half of all employees will need to change their skills sets to survive the new era of technology (Li, 2022). Companies need have this strategic foresight to understand what skills are needed for the future and how to align this to their strategic goals (Li, 2022).

Data as proven that children starting their learning journey now will have to develop skills different to that offered by the work force today (Li, 2022). This means that the foresight towards skills development should not end within organizational strategy, but this data should also feed downstream to the educational system to ensure that our future generations are also capacitated for the 4IR landscape (Li, 2022).

Withing the constructs of the South African Manufacturing sector, there needs to be an acceptance of the diverse cultural backgrounds of the workforce which needs to be incorporated into the workplace and filtered down to the educational institutions to which is said to fuel sustainable economies through innovation (Li, 2022).

With the disruption of Covid-19 the markets accelerated the need to move towards a more automation solutions to reform the way the manufacturing sector defines it processes. This acceleration meant that the journey towards a vastly more AI embedded future as exponentially sped up (Li, 2022). The survey from an article showed that an estimated 40% of the workforce will require reskilling over a 6-month period and another 50% over 5 years to keep up with these skills shift towards the AI embedded technology rise (Li, 2022).

2.4.1. Jobs of the Future.

The future of the job market and skill demand will purely be determined by the ability of the sector and its people to embrace the innovative technologies and have a drive to adapt and

survive. The world economic forum has published articles on which jobs and skills will thrive under the AI embedded era.
The data published by the world economic forum shows a major shift in skills between 2015, 2020 and 2025 (Li, 2022). Where complex problem solving was the number 1 skill requirement in 2015 and 2020, it is foreseen that by 2025 the new number 1 skill demand will be analytical thinking and innovation (Li, 2022). Complex problem moved to the third most skill in demand in 2025, and where Critical thinking was the number 2 skill demand was now replaced with Active learning and learning strategies (Li, 2022). Some of the skills that made the top 10 in 2020 such as Creativity, People management, coordinating with people, Emotional Intelligence, Decision making, Negotiations and cognitive flexibility was replaced which Creativity, Leadership and social influence, Technology use and design, Resilience and reasoning which shows that 7 out of the top 10 skills in 2015 and 2010 have been replaced in the top 10 skills of 2025(Li, 2022). This further emphasizing the need to change the mindset of people upskilling at all educational and organizational levels.

2.4.2. Technologies to dominate 4IR.

A good example to relate to is the emergence of the E-commerce sector which is taking over from the brick-and-mortar stores. There can be arguments to say that it was much easier for technology to take over that sector due to the ease of implementing the solutions in that environment. The risk there will always be if time is given to technology and this eventually starts to take over the manufacturing sector, is it worth the risk to not ensure the work force is left behind. This can have a detrimental effect on the employment rate and the economy of the country. The manufacturing sector of South Africa will have to adapt or be at risk to lose large manufacturing businesses to China or India.

AI and Machine Learning (ML) is one of the top 7 4IR technology drive especially in the manufacturing sector through Robotics and Automation. The Ability of AI to imitate intelligent decision making through programming has revolutionised the manufacturing sector. With the assistance of digital technologies, the barriers to access global Markets have significantly decreased which means the competition have increased. Countries other than South Africa are continuously becoming more efficient and cost effective even with the addition of transportation and import taxes as their manufacturing process is less labour intensive and has a higher productivity output.

2.4.3. South Africa and the Emerging Market.

The research of AI embedded technology cannot exclude the topic of the digital divide in the emerging economies. If a deeper look is taken to what is required to run these technologies effectively, there is a need for a link up to a network point to ensure that the software is continuously updated and learning from its mistakes. More than half the world does not have access or has limited access to a decent quality network line. The inability for countries to access the internet puts them at a disadvantage if they need these AI embedded technologies to catch up with the world's leading economies (Vimalkumar, Singh, & Kumar, 2020).

The Sustainable development goals (SDGs) explain that the access to internet is related to growth in job creation and societal development. The journal article by (Vimalkumar, Singh, & Kumar, 2020) focus was in the telecommunications sector but the theory behind the digital divide discussed is applicable across all sectors. The digital divide is broadly categorised into two sections. The first being access to computers and internet and the second being the ability of the individual to use these technologies (Vimalkumar, Singh, & Kumar, 2020). If there is already an existing gap in the knowledge and use of these basic technology requirements how are countries expected to capacitate themselves with a level such as AI embedded technologies.

Literature on the digital access divide explored the downside to the IT adoption rate of individuals and organizations at global level (Vimalkumar, Singh, & Kumar, 2020). The literature shows that the main factors that contribute to the effects of the digital access divide is age and socio-economic status (Vimalkumar, Singh, & Kumar, 2020). The second section of digital divide is the digital capabilities which shows even those who gain access to these technologies are unable to add value through their use. This is due to their late in life introduction to these technologies, computer skill level and the ability to self-train online.

When the literature starts focussing on the digital divide in detail within the emerging market, studies have shown that the adoption of technologies are slower in emerging markets versus developing economies (Vimalkumar, Singh, & Kumar, 2020). In emerging markets where gender and culture also play a strong role in moulding the population, there may be instances where this creates barriers in adoption of new technologies (Vimalkumar, Singh, & Kumar, 2020). In one of the studies In South Africa which used the TAM model research technology adoption and found that again socio-economic issues where the highest contributions to the inability to adopt. Another study also showed that household income played a role in the barriers to adoption as these users could not afford a basic level of internet and computers (Vimalkumar, Singh, & Kumar, 2020).

These studies were concentrated in emerging economies such as South Africa hence its relevance to this research. Within the South Africa there is a deep divide in economic equality and rich in culture, according to the studies these are the two main contributing factors to the adoption of technologies leave alone the topic of AI embedded technologies. If South Africa does not aim to fix this issue at country level, it will require much more effort from industries to further capacitate the workforce.

2.4.4. Evidence of Value Creation Using AI embedded Technology.

The industry perception of AI embedded technologies is broadly since AI can process data and use that data to perform tasks better that human intervention (Changlin, Teo, & Jansen, 2021). When a deeper look is taken into AI it can be shown that as much as it can improve the daily lives of people through transportation and telecommunication these technologies can be taken a step further to improve a business's productivity as profitability (Changlin, Teo, & Jansen, 2021). According to the latest PWC reports referenced in a journal by (Changlin, Teo, & Jansen, 2021) there will be a contribution to the global economy of 15.7 trillion USD. This mainly due to its consistently high output with minimum overheads and the ability to produce consistently good quality which cannot be done by a human being (Changlin, Teo, & Jansen, 2021). AI is consistently being used to personalized products for customers in a matter of seconds just by monitoring their historical trend patterns (Changlin, Teo, & Jansen, 2021).

In Countries that cannot afford decent quality education the used of AI can be used to provide classes online to countries across the world, these classes also do not need to be conducted by a human educator.
The measure of value creation is spilt into two section the supply of AI to the public sector and the demand within the sector. To see the value creation effect on a sector such as the public sector and link it back to how this can add value to the manufacturing sector will be a good gauge as to the possible effect this could lead to in future. Evidence has shown that the use of Information technology has become the primary access for the population to gain access to public services hence government is pushing to further improve this service through AI (Changlin, Teo, & Jansen, 2021).

In the manufacturing sector which in South Africa is also a private sector there has been much more use and research done on the value creation of AI embedded technologies. In organizations the strategic model features pillars such as disrupt our model which is done using AI embedded technologies. In a journal published by (Enholm, Papagiannidis, Patrick , & John , 2022) they made reference to a study by MIT's Sloan Management review which found that 80% of organizations see AI as a strategic lever, and 85% see AI as a way to remain competitive in the market.

Even though AI is set to create more value for the manufacturing sector, these AI embedded technologies are said to come with its own challenges. This can be seen in most organizations as they have invested capital, skill, and time into implementing these technologies and still to reap the benefits of the implementation (Changlin, Teo, & Jansen, 2021). This was due to the failure in implementation strategy and these technologies not aligned correctly with the organization's strategy (Changlin, Teo, & Jansen, 2021). The challenges such as correct change management, Skills shortages, and development as well as the fear of new technologies needs to be addressed through the correct pillars of a strategy. If organizations really want to gain the benefits of these technologies, they will need to address these challenges as a priority (Changlin, Teo, & Jansen, 2021).

The article by (Changlin, Teo, & Jansen, 2021) also makes mention that most research that's currently been conducted in the space of AI embedded technology focuses on understanding how AI technologies rather that the organizational challenges related to the implementation of these technologies.

The articles by (Changlin, Teo, & Jansen, 2021) also mentions that upon consolidation of different research papers it was found that there were three main enablers and inhibitors of technology which where technology, Organizational and environment (TOE). Below id and illustration of how AI links TOE to the impacts into business value (Changlin, Teo, & Jansen, 2021):

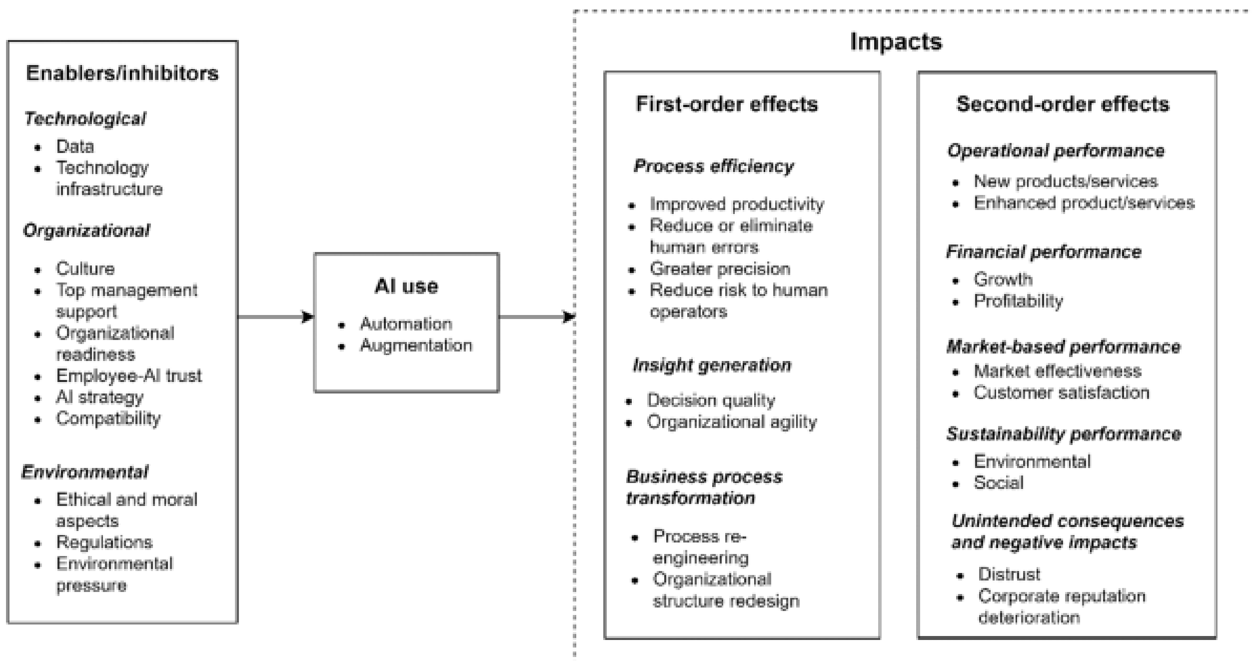


Figure 1: Organizational Framework of AI and Business Value.

2.5. Bringing it together and why it is important.

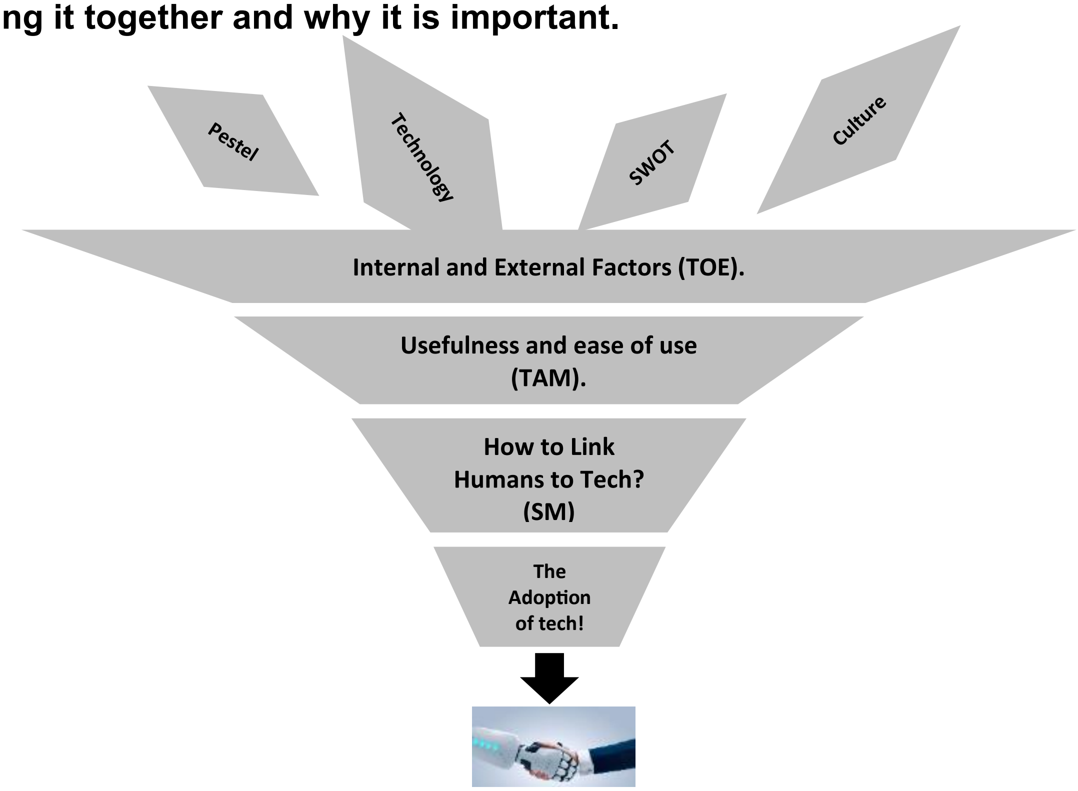


Figure 2: Funnelling the intention to adopt. (self-owned)

2.6. The Socio-Materiality (SM) of AI-embedded technologies.

The study of socio-materiality investigates the socio-technical perspective on the relationship between users and technology (Wang, Tussyadiah, & Zhang, 2024). Technology is known to be the solution to human problems whereas the social is defined as the working together of technology and humans to form a solution (Wang, Tussyadiah, & Zhang, 2024). Researchers have argued that the study of socio-materiality allows them to study technology from different perspectives which is why this is ideal for the research towards AI embedded technologies (Wang, Tussyadiah, & Zhang, 2024). Materiality and Socio materiality are both topics developed by the Information system (IS) researchers to identify the complexities in understanding the effect of technology and in this case AI embedded technology on humans in conjunction with their organizations (Wang, Tussyadiah, & Zhang, 2024). Materiality in this case refers to the forms of AI-embedded technologies such as learning software, robotics and any sort of automation intended to partner with humans to make the manufacturing processes more efficient and profitable. To break the separation of the material to the socio materiality there needs to be a link between the user and technology. The goal of the business needs to be linked to the effectiveness of the technology and the human, and not the technology alone. The user needs to think of technology as a tool to improve their actions and decision-making and align this with their key performance indicators (KPIs). Ideally, socio-materiality is studied in the use of the user's social life but for current research, the data gathering will be limited to the working life of the user as a key limitation of research. By applying the socio-material construct we can link up the theory without separating technology from human use. Below are how the research constructs will fill the final gap in the AI adoption process by incorporating the theory of Socio-materiality:

2.7. Linking the constructs of the theory

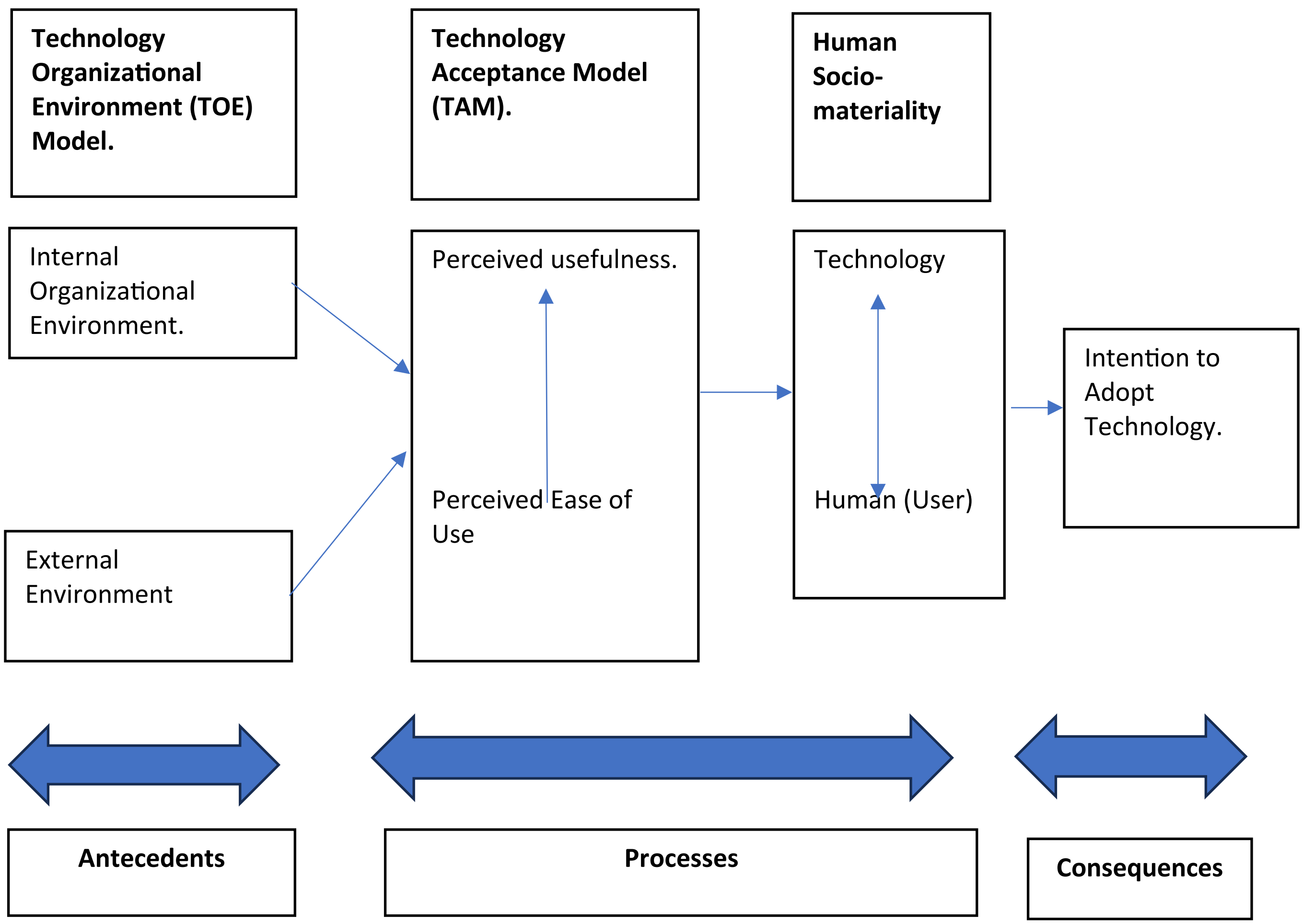


Figure 3: Linking SM to TAM and TOE ((Chatterjee, Rana, Dwivedi , & Baabdullah , 2021) (Wang, Tussyadiah, & Zhang, 2024).

2.7.1. Technology Organizational Environment

The TOE model consists of four internal environmental levels which are Organizational competencies, Organizational Complexity, Organizational Compatibility, and organizational readiness and two external factors Competitive advantage and Group Support (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Organizational Competencies.

The competence of the organization defines whether the people in the organization can use modern technologies or if they have the inherent skills to learn about modern technologies. If the workforce does not have the skills or knowledge it could lead to them feeling that these new technologies have no usefulness in their work environment (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Organizational Complexity.

This factor defines the ease of use of a system that needs to be implemented. Can the user easily control the new system? Is the user facing any difficulty applying the basic functions of the system? Human behaviour's increased complexity reduces the usefulness and ease of adoption of the technology (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Organizational Readiness

The readiness of an organisation is based on factors such as, does the organisation have the infrastructure to adopt modern technology (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). Does the organisation have the correct workforce and financial resources to ensure ease of adoption? Most importantly does the organisation have the correct leadership to steer the business in the correct direction once the technology is implemented.

Organizational Compatibility.

The compatibility of an organisation with modern technologies is a defining factor in the acceptance of technologies. The factors that are considered are whether the technologies fit with the user's capabilities. Do the technologies easily merge into the old company systems and infrastructure? Generally, if the new systems don't easily integrate into the old system as well as the business culture it could inhibit resistance to use and a reduction in innovative thinking (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Competitive advantage.

The implementation of such AI technologies comes with the opportunity to give the organisation a competitive advantage against other players in the environment. The communication of this advantage to the people within the organization is key for them to understand why the adoption of these technologies is important. Employees who have intense training will reap the rewards of the technologies and help the business gain a stronger advantage over its competitors (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

External Group support.

This external support refers to functional experts who are the sellers of this technology to form part of the teams who are using these technologies. These support functions help with the training and development of the users and allow for the transfer of knowledge to the specialists within the business (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

2.7.2. Technology Acceptance Model.

Ease of Use

The ease of use of technology is related to the acceptance of modern technologies. The belief is that the less complicated a technology is the more accepted by the user the technology becomes. The more the user enjoys the use of a technology the more they are expected to accept the technology. The easiness of using a technology promotes adoption and the intention to continue to use technology innovatively (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). 744

Perceived usefulness.

When a user determines a technology to enhance their performance and reduce the effort for them to meet their KPI it enhances their perceived usefulness of the technology. The user needs to find benefits from using the technology vs not having it (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

2.8. Literature Review Conclusion.

AI and its impact on organizations within academia is still a nascent body of knowledge with a bias towards advanced economies (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). Within the context of emerging economies such as South Africa, there is therefore a need to understand the impact of AI and such technologies given the nuances and diversity present. This therefore leaves room for an academic deep dive into the gap between emerging economies and advanced economies. There is also barely any data on the perception of the emerging economy workforce on AI-embedded technologies. The biggest mistake that emerging economies such as South Africa can make is to use the same frameworks and 1methodologies as advanced economies to implement AI-embedded technologies. The environment is vastly different and much more diverse. The models and frameworks defined will allow the researcher to do an internal audit of organizations to understand what are the factors that could hinder AI implementation and what are the options that leadership must implement the findings from the interviews and apply solutions within the framework of the organization’s strategic implementation. AI is the solution for future growth and South Africa needs to move swiftly to ensure the people of the country reap the rewards of economic growth. The incorporation of the TAM and TOE model will allow the researcher to understand the external and internal factors that affect the intention to adopt AI-embedded technologies and combine this with the ease of use and perceived usefulness towards the user.

Chapter 3: Research Questions.

To further understand how Socio-Materiality, TOE and TAM can identify the intention for a select population to adopt AI-embedded technologies and based on the outputs and the gaps identified in Chapter 2. The research questions also aim to address the strategic challenges faced by organizations and help better operationalize these technologies to enable efficiency business value.

RQ1. What is your understanding of AI embedded Technologies?

Research Question 1 aims to first understand the extent of theoretical knowledge the respondent has which will set the base for the quality discussion and deeper insight into the thoughts of the respondent. This will also help the researcher validate the quality of knowledge from the respondent. This research questions uses the constructs of the TOE to understand organisational readiness from a leadership perspective (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ2. Is the business environment capacitated to incorporate AI-embedded technologies in its strategy?

Research Questions 2 aims to understand if the respondent feels that manufacturing sector is ready to use AI embedded technologies as a value add to its business or is it just going to add more challenges. This research questions uses the constructs of the TOE to understand organisational readiness from a business enablement perspective (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ3. Does the current workforce have the skills and knowledge to embrace modern technologies?

Research Question 3 will aim to understand how the respondent feels the competence level of the current work force and if they have the skills to effectively leverage these technologies. This research questions uses the constructs of the TOE to understand organisational readiness from a workforce skills level availability (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ4. Does the Industry have the pre-requisite resources in place to ensure the businesses are ready for ease of adoption of modern technologies to leverage the usefulness of the modern technologies?

Research Question 4 aims to use the respondents' views to gain insight into if they believe that they sector has the capabilities to manage the introduction of AI embedded technologies. This research questions uses the constructs of the TOE to understand organisational readiness from an ability to transition over to the new age of technology (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ5. Can AI embedded technologies improve the quality of life for the workforce?

Research Question 5 aims to understand if there can be a business benefit as well as an employee benefit to support adoption of these technologies. This research questions explores the constructs of socio-materiality and seeks to understand if there can be a co-existing relationship between humans and AI embedded technologies (Wang, Tussyadiah, & Zhang, 2024).

RQ6. Can AI-embedded technologies be leveraged to allow the organization to gain a competitive advantage?

Research Question 6 aims to understand if the respondent believes that the use of AI embedded technologies can help ensure that business remain competitive and profitable. This research question seeks to understand if organisations can leverage a competitive advantage in the sector (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ7. Can developing a strong external support base help the ease of adoption of new AI technologies?

Research Question 7 aims to understand if customer relationships and strong change management processes can support in the implementation process and help create a safe environment for the transfer of knowledge from supplier to user. This question aims to understand the effect of the level of external Group support from the TOE constructs and how it affects adoption (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ8. If the technology is easier to use and less complicated to manage can this promote the acceptance of the technology in an organization?

Research Question 8 aims to verify if the ease of use is related to ease of adoption based on the literature review and to link it to views of the leadership in the manufacturing sector (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

RQ9. Can AI-embedded technology reduce effort and increase productivity in the user's environment?

Research Question 9 aims to see if there is a consistency of implantation of these technologies and an increase in productivity in the manufacturing sector (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021).

Chapter 4: Research Methodology and Design.

4.1. Introduction

The research methodology was designed to align directly with the research questions outlined in Chapter 3. By employing semi-structured interviews and a qualitative inductive approach, this study captures detailed insights into employees' perceptions, readiness, and potential resistance towards AI technologies. This approach not only addresses each research question but also supports the study's overarching purpose of understanding factors that influence AI adoption.

Based on the literature review, AI-embedded technologies are constantly advancing, this creates a domino effect within organizations to review their structure and skills of employees to adapt to the changing technology (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). If organizations want to remain competitive for extended periods, they must continuously adapt to gain a competitive advantage. The Implementation of AI-embedded technologies is going to be a game changer for businesses that can invest in these technologies (Gillani, 2020). With the current change in market conditions, short-term risk will be worth the long-term gain. Organizations that move to implement these AI-embedded technologies will begin improving the agility and capabilities of the organisation through the improvement of operational efficiency and quality (Gillani, 2020). This research will focus on the external and internal factors that affect technology adoption and incorporate ease of use and perceived usefulness into the model (Chatterjee, Rana, Dwivedi , & Baabdullah , 2021). The research will also aim to constantly link humans and technology to find emerging themes (Kecmanovic, Galliers, Henfridsson, Newell, & Vidgen, 2020).

4.2. Proposed Research Methodology and Purpose of Design.

This research intends to understand how organisations can re-structure their strategy implementation model to allow for the ease of transition of AI-embedded technologies into the working environment. The research will seek to acquire the experiences of employees within the manufacturing environment who are currently going through this transition, acquire lessons learned, and determine the feelings of the affected employees who will use these modern technologies. This research will seek to draw thematic insights from the outcome of the interviews to be used to identify key areas for adaptation in the strategic model. Secondly, the research will evaluate if the AI-embedded technologies will improve the organisation's business proposition. AI-embedded technologies can include entry-level automation, robots on manufacturing lines or automated guided vehicles. These technologies can also use big data to self-learn, continuously improve, and make processes more efficient to improve quality and profitability.

The choice of philosophy was based on the direction this research will take, positivism is based on facts that are currently available and were proven by measurable facts and is generally the path followed by quantitative research whereas interpretivism philosophy focuses on gathering data from social experiences in the real world and is the path followed by qualitative research (Saunders & Lewis, 2018). The approach needs to allow the researcher to acquire data without any bias and assumptions, if we consider a deductive approach which requires the researcher to build an argument and form their research around this, does not allow for real-life data (Saunders & Lewis, 2018). The inductive approach is more about formulating theory based on the observations from the data collected which is why the researcher aims to use an interpretive philosophy and an inductive approach by incorporating the experiences of specialists who maintain these AI-embedded technologies, users of these technologies and leaders who lead departments that are incorporating these technologies within their business (Myres, 2024), to understand how these technologies have improved the working environment and the quality of life for the employees (Saunders & Townsend, 2016). It will also help understand why there is resistance to accepting these modern technologies and what could the change management team have done better to implement these technologies. Furthermore, what could the organization do better to transition the old culture into the new innovative way of working? It is key for organizations to decipher how to capacitate their employees to buy into modern technology processes.

The qualitative approach will be the recommended direction for this research topic as the ideal outcome of the research is to gain high-quality data insights from semi-structured interviews and unbiased views from the participants (Saunders & Townsend, 2016). The researcher aims to leverage the real-life experience of the participants to form thematic conclusions that will be used to add to the available literature that will aim to solve the research questions (Saunders & Lewis, 2018). The manufacturing industry has a multicultural group of people working within the business environment which can form holistic themes on the research topic (Naidoo, 2024). The collection of this data will aim to find a holistic solution to the seamless implementation of AI-embedded technologies.

4.3. Philosophy and approach selected.

The Interpretive philosophy will aim to attain data from the daily experiences of employees who are affected by AI-embedded technologies (Saunders & Lewis, 2018). The research will try to understand the constraints of the key stakeholders affected by AI-embedded technologies and look to gain information on how businesses can adapt their strategies to incorporate the implementation of AI-embedded technologies seamlessly. The interpretive nature will seek to understand humans in their environment of business. The researcher will aim to use semi-structured interviews to gain high-quality insight into the beliefs of the participants and find themes across the multi-cultural interview group. The themes will be used to develop tools and frameworks to add to the literature existing on the strategic implementation on AI embedded technologies.

The researcher will use a qualitative inductive approach, the objective will be to analyse the views of each participant at various levels of management and the Engineers who implement these technologies (Saunders & Townsend, 2016). The participant's views will have a bias towards their skill level, passion for their job, and if their inputs are appreciated by the organization (Naidoo, 2024). This bias will help the research consider a new dimension of acceptance of AI-embedded technology based on their insecurities and if this factor affects the adoption of these new AI-embedded technologies (Naidoo, 2024). Therefore, to accomplish this the research will use an inductive approach to gathering data. The approach will also seek to understand what level of AI-embedded technologies the workforce is willing to adopt and why they are adamant that any higher level of AI-embedded technologies is a threat to their livelihoods. The data collected from these interviews can also be used to amend current strategic tools and frameworks designed for advanced economies and redesign these frameworks to work for emerging economies.

4.4. Methodological Choices.

The researcher will seek to use the mono-method combined with an interpretive philosophy using an inductive approach to add to existing literature. The data collection will be accomplished through qualitative semi-interviews to form a thematic analysis (Saunders & Lewis, 2018). The idea behind using the mono-method is to build on the theory by collecting excessive amounts of data which will make the research unclear (Saunders & Lewis, 2018). This choice of methodology will help better understand the perceptions of the employees within the AI-embedded space. There will also be frequent cross-referencing with the existing literature to understand the gaps within the existing frameworks of strategic implementation which will highlight why existing frameworks do not work effectively within the emerging economy's work environment.

4.5. Strategy

The chosen strategy aids the study in answering the research questions (Saunders & Lewis, 2018). The semi-structured interviews will enable the participants to express their views and experiences with the technological advancements within their operational environment. The strategy best suited for this research topic is to apply a narrative inquiry approach. It is important to gauge, the reactions, and expressions through their answers to add richness to the data collected and to better code the data of the interviews. It is important to stay engaged with participants and ensure that you can link how each participant can connect with the topic. By using qualitative narrative inquiry, small sample sizes can be applied to reach data saturation and still achieve quality data (Saunders & Townsend, 2016).

4.6. Time horizon.

The researcher will aim to launch an inquiry into the views of the participants at the time of the (Saunders & Lewis, 2018). The research will use a cross-sectional approach which allows an opportunity for future research to periodically check the pulse of the cultural beliefs of the people towards AI-embedded technologies. The researcher seeks to use the cross-sectional approach will be the most effective approach for this study (Saunders & Lewis, 2018). Each interview will take approximately 45 minutes depending on the quality of the data received.

4.7. Population

The researcher has identified a population group for this study which is limited to the manufacturing sector as this is the group that the researcher has access to through personal and professional networks. This study will run across different organizations within the manufacturing industry to remove bias and get different points of view from the data, the manufacturing industry includes the Automotive, Packaging and Logistics industries. The research will seek to draw from the design of the experiment conducted in the telecoms industry which proved to have successful feedback (Wang, Tussyadiah, & Zhang, 2024). The population group will include stakeholders from all levels to give a balanced view of these AI-embedded technologies. Middle managers within the organization would be the key stakeholders as they are exposed directly to the workforce and are tasked with communicating the strategy to the employees. Took back the status of implementation to the strategy task team. It is at this level where the quality of information lives, and it is key to extract this effectively. It will also be good to validate if managers need to amend the communication method to align with the culture of the employees as boardroom presentations may not land the same way with shop floor employees. The researcher will seek to analyse the decisions made by these leaders to find themes which can aid the intention to adopt AI-embedded technologies.

4.8. Unit of analysis.

In this study, the unit of analysis is managers who implement within the manufacturing industry and have their jobs or responsibilities in ways affected by AI-embedded technologies. This and be extended to the engineers and technical team who have a face-to-face experience with the receivers of the solution. The researcher aims to collect data to understand if they have a high acceptance of a feeling of resistance towards AI-embedded technologies and seek to understand why the participants feel this way. The responses from the participants which will be gathered via the data gathered through the semi-structured interviews are the primary unit of analysis. These responses will be coded and grouped to form categories and finally, these categories will be connected to form themes (Saunders & Lewis, 2018). However, for this to happen there needs to be a saturation point that is reached and a key factor of this is the chosen sample size and method (Naidoo, 2024). Other factors to support the responses can be the socio-cultural organizational component of the interview and unique phrases and gestures that the interviewer may capture.

4.9. Sampling method and size.

The researcher will seek to use a purposive sampling method which will be intended for participants who are actively affected by AI-embedded technology. This technique will allow the collection of data to be based on specific needs for this research topic. The criteria will focus on participants working in the manufacturing sector due to the limitations mentioned in section 4.9. It will Include employees on the shop floor who actively work with the technology “Machine Operators,” managers who lead the operations workforce “Operations Managers” or “Regional Operations Managers.” Implementors of the technologies “Process Engineering Managers" or "Technical Systems Managers" and finally Leadership who would translate the strategy of Technology implementation “Operations Director” and “Director of Process Engineering, Automation and Technical Systems.” The list of participants will not be limited to the above-mentioned as further interviews may be required to reach data saturation. The initial sample size would be between 12-16 participants (Stenfors, Kajamaa, & Bennett, 2020) although if the data collection does not reach saturation, then further interviews will be initiated. The sample that is selected will come from the professional network of the researcher.

4.10. Measurement Instrument.

The primary measurement instrument will be semi-structured which will be constructed using concise questions designed to gain detailed responses towards the topic. The choice of using individual interviews is to mitigate the influence of strong personal ideas on other participants (Naidoo, 2024). The aim is to get honest quality responses from all participants that reflect their views. The use of the interview guide plays a vital role in ensuring the questions asked to the interviewees are aligned with the questions this research intends to answer (Naidoo, 2024). There are six steps to compiling a high-quality interview guide in detail and fully understanding the topic is key to ensure you determine if the responses from the participants are of high quality. The questions will be broad and open to ensure there are no leading questions (Saunders & Lewis, 2018). To support the questionnaire the interviewer will look to expand on the questions to attain deeper insight into the topic or seek a clearer answer. The interview guide will then ensure that the key topics are covered within the scope of the research.

4.11. Data gathering process.

The data-gathering process will start by understanding the topic and ensuring that the instruments mentioned in 4.6 are prepared well in advance for the interview (Saunders & Townsend, 2016). A venue will be selected for the interview to take place, which is comfortable for the participants and is private for the interview (Saunders & Lewis, 2018). There will be a pilot interview held to ensure the semi-structured interview questions are fully aligned to research questions and improved, if necessary, which will allow for a seamless interview process. Due diligence will be conducted on all participants to ensure they are purposeful for this research (Saunders & Townsend, 2016). The interviewer will be dressed appropriately for the occasion to ensure the participant feels valued (Saunders & Lewis, 2018). A voluntary participation and recording consent form will be created for each participant to sign to allow the data collected to be used for this research (Saunders & Lewis, 2018). Before the start of the interview process, the researcher will convey the purpose of the interview to the respondent and highlight the process of the interview, how this will benefit business and academia as well as any potential risks (Saunders & Townsend, 2016). At this point, the respondent needs to be given piece of mind that if at any point they feel uncomfortable they can pull out of the process and all data collected will be deleted (Skarbek, 2019). The respondents will be offered anonymity and confidentiality, and only aggregated data will be reported (Saunders & Lewis, 2018). No names of the respondents will be reported when known by the researcher. The data will be recorded without attaching the names or unique identifiers of the respondents to the collected data to further protect the identity of the population (Saunders & Lewis, 2018). The consent forms will be stored segregated from the data collected and stored independently to make no linkage between the responses and the form. All unique identifiers will be removed from the question to keep the confidentiality of the respondent safe such as place of work, Names, and address (Saunders & Townsend, 2016). Randomised identifiers such as **“Respondent A”** will be used which will have no link to the respondent's identity. The data collected will be gathered digitally and stored on an access-controlled laptop that only the researcher has access to (Saunders & Townsend, 2016). The researcher will be the only one with access to the data and the only person analysing the data. The analysing and reporting of the data will not refer to any unique characteristics of the respondents that may reveal their identity. Respondents are limited to the reach of the researcher's network, but it will not discriminate in any way who gets interviewed (Saunders & Lewis, 2018). There will be a sample size of between 12 and 16 interviews (Hennink & Kaiser, 2021). In addition to the recording and transcription device, the interviewer will note any expressions or reactions that may not be attainable through recording to supplement the data. (Saunders & Lewis, 2018). Once all the data is collected the word processing process should be conducted immediately so as not to lose the authenticity of the collected data. The next step will be to analyse the data (Saunders & Lewis, 2018).

4.12. Analysis approach.

The researcher aims to collect data through a voice recording and text transcribed format, which will be exported into a Word format. The researcher will read the transcribed text and use the recording to correct any misspelt or context of the data. The researcher will aim to use a combination of information from the literature review and secondary data to form expectations that will emerge from the interview process. The prepared transcription will then be input into computer-aided data analysis software called Atlas ti. (Stenfors, Kajamaa, & Bennett, 2020).The first step will be to run the data through the program that will output the codes relevant to the constructs of the intent to adopt AI-embedded technologies (Saunders & Townsend, 2016). These codes will then be combined based on their similarities which will allow for a more filtered set of codes (Saunders & Townsend, 2016). There will be further refinement of information in line with the primary and secondary data. This will be assessed in line with discussed frameworks, TOE, TAM, and SM to further refine the codes.

The researcher will assess the coded data and draw themes using the method of triangulation. The researcher will then decide that the data collected is optimal once saturation for all responses is reached. If saturation is not reached the researcher will seek more samples to ensure that saturation is reached for a viable analysis. This will allow the researcher to form high-quality themes in line with the aim of the research which will align or dispute the existing theory.

4.13. Quality controls.

There will be four sets of criteria used to assess the quality of the data collection interview process which are Credibility, Confirmability, transferability, and dependability. The first is credibility which will use existing literature to build the questionnaire. The literature will be drawn from high-quality journal reviews related specifically to the topic of human behaviour and AI-embedded technology adoption (Stenfors, Kajamaa, & Bennett, 2020). Once the data collection is collected, it will be coded, and themes will be constructed based on the context of the research and the questionnaire. As the interviews progress, there will be constant re-evaluation of the questionnaire to ensure that the data collected is of high quality and remains within the context of the research. This will ensure that the credibility of the interview remains within the constructs of the research.

Secondly to ensure validity the researcher will interview employees from different organizations and at various levels and draw themes from these interviews until saturation is reached (Stenfors, Kajamaa, & Bennett, 2020). The researcher will also aim to compare the findings of the interviews with the existing interviews to verify if there are re-emerging themes (Stenfors, Kajamaa, & Bennett, 2020). Finally, the researcher will share the outcomes and themes from the interviews with the participants to validate if the analysis was consistent with how they felt. The researcher will also incorporate outlying themes that do not align with the emergent themes which will allow the researcher to be more objective in their analysis. The interviewer will defend the results using the data collected to not use the limitations of the research to justify its shortfalls now or in future research. The quality controls stated will assist in the continuous improvement process and are part of the inquiry process which is not dependent on external factors (Spiers, Morse, Olson, Mayan, & Barrett, 2018).

4.14. Limitations

In this study, the research is limited to the South African context specifically in the manufacturing industry (Naidoo, 2024). The participants in this research are limited to access to people who are available to the interviewer from personal and network connections (Naidoo, 2024). The responses of the participants are limited to the level of exposure to AI-embedded solutions and their understanding of the technology and how it currently affects the environment around them. The quality of the research is based on the researcher's ability to validate and verify the data gathered. Furthermore, the research was based on a qualitative methodology therefore any quantitative or mixed methodology approach was not considered to improve the validity of the topic (Saunders & Lewis, 2018). By continuously including more industries, countries and diverse people that use AI-embedded technologies the quality of research will improve and have a significant impact on introducing and using AI-embedded technologies in different industries.

Chapter 5: Findings and Results.

5.1. Introduction

This chapter presents the research analysis as described in chapter 4 gathered by the researcher which was collected through interviews from respondents within the manufacturing sector using an inductive approach. This will require the researcher to start from the ground up to gather new data and add to existing literature. The next chapter will show data on the respondents which will aim to prove their suitability for this research. Following this, the chapter will dive further into identifying the emerging themes through qualitative analysis based on the research questions in chapter 3. The process of analysis was adopted from the grounded theory which started by collecting open codes which is basically the transcriptions, then filter down to axial codes ideally between 30 to 40 codes then finally 5-7 codes which are the themes (Glaser & Strauss, 2017). Some of the threats to the reliability were the confusion of the types of technology and the respondent not forming part of the manufacturing industry, this was mitigated through purposeful leading questions to their experience and working experience.

5.2. Sample descriptive statistics.

Table 1 below displays data on the twelve respondents who participated in the study and were assigned unique identifiers to give them confidentiality and anonymity. Pseudonyms were used to replace any reference to a specific company such as "My company." The researcher embarked on a journey to extract qualitative views from the respondents to gain understanding from Directors, Senior Managers, Middle Management and Engineers to ensure high-quality valid data. The sample consisted of x2 Director level respondents, x4 Senior managers, and X6 Middle Management/Engineers. The respondent sample started the interview with respondent A who provided rich insight at the start of the process but thereafter the interviews were random based on availability and not in alphabetical order. There were four face-to-face interviews and eight virtual interviews as participants were not in the Gauteng region. During the Virtual interviews, the cameras were requested to be on so the researcher could pay attention to the body language of the respondent. The emotions viewed can help add value to the responses and quality of data. This would also ensure that the researcher would be able to see if their questions do not make the respondent feel uncomfortable. Although the camera being on was not compulsory if the respondent did not prefer this option. It is key that the respondent feels free to answer the questions, so the data is of high quality.

Participant Code	Industry	Position	Gender
Respondent A	Automotive Manufacturing	Plant Manager	Male
Respondent H	Supply Chain Manufacturing	Director: Process Engineering, Automation & Technical Systems	Male
Respondent I	Supply Chain Manufacturing	Process Engineering Manager	Female
Respondent B	Supply Chain Manufacturing	Technical Systems Manager	Male
Respondent D	Automotive Manufacturing	Quality Engineer	Male
Respondent C	Automotive Manufacturing	Process Engineer	Male
Respondent E	Automotive Manufacturing	Logistics Manager	Male
Respondent G	Supply Chain Manufacturing	Regional Operations Manager	Male
Respondent F	Supply Chain Manufacturing	Plant Manager	Male
Respondent J	Pharmaceuticals Manufacturing	Process Engineer	Female
Respondent L	Supply Chain Manufacturing	Technology Lead	Male
Respondent K	Supply Chain Manufacturing	Maintenance Supervisor	Female

Table 5.1: Respondent data

5.3. Data Saturation

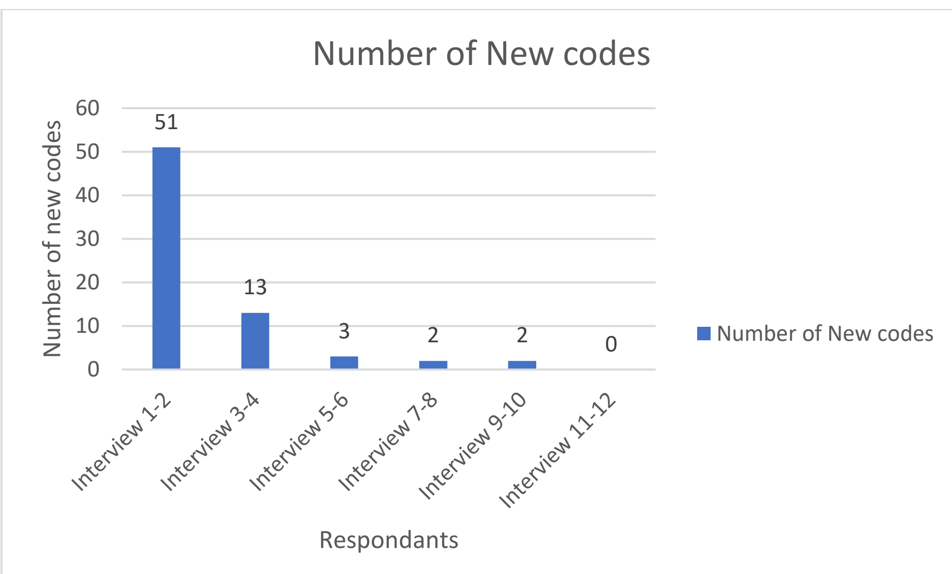


Figure 5.2: Saturation of Data from respondents

With reference to (Saunders & Townsend, 2016), the text advises that data should be collected until there are no new coded themes that emerge from the responses. This shows that there will be no new value added to continue to collect data through interviews and the researcher can now stop collecting data after the twelfth interview. If reference if made to figure 5.2 between interview 7-10 there were only two new themes that emerged and in the final two interviews, no new themes emerged proving that data saturation has been reached.

5.4. Suitability of the Sample

5.4.1. Understanding of AI embedded technology.

The researcher tried to validate that the respondents meet the criteria required to provide quality data for the research, each respondent must have had experience with being part of the implementation team of these technologies or received these technologies from the implementation team. This prompted the interview question one "What is your understanding of Artificial intelligence (AI) embedded technologies?" This allowed the researcher to ensure the suitability of the respondents and not waste the time of the respondents if they did not meet the criteria.

5.4.1.1. Participant's responses confirming their suitability for the interview- High-level understanding of AI.

High level Understanding
“So, I would understand it as a computerized. A program that can make its own decisions or assumptions based on inputs it's received from the user or from the product or from a sensor, and then it carries out preprogrammed selections from there."
“Improve costs long term for businesses so they are technologies that have the capability to execute tasks and functions with a level of cognitive ability based on you know, what has been programmed onto the system. And for example, if I look at robotics, if I look at some motion drives with server motors, you'd find that most of those units and technologies would have the ability to do what human beings used to do in the past."
“So artificial intelligence for me is a self-adapting self-learning sustainable entity or computerized system that can learn a process that can replay potentially replace a human interaction with that specific product or site for sequence or series of events.

5.4.2. Participant's responses confirming their suitability for the interview-Basic level understanding of AI.

Basic level understanding
"So say for example you take a piece of equipment that is meant to do a certain task. Then you integrate artificial intelligence into it so that it goes beyond what are the basic functions of that system, if I want to use the example conveyors that you used earlier, the conveyor's job is to our task is to convey material. But then if integrate software that is programmable to move save material that is not conforming to a certain location, then that becomes an advisory bedded technologies."
"AI is a technology that is embedded in any equipment you know to drive efficiency and effectiveness of the problem.
"Well, AI embedded technologies refer to a system where AI give abilities such as machine learning, computer visions and natural language processing are integrated directly into hardware or software to perform tasks that traditionally are done by us humans and they require a human intelligence of some sort."
"So, the AI is all about, but they come as we mentioned on the when your when you? It's equipment that can learn, but the human being can do it. But yeah, and I don't mean that. Do it better but they use it."
"So, with the brief and with a little bit of research that I've done, I learned that embedded I embedded AI technologies are the integration of AI into resources. "
"When I looked at the Question yesterday, I was putting tried with it, but my understanding of it it's luck giving gadgets that are not very powerful. A brain. I'm and if, if. If you look at it quite a lot, it's like each computing where blotted processes struck, they're not stored in a cloud in the central and central area."
"So, I think in simple terms, my understanding it's the by the use of technologies. Uh, and systems or digital systems in making doing the operations that were doing that would normally be done by humans."

5.4.2. Perception of respondents towards AI-embedded technologies.

As the researcher aims to build up towards the key interview questions the researcher will try to invoke a response to the respondent's perception of AI-embedded technologies. Understanding if the respondent has a positive or negative feeling towards these technologies will help set the tone and direction for the interview. This required question three to be asked: "What is your perception of AI-embedded technologies in your industry?" It should be open question with no bias which should allow the respondent to give their honest opinion of these technologies. A leader's perception of whether there is a positive or negative feel, can define the success of the implementation which in turn could decide if organisations within the sector may leverage these technologies to gain an advantage over their competitors.

5.4.2.1. Participant's responses to their perception of AI embedded technologies.

The structure of the interviews tried to ensure that the topic focused solely on the sector and not the specific company that the respondents were employed. This allowed the respondents to speak freely without the possibility of them being fearful of implicating their company in any negative comments.

5.5. Presentation of Results.

AI-embedded technologies are thought to be a game changer for organisations willing to invest and allow them to gain a competitive advantage. The research questions aimed to understand how key stakeholders affected by these technologies feel about the AI, can the implementation of these technologies improve the quality of life for the employees? Is the sector capacitated to roll out and maintain these technologies? If not, what can be done to improve? Can businesses leverage of the possible competitive advantage if there is one, and what are the key factors that influence the successful acceptance of these technologies. The interview questions were constructed in such a way, that it tried to allow the respondent to speak their truth and enables the researcher to decipher codes from the data which revealed common themes from the responses.

5.5.1. Triangulation of Data

The researcher aimed to understand the views of AI embedded technologies of stakeholders at various levels within the sector of manufacturing and to understand based on their responses if this has affected the workforce and how the implementation of these technologies can be rolled-out more seamlessly through the strategy formulation, Implementation and operationalising phase of the strategic process. To ensure validity of the results the themes codes and themes were taken across levels to remove authority bias. Table 5.3 displays themes from each research question and the details of the analysis can be found in appendix 3.

Table 5.3. Triangulation Matrix through Thematic Analysis.

Research Question	Theme	Number of respondents
RQ 1	1. Automation of Processes through Programmable software to provide live data. 2. Improvement of Efficiency. 3. Supported by Humans.	12
RQ 2	1. Strong leadership drives positive change. 2. AI will improve KPI's. 3. Investment is required in training and development to prepare for change. 4. Change Management is key to capacitating the business environment.	12
RQ 3	1. The Company must invest in upskilling their human capital. 2. There must be a clear communication plan and change management process. 3. There must be a plan to retain workforce through development. 4. Continuous exposure to new technology can change resistant culture.	12
RQ 4	1. Invest in Training of workforce on New AI embedded technology. 2. Create a feedback loop between business and the Educational system for continuous development. 3. Create a growth structure in organisations for employees to develop into. 4. Culture change needs to be part of the sectors Strategic goals.	12
RQ 5	1. Improved Quality of life for the workforce leading to higher productivity.	12
RQ 6	1. Companies that perform well attract the best Skills. 2. Improvement of KPI's and Customer satisfaction due to live data access and decision making.	12
RQ 7	1. The more informed the employees the easier the adoption. 2. Investment in best in class provides quality support.	12
RQ 8	1. Easier to understand and use technology promotes acceptance. 2. Increase exposure merged with training promotes acceptance. 3. Alignment with strategic culture can promote acceptance.	12
RQ 9	1. Productivity increases with Quality and consistency.	12

Table 5.3: Thematic analysis through triangulation.

5.5.2. Results for Research Question 1

RQ 1: What is your understanding of AI-embedded Technologies?

The aim of research question 1 was not only to try and ensure suitability but to also try to provide a gateway into the mind of the respondent to understand what their level is of understanding of AI-embedded technologies. There was a possibility that there could be underlying themes that could emerge such as a lack of understanding may deter their motivation to communicate the importance of AI-embedded technologies. Their feel and behaviours towards AI-embedded technologies may transfer to the workforce which could exponentially increase the resistance to these technologies. The question prompted high-quality discussion based on their understanding and experience with AI-embedded technologies. These reflections set a solid foundation for the interview process.

Table 5.4. Results from Research Question 1

<table>
<tr><th>Category</th><th>Theme</th></tr>
<tr><td>-Process Automation.
-Robot Technology.
-Data Driven Decision Making.
-Programmable Software.</td><td rowspan="2">1. Automation of Processes through Programmable software to provide live data.

2. Improvement of Efficiency.

3. Supported by Humans.</td></tr>
<tr><td>-Process Automation.
-Robot Technology.
-Data Driven Decision Making.
-Programmable Software.</td></tr>
</table>

Key outcomes from this research question could related to the level of understanding of AI-embedded technologies which were in some way or form related to the Automation of processes with programmable software. In all cases, there was a sense that AI with self-learning capability has not reached the sector. All AI technology experiences stemmed from human intervention through programming. In most cases, there has always been a value added to the sector whilst in some cases the value adds came through continuous improvement. There was a strong belief that the ability to access live data would help improve the capabilities within organisations and support customer demands. The visibility of data related to quality could also support customer improvement activities and improve customer satisfaction.

5.5.3. Results for Research Question 2

RQ 2: Is the business environment capacitated to incorporate AI-embedded technologies in its strategy?

Research question 2 sought to look even further once the respondent had consolidated their thought based on their knowledge, experience and what their opinion on AI-embedded technologies could be. It took an in-depth look into whether the respondents feel that whilst they may have a mandate to implement these technologies, they believe that the business environment is capacitated to integrate these technologies into the workspace. Table 5.5 shows the emerging themes from the respondents.

Table 5.5: Results of Research Question 2

Category	Theme
-Leadership is Indecisive. - positives if implemented well. -Positive effect on SQDCE. -Lack of Key Skills. -Lack of Training and development investment. -Business ROI will be affected by high initial investment. -High possibility of resistance due to fear of not understanding and poor change management.	1. Strong leadership drives positive change. 2. AI will improve KPI's. 3. Investment is required in training and development to prepare for change. 4. Change Management is key to capacitating the business environment.

The themes that emerged from research question 2 seem to be indecisive, although all respondents may have a positive outlook for the incorporation of AI-embedded technologies into the sector, most seemed to be concerned with the process of implementation as poor implementation may reverse the positive ROI of these technologies. There was a perception of a need for strong leadership being a possible enabler to the positive roll-out of these technologies. These leaders may need to incorporate training and development into their strategic objectives to prepare the workforce for these technologies. Fear of not knowing could be another key category that emerged throughout the interviews which can be addressed through communication and training.

5.5.4. Results For Research Question 3

RQ 3: Does the current workforce have the skills and knowledge to embrace modern technologies?

Research question 3 aimed to assess the confidence of respondents in the ability of the skills within the sector. This should allow the researcher to understand the perceived gaps in skills that are required and use this data to form possible recommendations for strategic formulation and implementation. Table 5.6 displays themes which emerged from the respondents.

Table 5.6: Results of Research Question 3

Category	Theme
'-Lack of Key Skills. -Lack of Training and development investment. -High possibility of resistance due to fear of not understanding and poor change management.	1. The Company must invest in upskilling their human capital. 2. There must be a clear communication plan and change management process. 3. There must be a plan to retain workforce through development. 4. Continuous exposure to new technology can change resistant culture.
-Lack of Key Skills to manage these technologies. -Lack of Exposure to these technologies. -Fear of Losing their Jobs. -Lack of Change management processes. -Lack of investment in training and development.	

Key points that came out from research question 3 were that there could be a lack of key skills such as maintenance skills and specialised AI skills coupled with the lack of investment in training and development. This fear of not knowing why and how could lead directly to the fear of losing their jobs. This fear could be strongly related to the resistance to the acceptance of these technologies.

5.5.4.1. Responses from Directors

Respondent A:

"It is an interesting question, umm and it's what we do as an organization.
It is what we do at the organization to make people accept AI. Do we carry them with us? How do we introduce that type of thing? So, you can consume, you can move, you know you can't sell and that impacted the market very big, you know because training and

development was never seen as a as a key strategic alive, you know factor into deploying self in the organization.

And so, for me, technology is very important and the same technology that you introduce must be introduced by people you know now, how do you create awareness?
How do you create training capacity or training capabilities in the organization to carry that job?"

Respondent H:
"In short, uh, it's a difficult answer.
To some extent, there is a yes, but I think there is a big no in most in most instances, especially because of the level of skill.
So, there is a belief out there that because I'm not skilled currently as it as of now, uh, then artificial intelligence and very technologies can take my job, right?
But in some instances where the employees are not aware that there are already Fisher AI embedded technologies, I mean they just accept it as it is.
But where they know or where you try to introduce it after the effect it is probably becoming a challenge."

At this level in the organisation, the leaders spoke more about the gap in terms of the skill of sustaining these technologies post-implementation and how they could integrate this into a more strategic approach.

5.5.4.2. Responses from Senior and Middle Managers

Respondent F:

"No, I don't even think the company is ready to accept AI-embedded technologies because they are not ready to invest enough in the workforce to catch them up.
So, if we look at the robotics you had the service centre, the business guys went through to install the robots, but there was no business case or real understanding of all of the other upscaling and stuff that would be required to maintain the things and use them.

So almost immediately when the line started up, the robots were left off for a month because no one knew how to put them on. And there was only one person that was qualified or certified to use it."

Respondent G:

"Our current with tools no. Why?
Because when everybody talks about technologies and changes all at the workforce, currently uses job loss and in South Africa, you know with we have the highest unemployment figures in the world, and you know so people are very scared of losing their jobs because where do they go after that when I think the more developed countries are a lot more acceptive of it."

There could be a trend where leaders who form part of the operational management team may think more about fixing now and ensuring business continuity. There is no feedback loop in the leadership team as to the challenges they face and how they can introduce a strategic solution to the challenge. There could be a major gap in the thinking patterns of Directors and Senior Managers. This gap may pose a major challenge in successfully communicating the organisational strategy across the business.

5.5.5. Results for Research Question 4

RQ 4: Does the Industry have the pre-requisite resources in place to ensure the businesses are ready for ease of adoption of modern technologies to leverage the usefulness of the modern technologies?

Research question 4 seeks to further validate research question 3 concerning the readiness of the environment to accept AI-embedded technologies. The question seeks to be more direct but still invokes the same thought from research question 3. The interview guide broke this question into two parts, to understand if the environment contains the pre-existing resources and if not, what can the industry do to develop these resources and eventually retain these resources. Table 5.7 below displays the themes and categories that emerged from the responses.

Table 5.7.: Results from Research Question 4

<table>
<tr><th>Category</th><th>Theme</th></tr>
<tr><td>-Lack of skills related to AI embedded technology.
-Lack of Project planning.
-No opportunities for Skilled workforce.
-Educational System not aligned with business needs.
-Resistance due to lack of understanding.
-Poor change management Processes.
-Creation of new Skills demand.</td><td rowspan="2">1. Invest in Training of workforce on New AI embedded technology.

2. Create a feedback loop between business and the educational system for continuous development.

3. Create a growth structure in organisations for employees to develop into.

4. Culture change needs to be part of the sectors Strategic goals.</td></tr>
<tr><td>-Lack of investment in training and development.
-Payment In-equality for skilled staff.
-Poor Leadership skills.
-Government failure in -Creating jobs and developing people.
-Culture misalignment with new technology.</td></tr>
</table>

Some key coded categories that emerged are that there could be a lack of AI-embedded specialised skills and there could be a failure in the educational system to prepare the workforce for the world of AI-embedded technologies. There also could be a loss of developing specialised skills as they feel that there is no growth in their career path, therefore they could make the move to general management in search of a better position and salary growth. The leaders in the organisation may need to integrate a culture shift strategy towards these new AI-embedded technologies to allow their organisations within the manufacturing sector to realise the return on investments.

5.5.5.1. Responses from Directors

Respondent A:

"The industry all it first.

First, let's say yeah, the industry, the manufacturing industry in South Africa has created a problematic trend.

That has allowed us to lose skill because we must define first what is the result of

You need resource space in terms of skills, and you need people you need artisans you need technicians; you need software specialists, you need this and that.

Now, why do I say the industry has created rather what I call best practice in terms of those processes?" "So now that perception has left people wondering whether me, being an engineer, do I have that potential of leading this organization and that that is where the resources come from.

And over time, we have lost a lot of resources because people come into the organization. After all, we don't have human resource structures that keep them in that environment and make and create Road maps in those in, in, in those the in that in that in that state or in that specialized work because in the organization I just joined for example, you'll find that the, umm, a guy has been a technician for five years or you know very good does his job.

Wonderful.

There's a production manager position being advertised is at is at.

Is applying now the question that you as a leader of an organization should be asking yourself is how is that possible, you know, moving from being as I isolated individual now you want to lead people."

5.5.5.2. Responses from Senior and Middle Managers

Respondent B:

“Think the exposure to AU currently is very limited and just based on that people don't know what's out there.

Then how are you?

How are they supposed to know what is out and what to improve upon?

If you want as the once again if once if one is not interested in a field and just do some research, then this you know going to get there."

Respondent C:

"This one question that I I've said before when we speak of.

Uh, training people or developing people?

Most companies will be worried about developing people to say what, if, if, what if I invest in Nishen developing Nishen.

Then he leaves and someone says.

What if you don't and he stays?

So, I think the industry or even the companies need to get to a point where they invest in developing people.

The part of the investment, if you want to invest in 4IR, the part of the investment needs to start with developing people.

Then you going to have a good implementation and sustainability and throughout.

So, I think companies need to spend more time and more resources in developing people and making people understand these technologies.

There must be part of the package when you do.

When you say I need to do, I need to move forward with technology.

They need to be part of the package."

Based on the respondent there seems to be common feedback that the current skills to roll out or maintain these skills may not widely be available and the skilled individuals that are available could seek roles in management because there may better growth strategy and salaries. There also seems to be a trend of installation across the sector of at least basic level AI embedded technologies but no budget could be available to train employees because it may not be considered as part of the project scope. These could be key challenges facing the roll-out of these technologies which could affect the exposure rate to the workforce within the sector, this lack of exposure may prevent the creation of a technology-focused sector.

5.5.6. Results for Research Question 5

RQ 5: Can AI-embedded technologies improve the quality of life for the workforce?

Research question 5 seeks to understand if AI-embedded technologies can benefit both the Organisation and the workforce within the manufacturing sector. The responses were perceived to positively relate to improvements in safety, ergonomics, and efficiency of the workforce. There were also hints of positive responses to the quality of the product that leaves the workplace. This could prove that there is less effort required by the workforce to produce a higher output which leads to a better quality of life for the employees.

Table 5.8.: Results from Research Question 5

Category	Theme
-Positive improvement of working conditions. Delivers higher output with better quality and less effort. Improved customer satisfaction.	1. Improved Quality of life for the workforce leading to higher productivity.

The were probable negatives related to feelings that was, at what point does the efficiency reach its max output for a customer where the organisation realises that the overheads may be in excess. This is when the fear of job loss comes into the industry.

5.5.6.1. Responses from Directors

Respondent H:

"Nishen.

I mean, it goes without saying.

I mean, if you look at Tests like quality control, I mean it's far much easier to use AI-embedded technologies because then the level of repetitiveness of doing the job is very high.

If you look at trying to help an employee do that, it's a high level of manual skill, but the outcome is less repeatable than the outcome it gets to with the AI-embedded technologies the same.

I mean that regarding safety if you look at AI's better technologies, the data they collected can help you improve the safety of employees.

What?

What can be done and what can be done and with the with the operator and improve even the design of equipment for the future?

Respondent A:

“Certainly, it can.

Uh, but also it can.

It can improve.

Uh, but also it can create problems at the same time, and I'll tell you why I say that.

Firstly.

In manufacturing, the most important thing is safety.

Now the question is, how do you then secure your safety?

You can.

You can either secure the safety of the equipment or secure the safety of the environment.

The environment includes, you know, people, uh.

Or it could be safety updates with me.

So, for me that then becomes, you know, an important aspect of saying yes, indeed, technology can make things better, you know, but also it can create a problem when someone has been given a technology to work with."

5.5.6.2. Responses from Senior and Middle Managers

Respondent D:

“Yes, of course.

Uh, AI and bedded technologies can improve working conditions by reducing the need for repetitive, hazardous or physically demanding tasks.

They can also lead to a more ergonomic workplace, and better safety standards through predictive analytics and also automation.

For instance, in the past as an example, we used to have spray painters to paint the whole vehicle before.

With the introduction of robotics and we had a lot of safety, safety concerns, health concerns as well around that and with the introduction of robotics were able to eliminate or rather reduce some of these risks through the introduction of AI-embedded technologies.

So yes, and they can improve quite a lot of a lot of conditions in the workplace, especially in manufacturing."

Respondent G:

“Yes and no,

Like I said, in some places I mean it's predicted that AR's going to make redundancies, that job redundancies grow a lot faster and some pretty 5% of all jobs every year will be taken over.

But in other cases, it makes people a lot more productive.

It reduces.

Uh, your error rates.

It can, it automates it, can automate certain functions.

You can process data at speeds and in ways it never thought before possible.

You know, so for people that analyse data, you've got a data analysis that's attached to your fingertips. But for others, it boils down to the three previous questions.

How many jobs are we going to lose and how are we going to replace those jobs with what? They say accountants, accountants, which is one of the hardest professions to qualify.

Chartered Accountants of the 2015 to 20 years that job is going to be an AI.

Yeah, you're going to need you.

You're going to have, and you need one analyst.

If you have 15 accountants or something like that.

I mean think about the, the, the Chinese that you started using AI to train fighter pilots. They said the base fought to follow, to enter up against an AI pilot the first time and he beat it. He went up the second time and he beat it the third. By the third time, he could not beat this thing anymore."

There could be a common theme across the levels within the sector that AI when implemented well and incorporates the people factor into its design could exponentially improve the quality of life whilst adding value to the business.

5.5.7. Results for Research Question 6

RQ 6: Can AI-embedded technologies be leveraged to allow the organization to gain a competitive advantage?

Research question 6 aims to understand from an employee point of view if these technologies live up to the hype of bringing value to organisations in the manufacturing sector and allowing them to compete. With the high initial investment these technologies come with, there should be a high ROI to facilitate the payback period and start seeing the reward of the implementation as quickly as possible. Strong Leadership and project management could be key enablers for this initiative.

Table 5.9.: Results from Research Question 6

Category	Theme
-Attraction of best-in-class skill. -Improvement in SQDCE KPI's. -Data Driven Decisions. -Improved customer satisfaction.	1. Companies that perform well attract the best Skills. 2. Improvement of KPI's and Customer satisfaction due to live data access and decision making.

The underlying competitive advantage of AI-embedded technology could be profitability through efficiency. Although there could be other benefits such as consistent quality products, higher output ability and access to data which can support efficient decision making. These all should culminate in an improved customer satisfaction index.

5.5.7.1. Responses from Directors

Respondent A:

"No one wants to go and join an organization, whether the fire all the time or where they fatalities all the time, you know, that's why in mining it is very important because if you have many incidences where there are fatalities in mining, who would want to go and join because it means you are going to join a company where your life is at risk.

You know, so for me, safety in manufacturing is a key aspect of competitiveness where you are assuring your tired employees and future potential employees that this is the safe environment and technology plays an important role in and because of.

How you create and for example your response.

Uh, technology in terms of fire, your response technology in terms of preventative, you know, maintenance activity that could lead to a fatality that worked or that could lead to anything you know.

So, for me, safety plays an important role."

Respondent H:

"Yes, it's definitely,

I mean, if you look at the amount of data that you get a guard that with this, yeah, AI technologies, it's a lot and decision making that is data-driven or data-backed is the best that you can ever get and data while it will always be collecting data with content to an era of big data now.

So, it's not data that you can collect manually to a spreadsheet daily.

That needs to be automated, so I think with this data comes a lot of fast and agile decision-making, which means we can be competitive.

I mean the efficiencies, it's a no-brainer.

Uh, with this data, we can improve your efficiencies of production lines.

We supply chains.

Uh, if you look at new product development as well, all this data that you collect, it's an input into NPD, which means whatever you develop as the next generation of your product is probably going to be far much better than before, yeah."

5.5.7.2. Responses from Senior and Middle Manager.

Respondent J:

"Yes.

Overall, I feel that AI-embedded technologies play a key role in improving businesses.

Productivity and competitiveness help well, I think they help automate processes.

Umm, with going to also improving analyst analytics.

Umm.

Of analysing basically of how when you introduce this equipment, like you analyse the productivity of having a machine and having a yeah and basically and also making it easier for the business to make Better Business decisions.

To say I'm having an AI in the company is giving so much profit or it's doing this much beneficial.

So, I think it is improving businesses.

Positively."

Respondent D:

"I think I can be used to optimize your supply chain, improve product quality, reduce operational cost enable faster decision making and also improve your lead time in terms of from the time of ordering and also to the time of delivery.

Uh, I think by leveraging this data analytics and businesses, businesses can anticipate market trends, and customer needs allowing them to stay ahead of the competition.

One example is that these AI can gain insight in terms of what the market the market currently wants to collect different information about our customers ensuring that we are able to offer product offerings that are needed in the market.

So, I think that will let you know.

Companies and upper advantage or upper edge in terms of being an ahead from their competitors."

Respondent G:

"You put it to sway the way the world's moving, those that don't adopt AI embedded or generative will not remain competitive. You know I am using data from embedded AI. You can predict market trends.

You can predict next it takes you to the next level, thinking you you're always ahead. The problem is how do you stay ahead of every company?

That's adopting AI."

Across all levels within the organisations that thrive using AI-embedded technologies in the manufacturing industry, there are positive themes that emerge regarding AI-embedded technologies. There is even a sense that if we do not adopt these technologies the sector will shrink and disappear in South Africa with the competition of Chinese imports.

5.5.8. Results for Research Question 7

RQ 7: Can developing a strong external support base help the ease of adoption of new AI technologies?

Research Question 7 investigates understanding how the manufacturing sector will leverage external support to develop their AI-embedded infrastructure to bring these technologies into the business environment and capitalise on the knowledge transfer from this support to ensure that the sector can maintain these technologies internally post-implementation.

Table 5.10.: Results from Research Question 7

Category	Theme
Better relationships create strong collaboration. You pay for what you get. Organic relationships lead to better skills transfer which allows employees to accept technologies.	1. The more informed the employees the easier the adoption. 2. Investment in best in class provides quality support.

The message that came through strongly in this research question was that due to the immaturity of these technologies in the sector, it is key to leverage of the knowledge of external partners. Compromising on cost for a technology that is still nascent may cost more in the long term. These relationships must be organic to allow the partners to transfer as much knowledge during the handover phase and still through these relations continue post-handover. The more the workforce is empowered the less complicated the acceptance.

5.5.8.1. Responses from Directors

Respondent A:

"That's your external and of course, the community at which you, manufacture or you operate becomes an external stakeholder.

So indeed, customers are consumer appliers a partner that makes it possible for you to supply your consumer on time and with the right quality. So, for me, that partnership is very important for any organization in manufacturing, and it must be defined by two things. It must be defined by the quality of the installation.

It must also be defined by the ability to transfer skills in a good way.

You know, for the sustainability of the installation because the installation is sustained is sustainable as it's installation.

If the installation is done in a good way, they'll the technology will be sustainable."

Respondent H:

"Actually yes.

If you think of it, every time you buy these technologies, you're probably going to be in a normal project management cycle, which ends up with the end of commissioning and the end of testing and all that stuff was normally software.

Anyway, if this is done in a way where the relationship between you as the buyer and the let me call it the OEM, then it means you still have one.

You're going to have a proper transfer of knowledge at the handover.

Proper aftermarket support for me includes continued training over some years you know because I may, I may take your software but then the people I that type live but if there is proper aftermarket, we can always have proper training with the technology owner.

So, I think this is there are some differences to make it more effective.

I agree with that, yeah."

5.5.8.2. Responses from Senior and Middle Managers

Respondent K:

“I do.

I do.

Umm, so what I've seen is that, uh, I'm going to make a typical example with a product that we have in Samrand, which is one of the server motors from ECW's and the server drive.

What we have seen is that obviously, it is something that requires more technical, you know, know-how to work on it.

And because we don't have the best relationships with our suppliers.

And they can assist us, but they will assist us at a fee.

However, if we build a better relationship, which is something I've done in the past with other companies, suppliers and vendors would be willing because you are using the product that much and because you are such a loyal customer to them, they would be willing to do certain things for us for free, which include training which includes skills transfer which includes, you know, the working together."

Respondent G:

“So here, look, it's.

It's about us creating partnerships rather than suppliers. You know we want to port your partner if we partner up with an AI skill, you know that's what they're doing for us.

But partnerships are mutually beneficial.

So, we're obviously either going to pay them a lot of money so they benefit like that or they're going to benefit from us in other ways. Yeah, I do think it's beneficial.

Just business in general, partnering with the right people with the right supplies and not just seeing that you can't just view them as a supplier because then all there ever will be the supplier. If you view them as a partner, you know they're going to walk this journey with you and again it teaches you what they know, and they're going to expect you to teach them.

If the leadership level is strategic or operational, the common response is on the basis that the internal resources may not be at the level required to sustain these technologies and partnerships could be key to ensure that with time the resources become upskilled to take over the ownership of the technologies.

5.5.9. Results for Research Question 8

RQ 8: If the technology is easier to use and less complicated to manage can this promote the acceptance of the technology in an organization?

The business environment maintains having two major stakeholders who are affected by these technologies. Firstly, there is production or operations which are the end users of the technology and where the value added is generated. Secondly, there is maintenance personnel who is responsible for conducting preventive maintenance and health checks on the system. During the development of these technologies, it could prove key to include these stakeholders as part of the project team. Further to that these solutions should make the life of the user easier and more productive; anything less may lead to rejection of the solution.

Table 5.11.: Results from Research Question 8

Category	Theme
Easier access to information allows the machine to be maintained more easily.	1. Easier to understand and use technology promotes acceptance.
Increasing exposure changes the mindset of these technologies.	2. Increasing exposure merged with training promotes acceptance.
AI-embedded technology should form part of the strategic direction to promote culture change.	3. Alignment with strategic culture can promote acceptance.

5.5.9.1. Responses from Directors

Respondent A:

"Let's look at the evolution of the phones.

The evolution of cell phones from big brick cell phones.

You know two small smartphones, what we call today's smartphones, that evolution you can hear the technology, you know, smart, smart, smart, smart, smart.

You start for me a particular period where the introduction was called the smartphone.

So, it means the intended use is to drive less complexity, so it means it's user-friendly.

It's uh, it's easy to do and what we call fault finding.

It's easier to identify the root cause of the problem."

Respondent H:

"Yes, but with, the challenge that houses our simplified, can you make technology big?

You know, I think technology, but I think the temp technology itself, I can't remember the definition, but I think it's very rare to find the easy new technology.

Yeah.

I think technology will become easy over time when it becomes mainstream.

I can think of myself when I touch the computer the first time in 1999 when I went to university, I was even scared of searching on the laptop."

5.5.9.2. Responses from Senior and Middle Managers

Respondent F:

"Yes, it would.

So obviously I mean, I think I've now, I've, I've conquered in the old days, you would have to go and code all your slips and upload them into the system. And now the system is so sharp you upload the slip and the AI sort of calculates already. Where did you go? And you just go and double-check it. I'm I think a little bit you lose some creativity and problem-solving techniques if it's in a plant environment.

If everything is always easy now, you just push a button.

Now you going to push the button.

Now that's a big problem. Umm, so we might lose a little bit of that skill, but then that could be and go back to the unskilled labourers or not able to do more things because it's a simple technology that they need to work with."

Respondent K:

"Umm.

Yes, it would.

Yes, it would, I think.

UM.

In all honesty, the fear behind the technologies that we have is the complexity of the technologies versus the capabilities of the people that we have in-house and hence that results in resistance to the implementation of such.

So, I think we would have, or we would see a lot more support and buy-in if the technologies have been simplified.

And because I think managers, they don't know, you know, managers and directors don't know technology or technicalities they are more affair with numbers, you know ones and zeros and you know dotted lines, bottom lines, but they also understand that technology can improve something but create an even bigger hole especially if we don't have the right capabilities within our industry.

So, if they are simplified, it would be much better to get the buy-ins of the right leaders to have solutions implemented."

Respondent D:

I think if AI technologies are designed to be user-friendly and less complex, they will certainly support Broader adaptation.

Simplified interfaces, clear documentation and ingenuity systems can reduce the learning curve and encourage more widespread use.

And so, for instance, if systems are much more worker-friendly, then it means that the organization doesn't have to undergo an intense change management process because that will require A to invest a lot more in terms of training and development.

And also, uh, invest a lot more in terms of a uh of assessment and the like.

So, I think if they are more, it's a simplified then you and I within our own personal capacity will be able to also adopt such technologies in our own personal capacity."

At the various levels, including stakeholders who manage these technologies in the initial project phase may ease the acceptance of these technologies. They will also feel more accustomed to using them if they feel part of the solution development as their input will define the ease of use.

5.5.10. Results for Research Question 9

RQ 9: Can AI-embedded technology reduce effort and increase productivity in the user's environment?

The scalability of organisations within the manufacturing sector is based on their ability to reply to the increasing demand of the customer whilst maintaining the quality of the product. A key limiting factor of a process could be the manual dependency of the process. These AI technologies can increase output exponentially whilst maintaining or even improving the quality.

Table 5.12.: Results from Research Question 9

Category	Theme
-Improvement on KPI's. -Higher Output vs human-dependent processes.	1. Productivity increases with Quality and consistency.

The responses depicted a positive outcome of AI-embedded technologies with one key disclaimer, the technology must be implemented well and portray strong project management traits and change management principles.

5.5.10.1. Responses from Directors

Respondent A:

***"For** example, before the vehicle goes into as the vehicle comes out of as the oven, it goes into a boot that is got a technology that picks up the defects.*

OK, but did you are you know the magnitude to say this booth is designed it has parameters that pick up how many pieces of dirt are in the car, and it marks them in a TV you know so that the operator doesn't have to inspect.

So, when the car comes into the rectification line, the operator is already in the TV, and the system is communicated in the TV.

He can see where the defect is.

It just goes there.

As you know, he cleans the defect, so those.

That's the type of technology to advance quality to advance speed, to advanced productivity to, you know, to reduce.

What do you what do you?

We would normally call a non-value-adding operation in an in.

In the process, you know it's important to be able to identify what does a value add and what does a non-value add, and you have to always use them.

See how we can best use technology as part of, you know, and a helping the men-made process to reduce, you know, a loss in the production line, you know, and effectively increase efficiency. Yeah."

Respondent H:

"*Yeah, it has.*

And it's through continuous I think for me the best thing that this has brought is decision-making, which is data driven.

There is no other way of collecting data in this data world that is better than these technologies because if you don't do that, manually collecting that data is not going to be easy.

Imagine collecting manual data from a Coca-Cola brewery, but a Coca-Cola beverage company that is making 10 million cases of there is dead.

It's just almost impossible, and I think I've seen that this works a lot also in terms of where wherever you would automation and it's it, it is far much easier for you to have repetitive tasks done quicker.

You know, once intermediaries all repetitive tasks that picker which improve your efficiency as well.

We are seeing a lot of these also being used in continuous improvement post continuous improvement in most cases is driven by data collection as well.

I mean, talk of 6 Sigma taking off lean manufacturing.

It's better to do either.

So yes.

Productivity.

Yeah, it's improving."

5.5.10.2. Responses from Senior and Middle Managers

Respondent D:

"I think the introduction of AI-embedded technologies has generally led to improvements in productivity by automating repetitive tasks, reducing errors and optimizing production processes, and this allows us to focus on more strategic and complex tasks.

And then in in, in doing the repetitive the repetitive work.

So, for instance umm with AI now you are.

We are now able to support a lot more customers.

Uh, in the Southern African religion region as a whole?

What else?

Initially, we only focused on our neighbouring countries and with the introduction of AI-embedded technologies, you can have a much more global reach in terms of adding your product and improving your lead time to deliver.

Being."

Respondent E:

"I will say yes.

OH, one it's it helps.

I will give an example of a conveyor belt that was introduced.

You know, we used to have lost time in this station in the, in the, on the line we used to have, you know, operator, leave the line without attending to the units and then the output of that day will be less than the original plan output.

So, this can be updated as help to paste you know the line in a very good way that you are able to get your required output as well.

And I'll make another example with the, you know supply chain. You know, we normally plan manually, you know using the Excel file, but now we starting to introduce a system called "Project 44" whereby you can plan, you just need to put the input of whatever you are you are you want to trace.

And I tell you the AI embedded technology will help you to generate the output and also give you some tolerance to say this is you know such if there is if there is a case of this nature and then it can be the ETA can move out by one or two days and that makes your life easier and very seamless.

Right, because you can plan accurately using these technologies because we used to plan manually.

Yeah, a lot of errors."

Respondent C:

"Of course they would.

It would.

You know, of course, it will.

It will.

It will assist you to the users to be able to adapt and remember, uh, every person wants to get to a point whereby they get to the operation that they need to do and it's easy to use.

So, the moment they get complicated, it becomes.

It even makes the change resistance more because the moment you start, let's say the machine has a lot of parties that you need to press, and the moment they see that, they start saying, hey, me know I'm used to this.

I want to stick to this, but if it's a 1 button push for example, it's easier for them and its less work for them.

So, I think it will make it.

Yeah, and easy to adapt to the solutions of course."

All levels of leadership portray positive responses to the value added from a productivity perspective to the sector. The increase in productivity should lead to access to markets that would have normally been out of reach for the local manufacturing sector. This type of scalability can have a ripple effect on the Country's GDP and skills development ambitions.

5.6. Conclusion

The findings from the interviews were used to explore the views of the respondents concerning the research questions in Chapter 3.

The information gathered from the interviews enabled the researcher to gain insight into the factors that enable the ease of implementation of AI-embedded technologies into organisational structure without removing the human aspect from the process. These questions were devised based on the theory and constructs based on the TAM, TOE, and Human Socio-materiality and how this is related to the intent to adopt. Whilst there were success using these frameworks in the telecoms industry this could be different for an immature industry such as the manufacturing sector. Due to the high dependency on human capital removing the human factor could have adverse effects on the currently deuterating South African employment statistics. There were key insights brought forward by the middle to senior leadership team within organisations and these views can be structured to create strategic objectives to mitigate the risks that these factors may pose to the operations of organisations.

The outcomes revealed key themes which can be used to ease the adoption of AI-embedded technologies in organisations. The themes were both positive and negative which means there will be themes which we can leverage as strengths and actions that will need to be implemented to ease the adoption. There were positive themes such as the improvement in business efficiencies, improvement in business KPIs, improved quality, improved customer satisfaction and productivity increases. If there is a deeper look into these positives there will be a strong bias towards these only benefiting the organisation and a lack of benefit to the user. In the process of adoption if the user is not the centre of the solution and their job is not made easier there will be strong resistance towards these AI-embedded technologies.

Some of the key challenges that needed attention were the lack of leadership capabilities, lack of investment in training and development, poor change management, the break in communication between the business environment and the educational system, the lack of growth opportunities in specialist positions, misalignment between culture and technology, the lack of knowledge transfer, poor relationships between businesses and external stakeholders, poor relationships between businesses and external stakeholders, complexity of the technologies, lack of exposure to these AI embedded technologies and misalignment between the organisations strategic culture.

The positive themes from the responses gathered were the normal benefits expected when implementing these technologies as these have a direct correlation with the ROI calculation for these AI-embedded technology investments. But if we look at the structure the value in these technologies can only be realised as soon as the value is added through efficient use of the technologies.

The expected themes such as fear of not knowing and fear of losing their jobs came through strong in all interviews and will be a key driving factor in navigating around the adoption rate.

It was positive to also note that there are ways to convince the workforce to adopt these technologies through training and development and information transfer.

The next chapter will discuss the findings in further detail and link them to the frameworks and tools mentioned in Chapter 2 the literature review.

Chapter 6: Discussion of Results.

6.1. Introduction

This section presents a detailed analysis of findings, directly linking the themes discovered to the research questions and overall purpose of understanding AI adoption in South Africa's manufacturing sector. The information collected and presented in chapter 5 were gathered through semi-structured interviews, the processes is further defined in Chapter 4 and is aimed to be discussed in detail within this chapter. The views gathered from the respondents were coded and categorised to form themes which will be compared to the existing literature in Chapter 2. This will allow the researcher to arrive at the findings which he aimed to invoke through the questions in chapter 3 of the research questions. The views of the respondents aimed to unpack the factors that affect the acceptance of AI-embedded technologies in the manufacturing sector. The study identified common themes across the diverse leaders within the reach of the researcher's network and used this information to form actions to address the challenges which could cause a risk of rejection of AI-embedded technologies. As the frameworks and tools used in this research showed positive outcomes in other industries individually, the researcher aimed to combine the TAM, TOE, and Human Socio-materiality to uncover deeper thoughts on this topic.

The sample criteria were middle management up to director level in an organisation within the manufacturing industry who are affected by AI embedded technologies, whether it being their responsibility to implement these technologies, maintain these technologies or the end user of these technologies. Research question 3 aimed to understand if the workforce possessed the skills to manage these new technologies and if this affected their feelings to accept the technology and research question 5 aimed to understand if these technologies can help improve the life of the workforce. Together these questions aimed to reveal if these technologies can not only benefit the organisations but also the workforce and with this information can help ease the process of implementation in these organisations. Research questions 1 aimed to ensure that the respondents meet the basic criteria for them to provide quality data to the research to not skew the views of the population. This ensured that the respondents brought credibility to the research which re-enforced the quality of the data collection.

6.2. Discussion of Results for Research Question 1.

Research Question 1: What is your understanding of AI embedded Technologies?

Research question 1 aimed to gain insight into the level of knowledge on AI-embedded technology that the respondent possessed. The researcher will use this information to verify if the respondent meets the minimum requirement for the interview. Research question 1 was split into 2 parts which were the respondent's understanding of AI-embedded technologies and if they have any experiences with these technologies. The question also indirectly aimed to trigger emotions from the respondents which would give a more realistic feeling when the researcher moved to the next question which was their perception of AI-embedded technologies. Within this section the researcher will explain each category that emerged from the data, how they merged to form the themes and an in-depth discussion of each theme. There were many open codes which were collected per interview question and allowed for numerous texts, as the process filtered through axial and selective codes to form themes, the questions used to answer research question 1 form the below categories and themes.

6.2.1. Process Automation

As the researcher aimed to ensure that the respondent met the criteria for the interview, the understanding of process automation came through which was defined as the use of AI in process improvement through automation. This can be true as businesses used these technologies to remove waste from the system and improve efficiencies.

6.2.2. Robotic Technology

Partnered with the use of AI-embedded technologies and process automation was the re-occurring theme of using robots to carry out human-intensive tasks and improve efficiency and safety. Robots can be developed to be self-thinking and self-adapting and use deep learning to carry out tasks and continue to self-improve as a rate far superior to the speed of humans.

6.2.3. Programmable software.

AI-embedded software has strongly drawn a picture of software that needs back-office programming to perform the unique tasks required by the user or customer. This should allow the possibility of AI-embedded technologies to be endless and only limited to the skills of the programmer. There are risks of AI-embedded technologies being biased based on the criteria set by the programmer and this bias needs to be managed through policies, laws, and regulations to ensure equal opportunities exist for a diverse workforce.

6.2.4. Data-driven decision making.

A possible strong driver towards the use of AI-embedded technologies was the ability to have access to live data and use this data to make quick decisions, especially for the benefit of the customers these organisations serve. Access to data could support safety decisions, quality decisions as well as output demand from the customer. These three KPIs are key for ensuring the sustainability of organisations.

6.2.5. Theme 1: Automation of processes through programmable software to provide live data.

During the selective coding process, the researcher identified a common theme which was the ability to automate processes using programmable software to provide live data. When simplified, these processes should focus on executing basic, repetitive tasks to improve operational efficiency and consistency. By incorporating AI-embedded technologies into the process, you have a robot embedded with AI which is not affected by fatigue, lunch breaks and human intervention until preventative maintenance is required. This coupled with the ability to draw numerous forms of data could be a major value add to any organisation willing to invest in these technologies in the manufacturing sector.

6.2.6. Theme 2: Improvement of Efficiency.

In the interviews the respondents referred to the improvement of operational efficiencies with the implementation of AI-embedded technologies. However, this was only the case when the technologies were implemented well or there were numerous continuous improvement activities to get the technologies to work well for the organisations. With the high initial investment required it made sense for these technologies to improve efficiencies as there needs to be some motivation through high ROI for shareholders to release the funds for the investment request.

6.2.7. Theme 3: Supported by humans.

With the research being limited to the context of the South African manufacturing industry, the respondents are familiar with the challenges of the escalating unemployment rate in South Africa. This background led to most leaders being realistically inclusive of people within the design of these technologies. The drive to find solutions that could improve the organisation whilst keeping a healthy workforce or upskilling the workforce was something the leaders saw as a challenge and are looking for ways to keep the workforce and technology as one entity.

6.3. Discussion of Results for Research Question 2.

Research Question 2: Is the business environment capacitated to incorporate AI-embedded technologies in its strategy?

6.3.1. Leadership is Indecisive.

During the interviews, most of the leadership population could not confidently say that their business is ready to integrate AI-embedded technologies into their environment. This was largely due to the culture shift within the organisation. The lack of exposure and knowledge about these technologies adds to the fears of the workforce which leads to the natural resistance of new solutions. Leadership has witnessed solutions being implemented and not utilized after a few months due to poor change management. These issues will be unpacked in further detail as the themes and categories are defined.

6.3.2. Positives if implemented well.

The above indecisiveness of leadership could be because of the process of managing the implementation of these AI-embedded technologies into the operational environment. The lack of project management skills and a silo working methodology could be detrimental to the implementation of these technologies. Excluding the end-user input into the solution that will be implemented in their area of work may cause resistance to the technology.

6.3.3. Positive effect on Safety, Quality, Delivery & Cost (SQDC).

There was consistent feeling that once the AI-embedded technologies were implemented fully, there was an improvement in safety incidents, better and consistent quality of product with increased output. The cost to manufacture the products was significantly reduced which could enabled the organisation to hand this saving to the customer.

6.3.4. Lack of Key Skills.

Within the manufacturing sector, there seems to be a common belief that from the shop floor level, there is a lack of skill from all affected business units. The first is the operator who will work with these technologies where these technologies are used as human support solutions. The user finds it challenging to use the technology because of the lack of exposure and training. The next would be a lack of technical skills from the maintained team who ensure these technologies are operating at optimal.

6.3.5. Lack of investment in training and development.

The lack of knowledge for the end user and maintenance personnel could mainly be due to the lack of inclusion of training and development into these new technologies. This can a failure on both the project side and operational leadership side as this budget may have been excluded from the capex and leadership fails to include this as part of their people development strategy budget. This cost-saving initiative may cost the organisation in the long term.

6.3.7. High possibility of resistance due to fear of not understanding and poor change management.

The belief from the respondents is that they faced a high level of resistance from their team because they were not confident with the solution as they were not being included and not effectively trained on these new solutions. This could have emanated from the lack of change management principles incorporated into the handover of the solutions to the users.

6.3.8. Theme 4: Strong leadership drives positive change.

Throughout the analysis of the categories, the failure to manage these technologies and their implementation came through as poor leadership. If organisations want to see effective change, they could incorporate a combination of transformational leadership and inclusive leadership to enforce the use of these technologies effectively.

6.3.10. Theme 5: Investment is required in training and development to prepare for change.

Leadership believes that if the project aims to be a success the incorporation of training and development should be a key part of the project KPIs. Excluding this as part of a project objective could delay the organisation from gaining value from these technologies.

6.3.11. Theme 6: Change Management is key to capacitating the business environment.

The project team needs to develop a detailed matrix of the site acceptance testing for these technologies. The team must agree on the rate of output, quality of product and speed and skill of employee KPIs before they accept the handover.

6.4. Discussion of Results for Research Question 3.

Research question 3: Does the current workforce have the skills and knowledge to embrace modern technologies?

6.4.1. Lack of Key Skills to manage these technologies & lack of investment in training and development.

This was a key recurring category which repeated from 6.3.4 and 6.3.5.

6.4.2. High possibility of resistance due to fear of not understanding and poor change management.

This was a key recurring category which repeated from 6.3.7.

6.4.4. Lack of Exposure to these technologies.

As much as companies want to embrace these technologies leaders agree that the lack of exposure to these technologies from an earlier stage in an employee's career puts them at risk of trying to understand a highly complex system. This could slow the acceptance rate of these technologies into the business environment.

6.4.5. Fear of Losing their Jobs.

The leaders who have direct interactions with the shop floor do express serious concerns that their workforce is naturally resisting these technologies even though it can make their jobs much easier, they could still be afraid these technologies are taking away jobs from the people.

6.4.6. Theme 7: The Company must invest in upskilling their human capital.

This is a recurring theme from 6.3.10.

6.4.7. Theme 8: There must be a clear communication plan and change management process.

In addition to the theme mentioned in 6.3.11. there is a lack of communication of the organisation's vision and strategic alignment exclusion could make the workforce feel excluded from the company's future.

6.4.9. Theme 9: Continuous exposure to new technology can change resistant culture.

Leadership has a reactive approach to culture change within the organisation, the lack of exposure can slow the rate of adoption and skills development in the organisation.

6.5. Discussion of Results for Research Question 4.

Research question 4: Does the Industry have the pre-requisite resources in place to ensure the businesses are ready for ease of adoption of modern technologies to leverage the usefulness of the modern technologies?

6.5.1. Lack of skills related to AI-embedded technology.

This is a recurring theme from 6.3.4.

6.5.2. No opportunities for a Skilled workforce.

The researcher found an important theme hidden in the context of the responses from the leaders. Most of the leaders being interviewed started their careers in Engineering or Maintenance and shifted their focus to people and business management. These codes also displayed thoughts that the respondents felt strongly that they start with recruiting skilled staff but lose them to a management position because the growth path is limited for skilled employees. They have also experienced a large percentage of the workforce migrating as South Africa is not creating opportunities for them to remain in the country. The loss of these skilled employees could become a high risk for the sector as the progress of these AI-embedded technologies may be halted.

6.5.3. Educational System not aligned with business needs.

As technology is progressing in the business world the demand to maintain and develop these technologies is growing, and skills supply is unable to keep up with this demand as the educational institutions are not producing these skills at a high enough rate or the institutions have not adjusted their curriculum to suite these new skills demand. This could lead to organisations bringing in skills from other countries to support South Africa a country struggling with a high unemployment rate.

6.5.4. Resistance due to lack of understanding.

This is a recurring theme from 6.3.7.

6.5.5. Creation of new Skills demand.

Where employees may feel the fear of these new technologies, some may see the need to leverage this new skills demand. South Africans need to be supported by organisations and be guided through their development to align with the skills that are needed and how they can be a value add to organisations within the manufacturing sector. These new skills demand may not solve the issue of unemployment, but it could take the country a step forward.

6.5.6. Poor Leadership Skills.

When dealing with people and introducing new solutions into the environment of business, people need to believe in these solutions. Workforces are generally termed as followers who are looking to believe in a leadership figure. If leadership is not decisive in ensuring that these technologies add value to the organisations the people could feed off that emotion and tend to reject these technologies. Leadership should show decisiveness in the rollout of these technologies and the people will follow.

6.5.7. Government failure in creating jobs and developing people.

The respondents also gave a feel that the major reason for the lack of exploration into these technologies could be that the Government has created a poor image of the Country which prevents international investments. This means the market is restricted in terms of who the manufacturing sector in South Africa can service. If the demand is low, it won't make financial sense in investing in these technologies which cripple the plans for exposure to these technologies and training and development on these technologies.

6.5.8. Culture misalignment with new technology.

It's human nature that if you have been manufacturing a product in a certain way for years, it's hard to change to a new way of working without reason. Changing people's culture is the hardest responsibility of a leader, and failure to do this could be the highest risk of failure if leaders are looking to incorporate these technologies into their business processes.

6.5.9. Theme 10: Invest in Training the workforce on New AI-embedded technology.

This is a recurring theme from 6.3.10.

6.5.10. Theme 11: Create a feedback loop between the business and the educational system for continuous development.

If institutions continue to work in silos, and not incorporate the skills demand data from organisations, they could either continue to create skills with low demand or redundant skills. This will continue to add to the unemployment rate of the country.

6.5.11. Theme 12: Create a growth structure in organisations for employees to develop into.

To retain skilled employees within an organisation and a country the manufacturing sector needs to create a growth structure within the organisations that give skilled employees the chance to grow in their field and earn a competitive salary.

6.5.12. Theme 13: Cultural change needs to be part of the sector's Strategic goals.

If we look at the responses from the leaders, it's clear that the topic of culture and communication is not part of the company's strategic pillars. The success of a strategy is based on the success of operationalising this strategy in a good way.

6.6. Discussion of Results for Research Question 5.

Research question 5: Can AI-embedded technologies improve the quality of life for the workforce?

6.6.1. Improvement of working conditions.

The analysis of the respondent's answers portrays a common feeling that when these technologies are implemented, the impact on the ways of working of the employees drastically changes towards a safer working condition. These technologies could support controlling ergonomically unfriendly tasks and lockout unsafe areas. Furthermore, it can reduce the strain the operator goes through to produce a product at a required rate.

6.6.2. Delivers higher output with better quality and less effort.

To further elaborate on 6.6.1, the operator is now able to produce the product at a much quicker rate with less effort putting less stress on the employee's physical demand and can support their mental concentration. This supported by the accuracy of AI could allow for improved quality of product.

6.6.3. Improved customer satisfaction.

To further expand on 6.6.2, the ability to adjust to the demand of the customer whilst providing consistently good quality can be key to a high satisfaction index. AI-embedded technologies can also allow the organisation to analyse live data to adjust the production process to the needs of the customer with a quick change in a program and removal of the waste of resources to train humans on the new standard.

6.6.4. Theme 14: Improved Quality of life for the workforce leading to higher productivity.

The main theme that was consistent across the respondents was that AI-embedded technologies support the quality of life and directly relate to the increase in output of the plants which could open the market for new customers to come into the sector.

6.7. Discussion of Results for Research Question 6.

Research question 6: Can AI-embedded technologies be leveraged to allow the organization to gain a competitive advantage?

6.7.1. Attraction of best-in-class skill.

The trend in generational shift shows that employees are now looking to join organisations which can add substance to their Curriculum Vitae (CV), this can mean that if you want to bring in the best-in-class skills, the organisation will need to prove that they can give the candidate the exposure to elevate their skills further. Job seekers these days are looking for companies that are incorporating the latest technologies into their processes so they can start enhancing their knowledge.

6.7.2. Improvement in SQDCE KPI's.

This is a recurring category from 6.3.3.

6.7.3. Data Driven Decisions.

As companies are moving into the world of 4IR, the dependency on data has increased to a point where no decision can made without hard data. Whereas in the past humans needed to physically gather data from the process using stopwatch time studies, now the machine can give you live data if you have access to the system. AI could also analyse this data and provide root causes and solutions for the team to fix immediately. Mean Time to repair (MTTR) can be a key KPI to manage skill level of the workforce.

6.7.4. Improved customer satisfaction.

This is a recurring category from 6.6.3.

6.7.5. Theme 15: Companies that perform well attract the best Skills.

Top-performing companies generally possess the best-in-class skills as this allows them to ensure their technologies perform at their peak and produce the results it was intended to. This supports future business cases to ensure the organisations within the sector continue to grow with the support of AI-embedded technologies and attract best-in-class skills.

6.7.6. Theme 16: Improvement of KPIs and Customer satisfaction due to live data access and decision-making.

This is a combination recurring categories from 6.3.3, 6.6.3 and 6.7.3.

6.7.7. Theme 17: There must be a plan to retain the workforce through development.

The respondents expressed their concern that the high turnover rate of skilled employees within the organisation is not mainly due to remuneration, but rather the employees feeling stuck in a position that they cannot develop. The leaders also linked training and development which is 6.3.10 theme 5 as a possible countermeasure to solve this issue.

6.8. Discussion of Results for Research Question 7.

Research question 7: Can developing a strong external support base help the ease of adoption of new AI technologies?

6.8.1. Better relationships create strong collaboration.

Leaders expressed their reliance on external stakeholders such as suppliers better known as partners as a high risk to the business as these unique skills needed to manage and maintain AI-embedded technologies are niche and require time for internal skills to develop to that level. During this development period, the respondents advised that having a strong relationship with their partners could support knowledge transfer from the partner to internal staff.

6.8.2. You pay for what you get.

When budgeting for the implementation CAPEX the finance team always tends to cut costs to save their financial KPIs. What the finance team does not see is the long-term loss from the low-level training that is paid for, or the push to select the supplier with the cheapest cost to implement these technologies. This could cost the organisation long-term expenses in terms of training and development, replacing cheap materials and lack of aftersales support.

6.8.3. Organic relationships lead to better skills transfer which allows employees to accept technologies.

It's always good to have Master Service agreements (MSA) or Service level agreements (SLA) in place, but this should not form the basis of the relationship with the solutions partner.

If the relationship is organic, then support is second nature, and the partner may always be willing to go the extra mile regardless of what the contract says. This could support both the supplier and customer to have sustainable solutions and relationships.

6.8.4. Theme 18: The more informed the employees the easier the adoption.

Leaders expressed that when they include the employees, especially the end user, from the initial stage of development of the solution, it could help with the convincing of the employee to accept the technologies as the solution will be inevitably developed around them. Leaders also acknowledged that the more frequent the communication of the organisation's plans, the easier it could be to roll out the solution as it gives the users time to acknowledge that this is the way forward for the business.

6.8.5. Theme 19: Investment in best-in-class provides quality support.

The respondents did give further insight into their personal experience when trying to save costs whilst implementing these technologies. They had major concerns with hidden costs that emerged after installation that was not included in the original quote which led to the cost seeming cheaper. They advise if it is excessively cheaper than other suppliers then there need to be a deeper scrutiny of the proposal.

6.9. Discussion of Results for Research Question 8.

Research question 8: If the technology is easier to use and less complicated to manage can this promote the acceptance of the technology in an organization?

6.9.1. Easier access to information allows the machine to be maintained more easily.

The leaders expressed that their teams solved issues much quicker when their machines incorporated AI-embedded technologies as these technologies can run self-diagnostics to provide the issues and solutions. Error codes are also pre-populated for maintenance and operations teams to make problem-solving much more effective and prevent the need for external support which can increase uptime.

6.9.2. Increase exposure changes mindset to these technologies.

It's human nature to accept something new more easily as exposure to these technologies' increases. Information also becomes readily available and the drive to learn could increase as it becomes a trend among the organisations in sector.

6.9.3. AI-embedded technology should form part of the strategic direction to promote culture change.

Leaders expressed their concern that there is extensive investment in AI-embedded technologies but during the strategic formulation phase there is no mention of innovation and technology as part of the driving pillars to attain the organisation's vision. If it is not clear to employees that this is part of the organisation's vision on the way forward, why should they make the effort to accept this new way of working?

6.9.4. Theme 20: Easier to understand and use technology promotes acceptance.

It's a common trend that when technology is easy to understand there is more inclination to give attention to using it and accepting it into the work environment. It's not in human nature to accept something that is going to make their lives more complicated.

6.9.5. Theme 21: Increase exposure merged with training promotes acceptance.

With a combination of 6.4.9 theme 9 and 6.3.10. Theme 5 exposure and training could support the process of acceptance of these technologies and remove the fear of not knowing throw knowledge development.

6.9.5. Theme 22: Alignment with strategic culture can promote acceptance.

There is a well-known saying “Culture eats strategy for breakfast”, this could be true based on the experience of the leaders in the interviews. If cultural alignment is not part of the foundation of the strategic purpose, then the vision has already failed in the eyes of the people.

6.10. Discussion of Results for Research Question 9.

Research question 9: Can AI-embedded technology reduce effort and increase productivity in the user's environment?

6.10.1. improvement on KPIs.

This is a recurring category from 6.3.3.

6.10.2. Higher Output vs human dependant processes.

The responding leaders all agreed to the extent that AI-embedded technologies could reach past the capabilities of humans. This can be related to output and attention to detail related to the quality of a product.

6.10.3. Theme 23-Productivity increases with Quality and consistency.

Leaders are not opposed to incorporating these technologies into the processes as they bring improved productivity and superior quality for the customer. These are two major KPIs for leaders which should be kept in control through strict protocols set in the machine through programming by a specialised employee.

6.11. Summary of discussion for research questions 1-9

Using the technology acceptance model, the constructs of the Technology – Organisation-Environment and integrating human socio-materiality across the 9 research questions there were recurring themes and unique themes that occurred to uncover the positives that are currently being perceived by AI embedded technologies and the challenges that are being faced. The recurring themes were related to the Improvement of KPIs, training and development, increase in exposure promote adoption and employee culture. Some unique themes were the disconnect between business and educational institutions, the organisational growth structure, and the improvement of the quality of life for the employees. The themes highlighted in this chapter can form the basis of a strategic plan to ease the acceptance of AI-embedded technologies in the manufacturing sector. These themes will be used to form recommendations for the manufacturing sector and can be benchmarked by other sectors in Chapter 7.

Chapter 7: Conclusions and Recommendations.

7.1. Technology Organisational Environment and the Subject of intention to adopt AI embedded technologies.

Research Questions **1** and **2** when referred to the literature review aimed to understand if organisational competence using the TOE model supports the adoption of technology. This proved that there is competence in the leadership based on their knowledge of AI-embedded technologies which is a positive start. There is also proof that there is a lack of both soft and hard skills to manage these technologies in terms of project management and implementation skills and the maintenance and use of these technologies. Without the support of humans, strong leadership and strong leadership AI AI-embedded technologies will continue to lag in the manufacturing industry. Leadership needs to invest in training and development from the offset to ensure the successful handover of these technologies into operations.

Research questions **3** and **4** aimed to assess organisational readiness using the TOE model to understand if the sector is ready to use these technologies effectively in the environment of manufacturing. The researcher uncovered that organisational readiness is key for the success of these technologies and some of the challenges are lack of investment in training and development, lack of change management principles, no workforce retention plan, lack of exposure to these technologies, culture conflict, no link between the sector and the educational system and no growth in specialised roles. These challenges from an organisational readiness perspective need to be addressed to attain success from these technologies.

Research question **5 aimed** to understand if the organisation is compatible with the technologies that need to be integrated using the TOE model. In the case of an organisation, there is a specific reference to the human capital. These need to be an added benefit to the workforce to promote the adoption of these technologies. This proved highly positive for the employees as there was an improvement in working conditions ergonomically and a much safer environment. This allowed reduced the resistance from the workforce towards AI-embedded technologies.

Research Question **6** aimed to understand can the organisation gain a competitive advantage upon implementation of these technologies. The data suggests that as per the TOE model,

the company performed better because it attracted the best skill through its investment in new technologies, and it also improved KPIs and provided live data for effective decision-making to leadership which in turn gave these organisations the advantage over its competitors.
Research question **7** aimed to understand if the sector had support from external experts on these technologies can this support the adoption through the TOE model. The data suggests that organic relationships, acquiring the best partners and strong collaboration allow for ease of knowledge transfer and best-in-class after-sales support.

7.2. Technology Acceptance Model and the Intent to adopt AI embedded technologies.

Research question **8** aims to prove that ease of use promotes acceptance through the TAM. The data suggests that when the technology was easier to understand through increased exposure and communication this being part of the strategic vision saw an increase in adoption of these technologies. Technology can only get easier with continuous training and development.
Research question **9** also seeks to use the TAM to prove the perceived usefulness of AI-embedded technologies. The data proved that AI-embedded technologies improved all KPIs and reached capabilities far superior to humans. This enabled the organisation to produce at a higher rate and consistently good quality.

7.3. Human Socio-Materiality and the Intent to adopt AI embedded technologies.

The research questions were constructed in a way that the human element was linked within the questions. The perceptions from the leaders portrayed elements of the limit of dissociation between humans and AI-embedded technologies. If you analyse research questions 1 and 2 themes such as the dependency of human programming and the need for change management to ensure the effective transition of these technologies.
Research question 3 also emphasises that humans need to be trained and developed to use these technologies and they need to be continuously exposed to these technologies to ensure they change their mindset towards their attitude towards AI-embedded technologies. It is key to understand that these are views from leadership. This characteristic displayed by leaders to continuously include humans could be attributed to their experience and understanding of

the impact of the unemployment rate in the country. The level of autonomy is strongly determined by the leadership to ensure that the organisation does not deplete the full workforce.

Leadership extends their reach to critiquing the educational system and discussing the point that the educational system is still stuck in the age of producing the traditional skills and has not adapted to the new 4IR skills demands that are more related to automation and coding in the manufacturing environment. The theme still revolves around the subject of humans within the constructs of AI-embedded technology.

The subject of work culture is a clear challenge that leaders display which they believe needs to be more strategic than operational. They believe if they can align the culture of the people with the shift towards AI-embedded solutions then any project related to AI should just be put on hold until the subject of culture is dealt with.

The inclusion of the user into the design and designing a solution that is easy to use and improves the quality of life shows that the co-existence of man and AI is a key contribution to the intention of humans to adopt technologies. Humans tend to naturally reject solutions which are designed to exclude them.

7.4. ACADEMIC AND BUSINESS CONTRIBUTION OF THIS STUDY

With academic rationale, two strong topics emerged from the constructs of the themes. The topic of leadership characteristics, organisational culture and human behaviour are the key academic contributions of this study. Humans need to believe that the leaders within the manufacturing sector have strong trust in AI-embedded technologies and have made this a priority which is part of the strategic direction going forward. When leaders portray positive beliefs towards ideas followers tend to incorporate this into their way of thinking (Peterson, Walumbwa, Byron, & Myrowitz, 2008). Although as much as transformational leadership is a critical factor, humans also need to feel included in the decision-making process of any changes within their working environment. This relates to the importance of inclusive leadership in the work environment. The humans feel included in building an organisation they keep an open mind about what gets implemented and what solutions are brought in from specialists (Bourke & Espedido, 2020). The combination of these two leadership styles, when academics are looking to advise future leaders on how to implement AI-embedded technologies, is a key contributing factor to this research.

The emergence of the need to align organisational culture with the phasing in of AI-embedded technologies is a key obstacle that needs to be overcome if organisations want to see effective returns on their investment. The common belief through the data collection was these AI-embedded technologies are here to replace humans in their jobs, this feeling can be understood as the emerging economies are struggling to keep their workforce employed due to the constant competitiveness of the Asian markets and their ability to deliver at a superior rate and better quality. Changing this mindset through strong leadership is key, ensuring that the communication plan is implemented to emphasise the benefits of AI-embedded technologies through upskilling and closing the wage inequality gap is a key strategy of the culture alignment plan (Kopalle, et al., 2021).

The research also inadvertently reinforced the constructs of the technology acceptance model by proofing that the intent to adopt is much easier to induce if the technology is easier to understand and information and training are readily available.

7.5. RECOMMENDATIONS

Whilst the study aims to understand the challenges that face organisations when it comes to operationalising AI-embedded technologies in the manufacturing sector these views are purely based on the recommendations from leaders within the sector and aim to give direction to leaders who are looking to transform their organisation into a technology hub.

Leaders are the backbone of organisational success, and their knowledge defines the level of technology that gets incorporated into the organisational processes, it was observed although automation, robotics and programmable software are part of the scope of AI-embedded technologies it’s just the surface level of the capabilities of these technologies. Leaders require ongoing training to stay updated with the advancements in AI-embedded technologies, enabling them to guide their teams effectively in adopting these new innovations. The next step will be to address any type of training and development through the strategic objectives of the organisations. There must be a pillar within the strategy that has a clear long-term plan for the development of human capital in the organisation to first keep the workforce empowered and in the know to remove the fear of being replaced.

Strategic communication plans are key for keeping organisations within the sector informed on the AI vision for the business and ensuring that they know that they are part of the transformation. This in parallel with a change management plan will allow a smooth transition into the new era of AI-embedded technology.

The development and design of AI-embedded technologies around a solution for manufacturing to produce high outputs and superior quality is the simple part of a design because this is primarily controlled by the designer. If these designs are not designed around the user such as operations workforce and maintenance personnel, the intent to reject will be the initial response to these technologies.

Therefore, it is key to have strong leadership, who are able to align the organisation culture with the vision of the organisation and ensure their human capital is ready for the new technologies.

7.6. LIMITATIONS

The initial limitation of the research was the restriction of the population group to the researchers' network. This introduced bias to specific industries within the manufacturing industries such as the retail and automotive industry. Based on the maturity of the various industries within the sector the views of the respondents could defer.

The next inherent limitation of the research was the low number of leaders who were willing to participate or qualifying to participate in the study. This could be due to not feeling comfortable not meeting the criteria to form part of the population. This could limit the type of responses collected and have a bias to the feeling towards AI-embedded technology within the sector.

The limitation of the male-to-female demographic was also a determining factor in the data collection, with their only being 3 females' part of the interview population which could sway the responses being more a male-dominated response. The lack of variation in response may provide uniform thematic data (Morse, Barrett, & Mayan, 2002).

The knowledge that the respondents possessed would limit the quality of the data that they are providing to the research. This research depends on the extent of knowledge they possess to understand the impact of these technologies on the manufacturing sector and how this affects the sector strategically.

Finally, the lack of experience of the researcher in conducting qualitative data from interview respondents could have affected the data negatively. The coding processes were also done by this research which could have introduced analytic bias to the coding processes which could have led to biased thematic outputs, which inherently would affect the recommendations of the research.

7.7. SUGGESTIONS FOR FUTURE RESEARCH

Future researchers could improve the quality of this research by expanding the interviews to the users of these technologies to get another perspective of AI-embedded technologies directly from the users. This may give a more user-based perspective and could improve the actions needed to ease the implementation of AI-embedded technologies.
Diversifying the population demographic can get a more realistic perception of AI-embedded technologies as gender and Age bias could severely sway the data and provide accurate data. This could lead to incorrect actions being implemented to ease the implementation of AI-embedded technologies and cause more issues than solutions.
Due to the high initial investments required to implement these technologies, research can be done on the effect of the skill level in relation to the remuneration within organisations and how this affects the quality of living of the workforce.
This research can be taken further to focus on the direct impact of different leadership styles on the effectiveness of the implementation of technology in a sector within South Africa.

7.8. CONCLUSION

In conclusion, this study provides a comprehensive view of the challenges and enablers for AI-embedded technology adoption within South Africa’s manufacturing sector. Each theme aligns with the study’s purpose, offering a strategic foundation for companies to develop AI-ready workforces. By addressing identified skill gaps and fostering organizational readiness, this research contributes valuable insights for both academia and industry, reinforcing the necessity of cohesive, culture-sensitive strategies for AI implementation. The TOE and TAM proved to enable the researcher to collect high-quality data to form themes to support the strategic actions required to induce the intent to adopt AI-embedded technologies.

AI-embedded technologies are still in a stage of dependency on humans to be successful in the manufacturing sector. The ability of leaders to manage the transition through strong change management principles and human capital upskilling can determine the success factor of the implementation.

AI-embedded technologies are trusted by leaders to bring in positive improvements in the business KPIs, Efficiency and profitability only if implemented well. If there are weaknesses in the project management principles, there could be a delayed realisation in ROI or to the extent of further losses upon implementation because the workforce that was expected to use these technologies was not included and is now rejecting the use of the solutions.

The Strategy formulation phase needs to be robust and inclusive of all business units and include subjects such as People development, Future Innovation and a possible culture disconnect to ensure that during the process of technology transformation people and technology are one entity.

Reference List

Kopalle, P. K., Manish , G., Kaplan, A., Ramachandran, D., Reinartz, W., & Rindfleisch, A. (2021). Examining artificial intelligence (AI) technologies in marketing via a global lens: Current trends and future research opportunities. *International Journal of Research in Marketing*, 1-19.

Ajwani-Ramchandani, R., Figueira, S., Jha, S., & . (2021). Towards a circular economy for packaging waste by using new technologies: The case of large multinationals in emerging economies. *Journal of Cleaner Production*, 1-30.

Andreoni, A., & Tregenna, F. (2020). Escaping the middle-income technology trap: A comparative analysis of industrial policies in China, Brazil and South Africa. *Structural Change and Economic Dynamics*, 1-17.

Bhatti, O. K., Irfan, M., Öztürk, A. O., & Maham, R. (2020). Organizational inclusion through interaction ofwork meaningfulness and servant leadership: Anartificial neural network approach. *Cogent Business & Management*, 1-27.

Bourke, J., & Espedido, A. (2020). The Key to Inclusive Leadership. 1-5.

Changlin, W., Teo, T. S., & Jansen, M. (2021). Public and private value creation using artificial intelligence: An empirical study of AI voice robot users in Chinese public sector. *International Journal of Information Management*, 1-15.

Chatterjee, S., Rana, N. P., Dwivedi , Y. K., & Baabdullah , A. M. (2021). Understanding AI adoption in manufacturing and production firms using an. *Technological Forecasting & Social Change*, 14.

Choi, T.-M., Kumar, S., Yue, X., & Chan, H.-L. (2022). Disruptive Technologies and Operations Management. *Production and Operations Management*, 10-30.

Desk, L. (2023, February 14). *SA government must prioritise AI in education*. Retrieved from Lifestyle & Tech: https://lifestyleandtech.co.za/ai-cloud/article/2024-02-13/sa-government-must-prioritise-ai-in-education

Economy, G. (2024, March 1). *Labour Cost by Country*. Retrieved from The Global Economy.com: https://www.theglobaleconomy.com/rankings/labor_cost/

Enholm, I. M., Papagiannidis, E., Patrick , M., & John , K. (2022). Artificial Intelligence and Business Value: a Literature Review. *Information Systems Frontiers*, 1709–1734.

Exchange, T. (2024, 5 9). *South Africa controlling Artificial Intelligence investments*. Retrieved from The Exchange Africas Investment Gateway: https://theexchange.africa/tech-business/south-africa-artificial-intelligence-investments/

Farahnak, L. R., Ehrhart, M. G., & Aarons, G. A. (2019). The Influence of Transformational Leadership and Leader Attitudes on Subordinate Attitudes and Implementation Success. *Journal of Leadership & Organizational Studies*, 1-36.

Forbes. (2023, March 30). *Which Jobs Will AI Replace? These 4 Industries Will Be Heavily Impacted*. Retrieved from Forbes: https://www.forbes.com/sites/ariannajohnson/2023/03/30/which-jobs-will-ai-replace-these-4-industries-will-be-heavily-impacted/?sh=458dff355957

Gillani, F. (2020). Implementation of digital manufacturing technologies: Antecedents and consequences. *International Journal of Production Economics*, 21.

Glaser, B. G., & Strauss, A. L. (2017). *THE DISCOVERY OF OF GROUNDED THEORY strategies for qualitative research.* Abingdon: Routledge.

Hennink, M., & Kaiser, B. N. (2021). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, 1-10.

HOEGL, M., & MUETHEL, M. (2023). *SHARED LEADERSHIP IN DISPERSED INNOVATION TEAMS: MUTUAL.* Germany.

Inc., E. B. (2024, January 1). *Britannica History and Society*. Retrieved from Britannica : https://www.britannica.com/question/Where-and-when-did-the-Industrial-Revolution-take-place

Javed, B., Khan, A. K., & Quratulain, S. (2021). *Inclusive Leadership and Innovative Work Behavior: Examination of LMX Perspective in Small Capitalized Textile Firms.* Routledge.

Juma, C. (2016). *Innovation and its enermires: why people resisit new technologies.* New York: Oxford University Press.

Kecmanovic, D. C., Galliers, R. D., Henfridsson, O., Newell, S., & Vidgen, R. (2020). THE SOCIOMATERIALITY OF INFORMATION SYSTEMS: CURRENT STATUS, FUTURE DIRECTIONS. *SOCIOMATERIALITY OF IS & ORGANIZING*, 18.

Li, L. (2022). Reskilling and Upskilling the Future-ready Workforce for Industry 4.0 and Beyond. *Information Systems Frontiers*, 1-16.

Liébana-Cabanillas, F., Singh, N., & . (2020). Assessment of mobile technology use in the emerging market: Analyzing intention to use m-payment services in India. *Telecommunication Policy*, 1-34.

Mangan, J., Lalwani, C., & Gardner, B. (2004). Combining quantitative and qualitative methodologies in logistics research. *International Journal of Physical Distribution & logistics Management*, 565-578.

Martine, T., Cooren, F., & Benel, A. (2020). What Does Really Matter in Technology Adoption and Use? A CCO Approach. *Management Communication Quarterly*, 10.

Mathenjwa, N. (2023, May 1). *Policy Brief*. Retrieved from Adoption of Artificial Intelligence: https://www.uj.ac.za/wp-content/uploads/2021/10/sarchi-id-pb-2023-05-mathenjwa-n--may-2023.pdf

McKinsey. (2019, April 26). *Confronting the risks of artificial intelligence.* Retrieved from McKinsey Quarterly: https://www.mckinsey.com/capabilities/quantumblack/our-insights/confronting-the-risks-of-artificial-intelligence

Mckinsey. (2019, September 4). *Mckinsey & Company.* Retrieved from The future of work in South Africa: Digitisation, productivity and job creation: https://www.mckinsey.com/featured-insights/middle-east-and-africa/the-future-of-work-in-south-africa-digitisation-productivity-and-job-creation

Morse, J. M., Barrett, M., & Mayan, M. (2002). Verification Strategies for Establishing Reliability and Validity in Qualitative Research. *International Journal of Qualitative Methods*, 13-22.

Myres, K. (2024). *Reasearch Skills Session 3.* Johannesburg: Gordon Instituate of Business Science.

Naidoo, N. (2024). *Research Proposal 7 pager.* Johannessburg: Gordon Institute of business Science.

News, E. (2024, April 2024). *key challenges hindering manufacturing growth in Africa in 2024*. Retrieved from Engineering News: https://www.engineeringnews.co.za/print-version/key-challenges-hindering-manufacturing-growth-in-africa-in-2024-2024-04-11

Ntshavheni, K. (2021, November 04). *Minister Khumbudzo Ntshavheni: Artificial intelligence regulation while encouraging innovation.* Retrieved from South African Government: https://www.gov.za/news/speeches/minister-khumbudzo-ntshavheni-artificial-intelligence-regulation-while-encouraging

Parschau, C., & Hauge, J. (2020). Is Automation stealing manufacturing jobs? Evidence from South Africa's apparel industry. *Geoforum*, 120-131.

Peterson, S. J., Walumbwa, F. O., Byron, K., & Myrowitz, J. (2008). CEO Positive Psychological Traits, Transformational Leadership, and Firm Performance in High-Technology Start-up and Established Firms. *Journal of Management*, 1-21.

Pillai, R., Sivathanu, B., & Mariani, M. (2022). Adoption of AI-empowered industrial robots in auto component manufacturing companies. *Production Planning & Control, 2022*, 18.

SA, S. (2024, May 14). *SA unemployment rate increases*. Retrieved from SA News: https://www.sanews.gov.za/south-africa/sa-unemployment-rate-increases

Saunders, M. N., & Townsend, K. (2016). Reporting and justifying the number of interviews participants in organisation and workplace research. *British Journal of Managment*, 836-52.

Saunders, M., & Lewis, P. (2018). *Doing Research in business and management.* Harlow: Pearson Education limited.

Sharma, M., Kamble, S., & Belhadi, A. (2021). Industry 4.0 adoption for sustainability in multi-tier manufacturing supply chain in emerging economies. *Journal of Cleaner Production*, 1-25.

Skarbek, D. (2019). Qualitative research methods for institutional analysis. *Journal of Institutional Economics*, 409-422.

Spiers, J., Morse, J. M., Olson, K., Mayan, M., & Barrett, M. (2018). Verification Strategiesfor Establishing relaibility and validity in qualitaitive research. *International Journal of Qualitative Methods*, 1-2.

Stenfors, T., Kajamaa, A., & Bennett, D. (2020). How to … assess the quality of qualitative research. *THE CLINICAL TEACHER*, 596–599.

Sutherland, E. (2019). The Fourth Industrial Revolution–The Case of South Africa. *South African Association of Political Studies*, 1-20.

Talwar, S., Talwar, M., & Dhir, A. (2020). Consumers' Resistance to Digital Innovations: A Systematic Review and Framework Development. *Australasian Marketing Journal*, 1-31.

Tortorella, G. L., Vergara, A. M., & Narayanamurthy, G. (2020). Effects of contingencies on healthcare 4.0 technologies adoption and barriers in emerging economies. *Technological Forecasting and Social Change*, 1-32.

Villiers, M. d. (2024, 05 02). *IT Web*. Retrieved from AI to the rescue of SA's floundering manufacturing sector: https://www.itweb.co.za/article/ai-to-the-rescue-of-sas-floundering-manufacturing-sector/DZQ58MV8G2xvzXy2

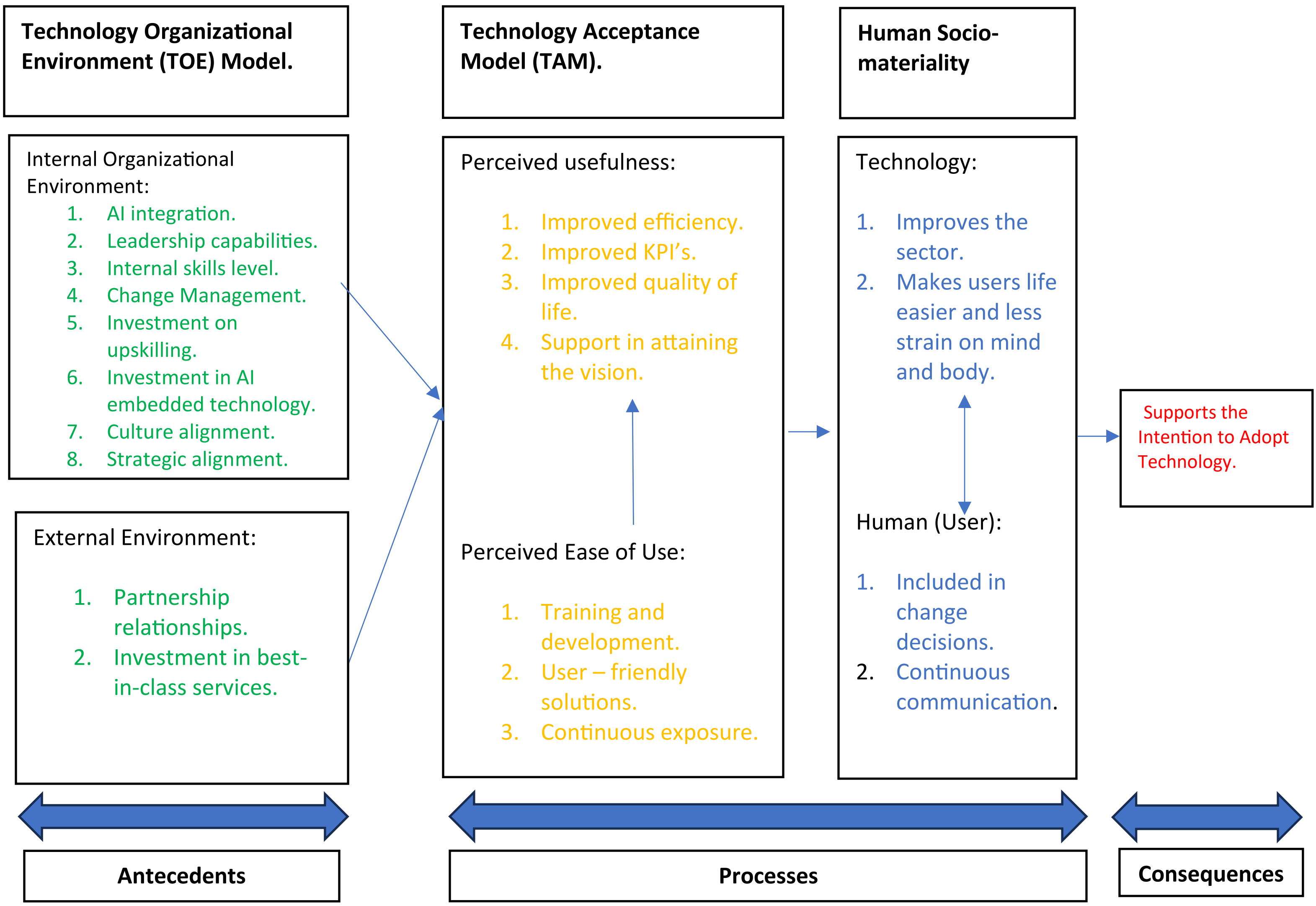
Vimalkumar, M., Singh, J. B., & Kumar, S. (2020). Exploring the Multi-Level Digital Divide in Mobile Phone Adoption: A Comparison of Developing Nations. *Information Systems Frontiers*, 1057–1076.

Wang, D., Tussyadiah, I., & Zhang, E. (2024). Shaping In-Destination Group Decision-Making: The Sociomateriality of Smartphones. *Journal of Travel Research*, 17.

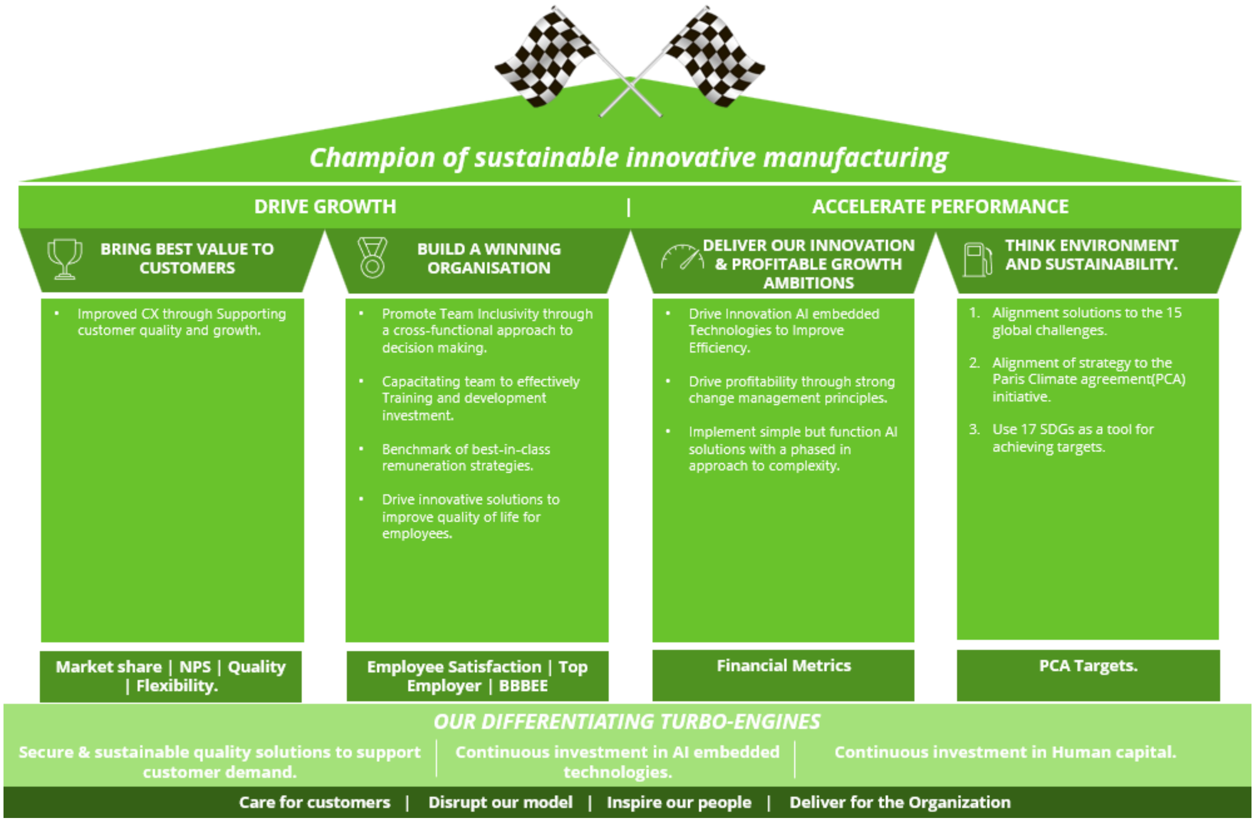
Yang, C.-H. (2021). How Artificial Intelligence Technology Affects Productivity and Employment: Firm-level Evidence from Taiwan . *Research Policy*, 1-12.

Appendices

Appendix 1: Alignment of thematic analysis to Literature.

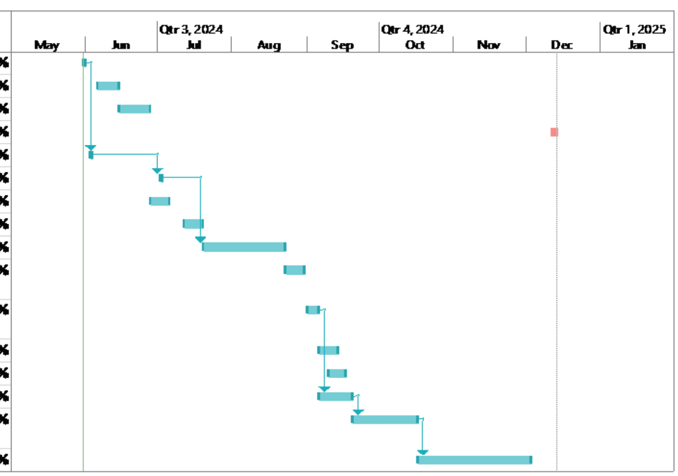


Appendix 2: Alignment to Strategy.



Appendix 3: Project Plan

ID	Task Mod	Task Name	Duration	Start	Finish	% Work Complete
1		**Research Proposal Submissior**	1 day	Fri 5/31/24	Fri 5/31/24	0%
2		**Leadership Individual Assignm**	7 days	Thu 6/6/24	Fri 6/14/24	0%
3		**Leadership Individual Assignm**	10 days	Sat 6/15/24	Thu 6/27/24	0%
4		**Leadership Syndicate Assignm**	3 days	Wed 12/11/24	Fri 12/13/24	0%
5		**Ethical Clearence Opens**	1 day	Mon 6/3/24	Mon 6/3/24	0%
6		**Ethical Clearence Closes**	1 day	Tue 7/2/24	Tue 7/2/24	0%
7		Mastering Strategic Foresight	6 days	Fri 6/28/24	Fri 7/5/24	0%
8		Sustainable Finance for Manufactu	6 days	Fri 7/12/24	Fri 7/19/24	0%
9		**Data Collection**	25 days	Sat 7/20/24	Thu 8/22/24	0%
10		Effective Execution & Project Management	6 days	Fri 8/23/24	Fri 8/30/24	0%
11		**Update report and supervisor review**	5 days	Sun 9/1/24	Thu 9/5/24	0%
12		Operationalising Strategy	6 days	Fri 9/6/24	Fri 9/13/24	0%
13		Business Technology Enablement	5 days	Tue 9/10/24	Mon 9/16/2	0%
14		**Update report**	10 days	Fri 9/6/24	Thu 9/19/24	0%
15		**Final Research Compilation and paralell supervisor**	19 days	Fri 9/20/24	Wed 10/16/24	0%
16		**Final Submission**	33 days	Thu 10/17/24	Mon 12/2/2	0%



Appendix 4: Consistency Matrix

Research Questions.	The section in Literature review.	Data Collection Tools.	Analysis Technique.
RQ1	TOE (Organizational Competencies).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ2	TOE (Organizational Competencies).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ3	TOE (Organizational Readiness).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ4	TOE (Organizational Readiness).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ5	Human Socio-Materiality.	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ6	TOE (Competitive Advantage).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ7	TOE (External Group Support).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ8	TAM (Ease of use).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.
RQ9	TAM (Perceived Usefulness).	Semi-structured Questionnaire, Team recordings, team transcription and Atlas Ti.	Triangulation through Thematic analysis using Atlas ti.

Appendix 5: Thematic analysis.

Research Question 1	What is your understanding of AI embedded Technologies?			
Interview Question	**Code**	**Category**	**Theme**	**Number of Respondents**
1. What is your understanding of Artificial intelligence (AI) embedded technologies?	Data Driven Decision Making. Data Driven Technology. Computerized Decision making. Process Automation. Programmable Software. Robot technology. AI Works With Humans. Linked to Human Intervention. Performs basic functions. Limited Human intervention.	-Process Automation. -Robot Technology. -Data Driven Decision Making. -Programmable Software.	1. Automation of Processes through Programmable software to provide live data. 2. Improvement of Efficiency. 3. Supported by Humans.	12
2. Have you experienced or encountered AI embedded technologies in your industry?	Data Driven Decision Making. Computerized Decision making. Process Automation. Programmable Software. Robot technology. Efficiency improvement. Limited Human intervention.	-Process Automation. -Robot Technology. -Data Driven Decision Making. -Programmable Software.		12

Research Question 2	Is the business environment capacitated to incorporate AI-embedded technologies in its strategy?			
Interview Question	**Code**	**Category**	**Theme**	**Number of Respondents**
3. What is your perception of AI embedded technologies in your industry?	Positive Feeling when Implemented well. Efficiency Improvement. Provides Consistent Quality. Cyber Security Concerns. New Skills Demand. Environmental Sustainability Targets. AI is Critical For Electrification. Poor Change Management. New Technology is too Complex. Improves Safety concerns. Lack of specialised skill. Revolutionary technology. Lower overheads. Lack of exposure to these tech. Lack of Computer skills. Higher Output. High Productivity Improvement. Limited Human Intervention. Lack of Maintenance skill. High Initial Investment. Lack of Investment in training. Migration of skill. Indecisive feeling. Implemented for compliance not functionality. Fear of not understanding. Promotes Customer satisfaction. Easier to manage than humans.	-Leadership is Indecisive. - positives if implemented well. -Positive effect on SQDCE. -Lack of Key Skills. -Lack of Training and development investment. -Business ROI will be effected by high initial investment. -High possibility of resistance due to fear of not understanding and poor change management.	1. Strong leadership drives positive change. 2. AI will improve KPI's. 3. Investment is required in training and development to prepare for change. 4. Change Management is key to capacitating the business environment.	12

Research Question 3	Does the current workforce have the skills and knowledge to embrace modern technologies?			
Interview Question	Code	Category	Theme	Number of Respondents
3. What is your perception of AI embedded technologies in your industry?	New Skills Demand. Poor Change Management. Workforce Resistant to change. New Technology is too Complex. There must be a link to Humans in SA. Job loss. Lack of specialised skill. High Unemployment rate in SA. Lack of exposure to these tech. Lack of Computer skills. Lack of Maintenance skill. High Initial Investment. Lack of Investment in training. Migration of skill. Fear of not understanding.	'-Lack of Key Skills. -Lack of Training and development investment. -High possibility of resistance due to fear of not understanding and poor change management.	1. The Company must invest in upskilling their human capital. 2. There must be a clear communication plan and change management process. 3. There must be a plan to retain workforce through development. 4. Continuous exposure to new technology can change resistant culture.	12
4. Do you feel that the work force in your work environment is ready to accept AI embedded technologies?	Link humans to Tech. AI Policy Alignment. Policy Deployment. Strategic Alignment. Communication plan. Technology Integration. Invest in training and development. Must implement to support the business. Lack of Exposure to these tech. Aging workforce. Indecisive feeling. workforce still learning. Technology is too complex. Workforce not ready. Job Loss. New Skills demand. Need Education on AI tech. Lack of maintenance skill. Fear of not understanding. Change management. High Unemployment.	-Lack of Key Skills to manage these technologies. -Lack of Exposure to these technologies. -Fear of Losing their Jobs. -Lack of Change management processes. -Lack of investment in training and development.		12

<table>
<tr><td>Research Question 4</td><td colspan="4">Does the Industry have the pre-requisite resources in place to ensure the businesses are ready for ease of adoption of modern technologies to leverage the usefulness of the modern technologies?</td></tr>
<tr><th>Interview Question</th><th>Code</th><th>Category</th><th>Theme</th><th>Number of Respondents</th></tr>
<tr><td>6. Do you feel that your industry has the pre-existing resources to ensure that these technologies are implemented and sustained through its installation and life?</td><td>Strong Engineering Skills.
Lack Maintenance Skill.
Lack of Ai Specialised skill.
Lack of IT Skills.
Lack of Exposure.
Lack of employee drive.
Poor Implementation plan.
No Growth in a specialist field.
Movement from Specialist to Generalist.
Movement for Salary Growth.
Educational system failure.
Government failure to Create Jobs.
Lack of Collaboration between business and Institutions.
Fear of not understanding.
New Skills Demand.
Lack of Change Management.</td><td>-Lack of skills related to AI embedded technology.
-Lack of Project planning.
-No opportunities for Skilled workforce.
-Educational System not aligned with business needs.
-Resistance due to lack of understanding.
-Poor change management Processes.
-Creation of new Skills demand.</td><td rowspan="2">1. Invest in Training of workforce on New AI embedded technology.

2. Create a feedback loop between business and the Educational system for continuous development.

3. Create a growth structure in organisations for employees to develop into.

4. Culture change needs to be part of the sectors Strategic goals.</td><td>12</td></tr>
<tr><td>7. What can the manufacturing industry do better to ensure that the skills in the country remain on the level required to maintain these technologies?</td><td>Invest in training and Development.
Create a organisational growth Structure for Specialists.
Payment Equality for Specialists.
Better Remunerations structure in SA.
Strategic Alignment.
Improve Exposure to these tech.
Leadership Training.
Stronger Recruitment processes.
Link Humans to tech.
Human Capital Guidance.
Business and Educational System alignment.
Government needs to create jobs.
Government needs to invest in Human capital.
Improve exposure to these tech.
Culture Change.</td><td>-Lack of investment in training and development.
-Payment In-equality for skilled staff.
-Poor Leadership skills.
-Government failure in -Creating jobs and developing people.
-Culture mis-alignment with new technology.</td><td>12</td></tr>
</table>

<table>
<tr><td>Research Question 5</td><td colspan="4">Can AI embedded technologies improve the quality of life for the workforce?</td></tr>
<tr><th>Interview Question</th><th>Code</th><th>Category</th><th>Theme</th><th>Number of Respondents</th></tr>
<tr><td>5. Do you feel that AI embedded technologies can help improve the working conditions of the work force?</td><td>Safety Improvement.
Ergonomic Improvement.
Efficiency improvement less effort.
Positive improvement in working conditions.
Data Driven decision making.
Consistent quality with less effort.
Reduced operator error.
Higher output less effort.
High productivity.
Better customer satisfaction.</td><td>-Positive improvement of working conditions.
Delivers higher out put with better quality and less effort.
Improved customer satisfaction.</td><td>1. Improved Quality of life for the workforce leading to higher productivity.</td><td>12</td></tr>
</table>

Research Question 6	**Can AI-embedded technologies be leveraged to allow the organization to gain a competitive advantage?**			
Interview Question	Code	Category	Theme	Number of Respondents
8. How can we use AI embedded technologies to ensure that businesses remain competitive?	Skills are attracted to a safe Environment. Consistent Quality for customer. Efficiency improvement. Higher Productivity. Better -lead-times for customer. Data Driven decision making. Data to determine market trends. Sustains Competitiveness. Higher output. Lower overhead costs. Better customer satisfaction. adopt or die. Late adaptors. Can Achieve competitiveness if implemented well.	-Attraction of best in class skill. -Improvement in SQDCE KPI's. -Data Driven Decisions. -Improved customer satisfaction.	1. Companies that perform well attract the best Skills. 2. Improvement of KPI's and Customer satisfaction due to live data access and decision making.	12

Research Question 7	**Can developing a strong external support base help the ease of adoption of new AI technologies?**			
Interview Question	Code	Category	Theme	Number of Respondents
9. Do you feel that if businesses have better relationships with the suppliers of these technologies the skills transfer can be more effective?	Better relationships aid Supplier support. Better relationships aid skills transfer. Ease of knowledge transfer. Choose best not cheapest supplier. Lessons learnt from suppliers. Must be an organic relationship. Mutually beneficial Partnership. Communication plan. Suppliers fear sharing IP as they may lose customers.	Better relationships creates strong collaboration. You pay for what you get. Organic relationships lead to better skills transfer which allows employees to accept technologies.	1. The more informed the employees the easier the adoption. 2. Investment in best in class provides quality support.	12

Research Question 8	**If the technology is easier to use and less complicated to manage can this promote the acceptance of the technology in an organization?**			
Interview Question	Code	Category	Theme	Number of Respondents
10. If these technologies were designed to be less complicated, do you believe this could support the adoption of the solution?	Less Complexity promotes adoption. Easier fault finding. Easier to access information. Must improve exposure . Should have a phased in approach. User-friendliness promotes adoption. Training can help make the technology easier. Fear of not understanding and job loss is key. Lose creativity. Technology cannot always be easy. AI should align with Culture.	Easier access to information allows the machine to be maintained easier. Increase exposure changes mindset to these technologies. AI embedded technology should form part of the strategic direction to promote culture change.	1. Easier to understand and use technology promotes acceptance. 2. Increase exposure merged with training promotes acceptance. 3. Alignment with strategic culture can promote acceptance.	12

Research Question 9	**Can AI-embedded technology reduce effort and increase productivity in the user's environment?**			
Interview Question	Code	Category	Theme	Number of Respondents
11. Has the introduction of AI embedded technologies improved the productivity of the operations?	High Productivity improvement. Strong technology integration. Improvement in Efficiency and improved quality. Improves productivity to allow tap into global market demands. Access to data . No improvement if not implemented well. Technology too complex to see improvement. Poor Change Management. Lack of Stakeholder engagement.	-Positive improvement on KPI's. -Higher Output vs human dependant processes.	1. Productivity increases with Quality and consistency.	12

Appendix 6: Informed consent

Informed Consent:

I am currently a student at the University of Pretoria's Gordon Institute of Business Science and completing my research in partial fulfilment of an MBA.

I am conducting research on the impact of socio-materiality and AI technology adoption within the manufacturing Industry. Our interview is expected to last about an hour and will help us understand how AI embedded technologies are influencing the environment of the manufacturing industry. **Your participation is voluntary, and you can withdraw at any time without penalty**. All data will be reported without identifiers. You will have anonymity, confidentiality and only aggregated data will be reported. By completing the interview, you indicate that you voluntarily participate in this research.

If you have any concerns, please contact my supervisor or me. Our details are provided below:

Researcher name: _Nishen Naidoo_________________________________

Research Supervisor Name: _Rishal Balkissoon_______________________

Researcher Email: _23036461@mygibs.co.za_________________________________

Research Supervisor Email: _rishalbalkissoon@gmail.com_________________________

Signature of participant: ______________________________

Date: ________________

Signature of researcher: _________________________________

Date: ________________

Appendix 7: Interview Guide

Project Brief:

Artificial intelligence embedded technologies are technology which includes any form of automation and robotics that is either programmable to perform repetitive tasks efficiently and with consistently good quality and could also have a level of machine learning capability. Some examples could be Robot welders on a production line, automated conveyors on an assembly line of sorting robots on a repair line.

The research seeks to investigate the manufacturing industry and explore the views of employees exposed to the changes in AI-embedded technology. It is important to better understand the requirements to create the strategy implementation plan for AI-embedded technology, to better operationalize these solutions and to develop strategies to gain buy-in from the stakeholders involved in deploying, implementing, and receiving these technologies.

A key factor that will link the constructs is to determine if there is resistance toward AI-embedded technology in the manufacturing sector. For a country like South Africa, it is important to understand the multicultural thinking of the Fourth Industrial Revolution(4IR) to help set the foundation for creating a model for operationalizing AI-embedded technologies in the environment of business.

From a business perspective, many beneficial aspects can be used in this type of study to support businesses in crafting a strategy towards AI-embedded technologies. Some of the key factors such as human understanding will be a key factor as to the perception of AI technology in the workspace.

Questionnaire:

1. What is your understanding of Artificial intelligence (AI) embedded technologies?
2. Have you experienced or encountered AI embedded technologies in your industry?
3. What is your perception of AI embedded technologies in your industry?
4. Do you feel that the work force in your work environment is ready to accept AI embedded technologies?
5. Do you feel that AI embedded technologies can help improve the working conditions of the work force?
6. Do you feel that your industry has the pre-existing resources to ensure that these technologies are implemented and sustained through its installation and life?
7. What can the manufacturing industry do better to ensure that the skills in the country remain on the level required to maintain these technologies?
8. How can we use AI embedded technologies to ensure that businesses remain competitive?
9. Do you feel that if businesses have better relationships with the suppliers of these technologies the skills transfer can be more effective?
10. If these technologies were designed to be less complicated, do you believe this could support the adoption of the solution?
11. Has the introduction of AI embedded technologies improved the productivity of the operations?
12. Do you have any final comments or recommendations for this research?