NELSON MANDELA UNIVERSITY

Business School

Future scenarios in the automotive industry as a result of the social impact of industry 4.0 in the period up to 2033

BY

Siyabonga Nongendzi 20530225

Submitted in partial fulfilment of the requirements for the Degree

MASTER OF BUSINESS ADMINISTRATION

In the
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Nelson Mandela Metropolitan University

Supervisor

Prof. Chris Adendorff

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DECLARATION

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NAME: Siyabonga Nongendzi

STUDENT NUMBER: s20530225

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- To my Mom and Dad, thank you for the solid upbringing and grounding that you have given me, as well as showing and teaching me to never give up and always chase my dreams.

- To the rest of my family and extended family, thank you for the encouragement and words of motivation.

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ABSTRACT

With increasing human population growth, rising GDP levels, and more affluent lifestyles, the human race is progressively consuming, leading to an ever-increasing demand for renewable and non- renewable resources. The problem of resource scarcity is, therefore, emerging because it is questionable whether economic growth in a world with finite natural resources can be sustained. One of the objectives of this work is to analyse the potential of industrial 4.0 applications to achieve a more sustainable South African automotive industry. Even if the economy is still locked up in a system that favours the linear traditional production model, stricter environmental standards, a scarcity of resources and changing consumer expectations will force entities to find alternatives.

New technologies can be used to trace materials through the value chain and to track the status of the product during its life cycle. Companies are beginning to capitalize on the potential of emerging technologies to more sustainably reorganise production, services, business models or entire organizations. What is certain is that many expect that the fourth industrial revolution will have a substantial effect on jobs worldwide as advanced robotics, artificial intelligence and automation are becoming more influential. Digitisation has a full impact on both the automotive industry and society. Automation we've seen in the past has intensified.

Digitisation has an ongoing and unprecedented effect on the operation of firms. It impacts all aspects from development to manufacturing and logistics and challenges business models and changes the place of work and the way we work. For this reason, a well- developed infrastructure and skilled workforce are key factors in transforming the industry successfully. From a South African point of view, qualification is a key challenge for industry 4.0 and requires decisive action. The challenge of skills in the manufacturing sector is growing as the industry becomes more digital. The plans of manufacturers to drive productivity improvements and capitalise on the fourth industrial revolution could be eroded because the education system is struggling to provide the right quantity and quality of skills to meet the needs of the sector.

Manufacturers will need to keep investing in training current employees to keep up with new processes in line with company needs. One major challenge is to increase the digital skills of current and, in particular, older workers, by creating an offer of digital

training. The research study aimed to develop insights into the future of the South African automotive industry by constructing two scenarios towards 2033: *Worst case*; South African automotive industry did little to change current linear traditional production mode trends in 2033; This narrative has seen the sector fall into the nightmare of its own dystonia.

Best case; South African automotive is a success in 2033; The South African automotive industry finds its competitive global niche. And even with breakthroughs in robotics and artificial intelligence, there is a major disruption in employment throughout the world, South Africa has succeeded in creating a small but intelligent base for youth who can recognise and exploit opportunities on the global market. Industry 4.0 has a high potential to ensure more sustainable production methods.

Keywords: Automotive industry, futures studies, scenarios, fourth industrial revolution, education, sustainable development, singularity, artificial intelligence, robotics, disruption.

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ABSTRACT

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CHAPTER 1: ORIENTATION AND SCOPING

1. INTRODUCTION

Living in a developing country with a high rate of unemployment, poverty and an education system which is questionable was one of the triggers of the study. There are less and less people in the shop floor due to automation. The fourth industrial revolution will require different skill sets which the countries institutions are unable to provide at an affordable rate. One of our key performance areas in my department at company X SA is to become the first to lead innovation within the plant. The fourth industrial revolution, which the Germans have subsequently called Industry 4.0 is a buzz word in the plant.

There has been no one global definition for the term. What can be put to a clear definition are the drivers of the revolution which include Big Data, Artificial intelligence, Digitisation, 3D printing and Internet of Things). The plant is equipped with most of these drivers, the missing one is artificial intelligence and data analytics tool. Innovations such as smart phones for all employees has enabled workers to use their digital devices as gate passes, receive pay-slips, and shortened communication time. The most recent innovation from the Information Technology (IT) department is the acquisition of a Human-Robot. The factory is fast becoming dehumanised and the workers do not realise this. One of the key issues lies with the readiness of the labour force in the private and public sector with regard to the Industrial revolution that is upon us. Additional to the problem is the countries Information and broadband infrastructures which lacks High transmission speeds.

1.1. PROBLEM STATEMENT

The dynamic changes which face the automotive industry on a local and global scale makes strategic thinking and foresight acutely important to create optimum socio-economic impact and to ensure sustained development. The industry has many facets to be considered, it requires a systematic and an all-inclusive insight into the dynamics that have an effect on growth and profitability. A well-informed structured method to the future is essential. The external environment changes rapidly in an unpredictably manner, this is a resultant of the technology revolution(Gordon, 2018).

Uncertainty and complexity is inescapable, these are the fundamental challenges which organisations face on an ongoing basis(Du Plessis, 2016). According to

Inayatullah (2008), human beings often make the mistake of believing that there is only one future and cannot see alternatives which leads to repeatability of the same mistake. We live in a volatile world. Leaders of firms need to apply strategic foresight to mitigate threats and recognise new opportunities.

The South African automotive industry is influenced by global economies. Developed economies in the global automotive environment have big influences on developing nations, they import technologies to the host nations but only in concentrated areas of interest in other for them to maximise their profits, this investment in developing countries by multinationals is driven by international markets and macro-economic factors, this has a direct impact on both the demand for resources and profitability.

It is critical that the South African automotive industry positions itself in this continually altering, dynamic, and complex global environment through enhanced insight into what is happening and recover its confidence in the future.

Diffusion of new technology advances partially depends on social, legal and ethical issues especially in developing economies with high levels of unemployment and poverty. The prospects of high levels of automation within the next two decades could easily be premature (Schröder, 2017). Concerns that automation could lead to job losses in a country have no academic research backing them and are baseless. The fourth industrial revolution can unfold its potential just by means of the applied knowledge, insight and flexibility of the labour force. The industrial revolution started in England on the second half of the 18th century, the first phase dated from about 1760 to 1830. The first stage was triggered by major developments in the textile industry (Ladenburg, 2007). The term revolution generally means change in a drastic manner. An industrial revolution in socio economic terms would be the movement of farmers to go live in urban areas.

Between the 18th and 20th century the United States (US) experienced a drastic change that saw a mind shift in its citizens. Their thoughts, life styles and dress code related to one another. The citizens shifted from being a nation of farmers to an industrialised society, thus they started doing things in a more systemic way (Ladenburg, 2007). 250 years since the industrial revolution began, we have experienced a permanent transformation of economic, social relations, living and labour conditions (Daimler, 2017).

1.2. RESEARCH OBJECTIVES

The primary objective of the study is to develop future scenarios in the South African automotive industry as a result of the social impact of industry 4.0 in the period up to 2033. The study will explore possible future scenarios in the automotive sector. The National Development Plan (vision 2030) for South Africa seeks to create an economy close to full employment where people are skilled and where production factors are more equitable and diverse. The period up to 2033 upon realisation of the NDP will be critical for strategic scenario planning.

In order to achieve the above-mentioned primary objective, this study will pursue the following secondary objectives.

- Conduct research on South Africa's stance on Industry 4.0.
- Critically analyse the drivers of the fourth industrial revolution.
- Conduct an analysis on technological factors which enable change
- Investigate the education system and support factors to technology.
- Do an analysis on the economy and political land scape.
- Investigate which factors will give the nation a competitive advantage in the implementation of Industry 4.0.
- To propose practical inputs for industry stakeholders with development of strategic policies and Good governance frameworks pertaining Automotive Industry.

1.3. CONCEPTUAL RESEARCH FRAMEWORK

This study will utilise the Casual layered Analysis as a platform for developing the future scenarios of the South African automotive sector as a result of Industry 4.0. Casual layered analysis provides a framework for assessing the social hypothesis of the real and proposes a step-by-step methodology with which to scrutinise the effects from key focus areas of the research (B. S. Inayatullah, 2014).

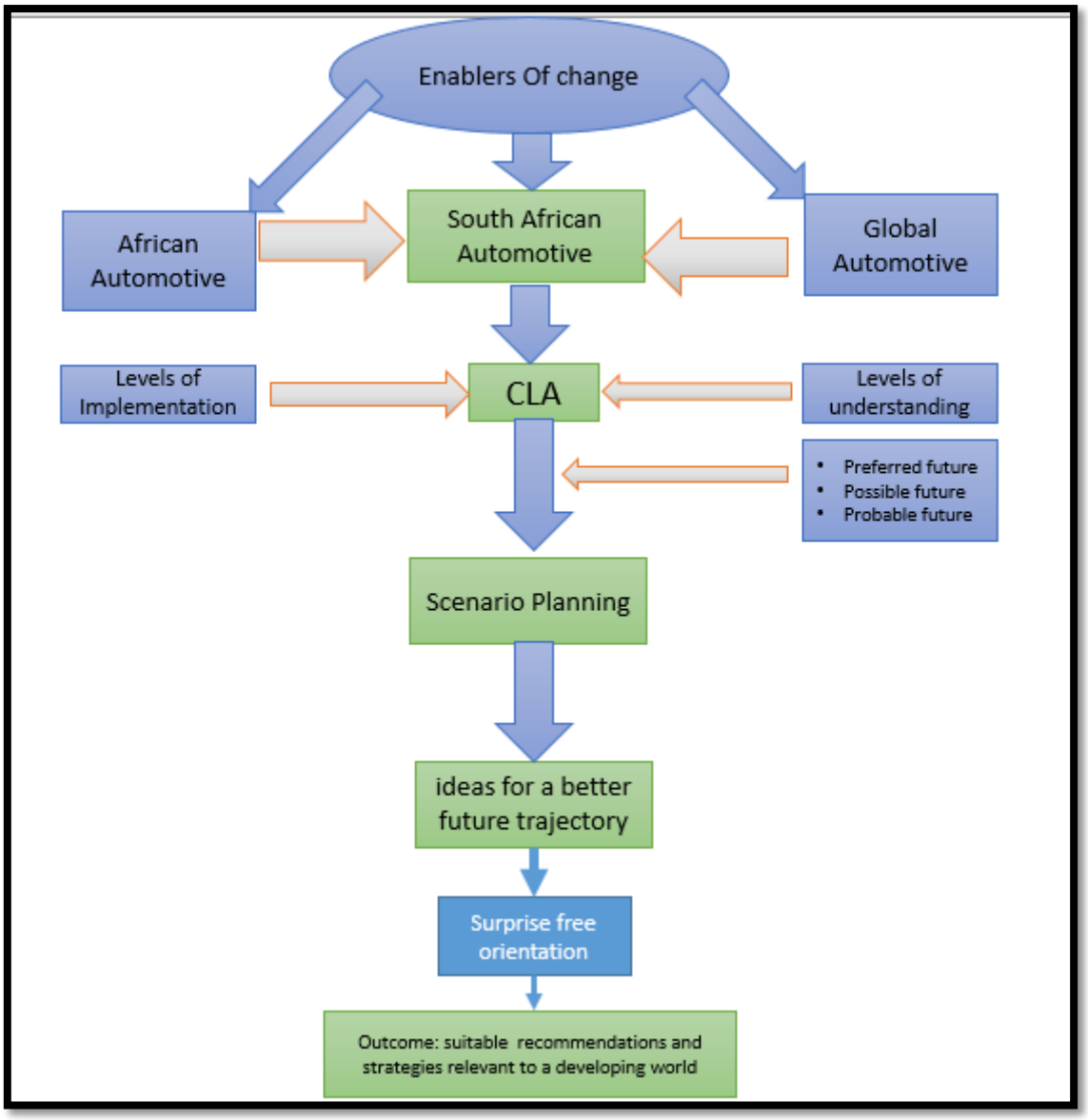

Figure 1: Conceptual framework

Source: (authors own construct)

According to Du Plessis (2016), CLA is a highly-regarded and an influential futures study framework which provides a system of futures thinking which is linked to methodologies and tools. Causal layered analysis enables the analyses of the past, present and future theoretical perspectives of futures studies and the social sciences (Mark Ludwig Putzier, 2017). The CLA technique adopts four dimensions of analysis:

1. Dimension 1: The litany is the official public portrayal of the issues;
2. Dimension 2: The systems level at which some underlying systemic causes are revealed;

3. Dimension 3: The ‘world-view or paradigm’ level, in which the analysis examines the deeper assumptions behind the problem.
4. The ‘myth/metaphor’ level, where the view is rational and the method is trying to discern the irrational (Mark Ludwig Putzier, 2017).

Causal Layered Analysis draws out different levels of realities and ways of knowing, this method is extensively applied by futurists focusing on diverse areas of content(Du Plessis, 2016). The methodology’s value is not in predicting what will happen, but in creating transformative spaces for creating alternative futures and developing more efficient, inclusive and long - term policies (Du Plessis, 2016).

1.4. RESEARCH DESIGN AND METHODOLOGY

The study is qualitative in nature. The conceptual framework will look at various technological global trends, drivers for change and the progress of South Africa in the technology space. Proposed scenarios for better future projections will be made. The attractiveness of qualitative research is that it enables the researcher to pursue an in-depth analysis about an extensive array of themes, expressed in a plain and everyday manner (Mark Ludwig Putzier, 2017). Additionally, qualitative exploration allows greater flexibility in choosing topics of interest.

1.4.1. Quantitative research

Quantitative research refers to the explanation of a concept through empirical data, equations and graphs, while qualitative is based on subjective reasoning, views and perceptions of certain issues (Uglovskaia, 2017). Quantitative methods include computations based on real data sets (different variables and indicators). Quantitative research makes approximations or hypotheses about the reality and uses measures to fit the divergent views into predetermined response categories (Hänninen, 2014).

1.4.2. Qualitative research

Qualitative research is the development of concepts that aid in the understanding of social phenomena in the natural (rather than experimental) environments, with due emphasis on the participants ' meanings, experiences and views. Many qualitative researchers assume that the empirical evidence they collect is linked to theoretical ideas and structures below observable reality. However, the data from the observable surface reality are only examples of what happens on the visible surface. (Bazeley, 2013). Qualitative techniques don't include quantitative measurements and data

analysis, and as such, qualitative methods are often based on skills such as creativity, intuition and expertise. (Giyose, 2014). Qualitative research views reality from the perspective of people and attempts to develop understanding by observing (Hänninen, 2014).

1.5. RESEARCH QUESTIONS

- What are the future social impact of industry 4.0 in the South African automotive industry?
- What are the factors to be considered for South African business to evaluate their readiness for industry 4.0?
- What are the labour force implications as a result of industry 4.0?

1.6. IMPORTANCE AND BENEFITS OF THE STUDY

In view of all this significant change, the main goal of the automotive industry remains the same: to remain competitive globally. The opportunities offered by manufacturing digitization are therefore critical. Many manufacturers already embrace digitisation by using increasingly affordable technologies, such as sensors, to connect their factories and draw on the data they produce so that processes and products are improved. Digitalisation can help manufacturers save time, reduce costs and respond more efficiently to customer demand as part of the innovation culture and continuous improvement within the automotive industry 's DNA (Hawes, 2016)

South Africa’s digital infrastructure needs to be improved, clear cyber security policies need to be set up, the skills gap needs to be addressed and investment in digitalisation needs to be speeded up. These are some of the challenges that industry and government must overcome if the fourth industrial revolution is to be realised. In order to be successful, the government, the automotive industry and other stakeholders must cooperate. This means bringing digitalisation to the forefront of the new industrial strategy of the government and working in partnership to ensure that we understand the opportunities presented by this technological change. In so doing, we can help ensure that South Africa takes a progressive and innovative position and maintains its inherent global competitiveness. (Hawes, 2016).

The outcomes of the research would be recommendations which are relevant to a developing South African economy. The contribution will be on IT infrastructure upgrade, skill development and an increase in the overall competitiveness of the

country. The more the country produces the bigger the GDP (gross domestic product) which measures our countries growth.

Industry 4.0 puts a developing country in a competitive landscape with already developed nations. If the country responds quickly, it can compete in the global arena as barriers of certain technological resources is minimised.

Current business needs to adapt in technological innovations like industry 4.0. To keep up firms need to transform so that they can become competitive and stay afloat as any business has many competitors after the same market. Future business are going to be more digitised, economical and require very few workers. Computer science has taken dominance more system will be autonomous and require minimum human intervention. There are a number of economic benefits that are associated with Industry 4.0, including building investments and network infrastructure. Adopting Industry 4.0 is not only for the sake of competing but will eventually be essential for business survival.

The president of the nation Mr Cyril Ramaphosa said on his state of the nation address in 2018, focus should be put on industry 4.0. The government is keen on supporting industrialisation. With industry 4.0 still on the concept phase, it is imperative to invest in research and benchmark against the best in order to maximise on the benefits of the fourth industrial revolution. An effective and efficient telecommunication infrastructure is needed to be able fully participate in the fourth industrial revolution. The education system must be on relevant topic which support technology. Maths and science studies must be improved.

The skill of today's technicians may lose their value, but other qualifications may also gain in value as production becomes more complex, requiring increased expertise to manage. Organisations understand the need to increase their competitive edge by providing customers with shorter delivery times, and customised service. Many companies face challenges such as volatile and sluggish market conditions, on top of labour shortages. Automation will reduce the need for repetitive tasks and open opportunities for higher-level roles for people working in manufacturing environments, helping to address many issues. Adopting Industry 4.0 is not only for the sake of competing. Eventually, it will be essential for survival. Management and organisation structures will need to be re-examined as supply chains move towards increased

digitisation. The role of employees will come under scrutiny as these developments unfold.

1.7. CHAPTER OUTLINE

Chapter 1

Provides the background against which this study is conducted. This chapter describes the research problem, research goals and research problems. It also details the study's intended contribution to stakeholders identified. It also provides abbreviated research methodologies that are used to achieve the primary and secondary goals of research.

Chapter 2

Looks at the futures research methodologies that will be used to achieve the research objectives. Sets the scene and addresses the research design and rationale followed by the research process and evaluates the design criteria to ensure an acceptable' surprise-free' research result. The future research methodologies identified are Causal Layered Analysis, Professor Inayatullah’s brainchild and scenario planning.

Chapter 3

The focus is on reviewing the literature study used to understand the research problem. Enablers of changes affecting the future of automotive industry will be explored to gain a comprehensive understanding of them. In addition, specific drivers from South Africa will be examined in detail.

Chapter 4

Application of causal layered analysis and scenario planning methodologies to the study of possible futures in the South African automotive industry by 2033 will be the focus of attention in chapter 4. These methodologies were identified as the preferred forecasting techniques for this study

Chapter 5

Chapter 5 will provide an ideal, achievable future for South Africa and its automotive sector within the framework of industry 4.0. This forecast will be presented together with a set of related, practical recommendations and, lastly, an overview of the research and a summary of its findings and conclusions.

CHAPTER 2: RESEARCH METHODOLOGY AND DESIGN

2. INTRODUCTION

Chapter 1 outlined the scope of the study in terms of the research problem definition, research goals, research questions, and the study's suggested contribution. There was also a brief explanation of the research methodology to be used. This chapter attempts to explain in detail the methodologies of future research that will be used to meet the research goals.

The study under consideration is a futures study. Inayatullah (2013) describes futures studies as a methodical study of possible, probable and preferable futures encompassing worldviews and myth that underlie each future. As the study is based on Futures, It is suitable to employ discipline specific methodologies , namely Futures Research Methodologies (Kasvosve, 2017). Futures studies can be defined as the study of possible, probable, plausible, and preferable images of the future. Figure 2 below demonstrates the phenomenon of Futures Studies.

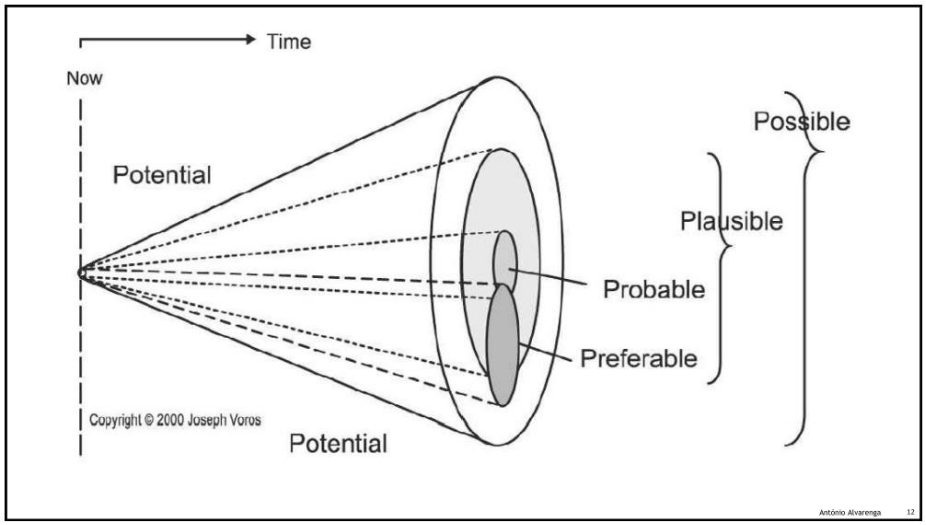

Figure 2: Futures Studies

Source: Voros, 2015

2.1. Types of Potential Futures

There are four classifications of potential alternative futures. Possible futures, plausible futures, probably futures and lastly preferred futures. **Possible futures** encompass all the types of futures one can possibly envision - those that could happen regardless how far-fetched or unlikely they may seem. **Plausible futures**, this classification includes futures which could happen according to our present

understanding of how the environment functions. **Probably futures** cover futures which are regarded as likely to happen, and stem in part from the continuance of current trends. Other probably futures are considered more likely to occur than other alternatives. The ones which are considered most likely are referred to “business-as-usual". **Preferable futures**. Concerned with what we "want to" happen; in other words, these futures are largely emotional rather than cognitive (Voros, 2015).

Futures approach involves systematically exploring, creating and testing both the possible and desired futures. The primary objective of the methodology is to improve decision making (Kasvosve, 2017). Future studies take into consideration analysis of the policies and the consequences of the implementation of those policies and actions (Kasvosve, 2017)

2.2. FUTURES STUDIES

Over the past fifty years future studies have moved away from predicting the future to mapping alternative futures in order to shape desired futures, both at external collective levels and inner individual levels(S. Inayatullah, 2013). Adendorff (2013) concedes that the future is changing rapidly in an unpredictable manner, with change no longer optional but the only way to survive. The rate at which change has taken place in the past two decades has increased drastically when compared to the past century (Adendorff, 2013). As a result of this rapid change firm competencies like flexibility, adaptiveness and ability to respond have become critical success factors. Futures studies aim to assist individuals and entities better comprehend the processes of change so that intelligent and preferred futures can be realised (S. Inayatullah, 2008). Futures studies research emphasises that there is no one single future, but many alternative futures. The future is associated with people’s choices, values system and fundamental principles that are diverse and based on culture, practical knowledges, and generations. As Giyose (2014) indicated It is of uttermost importance to respect this multiplicity in relation to both people who are already able to make decisions and others who have yet to begin their life on planet earth (Giyose, 2014).

2.3. Principles of Future Studies

Modern futures studies suggest that the future is not completely determinable, theories accept that different future developments are possible (Kasvosve, 2017). According to

Inayatullah (2013) Futures studies creates alternative futures by making basic assumptions problematic. Futures studies has six pillars. Before exploring the six pillars, one way to create the desired future is to first address the following questions.

2.4. Six Basic futures questions

Table 1: Six Basic futures Questions

NO	Six Basic futures questions
1	What do you think the future will be like? What is your prediction? More and more progress and wealth? Wealth for the view? A dramatic technological revolution? Environmental catastrophe? Why?
2	Which future are you afraid of? Random acts of violence? Do you think you can transform this future to a desired future? Why or why not?
3	What are the hidden assumptions of your predicted future? Are there some taken-for-granted assumptions (about gender, or nature or technology or culture, or . . .)?
4	What are some alternatives to your predicted or feared future? If you change some of your assumptions, what alternatives emerge?
5	What is your preferred future? Which future do you wish to become reality for yourself or your organization?
6	And finally, how might you get there? What steps can you take to move in toward your preferred future? As it says in ancient Buddhist texts, much of the solution to the challenge of life is simply in being pointed in the right direction.

Sources: Inayatullah, 2013

These six basic questions could be summarised to; Will, Fear: Hidden assumptions, Alternative assumptions and lastly preferred future next steps. Inayatullah (2013) argues that the objective of future studies is to map alternative futures in order to realise desired futures considering external collective levels and inner individual levels. People live lives based on their perception of the future, or the image of the future that they want to create for themselves(S. Inayatullah, 2013)

The conceptual framework for understanding the future used in this study is the six pillars approach developed by Professor Sohail Inayatullah. These six pillars provide a theory of futures thinking which is interfaced with methods and tools(S. Inayatullah,

2008). The six pillars are: mapping, anticipation, and timing, deepening, creating alternatives and transforming (MATDCT).

2.5. THE SIX PILLARS OF FUTURES STUDIES

2.5.1. Pillar one: Mapping the future

The first pillar of futures studies is mapping, the past, present, and future are mapped in order to show where we have come from and where we are heading toward(Du Plessis, 2016).The Mapping the Future aims to craft an initial map of the future(S. Inayatullah, 2017). It employs at its core, the futures triangle methodology. The Futures triangle has three main characteristics: the pull of the future, images of the future; the push of the present, the critical enablers; and lastly the weight of history which tends to include barriers(S. Inayatullah, 2017). The futures triangles can be imagined graphically as depicted Figure 3 .

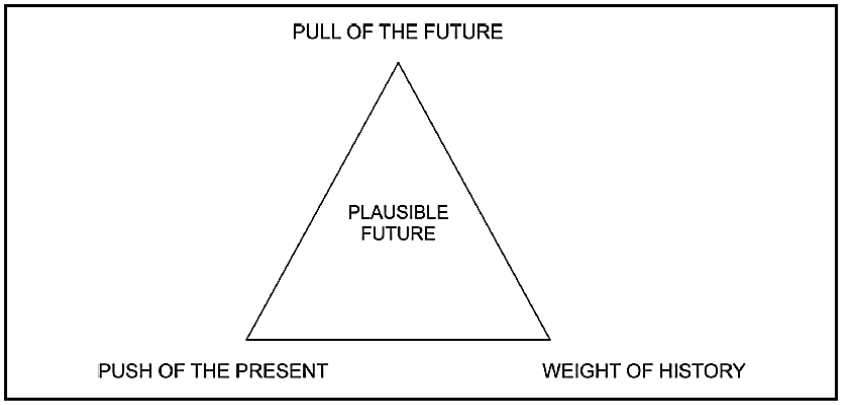

Figure 3: Futures triangle

Source: Riedy, 2012

2.5.2. Pillar two: Anticipation

The second pillar is anticipation. The fundamental methodology used is emerging issues analysis and the futures wheel. The aim is to disturb the mapped future and detect possibly the unlikely and unknown issues which could contest how the future was being assumed(S. Inayatullah, 2017).Organizations which focus only on the daily operations of the business get extinct sooner rather than later. The notion behind emerging issues analysis is move upstream toward anticipation by identifying and addressing issues before they become detrimental to the organisation. Figure 4 illustrates the concept of emerging issues analysis

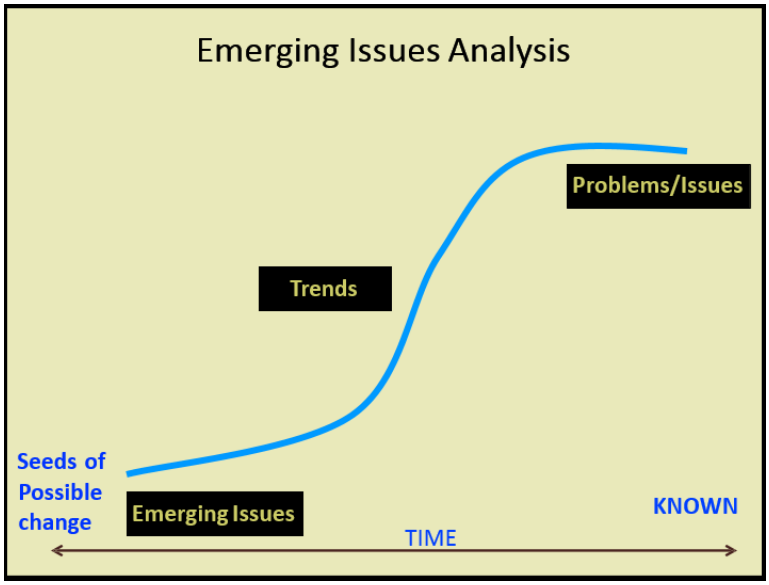

Figure 4: Anticipation

Source: Inayatullah, 2004

emerging issues analysis attempts to detect issues before they become unconceivable and expensive (Kasvosve, 2017). Although the main goal is focused on disruption, the ideal is only be detecting new technologies that yield to the hype cycle which leads to a much deeper understanding that is required(S. Inayatullah, 2017).

2.5.3. Pillar three: Timing the future

Timing the future involves looking for the grand patterns of history and recognising models of change. Timing the future comprises of issues such as how the future might be affected by people's actions coupled with the possibility of planning around such actions(Du Plessis, 2016). According to Inayatullah (2008) there are a number of patterns which are critical if we wish to understand the shape of time.

The issues tackled in the timing of the future interrogate questions such as: Is the history and future linear, cyclical, pendulum or spiral? When, where and how should one intervene? There questions resulted in the following described by Inayatullah (2008) as follow. Figure 5 depicts a graphical representation of timing the future.

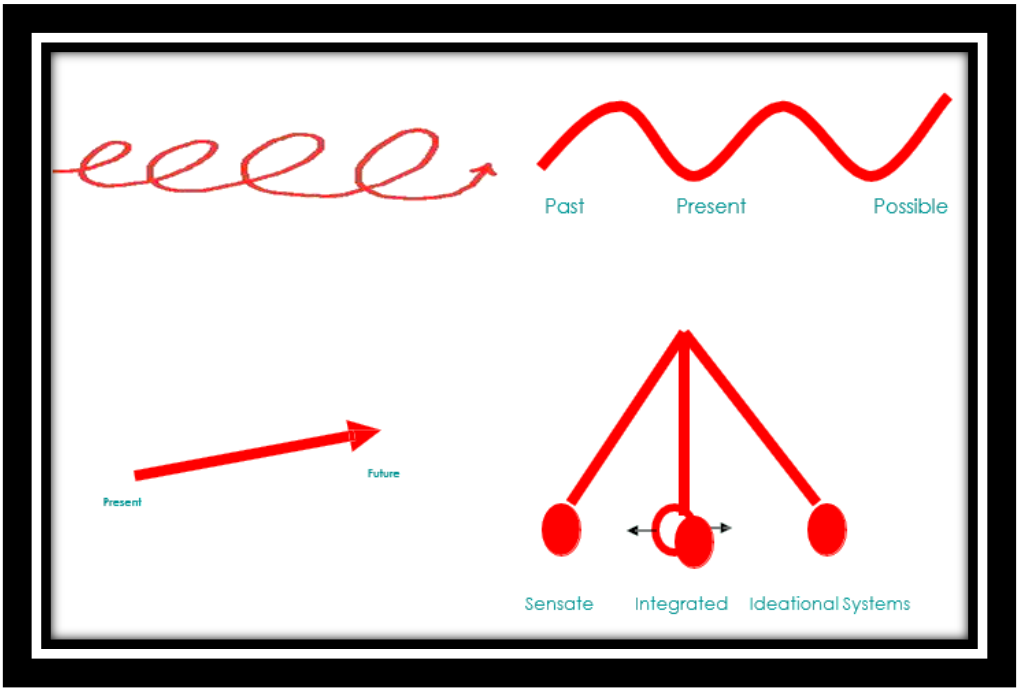

Figure 5: Timing the Future

Source: Inayatullah, 2013

- The future is linear, sequential, hard work secures a good future;
- The future is cyclical with limits upper and lower limits. Eventually the top performers will be at the bottom as time progresses. Since they are at the top, they cannot adapt and adjust in a complex economy. Their reputation was built on mastery of the talents of the past. Very few can reinvent their most core narratives;
- The future is a spiral: parts are linear and progress-based, and parts are cyclical. With leadership that is fearless and has foresight, a positive spiral can be created. The doctrines of the past are challenged but the past is not rebuked, rather it is incorporated in a march toward a better future;
- The future is spiral. With a linear and progressive shape. Courageous leadership with strategic vision can create a positive spiral, take ownership of the past and take it onto the road to a preferred future;
- New futures are more often than not driven by a creative minority. New futures are more often driven than not by a creative minority. They challenge the concept of a used future. They innovate instead of imitating what everyone else does.

- There are turning points in the history of human kind. The actions of a minority can make an evolutional change. It is within these times, that old ways of doing things tend to be less useful: what flourished before is no longer relevant.

Inayatullah (2013) contends that real change ought to come from changing how we view the world, which includes appreciation and looking for positives in every situation. New technologies change our way of doing things. Technology creates new economies and business models.

2.5.4. Pillar four: Deepening the future

Causal layered analysis (CLA) is a critical futures research technique which aims to deepen the understandings about the futures changes (Talebian & Talebian, 2018). Causal layered analysis is centred around the notion that the way in which a problem is framed will have an influence on how a change in the issue will be pursued (Talebian & Talebian, 2018). CLA makes an effort to broaden the framing of an issue to be inclusive of all forms of knowledge and emboldens different perspectives of the issue being perused. The method has a wide scope for analysis through its "nested social-analytical perspective (Botta, 2016).

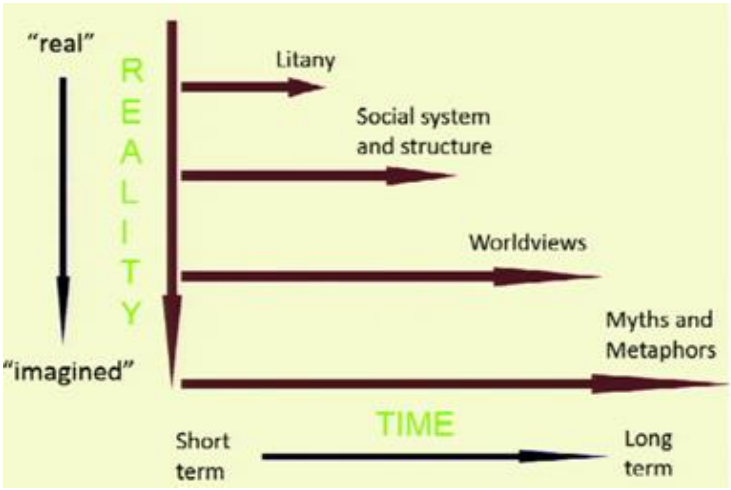

Figure 6 :CLA

Source: *Russo, 2010*

Deepening the future through the causal layered analysis method creates alternatives via scenario planning and concludes with transforming the future using visioning and back-casting(S. Inayatullah, 2017).

CLA technique brakes down issues using four layers of analysis classified vertical from litany, systemic cause, worldview, myths/metaphors, the layers can be depicted in Figure 6. Litany is the first layer, it contains the publicly recognised and accepted features of a problem, and it is the undisputed view of reality. The systemic cause layer evaluates social, cultural, political and historic factors that impact the issue. The top two layers are similar to environmental scanning approaches (Botta, 2016). As the analysis deepens, the next layer advances investigation of worldviews in an attempt to discovery genealogy, identifying ideologies, and can also provide alternative stakeholder perspectives of a problem (Botta, 2016). The third layer is the worldview, it is the supporting discourse that legitimates the systems of social organisations (Green & Dzidic, 2014).

The fourth dimension is the myth or metaphor: the story line, it is the unconscious emotive dimensions of the issue. Metaphors are in many instances are the vehicles of myths (S. Inayatullah, 2013). The pain point is to do research that moves up and down these dimensions of analysis and thus is inclusive of different ways of knowing(S. Inayatullah, 2004). Undertaking CLA enables for the construction of reliable alternative futures leading to integrated transformation. This research study implements CLA methodology to deepen the future of the South African Automotive industry. The method will be discoursed and reviewed in more detail in Chapter 4.

2.5.5. Pillar five: Creating alternatives

This pillar focuses on methods to create alternative futures. The critical method in the fifth pillar is scenario planning. The future is further widened during this stage via the creation of scenarios, a value adding method of revealing the present, establishing the degree of uncertainty and presenting alternatives by painting images of the future (Du Plessis, 2016). Scenarios are the result of the scenario - based planning process and can be considered a free and holistic thinking tool (Giyose, 2014). Scenarios expand the mind and lead decision makers to imagine the future in realistic terms by focusing decision makers ' attention on detailed environmental principles. In addition, scenarios are used to create an environmental planning framework and guide decision makers with common reference points (Giyose, 2014). Scenarios therefore act as a test tool by identifying probable strategies by typical " what if " questions. (Adendorff, 2013).

2.5.6. Pillar six: Transforming the future

The last pillar which is the sixth: transformation, the future is finally forecasted towards the preferred future (S. Inayatullah, 2008). The ideal is on detecting win-win resolutions without compromising. Sustainability is engaged as the main guiding principle throughout this pillar. Problems which need consideration are included in the formulation of the future as desired by all the stakeholders of the South African Automotive industry on the way to the ideal future for the industry, leading 2033.

2.6. SCENARIO PLANNING

Studying the future begins by acknowledging its uncertainties and then transform them into sources of new philosophies and opportunities (Rialland & Wold, 2009). The future cannot be predicted, strategies that are founded on an anticipation of a future as a continuation of past developments are nothing more than business-as-usual and unlikely to foster real innovation (Rialland & Wold, 2009). Scenario planning is a methodical way for thinking creatively about possible complex and uncertain futures. The fundamental notion of scenario planning is to take into account a mix of possible futures that include many uncertainties in the system as opposed to focus on the precise prediction of a single outcome (Peterson, Cumming, & Carpenter, 2016).

To create effective strategies that assures sustainable competitive advantage, organisations have no choice but to be flexible and accept that tomorrow may be drastically different from the present. Being Open-minded to new ideas and thinking out-side-of-the-box are critical to make organizations capable to adapt and redesign their strategies according to changes in its surrounding environment (Rialland & Wold, 2009).Hence when dealing with uncertainties and volatility related to the future, strategic foresight and scenario based planning are powerful tools. Scenarios can be defined as different narratives about how the future might look like (Kosow & Gabner, 2008).

Bawden (2001) defines scenario planning as a dialogue method for the integration of judgments which is used in the business, military and government environment. The main emphasis of scenario planning is dealing with uncertainties, specifically responding to the need of many organisations to plan for uncertain futures. Typical judgments of specialists are integrated through this process (Bawden, 2001). Giyose

(2014) asserts that scenarios should be multi-layered and have a holistic approach in their application to futures studies. Scenarios pose a distinct ability to represent a multifaceted process with interactive dialogue. This ability is realised through combining social trends, political events, technological developments, economic variables and demographic changes (Giyose, 2014).

The scenario planning methodology considers the future as too intricate to merely reduce it to a single linear prediction, especially as one goes deeper into it. It is a superior tool in visualising the possible threats and opportunities that could be encountered by the South African Automotive industry towards the year 2033. According to Du Plessis (2016) survival in the business world entails consistently creating value for stakeholders, and the issue of survival begins with uncertainty, complexity, change and the need for organisations to adapt to ever shifting circumstances and needs.

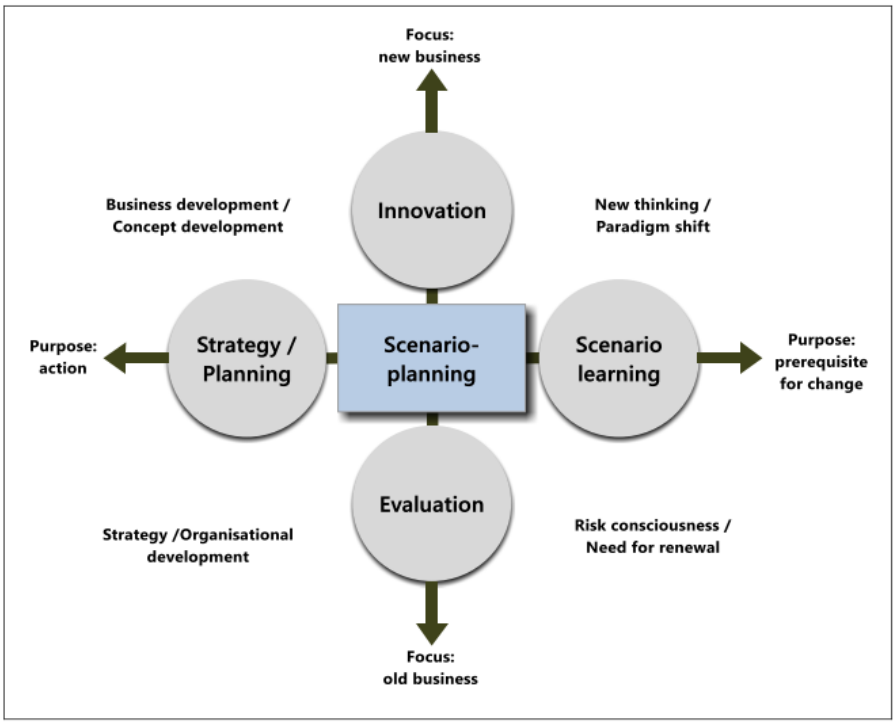

Figure 7: Dimensions of Scenario Techniques

Source: Du Plessis, 2016

Figure *7* above depicts the areas investigated by Du Plessis (2016) which illustrates application of different scenario techniques.

The concept ‘scenario’ ought to be used to pronounce a future situation; the progression from current conditions to that of several futures, unfolding the instrumental chain of decisions and circumstances which follow on from the present (Du Plessis, 2016). Scenarios enable leadership to frequently assess how they perceive the future, creating the successful continuation of the organisation towards its desired future. Scenarios aid to improve strategic thinking and the construction of tactics to support organisations towards sustainable competitive development. The application of scenario planning for strategic foresight enables rapid adaption to significant environmental changes light the new don of the fourth industrial revolution(Du Plessis, 2016).

If we overweight the present and overestimate our ability to control the future, the range of uncertainty considered can be reduced. In addition, it may be difficult to rely on expert opinion or local knowledge because scenarios often deal with issues that are poorly understood outside of the expertise of most people in such situations, the forecasts of experts or local people may not be better or worse than those of non - experts or external persons (Peterson et al., 2016).

2.6.1.1. The purpose and value of scenarios and scenario planning

Through the use of scenarios organisations can be able to create a broad framework for strategic planning. Constructing images of the future does not mean predict it, it’s merely preparing and responding to the question “what should we do if this would happen? (Rialland & Wold, 2009). Scenarios are narratives of journeys to possible futures, they reflect assumptions that are different about how the present trends will reveal themselves, how critical uncertainties will play out and what new factors will come into play (Kosow & Gabner, 2008). Scenarios are alternative futures in which today’s decisions may play out(Konno, Nonaka, & Ogilvy, 2014). Scenario planning represents the implementation of organisational learning, it brings about new strategic visions and adaptive planning tactics which then results in strategic conclusive organisational changes(Du Plessis, 2016).According to Giyose (2016) there are three distinctive procedures that can be used to foresee future events:

- Forecasts: depends predominantly on trends-based analysis and indicate long-term assessments. Forecasts are efforts to accurately predict a depiction of the

future. The most dependable forecasts are subject specific. The most suitable individuals to provide the most accurate forecast are focus-area leaders who have paramount experience regarding the continuity of current trends;

- Estimates: the main focus is on an evaluation of the present conditions in order to detect possible future events;
- Scenario-based planning: The result of this process is not an exact image of tomorrow, but it rather allows for making enhanced decisions about the future.

2.7. CHAPTER SUMMARY

This chapter has been dedicated to the research methodologies to be used to answer the research questions posed in chapter 1. In order to give context to the study, fundamental principles of future studies were researched. More importantly, it has also explored the six pillars that underpin futures thinking, Causal Layered Analysis (CLA) was selected as preferred methodology for the future to be used to achieve the study objectives as set out in Chapter 1.

A review of the literature on the automotive industry will be devoted to Chapter 3. Key drivers and trends that shape the automotive industry as we move to 2033 will be considered from the literature available.

CHAPTER 3: LITERATURE REVIEW

3. INTRODUCTION

The previous chapter focused attention on the methodologies of future research that will be used to realize the goals of this research. The purpose of this chapter is to review the literature on the automotive industry. A review of the literature involves a comprehensive and critical evaluation of existing knowledge on a topic that guides the research and demonstrates the location and analysis of the relevant literature. A thorough environmental scan of the South African automotive industry is carried out to detect the forces of the present and to identify the measureable drivers and trends which exist and will affect the industry's future.

The first industrial revolution was the movement of farmers to urban areas due to introduction of steam powered engines, which were utilised by machines like the reaper (Harvesting machine) and locomotives. The second industrial revolution happened in the second half of the 19th century, this was due to electrical-mechanical systems being developed. The electrical-mechanical systems saw the introduction of assembly lines by Henry ford, thus there was a collaboration between mechanical and electrical systems which was the beginning of mass production. The assembly lines made use conveyor systems which was broad by the notion of Henry Ford that the car should come to the operator.

By the 20th century the world experienced the introduction of computer technology and micro-electronics in production lines. The introduction of computers and the internet led to the third industrial revolution. Automation of production systems came to light, this was driven by robotics and automated systems which revolutionised the entire production processes. These technological innovations were disruptive in nature and they caused a shift in business models of existing firms and provided new opportunities for start-up companies.

The basic fundamental of the fourth industrial revolution is connectivity of things i.e. industrial internet of things and services. Big data, internet of things, advanced robotics and artificial intelligence are at the heart of the revolution. Automation and optimisation of processes are done in an entirely new way. Data analytics and machine learning play a big role. Machines are able to communicate with other machines to make smart

decisions based on big data analytics algorithms. Industry 4.0 will be fully realised with self-optimizing systems and a digital supply chain. Industry 4.0 can be defined as the digital transformation of manufacturing, making use of third platform technologies, such as Big Data/Analytics, Internet of Things (German Trade and Invest, 2015). The digitization requires the convergence of information technology and Operational technologies, robotics, data and manufacturing processes to realise connected factories. The transformation from the first to the fourth industrial revolution can be visualised in Figure 8 below.

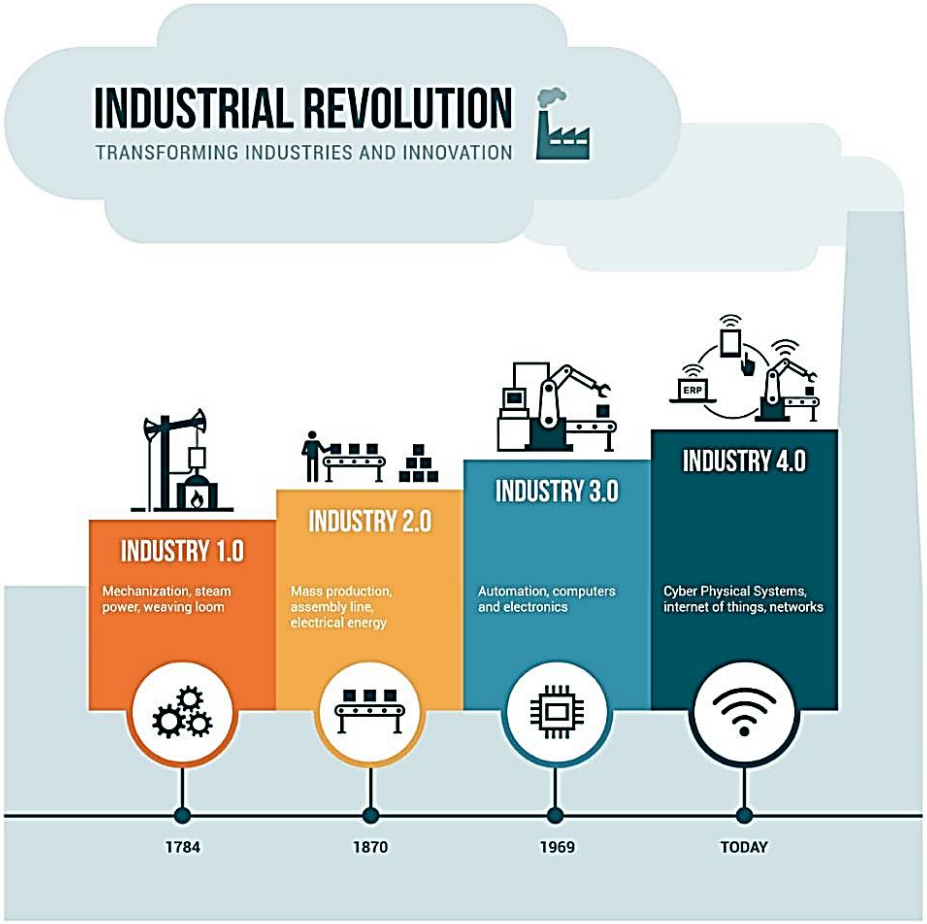

Figure 8: Industry 4.0 Transformation

Source: Adepetun, 2018

Currently industry 4.0 is still a vision for manufacturing which will be fully realised in the next 10-15 years. To have complete connectivity in the value chain will require an upgrade in the communication method of the internet protocol. Currently internet protocol version 4(IP V4) is in use, it has limitation of connecting up 4.5 billion devices. To achieve connectivity on a wider spectrum requires use IP V6 which can connect up

to 2^{128} devices (Adepetun, 2018). Light fidelity (Lifi), Blockchain will play a crucial role in the digitalisation of the entire value chain in the Automotive Industry. Thus, it should be viewed as necessary that scenario planning, which involves the multifaceted tasks of detecting possible alternative unconventional futures and choosing the preferred future, be applied in the South African automotive industry.

The integration of the data gathered in the value creation process requires the networking of different IT systems inside and outside an organization. Data can thus be exchanged in real time by functional areas such as procurement, production and sales. Due to the lack of resources, it is not easy for small and medium - sized entities to gauge the technological maturity of the pertinent solutions and their business uses. Management does not have a methodical approach to implement. Four out of ten small and medium - sized enterprises therefore have no comprehensive Industry 4.0 strategy compared to two out of 10 large companies. (Schröder, 2017) . McKinsey (2013) narrates a story which is largely optimistic and sometimes surprising. However, the most important narrative thread is that the global automotive industry is about to enter a period of wide-ranging and transformative change, as sales continue to shift and environmental regulations are tightening. The lesson learnt is that companies that want to have a successful, long-term future need to get key strategic decisions right in the next decade (McKinsey, 2013).

A single data model shared between the technical disciplines of engineering, production planning, manufacturing, procurement, finance, sales and marketing will bring considerable benefits. If engineering product models are directly linked to the specifications of materials and vehicles, many business processes can be modelled In the simulation, the full implications of any change in customer demand can be simulated instantly, requesting a new production schedule, purchase order and accounting entries to create a genuinely' digital factory. ‘With this objective, Siemens has developed software. Siemens has developed software with this aim (Hawes, 2016).

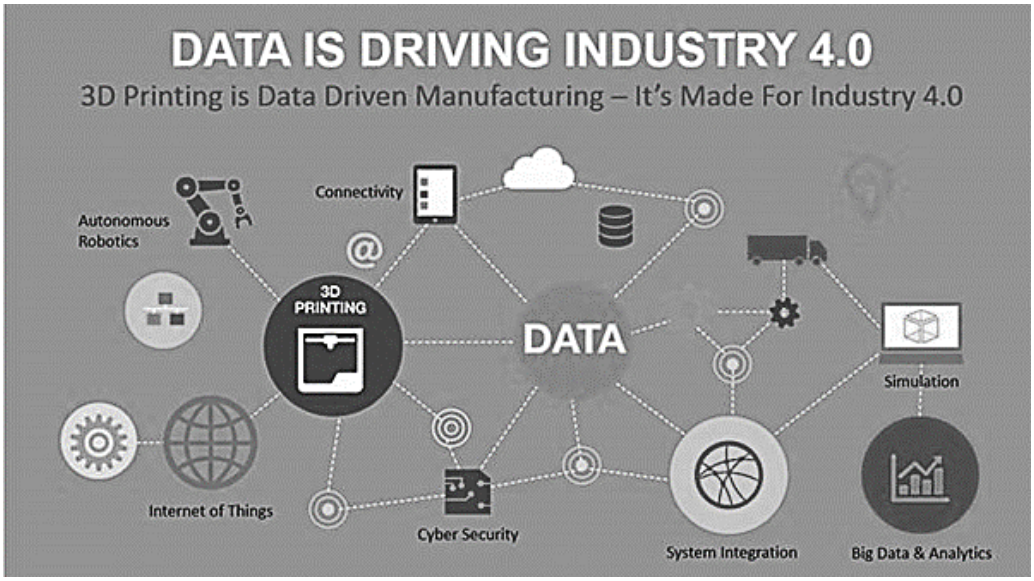

Figure 9: Industry 4.0

Source: Chapell, 2016

At the present stage, we find ourselves at the beginning of the fourth industrial revolution which builds on the digital revolution, the fuelling forces behind concept can be viewed in Figure 9. Industry 4.0 is the fourth major industrial revolution since the occurrence of the first industrial revolution in the 18th century. This report will also attempt to describe what is meant by industry 4.0 and will look and the drivers fuelling this new revolution. The impact that Industry 4.0 has on the country's economy, as well the impact on current and future businesses will also be addressed (Chapell, 2016). Industry 4.0 focuses on the establishment of intelligent products and production processes.

Technology innovations have revolutionised many aspects of our day-to-day lives. Industries are being transformed significantly with labour market being disrupted. Advances in big data analytics, advanced robotics and artificial intelligence have displaced a lot of job profiles, removed the tasks and needed skills within other occupations, and created entirely new job profiles(World Economic Forum, 2016). The consequences of these technological advances are currently already being felt today. Fast response to these technologies will have an impact on current business models. This will determine the relative stability or volatility of future labour markets(World Economic Forum, 2016).

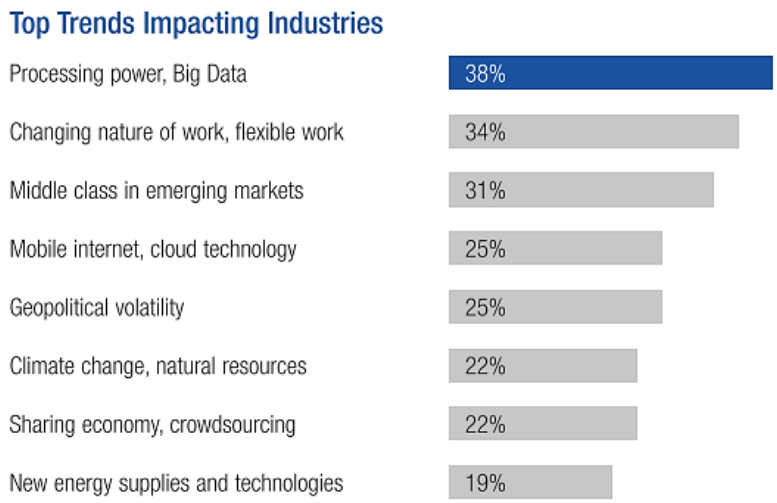

Figure 10: Enablers of Change in South Africa

Source: World Economic Forum, 2016

According to the World Economic Forum (2016) the most prominent drivers of change in South Africa can be depicted in Figure 10. Industry 4.0 will make it possible to gather data across different devices, making more efficient processes to produce higher quality products at reduced costs.

3.1. The South African Automotive industry

The South African automotive industry is facing many challenges in terms of competitiveness. As a result, the industry remains a marginal player worldwide, contributing only 0.65% of global vehicle production(Barnes & Black, 2017). Given the challenges faced by the South African automotive industry, it remains a central focus of the domestic economy industrialization strategy of the national government. It's one of the few manufacturing sectors in South Africa which has seen real growth within the last decade and represents a significant proportion of the total production output(Barnes & Black, 2017). While this is partly due to manufacturing output shrinking to only 13.2 percent of GDP in 2016 from 23.6 percent in 1990, the comparative resilience of the automotive industry, its well established structures, direct employment, export contribution and its recognized technology multipliers have made it a core, strategic industrial sector(Barnes & Black, 2017).

South Africa embodies the biggest local market for automobile production in the African continent and is by far the continent's leading manufacturer. The trade environment opened up fast during the 1990s due to the integration of the nation into the international economy after years of segregation due to sanctions because of the previous regime. The impact of lifting the banns on the South African economy is evident in the automotive industry, both domestic and international export markets have grown with over half of all vehicles produced in South Africa now exported (ASCCI, 2018).

The South African automotive industry began in the 1920s when global automotive manufacturers started assembling cars for the South African market within the framework of import substitution policies (McGrath, 2007). The initial investment decision was therefore based in large part on the growing size of the South African consumer market and the country's well- developed infrastructure. The presence of craftsmanship in engineering was nevertheless a precondition for the establishment of the first production facilities (McGrath, 2007). In the 1970s and 1980s, an economic slump and an increase in labour radicalism led to a widespread industry compromise, although often implicit, that larger export orientation was needed for which existing skills were not adequate. This was asserted in German companies (Mercedes, BMW and Volkswagen) with a larger proportion of foreign equity. Due to the nature of apartheid development of skills and labour relations, such a premise could have implications that are radical. But the possibilities were swiftly grasp by the industry's leading non- racial union, the National Union of Metalworkers of South Africa (NUMSA).

The automotive industry thus became the focus of discussions that formed the intellectual basis for an inevitable system of post- apartheid skills(McGrath, 2007). When democracy arose in the year 1994, the industry's opportunities were diverse. The post- mass production system now had clear government backing and vital NUMSA officials soon moved to the Labour Department.

The democratically elected government also stressed its urge to discard the old import substitution strategy and thereby threating the existence of the industry (McGrath, 2007) . In fact, the automotive industry was viewed as a key industry where a managed liberalisation mechanism would be targeted. The automotive Industry consists of

various players in the value chain which range from component manufactures to dealerships. All these strategic value adding partners contribute to the manufacturing and assembly of the automobile. The automotive industry was established in the late 18th century with many firms looking for opportunities to contribute and gain from the manufacture of the carriages which were horseless (Barnard, 2017).

The most dominant contributors in the industry has been for many years the European Nations in terms of efficiency and ingenuity. In terms of pushing volumes and mass production, the United States of America, China and Japan have been at the forefront (Barnard, 2017). The South Africa automotive industry is a critical source of progress in both the quantity of skills and quality in the country. Over the past years there have been several multinational automotive manufacturers who have invested in the republic of South Africa. The main vehicle producers in South Africa include thirteen manufactures of heavy and medium commercial vehicles, and roughly three hundred and sixty component manufacturers. The Department of Trade and Industry (DTI) instituted the Motor Industry Development Program (MIDP) in September 1995 to redirect the industry towards global competitiveness.

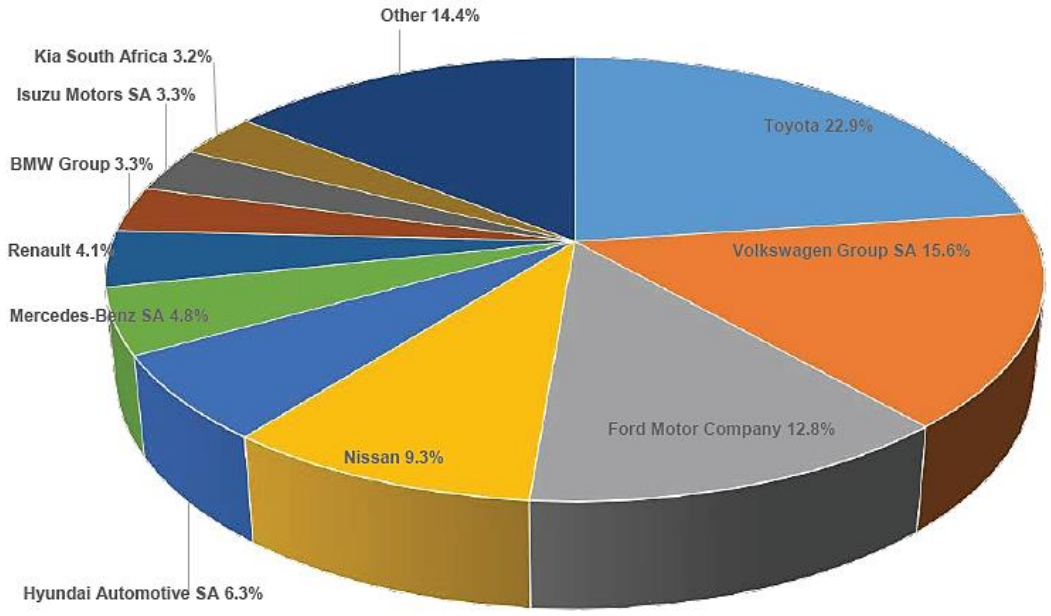

Figure 11: vehicle manufacturers

Source: Lamprecht, 2018

Figure 11 shows the most dominant players with their share of the market in the South African automotive industry. The primary drivers of the value chain are, Bavarian Motor

Works (BMW), Nissan, Ford, Volkswagen (VW), Isuzu, Mercedes-Benz South Africa (MBSA), and Toyota (ASCCI, 2018) .These Original equipment Manufacturers (OEM) are strategically positioned in four primary geographic areas. The four geographic areas include Gauteng, KwaZulu-Natal, Port Elizabeth and East London. The Gauteng region is home to BMW, Ford and Nissan and holds a market share of approximately 40% in the South African automotive components industry.

The second largest market share goes to Port Elizabeth with 30% followed by KwaZulu-Natal with 20%. East London is the home of Mercedes- Benz's assembly plant and roughly 6% of the automotive components industry (ASCCI, 2018).The automotive industry is one on the key drivers of economic growth in South Africa, it is the biggest manufacturing division which contributes approximately 6.9% to the Nation's Gross Domestic Product (ASCCI, 2018). Across all the Original Equipment Manufacture's the industry gives employment to 110,000 people. The projected annual production volumes amount to 573, 611 vehicles. During 2017, 58.7% of the locally produced automobiles were exported (ASCCI, 2018). Figure 12 reveals the top destination for exporting automotive products

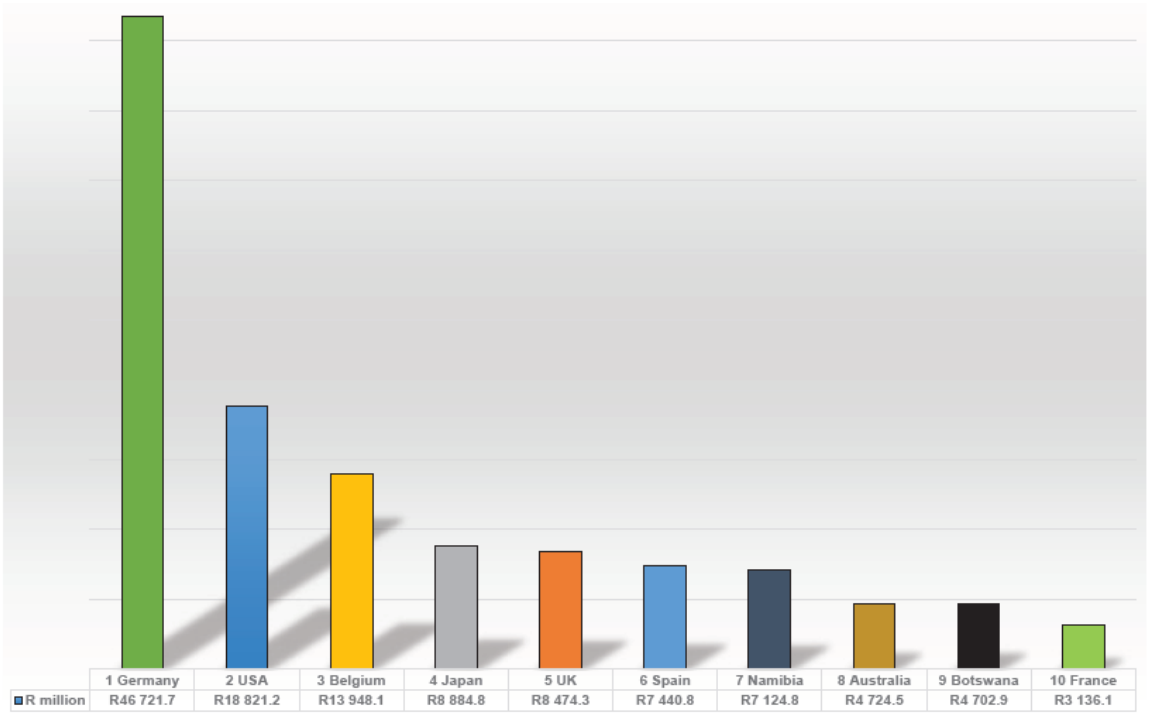

Figure 12: Top Export Destinations for the SA Automotive Industry

Source: Lamprecht, 2018

The multinational companies which have invested in South Africa have strategically positioned themselves to take advantage of the relatively low production costs which include cheap labour and availability of resources when compared to other countries with similar infrastructure (ASCCI, 2018). South Africa gives entry into unexplored African markets, this is as a result from the trade agreements which the country has with the European Union and the Southern African Development Community free trade area (Black, 2001). The entry into other uncharted African markets will be further expedited by the free trade agreement which covers large African countries.

The South African automotive industry is a critical part of the global supply chain as it is integrated seamlessly into the international automotive environment. The number of destinations with regards to quantity of vehicles and car part exports from South Africa is noteworthy. The focal point of the local automotive industry is to expand on existing exports and to encourage new investment opportunity (Lamprecht, 2018) . Export footprint continues to strengthen, first-world markets remain the target market for South African automobiles and automotive components. Be that as it may, diversification into new developing markets highlights competitiveness and drive to continually broaden the country's traditional trading base. From 2016 to 2017, the aggregate export values more than doubled in sixteen nations, which include: Tunisia, Liberia, Chad, Mauritania Bulgaria, Slovenia, Guyana , Mali, Burkina Faso, Croatia, Burkina Faso Kazakhstan, Cape Verde Islands , Uzbekistan, Latvia, Lebanon and , Jordan (Lamprecht, 2018).

South Africa has numerous appealing factors for foreign direct investors to exploit, for example, clear legislative framework, well established legal framework and strong financial administration instruments. To expand industrialisation requires devotion on enhancing competitiveness, the simplicity of doing business in the nation, and in addition improving the quality of goods and services which could compete internationally. Thus, it is vital to develop compelling multi-partner stakeholder associations that would unite every single significant player in the industrial development process. An empowering working arrangement condition, a decrease in the expense of conducting business, a decrease in administrative South Africa's automotive industry is an essential component in the nation's economy. This sector has been a strategically important sector in South Africa and it is imperative to ensure

not only the sustainability of the automotive sector in the country, but also the continued growth of the industry (Lamprecht, 2018).

Being the most sophisticated industrial manufacturing country on the African continent, South Africa continues to remain as one of the attractive destination of choice for foreign direct investors who wish to establish manufacturing plants (Lamprecht, 2018).

A major shortcoming in South Africa's current position in the automotive industry is directly related to its recent poor domestic market performance, the extent of imports into the domestic market and the deterioration of regional market conditions. The local market does not have enough demand to attract local assembly solely for domestic supply (Barnes & Black, 2017). In response to these pressures, the South African government commissioned the development of a South African automotive masterplan (SAAM) for the automotive industry leading up to 2035. The notion of the master plan was derived from analyses of the development experiences of Thailand's automotive industry and research on developments in Morocco, Turkey, Australia and Malaysia.

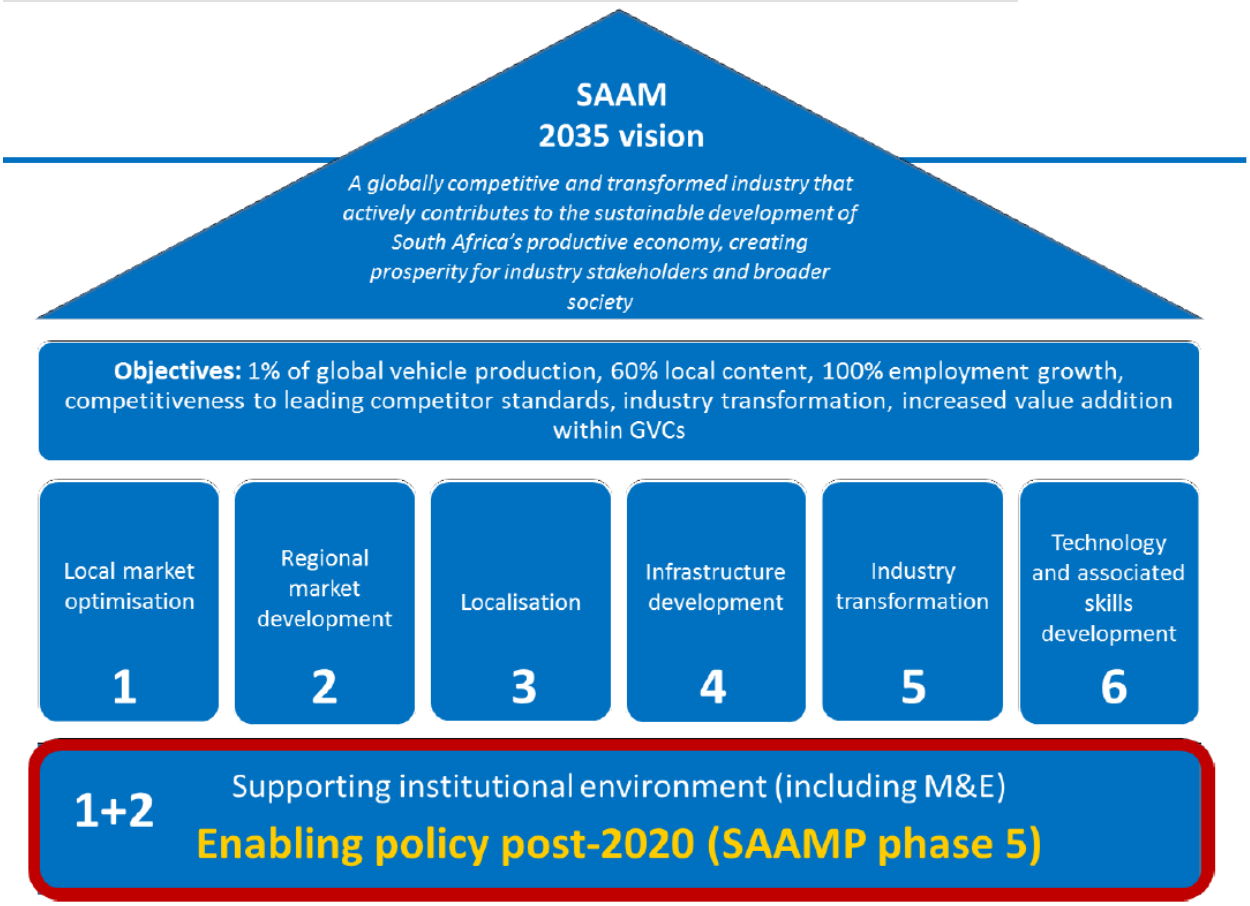

Figure 13: South African Automotive Masterplan

Source: Barnes & Black, 2017

As illustrated in Figure 13, the 2035 vision of the SAAM is to achieve “a globally competitive and transformed industry that actively contributes to the sustainable development of the productive economy of South Africa, creating prosperity for industry stakeholders and society at large." This vision has four main components. The first relates to the competitive position of the industry, and here the vision is clear. By 2035, the South African automotive industry will be competitive globally (related to the world's leading automotive producers). The second element is the contribution of the industry to the transformation of the South African economy. The key elements in this component relate to industry growth, employment, skills developed and the improved environmental impact of products and manufacturing processes (Barnes & Black, 2017). The final component pertains to the shared prosperity generated by the industry, which includes the financial health and well - being of companies within the

value chain, fair salaries for employees and the broader contribution of the value chain to South African expenditure. The four components of global competitiveness, industrial shift, sustainable development and socioeconomic contribution are at the heart of the SAAM vision (Barnes & Black, 2017).

Table 2: SAAM Objectives to 2035

Objective	Estimated impact on the SA automotive industry
1. Grow SA vehicle production to 1% of global output	• CBU production to 1.39m units annually (129% higher than 2015 levels) • Increase total value of vehicle production to R314bn
2. Increase local content in SA assembled vehicles to 60%	• Increase of R135bn on 2015 local content levels • 55% local content increase per vehicle produced
3. Double employment in the automotive value chain[8]	• Employment growth of 112,000 • Aggregate employment from 112,000 to 224,000
4. Improve industry competitiveness levels to that of leading international competitors	• Sustainable automotive industry based on comparative price and non-price competitiveness indicators • Sustained export competitiveness
5. Achieve transformation of the South African automotive value chain	• 25% Black-owned involvement at tier 2 and tier 3 component manufacturer levels, as well as in dealership networks and authorised repair facilities • Amplified skills development of Black South Africans • Enhanced employment equity at senior management, artisan, and professional employment levels across automotive value chain
6. Deepen value addition within SA automotive value chains	• Growth of auto component exports and production for the aftermarket at the same rate as CBU local content increases • Growth in R&D/other innovation metrics within the SA auto value chain

Source: Barnes & Black, 2017

The SAAM acknowledges that the vision of the South African automotive industry will only be realised by accomplishing a set of key development goals as depicted in Table 2. The anticipated commercial introduction of autonomous vehicles (AVs) in selected markets will also have a significant impact. According to Barnes (2017), fully autonomous vehicles will be adopted from 2025 and 75% will be adopted by 2035. As this new technology unfolds, it is argued that production for global markets will be transformed and that regional markets can also be affected by the demonstration of the benefits of autonomous vehicles outside testing sites.

3.2. African Automotive Industry

The rest of the African continent accounted for 18% of South Africa's total (R165 billion) automotive exports R29, 72 billion, in 2017 (Lamprecht, 2018). Thus Africa is an import focus area for the South Africa's automotive industry, even though vehicle exports to Africa weakened by R1,56 billion, or 5,0% pertinent to R31,28 billion sent out in 2016.In the year 2017, the gross domestic product growth in the SADC region has remained relatively weak due to subdued execution in its two biggest economies, South Africa and Nigeria (Lamprecht, 2018). Industrialisation and infrastructure development will hasten Africa's economic development. The unavailability of the necessary infrastructure not just hinders the continents capacity to trade with other international institutions, it is an obstacle to intra-Africa exchange (Barnes, 2000). The African Improvement Bank appraises that sub-Saharan African nations lose as much as 2,1% of Gross domestic product every year because due to poor infrastructure, which thus, inhibits advancement in the continent (Lamprecht, 2018). Table 3 illustrates the total production volumes and sales for the African continent.

Table 3: Production Volumes and Sales

	2016	2017
Vehicle production	1 025 292	1 065 677
New vehicle sales	1 315 163	1 195 765

Source: Lamprecht, 2018

The International Organisation of Motor Vehicle Manufacturers (OICA) outlined that vehicle manufacturing in Africa increased by 3, 9%, from 1 025 292 units in 2016, to 1 065 677 units in 2017 (ASCCI, 2018) . The continent accounted for1, 1% of global vehicle production in 2017. South Africa, with 601 178 units, represented 56, 4% of Africa's aggregate vehicle production, while Morocco, with 376 286 units, Algeria had 60 606 units, and Egypt, produced 36 640 units. Regarding passenger vehicle manufacturing, Morocco, had 341 802 units in 2017, record breaking number, outperformed South Africa's passenger vehicle production of 331 311 units (Lamprecht, 2018). New vehicle sales in Africa went down by 9, 1% from the 1, 32 million units logged in 2016 to 1, 20 million units in 2017. The projected vehicle PARC (number of registered vehicles) in Africa was in the region of 44, 8 million units and the motorisation rate at 42 vehicles per 1 000 individuals. The subsequent Table 4 shows Africa's vehicle production and new vehicle sales for the year 2016 and 2017.

Africa's new vehicle sales soared at 1.72 million units in 2014 but decreased to 1.20 million units by 2017 (Lamprecht, 2018).

The economic decline in Africa, driven by a sharp decline in commodity demand, has directly affected the continent's appetite for new vehicles. In 2017, new passenger car sales totalled 862 907 units and 332 858 units were sold for commercial vehicles. According to the World Bank, growth in the region of Africa is projected to increase to 3.2 percent in 2018 and 3.5 percent in 2019 as commodity prices are firming and domestic demand is gradually increasing. Africa's average vehicle ownership remains the lowest in the world by region. However, the continent has an immense potential to meet the mobility needs of the growing middle class. More intra- regional trade and industrialisation would also drive the growth of Africa.

The lack of access to trade and market information remains a major barrier to trade in intra-Africa. If trade and market information issues are solved on the continent and more opportunities for the export of manufactured goods are opened up, trade in Africa could significantly increase by around 15 percent from its present levels.

The main new vehicle markets on the continent are South Africa and the countries of North Africa. Imports of used cars are not allowed in South Africa and in North African countries, but account for the bulk of sales in the rest of the continent's countries and continue to diminish demand for new vehicles. The table 4 below shows the top ten new vehicle markets for 2016 and 2017 in Africa.

The table 4: Vehicle Production Sales

Countries and 2017 ranking	Total new vehicle sales 2016	Total new vehicle sales 2017	Passenger cars 2017	Commercial vehicles 2017
1. South Africa	547 546	557 701	368 112	189 589
2. Egypt	264 100	181 001	133 391	47 610
3. Morocco	163 110	168 913	155 218	13 695
4. Algeria	96 600	94 408	74 979	19 429
5. Tunisia	50 800	47 359	35 963	11 396
6. Reunion	29 547	31 039	25 289	5 750
7. Libya	46 400	23 600	15 800	7 800
8. Mauritius	11 000	12 597	10 353	2 244
9. Kenya	10 600	11 886	2 254	9 632
10. Ivory Coast	6 400	7 118	4 438	2 680
Total new vehicle sales	**1 315 163**	**1 195 765**	**862 907**	**332 858**

Source: Lamprecht, 2018

Over the past decade, the African continent has received increased interest from OEMs and a wide range of automotive stakeholders. This has resulted in a number of OEMs strengthen the administration of this market, while many national governments express their desire to create a domestic automotive industry. Investors need to be sure that their capital is safeguarded and that they are allowed to earn rewards if they invest in local companies. Large- scale manufacturing investment is a long- term decision that must be based on sound, efficient and stable policies to ensure that business can flourish and deliver consistently to the market.

Automotive manufacturers therefore move closer to African vehicle manufacturing markets – a practice mainly adopted by countries like Kenya and Nigeria due to local content promotion policies – resulting in import restrictions for second - hand vehicles and higher tariffs for new vehicles. As the African continent becomes increasingly valuable in the global economy, it is essential that South Africa utilizes its well-established regional network, develops other markets and builds relationships, in particular with nations where vehicle manufacturers are present.

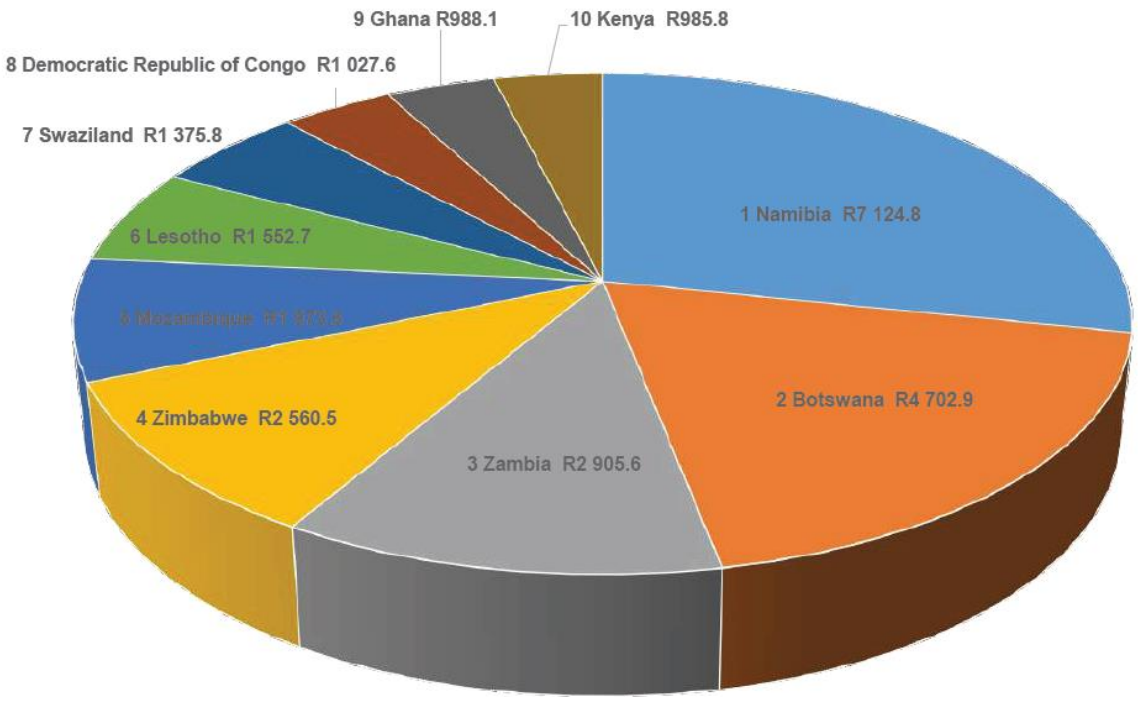

Figure 14: Top African export destinations

Source: Lamprecht, 2018

The focus on Africa is very much in line with the South African Master Plan 2021-2035, which focuses mainly on regional integration and trade. Figure 14 illustrates top export destinations in Africa with export values for the year 2017 (R million). The Republic of South Africa is the only nation in sub- Saharan Africa where the manufacture of vehicles has reached the scale to drive a cumulative connection building process. With it's know- how, the country is ideally positioned to benefit from the continent's increased demand for vehicles, assembly kits and automotive components.

The proximity of South Africa to other emerging markets and its knowledge of business conditions and practices in other African countries makes it an ideal partner to help set up a vehicle assembly operation. South Africa's incentive to help other countries in the region lies in economies of scale and increased foreign investment, which are made to specialize in certain models and parts in different countries in the long term. The expansion of automotive industries outside South Africa offers the opportunity for South African component manufacturers to export to infant assembly operations in Africa. Aftermarket production is also a potential starting point for nations in the region that still have no considerable demand for new vehicles or the ability to compete in the

full- scale production of vehicles. In general, the production of vehicles and components could also lead to significant overflows in other industries.

3.3. Global Automotive Industry

The automotive industry is part of an open, dynamic and self-organizing eco-system of physical assets, services and content. Discovering the correct balance between where to compete, collaborate or unite with industry peers and astutely integrating content from non-asset based digital challenger (KPMG, 2018).

In Europe alone, the car business represents around 12 million employments (counting related occupations); in the US, in excess of eight million; and in Japan, in excess of five million. McKinsey's (2013) examination recounts a story that is to a great extent hopeful and now and again astounding. In any case the most essential story string is that the international automotive industry is going to enter a time of far reaching and transformative change.

Electric fuel cell vehicles replaced electric battery vehicles as the number one key trend this in 2018 until 2025. Though fully electric drive trains like Battery Electric Vehicle (BEV) and Fuel Cell Electric Vehicle (FCEV) lead the ranking again this year, trends show that different drive train innovations will coexist with high reliance on specific applications, local guidelines and customer preferences in the future technology roadmap (KPMG, 2017). Furthermore, without digitisation, there will be no added value services and new content as one of the crucial enablers. According to KPMG (2018), connectivity and digitalisation continue to remain the 2nd best priority, with exception of content and service- related topics that are otherwise still lower.

The vast majority of executives argue that in future we will no longer distinguish between the business models for the transport of people and goods (KPMG, 2018). Autonomy, sharing and platform- based service delivery will reshape mobility trends and bring mobility and logistics together. One of the most startling results; 73 percent of executives are confident that traditional public transport solutions could be replaced by autonomous capsules on demand in 10 years (KPMG, 2018).Seen Figure 15 for global trends in the automotive industry.

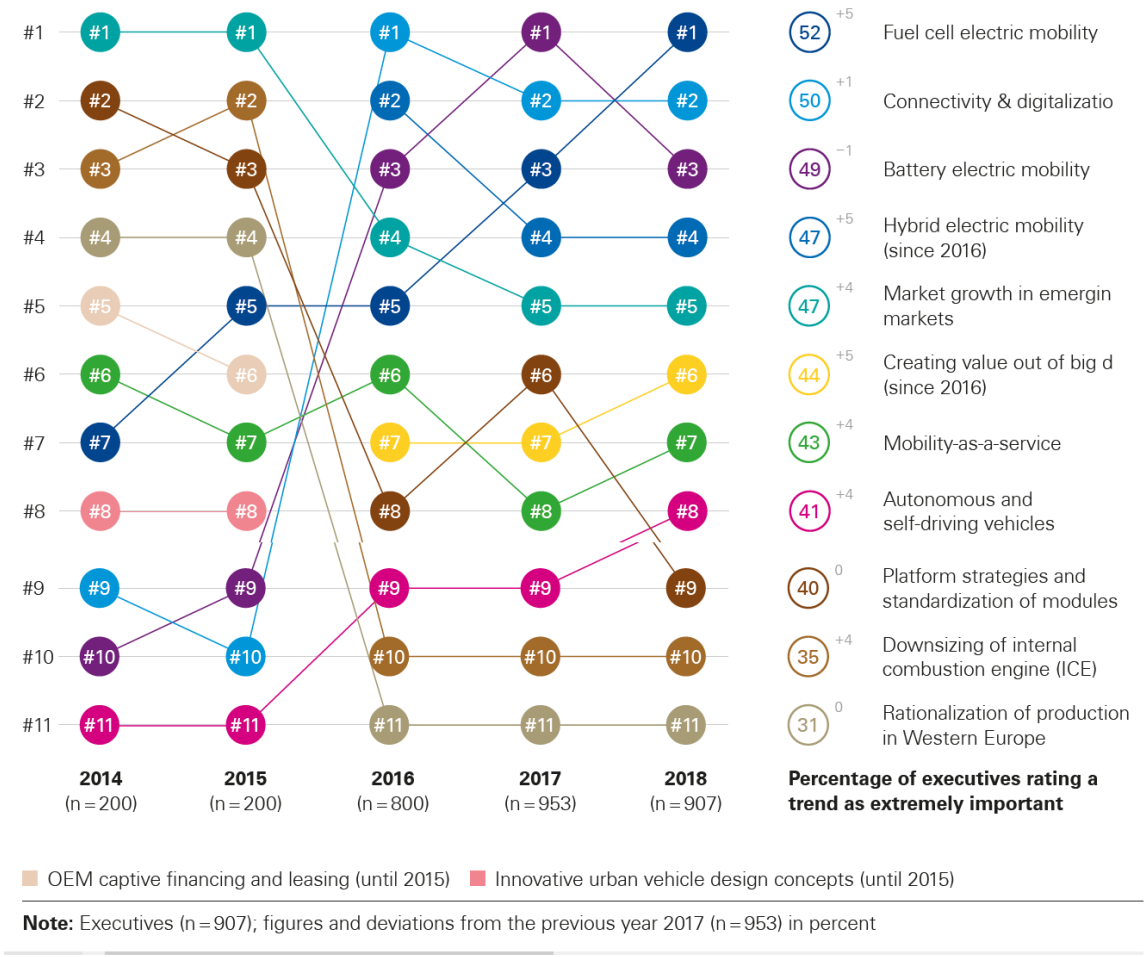

Figure 15: Global Automotive Executive Key Trends until 2025

Source: KPMG, 2018

Electric fuel cell vehicles superseded electric battery vehicles as the number one key trend in the year 2018 until 2025. Although fully electric drive trains dominate the ranking again this year, trends indicate that different drive train technologies coexist with high dependence on specific applications, local regulations and customer preferences in the future technology road map(KPMG, 2018). Fuel cell electric mobility is the number one key trend this year, rising from its number 5 ranking in 2016. Electric mobility, in general, is extremely high, with three of the top four ranks. This shows how traditionally product-oriented trends continue to dominate the agenda of executives(KPMG, 2018). Connectivity is definitely one of the most significant requirements for the provision of additional services and content in the vehicle and stresses the necessity for user friendly seamless human-machine interface in the vehicle(McKinsey, 2013).

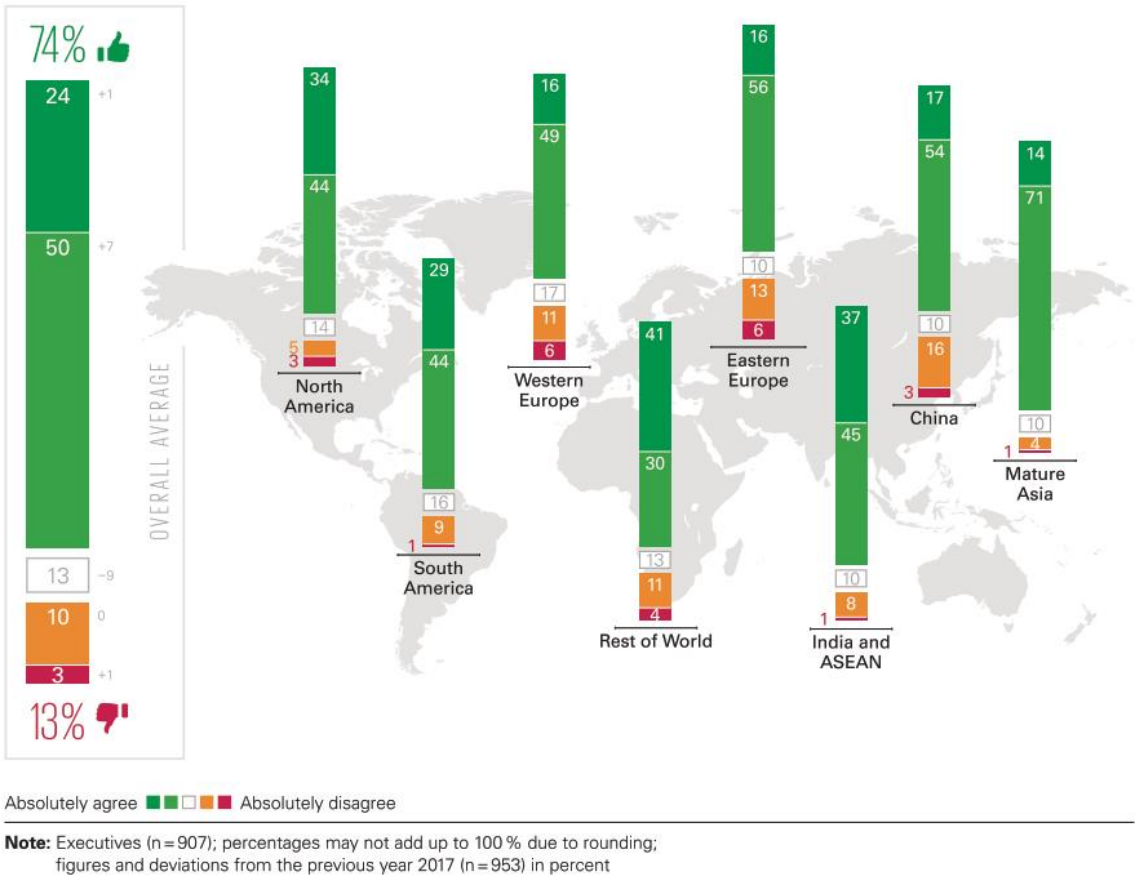

Figure 16: Global car production

Source: KPMG, 2018

Based on the opinion of the executives, Western Europe finds itself diving in terms of production volume. As reported by KPMG (2018), Figure 16 depicts future global car productions. Compared to 2017, in 2018 even more managers (74%) assume that Western Europe's automotive assembly will be around 5%, which by 2030 will only total to 6.1 million units of global output based on current market forecasts. Executives have come to the realisation that sustained growth can only be achieved in Asia and that the European OEMs must now react(KPMG, 2018). Western Europe 's profitability of survival can happen if European OEMs take advantage of their technological advantage and make use of automation around industry 4.0 and digital labour. Automated Artificial intelligence technologies and Machine learning might ensure that the remaining 5% of production is secured in the European economy, but they should also not underestimate the criticality and role of brand reputation(KPMG, 2018). The less the market becomes customized, the fewer brands and the more chances they could find themselves in a mass market environment. European OEMs, on the other

hand, could take the opportunity to distinguish themselves by product, design or service and use their premium brand value.

Autonomous driving will disrupt mobility patterns, social aspects and fundamentally alter the mobility paradigm as we today know it(McKinsey, 2013). Although the radar technology has not been clear in recent years, it now appears to cluster its market once again. There will be several drive-train technologies in the future, as in the past. Combustion engines will coexist with alternative drive technology. The deployment and implementation of electric drive trains will be a long-term process that develops globally at different speeds, dependent on market maturity, economic wealth, government regulations and activist interests (KPMG, 2018). The view of mobility not only in terms of autonomous driving but also in terms of asset ownership sets a framework for the gradual evolution of today's mobility concepts from driver- assisted shared mobility to autonomous mobility and shared autonomy(Daimler, 2017).

3.4. ENABLERS OF CHANGE

3.4.1. Technological factors

3.4.1.1. Big Data

The “Big Data “concept was initially used to refer to increasing data volumes in the mid-1990s. In 2001, Doug Laney, then a consultant analyst, expanded the concept of Big Data to include increases in variety of data created by entities and the speed at which these data were produced and updated. Those three factors; volume, velocity and variety; became the Big Data 3V’s.

The collection and comprehensive evaluation of data from various sources will become standard to support real-time decision making (Rüßmann et al., 2015). Predictive analytics tools allow Industry 4.0 data to be processed into data sets taking non-visible factors to create self-aware, self-maintaining production and service facilities (Nikolic, Ignjatic, Suzic, Stevanov, & Rikalovic, 2017). Big data shows that it is progressively a vital element of economic growth. The ability to access and combine large data sets opens up opportunities that traditionally were not feasible. (Uglovskaia, 2017).Big data; a collection of data and technology that accesses, integrates, and reports all available data by filtering, correlating, and reporting insights not attainable

with past data technologies. Big data can improve demand forecasts, supply chain planning, and other manufacturing areas (Peninsula & Africa, 2016).

Big data analysis differs from traditional analytics in that the processed data are now available in higher volumes, speeds and varieties than before. Big data can improve demand forecasts, supply chain planning, and other production areas (Strandhagen, Alfnes, Strandhagen, & Vallandingham, 2017). As can be depicted in Figure 17, big data encapsulates all forms of data from text, numeric, bio-metric and photo-graphics.

Figure 17: Big Data

Source: Uglovskaia, 2017

Data management and distribution in the Big Data environment is essential to self - learning machines. The real processing of Big Data into useful information is the key to sustainable innovation in an Industry 4.0 plant. (Lee, Kao, & Yang, 2014). Industry 4.0 is a complex concept that not only replaces old facilities with new facilities, but also changes the organizational culture and overcomes the managements challenges created by disruptive technologies in three different dimensions: operational efficiency prospect, new business frameworks and digital Transformation fundamentals of the company (Uglovskaia, 2017).

Cloud - based production will make an important contribution to Industry 4.0's success. The use of cloud - based applications facilitates the collection, monitoring,

distribution and analysis of data, it offers flexibility and unlimited access to all key information. It also saves costs by eliminating the need for heavy local software and hardware applications. Cloud - based solutions therefore facilitate the efficient use of large data flows not only between factories but also throughout the entire value chain.

Big data analysis, the collection and analysis of relevant production data is a key to an efficient decision - making process (Strandhagen et al., 2017). Data collection and analysis allows managers to base their decisions on evidence rather than intuition. With the ability to make information carriers for products and the possibility to track and identify products, this information can be used to support decision making and to control production (Lidong & Guanghui, 2016) . In the concept of industry 4.0, data collection and analysis is often referred to as big data.

The ability to acquire and organize large data to maximize profitability and improve decision - making is another benefit of the concept. Digitalisation increases understanding by making data accessible and ready for use (Uglovskaia, 2017). Big data analysis can point to different business economic advantages, such as new revenue possibilities, more efficient marketing, better customer service, improved operational productivity and competitive advantages over competitors driven by highly specialized analytics systems and software.(Rouse, 2018).

3.4.1.2. Artificial Intelligence

Rapid advances in artificial intelligence / machine learning and its potential role in our social, economic and political culture demonstrate its relevance to the next generation of undergraduates(Keating & Nourbakhsh, 2018). A wide range of expert fields emerge from artificial intelligence (AI) applications. Artificial intelligence is a subfield in computer science that is solely intended to give human intelligence to machines or robots that become self-related platforms and can autonomously make intelligent decisions (Toor, 2017). There are two types of AI, Narrow AI, that have been related to applications that we are witnessing in specific fields these days, and then there is " Strong AI, " which discusses artificial general intelligence (AGI), which is still under development. The AGI concept is broad, deep and comprises characteristics that surpass human intelligence in many configurations, such as analytical speed, memory, multi - tasking, pattern recognition and adaptability to new self-learned information. According to Kasvosve (2017), AI covers three broad areas; Cognitive Science

Applications; Robotics Applications; and Natural Interface Applications Figure 18 below depicts an overview of AI with the relevant applications in each of the domains.

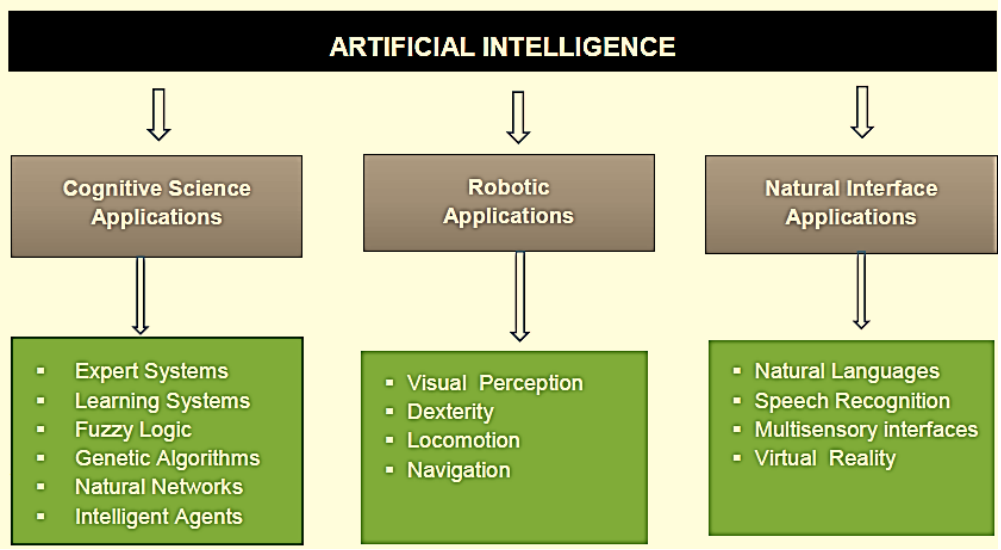

Figure 18: Artificial Intelligence Overview:

Source: Kasvosve, 2017

According to (Hawking et al. 2014), the success in creating AI would be the largest event in human history, but they are not sure that it could also be the last, if we do not learn how to circumvent risk., This means that the experts generally hold tentative views for AI (Hawking et al. 2014). Projections from the PwC (2016) study suggest that AI robots can take employment of up to 50% from humans in the next 30 years, for instance. Smart factories will be aided with advanced human resource programs in 'Virtual and Augmented Reality'. It is a simulated computer environment that is also called Virtual Reality (VR), it has the ability to create real-life like environmental space with the help of compatible digital devices which can help with employee training programs and in operational process assistance. By using Big Data Analytics and Artificial Intelligence (AI) machines can self-optimise (Lidong & Guanghui, 2016). A requirement is that machines have sensors and that large amounts of historical data is stored. The machines can optimize themselves based on different predefined criteria, for example shortest lead-time or lowest cost (Antonsson, 2017).

The application of artificial intelligence to manufacturing processes is normally seen as a natural step and can help create systems for decision - making and action based

on the current environment (Strandhagen et al., 2017). In the light of the fourth industrial revolution, enormous amounts of data can be collected where machines and products can interact without people's intervention.

3.4.1.3. Internet of Things

In an Internet-connected world, data is essential to the global economy. While global trade in goods has levelled off and cross-border capital flows have sharply declined over the last decade, cross-border data flows have increased more dramatically than anticipated. Based on the rapid adoption of new technologies, the use of data, when well-managed, can change business models and improve efficiency. While existing economic activity and, to a significant degree, economic growth is dependent on data usage and sharing, some nations are enacting barriers to international data transfers (Sater, 2017). A concept design of a network showing inter-connected devices can be viewed in Figure 19.

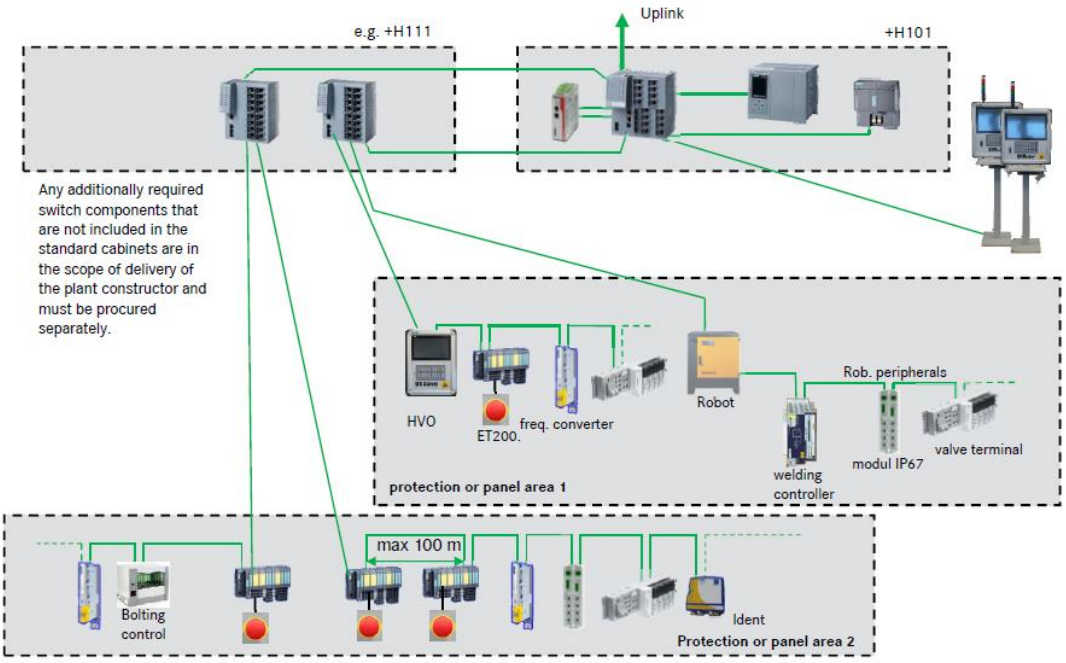

Figure 19: Networked Internet of Things

Source: Daimler, 2017

The Internet of Things (IoT) is a concept that includes different objects and communication methods for exchanging information. Today IoT is more a description of a vision that all things should be connected to the Internet. IoT will be crucial in the future because the concept opens up new services and innovations. All objects will be

linked to one another and can communicate effectively in unprotected environments. This later aspect leads to major security challenges (Bude, Kervefors, Bude, & Kervefors, 2015).

One of the most discussed technological developments impacting businesses across industries is the Internet of Things .The IoT can be described as the pervasive presence of a variety of things or objects around us, such as radio frequency identification (RFID) tags, sensors, actuators, mobile phones, etc., which can communicate with one another and collaborate with their neighbour's through distinctive addressing schemes can interact with each other and cooperate with their neighbour's to achieve common objectives (Ali & Ali, 2016).

To simplify the definition IoT is the connection of devices to the internet. According to Gartner (2017), the number of smart connected devices (SCD) will increase from 4.9 billion in 2015 to around 25 billion until 2020. Swan (2012) even estimates that 50 billion SCD will exist by 2020 as shown in Figure 20. The IoT will have a huge effect on the economy by turning many enterprises into digital companies. Facilitation of new business models, improved efficiency and greater interaction between employees and customers (Gartner Inc. et al., 2017). Figure 20 shows a continuous incline in the number of connected devices since 1992.

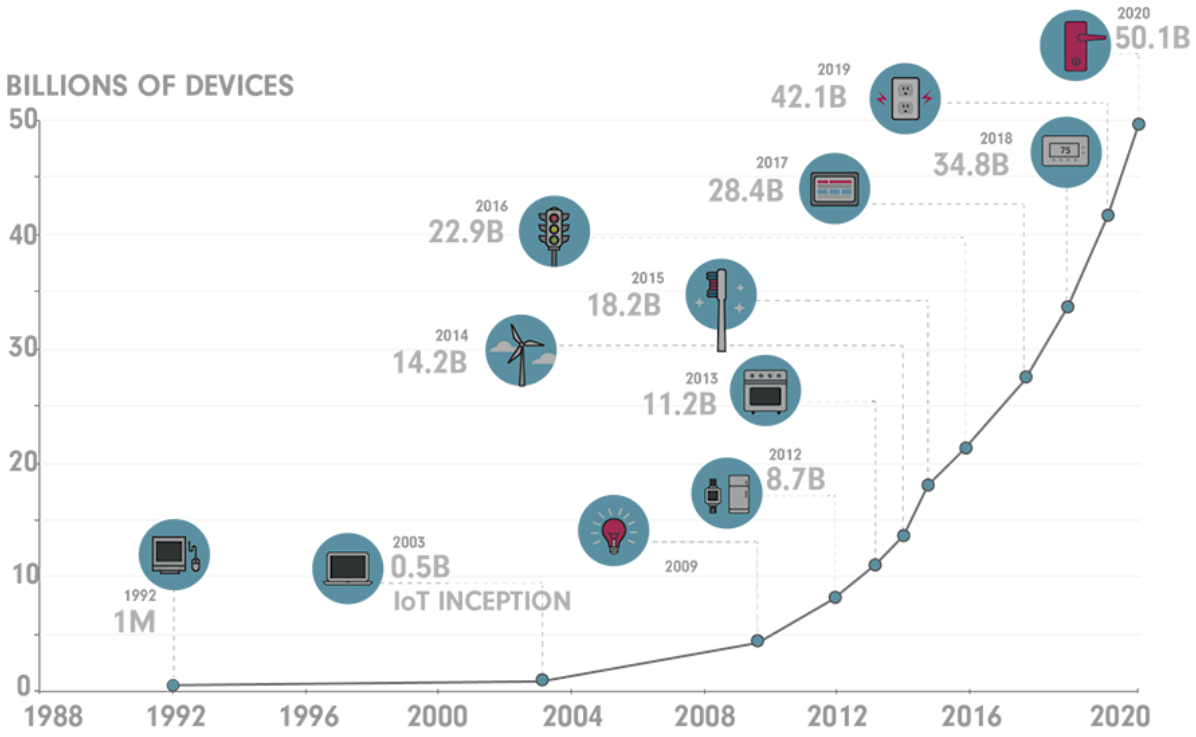

Figure 20: Number of SCD, Internet of Things

Source: NCTA. 2016

The Industrial Internet of Things (IIoT) is the use of the Internet of things (IoT) in manufacturing technologies, it incorporates machine learning and Big Data technology, machine - to - machine communication and automation technology, which has been around for many years in industrial environments. The driving force behind this is that intelligent machines capture and communicate data consistently and accurately better than human beings.

Companies in the automotive industry that are already part of IoT believe that IoT has a business potential for their future use, they mostly use the term to describe a way to improve efficiency of production and innovation. Cisco describes IoT as a notion in which more and more things are connected to the Internet to facilitate the daily lives of people. As we connect more things, however, the need for Internet Protocol version 6(IPV6), Big Data and cloud computing will increase, thus making the concept of IoT an Internet of everything (IoE) (Bude et al., 2015).

Substantial progress is already being done in South Africa, as IoT plans are in headway and the development of smart cities is of top priority(Mark Ludwik Putzier, 2017). According to Putzier (2017), the city of Johannesburg and Cape Town are

regarded as trend setters in the progression to become smart cities. The IoT is crucial to the realisation becoming a smart city, it enables navigation between the physical and the digital space. South African metropolis need to have a long-term strategic plan in order to manage the following six key areas:

- Gas and electricity
- Sanitation and waste;
- Safety and security;
- Water;
- Transportation and traffic management;
- Connectivity.

3.4.1.4. Lifi

Globalisation has connected us through a large number of visible and not so visible networked pathways. These networks cover houses, towns, nations and continents. The world is truly becoming a global society whose appetite for connectivity, data and convenience is now insatiable(Fergusson, 2016). The world is exponentially developing and has adopted smartphone technology that allows us to carry advanced microcomputers in our pockets. Most of these smart devices are wirelessly connected to Internet service providers who connect to the World Wide Web. With just a swipe of a finger you can find the weather in any nation state on the global map at that exact moment (Hendriks, 2016). Apart from the negative impact that this has on our social skills, there is a price we pay in the airwaves. (Fergusson, 2016).

This ' wireless ' communication is completed through the Radio Frequency (RF) band and limited by frequency blocks, each of which has a limited bandwidth (Fergusson, 2016) . There will be a time when the majority of accessible bands are allocated altogether, which means that the consumer blocks are blocked, and that communication is incapable and disrupted (Fergusson, 2016). Although it is a' first world problem,' it will have a negative impact on society, with deeper exclusivity in signal allocation and wireless communications (Fergusson, 2016). An additional or substitution strategy for communication should be developed to combat the unavoidable saturation of the RF band. There is such a strategy and it uses a generally

undiscovered source of waves, with an amazingly extensive transfer speed. This method uses the visible light spectrum band, which is shown in Figure 21 below.

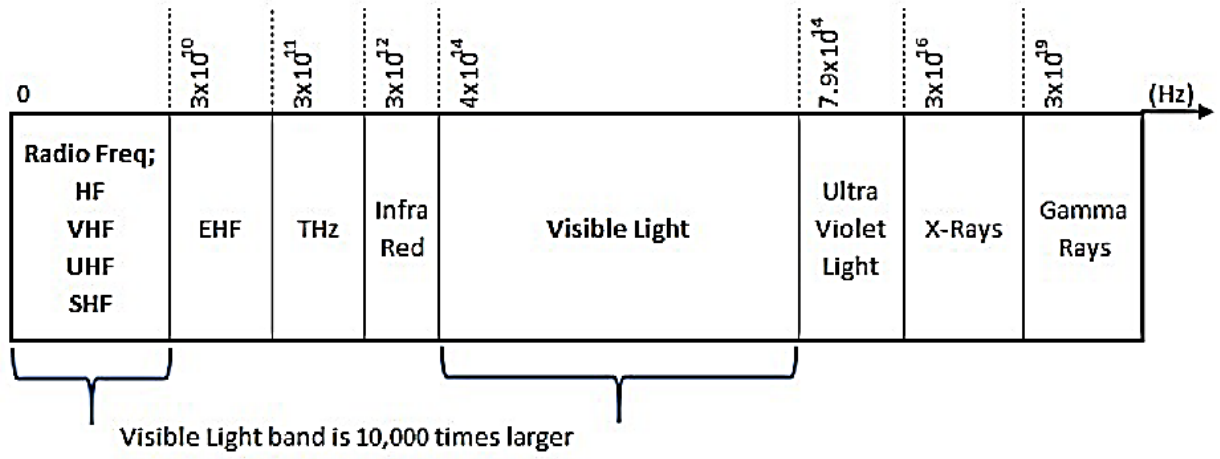

Figure 21: electromagnetic spectrum

Source: Fergusson, 2016

The available electromagnetic spectrum of RF and Visible Light can be seen to be allocated disproportionately in current communication methods. There is not only greater space to grow, it is safer on the environment, the band cannot be regulated, leased or saturated, it does not create electromagnetic interference with other devices and data modulation at frequencies that the human eye cannot detect. (Stefan & Haas 2014). Research conducted by Rajagpol et al. (2012) is underway in which data streaming is carried out at light levels so that light appears to be off according to the human eye.

This could account for dark environments or during the day when people use their devices intentionally. With such a relatively new green technology, the limits are at the outer bounds of current electrical equipment, similar to Wi-Fi when it emerged(Haas, Yin, Wang, & Chen, 2016). The uses seem endless, ranging from vehicle to vehicle communication, line of sight secure data networks, underwater communication and all communication speeds greater than 3GB per second that are not accessible to everyday society at present. (Stefan & Haas 2014).

Visible light communication (VLC) is a field of research that has as of late gone up against more noteworthy significance within our modern day lives. The establishment of this technological product is based on the establishment of VLC combined with radar and machine vision. The idea of transmitting information by means of light waves

is developing into a subject that can yield solutions over our lives, including RF band clog and fulfilling the worldwide need for quicker and more complex data transmission (Fergusson, 2016). The quick expanding demand for wireless data communication has made the accessible radio range below 10 GHz to end up being inadequate(Haas et al., 2016). The wireless communication industry has reacted to this challenge by looking in to the radio range over 10 GHz (Haas, Yin, Wang, and Chen, 2016).

3.4.1.5. Cyber security

Cyber-Physical Systems (CPSs) integrate physical process dynamics with software and communication dynamics, providing design and analysis techniques for the integrated system (Shi, 2011). A CPS generally entails of two key functional components: (a) Advanced connectivity that ensures real - time physical data acquisition and cyber space feedback; (b) Smart data management, computational and analytical capabilities that builds the cyber space (Lidong & Guanghui, 2016). Some CPS-related technologies include IoT, wireless sensor networks and cloud computing. Wireless sensor networks are considered an essential part of the CPS. The necessity to safe-guard critical industrial systems and manufacturing lines against cyber security threats increases dramatically with increased connectivity and the use of Industry 4.0 standard communications protocols.

Safe, reliable communication, sophisticated identity and access management of machines and users are therefore essential. (Thames & Schaefer, 2017). Cyber security is central to competitiveness. Innovative ways of handling Big Data and exploiting the potential of cloud computing will create new ways of using information. (Dujin, Geissler, & Horstkötter, 2014). Advanced production benefits from improvements in communications technology and tends to increase connectivity in all sectors. With increased connectivity and the use of standardised communication procedures, critical industrial systems and production lines must be protected from cybersecurity threats. (Moraes & Lepikson, 2017).

Computer dynamics, networking and physical systems interact in ways that essentially require new design technologies. The technology relies on multi-disciplines like integrated systems, computers and communication protocols. Cyber security will be one of the major categories of risk. It is also believed that data protection and various

communication protocols in single factories and between companies pose a major risk to the future of smart factories. (Schlötzer, 2015).

3.4.1.6. Block Chain

Blockchain is a technology used in society, and like most technologies it is a tool designed to make society better and merely about change management(Paper, 2018). Simply put, Blockchain is a new type of database without a middleman, opening up a variety of new opportunities which was released as an open source software, based on distributed ledger technology (Shanti, 2017). A blockchain is a decentralized, distributed database which is used to retain a constantly developing list of records, referred to as blocks. Each and every block encompasses a timestamp and a connection to a preceding block(Shanti, 2017).

Blockchains are fundamentally resistant to any type of modification of the data, this is due to their design and purpose. Blockchains can work as 'an open, distributed ledger which can record trades between two parties in an efficiently and reliable away(Fu, Shu, & Liu, 2018). Fu et al (2018) argue that blockchain could be regarded as a distributed electronic ledger that enables a way to log and share data from a community based on software algorithms. Each member in the community maintains their own copy of the data and all members must validate any updates collectively through complex mathematical software algorithms, cryptology enables the replacement of third-party intermediaries as the keeper of trust (Fu et al., 2018)

The technology was initiated by virtual currencies and their disruptive potential on financial markets. Bitcoin which is a cryptocurrency was introduced on 31 October 2008 by Satoshi Nakamoto made use of blockchain technology (Abeloos, 2017). Blockchain's key building blocks include 5G, cloud computing, Internet of Things, Big Data and cyber security technologies. The technology will can benefit application areas which include: eHealth, smart energy and cities, connected & automated vehicles, advanced manufacturing. This new technology allows a shared digital ledger to be kept, making it impossible to interfere with any single record without being noticed. (Hawes, 2016). Figure 22 shows the phenomena graphically.

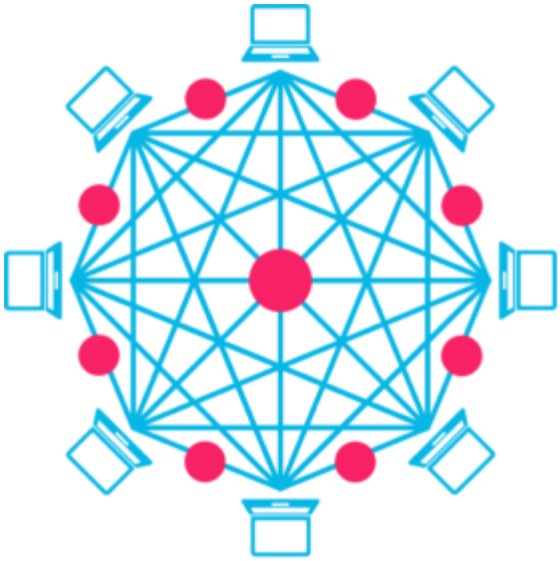

Figure 22: Blockchain

Source: Dughi, 2017

Blockchain provides digital trust and automation in information exchange between trading partners (Dughi, 2017). Cybercrime is on the rise, as the world gravitates more towards digitalisation, more opportunities open up within the cybercrime space. Substantial improvements in cybersecurity and blockchain innovations give companies the confidence to connect their factories and store large amounts of intellectual property data in the cloud. (Hawes, 2016).With cryptographic algorithms as the fundamental baseline, blockchain offers distributed control and the very critical benefit of creating a secure system(Mark Ludwik Putzier, 2017).

Trust issues in society are the driving force behind such comprehensive regulatory frameworks, but emerging technology like blockchain can aid in minimizing these privacy concern. Therefore, blockchain offers significant promise to further unlock the value of globally transferable data. However, a traditional permission less and publicly accessible blockchain, like Bitcoin, may not always be the most appropriate option for use by corporations because of the scalability issues, the lack of overall infrastructure controls, and the energy-intensive nature of proof of work. Conversely, an entirely private blockchain, one that is not publicly viewable or accessible, is mostly a traditional system with cryptographic capabilities. Because corporations require a hybrid of various configurations, this paper focuses on a consortium blockchain, which is a semi-trusted and permissioned blockchain that allows only an approved group of

entities or individuals to create, view, and verify transactions. This configuration is a superior option for organizational collaboration. The Enterprise Ethereum Alliance, which utilizes the Ethereum protocol, and Linux's hyper ledger Project are consortiums of multinational companies building industrial blockchain applications. While Hyper ledger is not a protocol like Ethereum, both consortiums share the goal of utilizing a community effort to produce interoperable and modular blockchain solutions across multiple industries (Sater, 2017).

Blockchain is indeed one of the key breakthroughs within the current technology revolution. A technology that allows big groups of people and firms to reach agreement on and permanent record of data without a third party acting as the intermediary. The tool is critical for creating online trust with the potentially of providing infrastructure for a rational, inclusive, secure and democratic digital economy (Lyons, 2018). Tax and accounting treatment of crypto-assets is still very unclear.

3.4.1.7. Key challenges and barriers for Blockchain

Considering the fact that it is still a relatively young technology and open-source, blockchain is also still quite malleable. People can and do experiment with it, change it, adapt as it is still evolving very rapidly. There are critical areas that this technology touches on in which there is no or little legal and regulatory clarity or unity, lack of clarity can hinder the development of the innovation(Lyons, 2018). Security is another issue. Blockchains rely on sophisticated cryptography to encrypt data and maintain the integrity of the ledger. The introduction of quantum computing may make the encryption algorithms that underlie many of today's blockchains vulnerable to attack, making it probable, for example, to break the elliptic curve signature scheme and calculate the private key based on the public key. However, it is quite possible that by the time quantum computing becomes mainstream, many blockchains will have switched to quantum-resistant solutions (Lyons, 2018)

3.4.1.7. 3D Printing

3-D printing is a technology that creates physical objects from digital designs by creating multiple layers of plastic, resin or other materials in an accurately defined form (Uglovskaia, 2017). The technology can be an enable of more customised production, which is one of industry's goals 4.0 (Strandhagen et al., 2017). 3-D simulations of

products, materials, and production processes are already used, but in the future, simulations will be used more extensively in plant operations as well. These simulations use real - time data to reflect the physical world in a virtual model that can include machines, products and people. (Rüßmann, et al., 2015). 3D printing, advanced robotics and energy storage are drivers that reduce costs and increase the benefits of digitalisation in terms of quality (Uglovskaia, 2017). 3D printing is not widely used in the South African manufacturing industry, although there is a high awareness of the importance and potential of this growing technology. (Deloitte, 2016).

3.4.1.8. Automobile mobility

The future in automotive mobility still has not started properly, as some are already planning the uprising. It's about the retrofitting of assistance systems and autonomous driving – one the coming gaps in the market. The current developments in this field are usually only in the newest Series deal - and for a lot of money. Always more companies are now beginning to change that. They search for solutions as they cost the security features accessible to a broad mass of motorists can do. Mobility has continually relied depended on an asset - based product and will always depend on it, but we will see a change in perception. While the product itself has in the historically has been the main focus of OEMs internally and to the end user, it will be integrated into the ecosystem in the near future, whereby the customer will not want to differentiate between product, service and content (KPMG, 2018).

One of the first to be involved was George Hotz, a young IT expert from California. He founded the company comma.ai (www.comma.ai) with the aim of to offer "Ghost riding for the masses" at a reasonable cost. In 2015, he introduced "comma one", a retrofit kit for modern vehicle types, autonomous driving for the price of around $ 1,000. It consisted from a converted smartphone with appropriate Software, a vehicle mount and a connection to the on-board electronics. The system took advantage of existing ones Cameras and assistance systems in the car too. Compared to the first system available on the market Tesla, which was six times more expensive, resembled the offer from comma.ai a bargain - especially since they are the same functions like Tesla's autopilot offered. Both developments made level 2 of automated driving possible. Figure 23 is a visual representation of the concept which is yet to be fully realised.

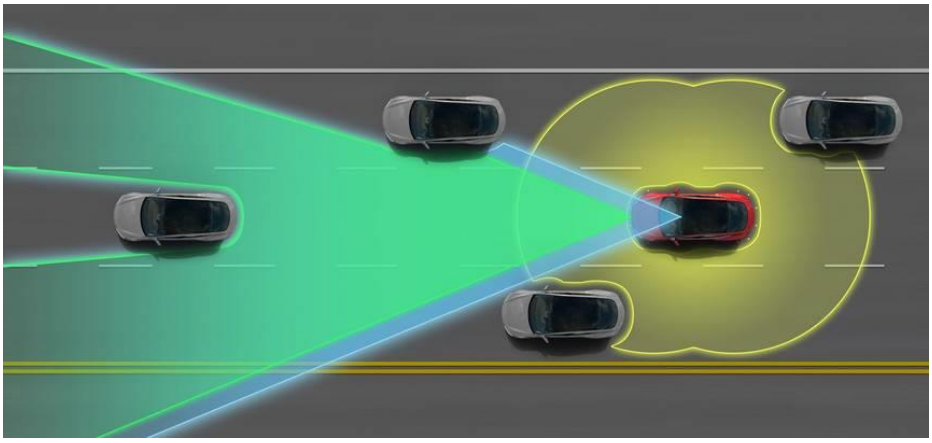

Figure 23: Autonomous Driving

Source: Daimler, 2017

Various retrofits for autonomous driving Imitators emerged fast. Matt Schulwitz, for example former Tesla employee, founded the company Neodriven (www.neodriven.com) and developed on the basis of the Hotz system a separate module for autonomous Drive. Like comma one also uses Neodriven as central processing unit a smartphone and offers that Retrofit kit for $ 999 on the website.
The Californian Start-up is considered one the pioneers for the Retrofit from autonomous driving. In 2015, it brought in the software-based application out, put but the sales quickly back in and out published the Technology online. Imitator found each other quickly

3.4.1.9.5 G

The fifth generation of the mobile network will be ten times be faster than the current 4G / LTE network. Data transfer rates 1.25 gigabytes per second should be possible with it. Latencies (delays in transmission) from below one millisecond between the real-time communication transmitter and receiver possible. Such a mobile network is in a world in which autonomous moving cars with each other and with traffic management systems communicate with users of car-sharing services, essential. Because the traffic of the future will be huge Data volumes communicate safely and without delay have to arrive at the receiver.

3.4.2. Technology

Technology has been described in a variety of ways. For a scientist, technology is the end product of research inventions and know- how developed in a commercial product

such as research papers and patent disclosures that can be reused to demonstrate an inventive concept. The engineer believes that technology is a tool or process that can be used to produce better products. Engineers often develop new technologies that have a significant impact on income and profitability of the company. It is important to recognize different approaches to technology definition. The range of definitions shows that a variety of things are different. The processes used to change inputs into outputs

- Using knowledge to perform work;
- The theoretical and practical knowledge, skills and artifacts used in the development of products and their production and delivery systems;
- The technical means by which people improve their environments;
- Use of science, especially for industrial or commercial purposes
- And the entire body of methods and materials used to achieve such objectives

Although the definitions of technology vary widely, there are also certain mutual elements in each definition. Each definition suggests that technology involves a process, that technology results from change and that technology involves a systematic approach to delivering the desired results (improvements, goals and outputs). Technology is the knowledge, products, processes, tools and systems used in the manufacture or supply of goods.

Rubenstein (2000) defines innovation as “the process whereby new and improved products, processes, materials, and services are developed and transferred to a plant and/or market where they are appropriate. Technology and innovation influence both the firm and nation as a whole, and this impact is continuing at a rapid pace. Industries can be created or destroyed very quickly because of new technologies (Sahlman, 2010).

One of the key ways that a firm obtains efficiency and profitability is through the use of technology. Technology helps push firms to lower costs. Thus, the use of technology in one domain typically leads to greater need for changes in technology in other areas. Technology and innovation must add value to the firm or to society in order to have competitive advantage (Utah Valley University, 2017). The goal of technology and innovation processes is to add value to the business but not just for the purpose of

creation. This typically means that there is a profit motive for the business or an efficiency and effectiveness motive for nonprofits

Integrating your business and IT strategies requires a deep understanding of customers and competitors, as well as your own operating process and accounting needs. Further understanding how technology impacts on each of the drivers is essential to evolve an IT planning that becomes core element of your business strategy. Technology is the result of our strategy not the cause of it, but most importantly, customers are the source of our strategy. (Shultz, 2005)

The advances in technology drive a great amount of the change that occurs in business organizations. The competitive advantage in today's business environment includes, in great part, staying on top of technological advancements that impact your industry. According to White and Bruton (2010), technology is a critical part of the organisation strategic success that should be planned, actively chosen, and constantly evaluated and adjusted as necessary. Strategic management is thus critical for an organisation as it helps the entire organisation move toward consistent goals.

Van Der Zee and De Jong (2015, p. 143) suggests that the process of integrating business and management of technology needs to be carried out by those who understand the strategic direction of the company, who are deeply involved with the business issues at hand, who are able to think in terms of business results, and who understand the capabilities of today's technology.

3.4.3. ENTREPRENEURIAL ECOSYSTEMS

Entrepreneurship can be thought of as a wide field of exploitation with opportunities available in all industries. According to Stam (2014), an ecosystem is a biological system of organisms which interacting with their physical environment. The concept emphases that entrepreneurship happens in a community of interdependent actors and factors synchronized so that productive entrepreneurship is possible (Erik Stam, 2015). The entrepreneurial ecosystems approach shares with more established concepts like clusters, industrial districts, innovation systems and learning regions that focus on the firm’s external conditions for innovation and business performance (Erik Stam, 2014). Researchers argue effectively for an ecosystems approach that supports entrepreneurial development systems. The ecosystem will create and grow a source

of entrepreneurial talent. Some academics argue and document the significance of creating communal capacity at a local level as a precondition for the formation of an effective ecosystem(Markley, Lyons, & Macke, 2015).

There is no one globally accepted definition of what the entrepreneurial ecosystem is, the concept is relatively new and lots of researchers are engaging in the debate (Kuratko, Fisher, Bloodgood, & Hornsby, 2017). The term consists of entrepreneur and ecosystem. An entrepreneur can be defined as a person who disrupts current economic order by presenting new products and services or by introducing new manufacturing methods or by creating new organizational forms and also by exploiting new raw materials.

The entrepreneurial ecosystems attempts to unite local cultural outlooks, investment capital, education institutions, economic policies, and social networks which produce environments conducive of innovation-based ventures (Spigel, 2017).

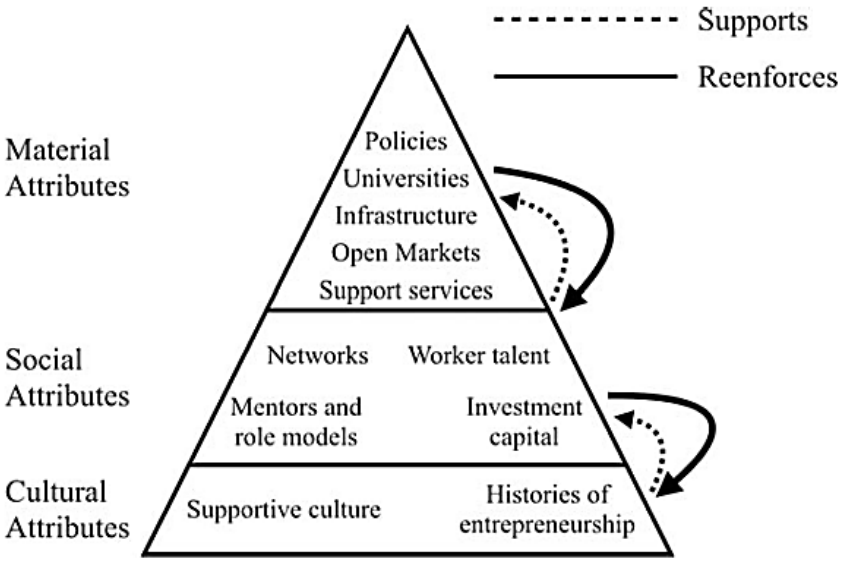

Figure 24: Relationships among Ecosystem Attributes

Source: Spigel, 2017

Ecosystems do not exist in isolation, organism must interact with one another in order to be productive and survive (Spigel, 2017). Similarly, entrepreneurial ecosystem has support and re-enforcing factors which influence one another. Sigel (2017) modelled the attributes of an ecosystem as having three hierarchical levels as depicted in Figure 24. The relationship between the elements of an ecosystem is a complex one in which all actors have a direct influence on each other regardless if the actor is on top or at

the bottom of the pyramid. Culture creates an environment through which supportive social attributes can develop. The cultural support plays a part in developing networks amongst entrepreneurs, venture capitalist, and consultants. The success of material characteristics strengthens social characteristics, which in turn strengthen cultural characteristics (Spigel, 2017). Programs and policies intended to boost entrepreneurship would be no use in the absence of entrepreneurs, consultants, and labour force who deliver productive outputs. These programs would not be successful without supportive social and cultural attributes (Spigel, 2017).

Public funding organisations which seek to address the issue of unemployment have started to shift focus towards entrepreneurship-focused interventions. The President of the Republic of South Africa Mr Cyril Ramaphosa on his state of the nation 2018 address said: " We will work with our social partners to build an ecosystem that supports, nurtures and promotes entrepreneurs in small businesses. (Politicsweb, 2018). Experience has shown interventions of financial supports have many floors. Policy makers have started to look towards more broad-based strategies of engagement which are aimed at enabling “entrepreneurial ecosystems” on local and regional scale(Davis, 2014)

Business science studies have generally overlooked the role of entrepreneurship in economic systems. Similar entrepreneurship research has also ignored the role of systems in explaining the prevalence and performance of entrepreneurship (Acs, Stam, Audretsch, & O’Connor, 2017).

The entrepreneurial ecosystems approach has the potential to correct these limitations in the entrepreneurial space. There are two lineages that are predominant, regional development literature and the strategy literature (Acs et al., 2017). Both lineages provide renewed insights and add new value in the community of entrepreneurship. But studies of both regional development and strategic management have to a large extent overlooked the role of entrepreneurs in new value creation (Acs et al., 2017). Markley et al (2015) argue that creating a community’s ability to participate in entrepreneurial activities in conjunction with a systematic method to developing entrepreneurs enables a more sustainable economic growth. This concept establishes that entrepreneur development is a community-based phenomena (Markley et al., 2015).

The notion of entrepreneurial ecosystems has fast set itself as one of the most recent trends in entrepreneurship research. At the forefront, this type of systemic approach to entrepreneurship brings about a new and idiosyncratic path for academics and policy makers to assist in the understanding of entrepreneurship (Brown & Mason, 2017).

Markley et al (2015) argue that entrepreneurial support programs tend to concentrate on growing the supply of technical assistance, consultative services and investment capital to would be entrepreneurs. These types of approach are not adequate to create the magnitude of influence required for sustainable regional economic development (Markley et al., 2015). Regions on a global perspective which communities want to emulate do not only attract or recruit entrepreneurs from other areas of the world, they develop them(Lichtenstein & Lyons, 2001). Successful entrepreneurial regions around the world include: Silicon Valley, Route128, Research Triangle, Emilia Romagna in Italy, and Tokyo.

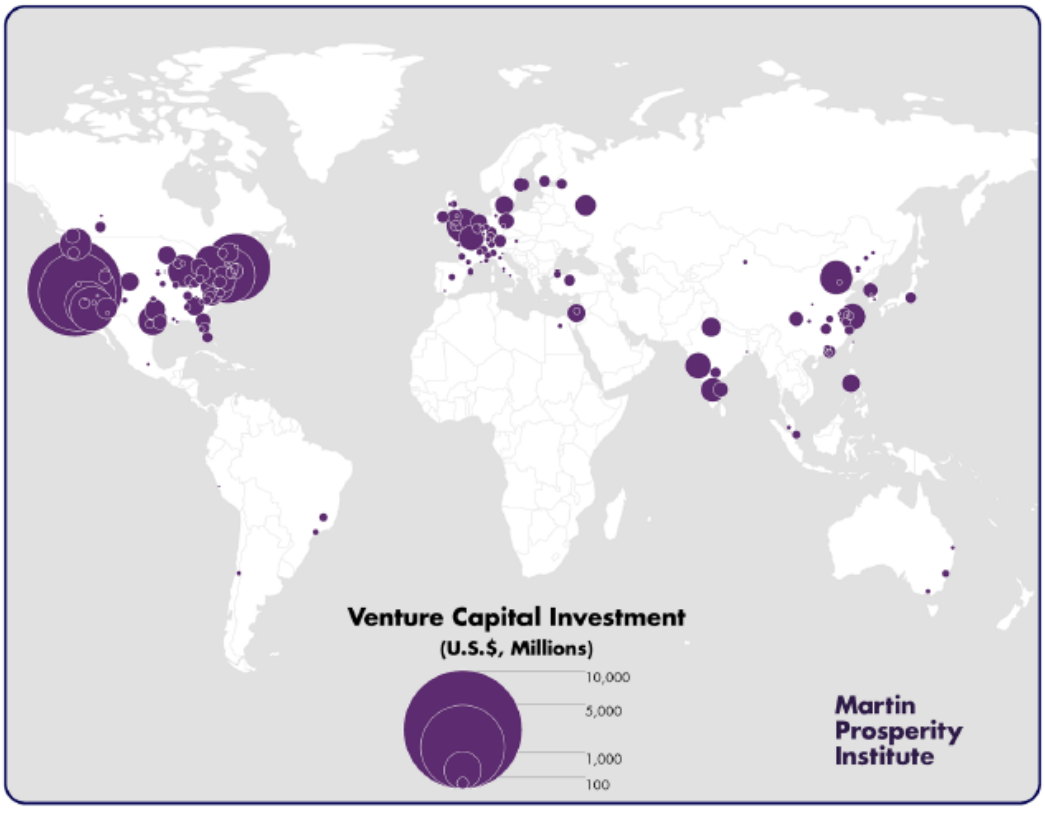

Figure 25: Global Venture Capital Investment

Source: *Florida & King, 2012*

Nearly seventy percent (68.6%) of the total global venture capital is accounted for by the United States of America, seconded by Asia at around14.4 %, then Europe which accounts for 13.5%.

Figure 25 above depicts the leading centres for venture capital investment across the world. The bigger circles represent the largest levels of venture capital investment. As can be seen these regions are located on the East and West Coasts of the United States of America. There are big concentrations also in Western Europe and around the big-cities of China and India (Florida & King, 2012).

According to Inkpen (2002), one of the reasons of success for India, Taiwan and China is because of migrants coming from Silicon Valley who assisted in industrial improvements. Silicon Valley's innovative engineers and entrepreneurs have aided in establishing global networks, especially in Taiwan and India, and gradually increasing in China (Inkpen, 2002).

According to Lichtenstein & Lyons (2001) the ability to create entrepreneurs is the reasons for the success and the abundance of money available for investment of these regions. The success of these regions is not qualified by the presence of financing and technical assistance, although these factors do play a role. Such a conclusions blurs the consequences of success with its causes(Lichtenstein & Lyons, 2001). The

capacity of the community or region to support and advance ecosystem development becomes a forerunner to an essential condition for, creating entrepreneurial talent (Markley et al., 2015).

Brown and Mason (2017) stipulate that the lack of specification and theoretical limitations has without a doubt held back the understanding of this complex concept. The quick adoption of the concept of Entrepreneurial Ecosystem has had a tendency to overlook the ecosystem's heterogeneity. Brown and Mason (2017) concluded that entrepreneurial ecosystems are a highly varied, multi-actor and multi-scalar phenomenon that requires tailor - made policy action.

The development of regions like Silicon Valley are linked to certain events which includes the founding of Stanford University which focused highly on industrialisation

on their course offerings. History reveals that the USA government shifted defence research budget away from the east coast in the 1930s and 1940s, this was then the emergence of the venture capital industry in the 1950s and 1960s. The USA has a culture that promotes risk taking, and innovation (E Stam & Spigel, 2017) .

3.4.3.1. Entrepreneurial Intention

Although there is no universally accepted definition for what an entrepreneur Shafi & Dad (2012) define an entrepreneur as a person who owns and runs a commercial enterprise by either adding value in an existing business model or creating new innovative business models. An entrepreneur can be characterized as a risk taker who brings change in their immediate surroundings (I, Shafi, & Dad, 2012). Entrepreneurship has been deemed in many instances as one of the main drivers of economic growth and development. A lot of researchers concur that environmental and personal characteristics are essential for becoming an entrepreneur, it is unclear if these characteristics influence are of equal importance (Pejić, Skok, & Suša, 2016). Various researchers have alluded to uncertainty regarding the relationship between innovativeness, gender, and entrepreneurial intensions.

Research concerning entrepreneurial intentions has shown the impact of various factors which influences one's intentions of becoming an entrepreneur. Amouri et al. (2016) found that entrepreneurial intentions are affected by an individuals' personal attraction to entrepreneurship, social norms among micro and macro environments that shape beliefs and attitudes towards entrepreneurship, and also perceived self-efficacy of an individual. Other research studies postulate that entrepreneurial intentions are strongly affected by gender, personal attraction and creativity of the individual. Bosma et al (2011) describes entrepreneurship as a procedure and capability of observing and taking advantage of good business opportunities in order to create value while accepting risks.

3.4.3.2. Factors Influencing Entrepreneurship

Role models are often perceived as crucial for shaping ones career choice and future aspirations. The global trend in higher education institutions is to involve entrepreneurs in their educational programs in an attempt to encourage, stimulate and support entrepreneurship among learners (Bosma, Hessels, Schutjens, Praag, & Verheul, 2011). Role models are regarded as influential individuals by a substantial proportion

of entrepreneurs, in the start-up phase entrepreneurs use them in their new venture creations (Lackéus, 2015). The main purpose of a role model is ‘learning by example’, although ‘learning by support’, ‘increasing entrepreneurial self-efficacy’ and ‘motivation’ are also important functions of role models. According to Amouri et al. (2016) people connected to role models as sources of tacit knowledge, tend to have a positive impact on entrepreneurial intentions.

Family. Parents have the strongest influence on their children’s attitudes, intentions and knowledge as they are the ones responsible for the upbringing of their offspring’s. Thus, individuals who grow up in an entrepreneurial environment which offers the opportunity to learn from self-employed parents benefit the most from the parents as role models. The parents provide a more holistic and realistic view point of self-employment. Entrepreneurial role models within a circle of family members are a unique source of tacit knowledge regarding business strategy and decision making (Amouri, Sidrat, Boudabbous, & Boujelbene, 2016).

Culture. Shafi and Dad (2012) conducted research on impacts of a countries culture on entrepreneurial intention, the study focused on perceived feasibility, and desirability and entrepreneurial experience. The study had limitations as it only covered Pakistan hence no conclusions came to pass. The study recommended education system in higher institutions would assist to increase the skill and competencies of students regarding entrepreneurship. Entrepreneurial intention differ culture to culture within different countries. Researchers are still uncertain, the overall impacts of culture on entrepreneurial intention, every nation has its own its values, norms and beliefs systems that influence the entrepreneurial intention, in some instances culture plays an important role in decision making. Lackeus (2015) in his report suggested that an education system which supports entrepreneurship is one of the factors which impact on entrepreneurial intention.

3.4.4. Leadership

Various academics and authors define leadership from different viewpoints. There is no one globally accepted definition of the concept of leadership. Leadership can be defined as an effort to influencing the activities of followers through the use of communication in an attempt to attain specified goals(Charlton, 2005). Another author defines leadership as an influence process that enable managers to get their people

to do willingly what must be done, do well what ought to be done (Smallwood, 2007). Leadership is defined as the process of influencing the activities of an organized group toward goal achievement(Collins, 2001). Though the concept of leadership is broad there are common traits across all definitions from various academics.

- Leadership is a process;
- It occurs in a group and;
- It involves influence.

Leadership is the art of influencing others to their maximum performance to accomplish any task, objective or project. Individuals with well-defined brands are clear about their identity. They know how to exploit their individual competencies (PWC, 2015). A leadership brand conveys your identity and distinctiveness as a leader, how others view you based on identity and differentiation. It communicates the value you one offers. If an individual has the incorrect leadership brand for the position, he/she holds, or the position ones aspires towards, the hard work is not going to have much of an impact it could exhibit.

The public and private sectors have many leaders who are exposed to immoral and unethical behaviours. Greed and corruption have caused corporate meltdowns, and escalating unethical practices. There has been a lot of financial scandals which revealed prominent companies of wrong doing. Leadership and management academics have begun to place a renewed emphasis on the importance of ethics and morality in exemplary leaders, and a plethora of values based leadership theories emerged(Copeland, 2014).

In the passed the most looked at leadership styles included charismatic and transformational leadership. These styles were encouraged and advanced as a strategy for increasing the effectiveness of business and society leaders.

Values based leadership describes behaviours that are deep rooted in ethical and moral foundations(Frost, 2014). Examples of the most notable VBL styles in the leadership research studies include, transformational, authentic, servant, spiritual, and ethical leadership.

The process of leadership has largely been characterised into three leadership styles: transactional leadership, transformational leadership and transcendental. A

transactional leader aims to influences people through use of rewards and punishments (Mugwagwa et al., 2018). Transformational leaders attempt to inspire, motivate, and lead with vision and ethics. The leadership style is crucial for institutions which want to succeed in the dynamic competitive environment of business, politics and economic society. Transformational leaders inspire and drive their teams to greater heights of performance, ethical behaviour and ideals (Mugwagwa et al., 2018).Transcendental leadership combines transactional and transformational characteristics of leadership styles. The style is effective at executive level.

3.4.4.1. Level 5 Leadership

The researcher aspires to level 5 leadership style. Leadership is the highest level in a hierarchy of executive competences(Collins, 2001). Empirical research done by Collins (2001) shows that fully developed Level 5 leaders entails all five dimensions of the pyramid depicted in Figure 26 . Collins research concluded, transforming a company to exceptional performance and value requires a leader with a peculiar set of characteristics in business standards (Manunga et al., 2018).

Opposite to popular belief, leaders who are extroverted, egocentric, and boastful and that seek public attention have not proven to be the best when it comes to transforming and sustaining best performing organizations (Manunga et al., 2018). Level 5 leaders reflect characteristics of being modest and wilful, humble and fearless. They value generational success ensuring sustainability in all they embark on by making certain that equally skilled successors are identified.

Figure 26: Level 5 Leadership

Level 1 Get things done, have good habits, and refined leadership skills.

Level 2 Work well with other individuals, teams, or organizations.

Level 3 Develop capacities to lead and manage other team members.

Level 4 Build cross functional systems to support the mission and a thriving culture.

Level 5 Leaders are humble, are determined and persistent, and are servant-minded.

It critical for the implementation of the fourth industrial revolution that leaders have sound ethical leadership in order to maximise economic performance.

3.5. GLOBALISATION

Globalization constitutes the integration of national economies into a world economy through trade, foreign direct investment, short- term capital streams, international flows of employees and civilization generally, and inflows of technology (Huchet, Richet, & Ruet, 2006). The general term globalisation refers to the economic, social and political integration that crosses the borders of nations and conclusively affects the lives of the individuals living in those countries (Coposescu, 2009).

Globalization is a reality that now impacts every part of the world and every individual in it, although in a wide variety of local environments. A gradual rise in the scale of social courses at local or regional level to global level. When globalisation is defined

as internationalisation, the name refers to a growing interdependence between nations leading to more trade policies. Globalisation can be classified into economic globalisation, technological globalisation, cultural globalisation, political globalisation.

- **Economic globalisation**: Increasing manufacturing, trade and financial exchange incidences, speed and intensity, this is the key role of multinational companies
- **Technological globalisation**: A worldwide technological revolution focused on linking information and communication technology
- **Cultural globalisation:** Growth in cultural exchange between countries and individuals
- **Political globalisation**: International countries and organisations that shape the world as a whole, e.g. the United Nations; the World Bank, the EU, the AU, the BRICS, etc.

Globalisation continues to focus on competitiveness and is triggering the fourth industrial revolution, leading to a new worldwide distribution of manufacturing and markets (Huchet et al., 2006). According to Scholte (2008) comprehension of globalization largely depends on how the word is defined. The articulation of globalization should include a thorough and critical review of the term itself. A confused or misguided basic concept would impair our overall understanding of the term.

A robust and revealing description, on the other hand, ratifies insightful, motivating and empowering knowledge, an understanding that helps moulds our destiny in constructive directions (Scholte, 2008). In academic and lay circles, many have understood that this concept could provide an analysis of continuity and change in modern society. Coposescu(2009) argues that generally the concept of globalisation is characterised by two key opposing forces. There are, on the one hand, economic and technological forces that promote expansion and growth in the efficient functioning of businesses beyond traditional national borders. However on the other hand, social and cultural forces are opposed to the expansion of multinational structures and entities (Coposescu, 2009). Further research conducted by Coposescu (2009) concluded that the aggressiveness of transnational organisations based on their technological and economic power to maintain their goals (e.g. earn profits),

disregarding national borders and identities, is counterbalanced mostly by the opposition of the national, regional, local cultural and social forces.

3.5.1. Benefits of globalisation

Globalisation can be an opportunity for manufacturers to take advantage of economies of scale, to exploit differentiated advantages, to benefit from geographical advantages and thus the advantages of their own market dominance. Diversifying abroad and business growth are the main strengths to gain economies of scale benefits, thus attaining significant cost reductions for unit production costs, sales system costs (sales, marketing) and supply costs. Globalisation signifies free trade that supports global economic growth; it has the potential to create more employment, makes businesses more competitive and lowers consumer prices. It also gives poor countries the opportunity to develop economically and by spreading prosperity through injections of foreign capital and technology, offers the potential under which democracy and respect for human rights can thrive. There is a greater inflow of information amongst two nations, which have nothing in common. Culture intermingles, and every nation learns more about other cultures. Workers can move to market their skills and talents from country to country. Technology sharing with developing countries will assist them advance.

3.5.2. Disadvantages of globalisation

The general objection about globalisation is that it has enriched the rich and made the poor poorer. It adds more benefit to management, equity holders and investors, but not good for labours and the environment (Koolstra, Peeters, & Spinhof, 1999). The greatest problem for developed nations is the loss of jobs and the transfer to cheap labour countries. The ability of large corporations to exploit offshore tax havens in other countries to avoid paying taxes. Multinationals are accused of social injustice, exploitative working conditions (such as slave labour, living and working conditions), lack of environmental concern, mismanagement of natural resources and environmental damage(Daniel, 2004). The construction of products abroad in countries like China risks technologies and intellectual property being copied or stolen, which happens frequently (Koolstra et al., 1999).

3.6. ENVIRONMENTAL ANALYSIS

3.6.1. South African Economy

The South African government is a democratically elected government. Fairness and freedom of speech are practiced. South Africa has a working legal system based on elements of the Common Law of Britain. The constitution gives, the separation of powers and freedom of the media, the independence of the judiciary and respect for political practice (Batch , 2013). South Africa has a stable political environment. The government system operates with a multiparty democracy (Stats SA 2017).

The South African economy is diversified, income is derived from manufacturing, tourism, textiles, financial services, sugar, and is expanding into fish processing, hospitality and property development and information and communications technology. South Africa is sub Saharan Africa's most competitive economy according to the latest publication of the Global Competitiveness Index 2016 – 2017 of the World Economic Forum. It also topped the overall Good Governance in Africa in Ibrahim Index of African Governance (IIAG) for a decade (Schwab, 2016).

On the macroeconomic environment level, the country benefits from a favorable fiscal situation, a high savings rate and an inflation rate which is under control. The gross domestic product per capita was recorded at 6 160, 73 USD in 2017. In 2017 growth was recorded at a steady1.3%, a similar figure to 2014 (The World Bank, 2016). One of the key drivers of the economy is the manufacturing industry. South Africa has a population of 56,717,156million, 50.5 % are female and 49.95 are male (Stats SA 2017). The population mix is a combination of Chinese, Indians Africans, and European citizens. High-tech and software services play a big role in the development of the economy. There is a relatively poor telecommunication network in the country. The number of Internet users in South Africa grew rapidly between years 2000-2007. Real gross domestic product (GDP) is forecast to increase by 2% p.a. from 2016 to 2022. GDP growth at -6.5% was slower and GDP per capita at US$5,261 was higher than average in 2016.

3.6.2. Income inequality

South Africa has one of the highest Gini coefficients, it is often said to be the world's highest, but this is not entirely true, some countries like Namibia and Seychelles have

higher Gini coefficients, others prefer not to measure income distributions for obvious reasons. (keeton, 2014). Wealth can take many forms, such as non - monetary items like property and shares. Individuals who live in homes they have acquired by inheritance or are paid out through any form of financing are generally not pleased. The property appreciates enormously in value over time, but people's incomes are lower than the status of the property suggests, which causes unhappiness. Other people have high incomes but spend all their earnings on materialistic things that are not essential. In some cases, they must borrow from financial institutions to maintain the sumptuous lifestyle with high incomes, which makes them unhappy.

Even in rich countries like the USA, income inequality exists. The social consequences of this uneven distribution of income differ from those of developing countries such as BRICS (Brazil Russia, China and South Africa) nations. Selin et al (2010) Research focused exclusively on the American population. Their study was based on the following proposition: low- and middle-class people will probably identify the world as unfair if the rich get richer, and secondly income inequality divides communities and raises trust issues. In their empirical research, they have shown that the income inequality and happiness have an inverse relationship. The results concluded that the more uneven the income distribution was, the fewer people were happy. They showed that the cause of unhappiness was not the reduced income, but the perceived injustice and relationships of trust.

Therefore, individuals with more money can save and invest and grow their money. While low income earners on the other hand use their earnings for essential items such as food and shelter. Harsh climate, poverty, corruption, uneven distribution of income, high inflation rate and ill mental health are all contributing factors to the unhappiness the country is going through. South Africa is seen as a safe haven by African immigrants. This then leads to high illegal immigrants coming inside the country seeking asylum. The illegal immigrants offer cheap labour work in syndicates to thrive. This gives them a competitive advantage. All these factors contribute in the unhappiness of South African citizens. The political land scape also plays a larger as the political leaders currently occupying position are seem as unethical in their behaviour.

3.6.3. Happiness Index

According the Inayatullah (2017) if we keep measuring the performance of the economy using the same method, it is likely that we will get the same result. The concept of á happy worker is a'' productive worker'' has a deep meaning. Economists have studied the relationship between happiness and several variables (income inequality, corruption, inflation rate and economic growth). Recent trends reveal economists are working closely with psychologists to define and measure happiness. The notion is to determine if applying happiness measures to public policy and economics could improve life for people around the world.

New "analytical and research tools" now enable an objective evaluation of a highly subjective topic, "the study of happiness." (Graham, 2010). Easterlin, 1974 (as cited in Arvin & Lew, 2014) conduced early studies which focused more on the relationship between happiness and GDP per capita income. The research was based on western countries which had high economic growth rates.. The conclusion from Easterlins studies were the change in happiness was very small relative to the increase in per capita income. In his studies he further concluded that some countries improvement in standard of living did not produce any happier people. Findings from other researchers came to the same conclusion: there is little or no association between increases in per capita income and mean happiness levels (Arvin & Lew, 2014).Kuznets argued that in developing countries economic growth initially leads to increasing levels of inequality

The definition of happiness has taken evolved overtime it has gone from being associated with good luck and fortune to a subjective emotional feeling. The Greek philosopher Aristotle suggested that happiness lies between two extremes of life, the one end being hedonic (immediate pleasure) the other being unpleasant or painful (Limbasiya, 2015). Aristotle also postulated that happiness should be a combination of immediate pleasure and a life well. Environmental that influence happiness can be external or internal.

External objects that bring satisfaction include the basic need for shelter, food then the ultimate satisfaction that brings about happiness is self-realization. This definition is consistent with Maslow progression principle. The western view of the concept of happiness identifies happiness as something that one has control over and can

actively pursue it (Arvin & Lew, 2014). Philosophers and historians view happiness as this rare antique associated with good luck and fortune (Oishi, Graham, Kesebir, & Galinha, 2013). In ancient times luck and fortune were the leading defining terms of happiness; the modern day definition of happiness is associated with social wellbeing, health, wealth, economic stability.

Other notions that converge in line with an old Chinese saying define happiness as "something to do, someone to love, and something to hope for" (Kets de Vries, 2017). Happiness is a highly subjective matter individuals ultimately decide what constitutes then being (Limbasiya, 2015).Some of the contributing factors in happiness is, Income inequality, corruption, high inflation rate low growth rates. The experience of happiness shifts between happy and unhappy. Maslow's progression principle is a virtuous circle, as soon as individuals satisfy their basic needs and reach state of self-realisation happiness is attained. But this is short lived as new needs arise. With self-realisation the state of happiness.

3.6.3.1. How Countries Measure Happiness

Predominantly happiness is measured through surveys. People around the globe are asked are asked questions like -- how happy and satisfied they are with life and objective. People answer the same set of questions, either on questionnaires presented on online surveys. The way questions are presented to the respondents is adjusted to this technique, and that means typically that question are answered selecting from a limited number of response options. (Kalmijn, 2015). This is the standard way of measuring happiness.

There are two levels happiness can be measured. The individual level and collective level. At the individual level, the researcher relates the responses for both happiness and the correlate of the study of each respondent separately. In this way one can investigate whether for example very happy people are living more frequently in a rural than in an urban environment (Kalmijn, 2015). At the collective level of nations this is usually not possible. A scientist who wants to compare the happiness situation of the South African population to Kenya is not interested in all individual responses, but is most likely interested in the statistical distribution of the happiness intensity in both nations separately. 'Measuring happiness at the collective level' is a short-hand term for measuring this statistical distribution of individual responses of the members of this

collective. (Kalmijn, 2015). Cantril ladder life scale is another critical tool for measuring happiness.

3.6.3.2. Corruption and happiness

Corruption has no geographical limitations it exists worldwide. It should thus be considered as one of the major contributors when considering how happy a nation is. Corruption reverses growth and disrupts general welfare. Arvin & Lew, 2014 argue that high levels of corruption are not necessarily linked to happiness. Research by Graham and Chattopadhyay as reported in (Graham, 2010) concludes the determinants of happiness has not identified corruption as a possible source.

The link between happiness and corruption is fundamentally dependent on a country's level of per capita income (Arvin & Lew, 2014).The results of the research carried out by Arvin & Lew in 2014 showed that the relationship varies across the revenue spectrum. Corruption decreases happiness, but only for countries with high incomes– about the top half of the income range. The intuition for this finding is that corruption can be deeply rooted in society and cannot be discerned among the many depravities at low - income levels. Therefore, happiness may not correlate with corruption in low income countries. When corruption becomes discernible and felt at higher income levels and people become concerned, politicians subsequently begin to take tougher positions against corruption. As income increases above a certain threshold, anti-corruption measures are beginning to take effect. As a result, corruption decreases, and people enjoy a high level of satisfaction with life. Therefore, low levels of corruption at high incomes are linked to higher levels of happiness. According to the world happiness report (2018) South Africa is ranked number 105 out of 155 countries. African nations in general are dominating in the bottom 50 of the report. The bottom of the report looks as in Figure 27 follows:

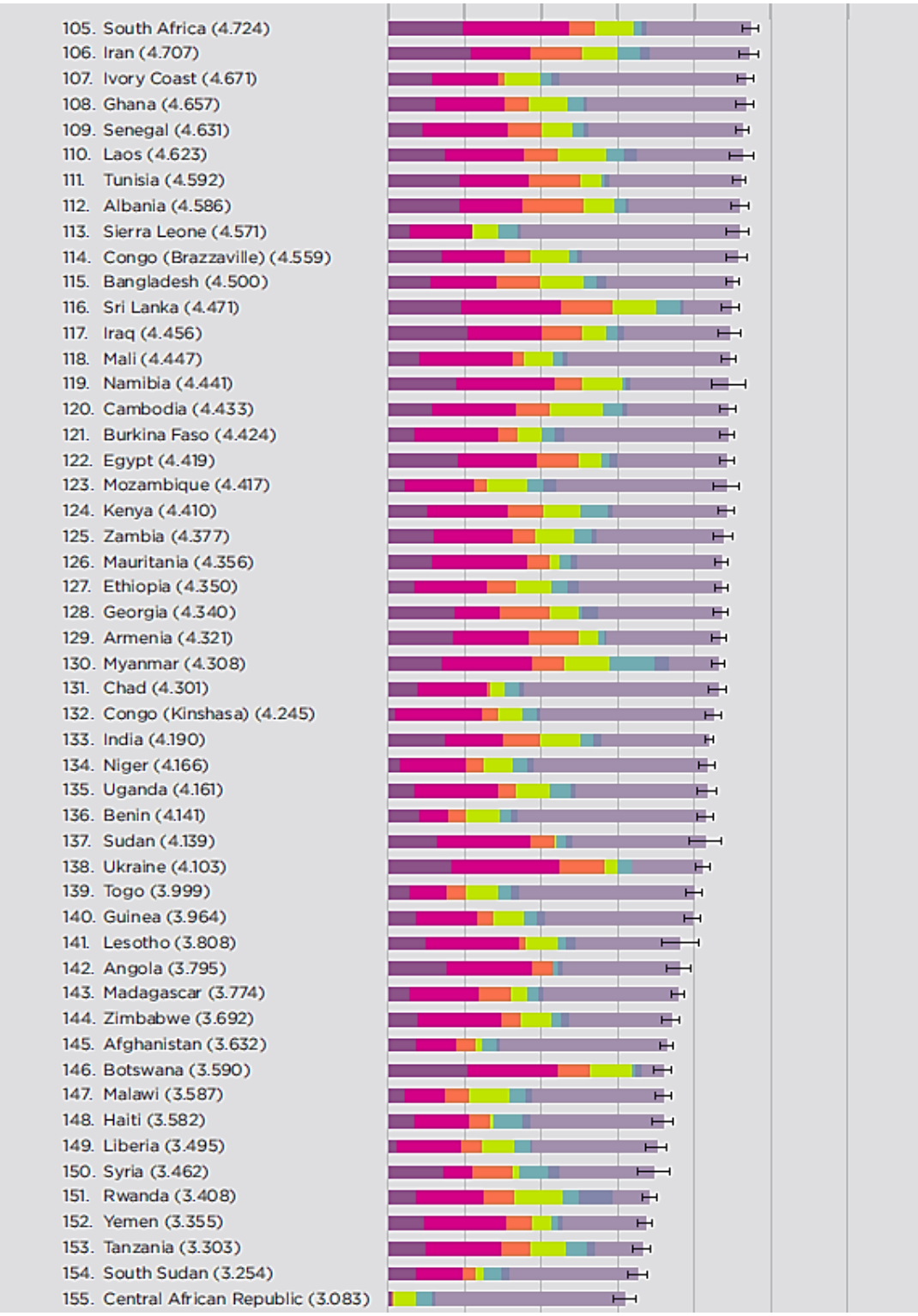

Figure 27: World Happiness Report

Source: WHR, 2018

3.7. GDP as A Measure of Economic Performance

Gross Domestic Product (GDP) has long been the main yard stick of economic performance. The GDP is a widely accepted indicator for well-being and social welfare. The have been debates on whether high growth increases social well-being (Boyle & Simms, 2010). Modern economics promotes social and ecological" values in public policy. GDP cannot truthfully evaluate a country's well-being. Using rising GDP as a measurement for national progress misses important societal and environmental costs (Layard, 2011).

Even though GDP growth has been a good measurement of national economic performance, there are some concerns relating to improvements in the well-being of a society despite positive growth in GDP (Kets de Vries, 2017). At times the GDP measures and promotes unplanned consequences. For example, working more hours increases GDP, but decreases relaxation time which then leads to unhappiness. The costs of containing the pollution caused by more production and of combating rising crime in decaying communities all raise GDP. Even fast food enthusiasts who eat a lot and subject themselves to liposuction add to the growth in food and cosmetic surgery revenues, also upping GDP. The new economics" tries to incorporate all aspects of life (Boyle & Simms, 2010).

3.5. CHAPTER SUMMARY

Chapter threes main focus was on reviewing the literature study used to understand the research problem. Enablers of changes affecting the future of automotive industry were be explored to gain a comprehensive understanding of them. In addition, specific drivers from South Africa were examined in detail.

Chapter 4 will put emphasis on application of causal layered analysis and scenario planning methodologies to the study of possible futures in the South African automotive industry by 2033. These methodologies have been identified as the preferred forecasting techniques for this study.

CHAPTER 4: APPLICATION OF CAUSAL LAYERED ANALYSIS

4.1. INTRODUCTION

The previous chapter was dedicated to the review of literature relevant to answer some of the research questions raised in chapter one. There were a number of drivers who shaped the nature of the automotive industry in South Africa as we moved towards 2033 were taken into consideration. The progression of South Africa's automotive industry over the next decade will be influenced by a number of change drivers and adaption of new policies by the sector in response to the ever-changing environment. These enablers of the shift will generate changes in the global environment and the South African automotive industry. The South African automotive industry faces numerous challenges which include: regulatory uncertainty; high production costs; unstable political and societal demands; a volatile global economy; labour unrest; high salary demands; and infrastructure constraints.

The subsequent chapter will apply causal layered analysis as a systemic methodology to deepen the future through reviewing the present and past of the South Africa automotive industry. Causal layered analysis enables the narration of constitutive discourses and is, in crux, an exploration for integration in methodology (Inayatullah, 2008). Upon conclusion of the chapter the development of alternative futures for the automotive industry of South Africa is done through scenario planning.

4.2. TIMING THE FUTURE

Timing the future implicates searching for grand patterns of history and recognising models of change. Timing the future encompasses issues such as how the future might be affected by people's actions coupled with the possibility of planning around such actions(Du Plessis, 2016). The South African automotive industry is faced by several complex challenges due to the eminent fourth industrial revolution. Not limited to technological changes only, other issues include rising cost pressures, escalating public expectations, poor infrastructure, a weak education system and regulatory uncertainty. In order to continue to remain relevant into the future, the sector must reinvent itself and transform with the support of the government institution, this will enable the country as a whole to adapt to changing market conditions. New innovative

strategic methods which enable the manufacture of goods at reduced cost in a volatile global economy where uncertainty and complexity are the new standard need to be developed.

The automotive industry challenges and colossal changes which are currently taking place in the global space are forcing the South African automotive industry to accept that “business as usual” is not an option. The external pressures due to globalisation is forcing the industry to transform, become innovative to ensure survival and long-term progress. In order to make a notable contribution to the economic growth of the country, the South African automotive industry with partnerships from public and private sector needs to surpass the old-fashioned conservative approach, this will enable a drive for innovative industry transformation. The researcher has faith that transformation of the South African automotive industry is attainable Though it can be proved to be quite difficult to alter the external environment, the researcher is optimistic that transformation of the industry is achievable through courageous and ethical business practices endorsed from within leadership structures.

The long-term success of the South African automotive industry can be realised through adoption of innovative solutions and a drive for implementing the enablers of the fourth industrial revolution. The labour force needs to alter consciousness and vision so that the industry can transform its future through increased productivity endorsed by technology adoption and skills development. Also, it is critical that a sheared vision and drive for transformation is reinforced by transparent policies, institutional change and a stable economy.

In order to achieve long-term sustained growth, the South African automotive industry needs to reinvent itself by concentrating on sustainability of the manufacturing sector and the strategic plans mandatory to attain a preferred future sheared by all stakeholders involved. Innovation requires transformation which involves creating new ideas and concepts thus shifting the normal business-as usual approaches to achieve a progressive and a prosperous industry. The realisation of innovative transformation and efficient performance must be founded on a bold sheared future vision of the South Africa’s automotive industry.

The preferred future of the automotive industry as a result of industry 4.0 should be clearly defined and co-created by all sector stakeholders in order to make sure that all embrace and support, the preferred future. The researcher is of the belief the future of the South African automotive industry is a strategical planned rational activity generated by choice. Through foresight, future mindfulness, bold leadership and actions, a progressive outcome can be created as preferred by the collective automotive community.

The concept of a used future should be questioned through technological innovation, social change and in envisioning a transformed future that is inspiring. According to Inayatullah (2015), systems at a particular point come to a crisis, whereby they respond by implementing imitative tactics thus creating structures of bureaucracy or, they innovate through a creative, inspired minority and create a higher order complex future.

The South African automotive industry is finding itself in a period whereby a collaborative sheared vision and plans can make a potent difference to its future. The researcher believes in the model of social change concepts: “crisis lead to real change”. The belief is based on innovative transformation of the automotive industry in South Africa which can be achievable through strong ethical leadership and supportive stakeholder partnership.

4.3. DEEPENING THE FUTURE

As alluded in the preceding Chapter 2 the fourth pillar of futures thinking is deepening the future. The study then defined causal layered analysis (CLA) as a futures methodology which enables issues to be seen from multiple viewpoints. CLA is a systemic method which enables detection of the roots cause of problems, the methodology unearths the primary worldviews and the myths these worldviews are based on(Du Plessis, 2016). Inayatullah (2004) asserted that causal layered analysis enables and instigates the development of dependable alternative scenarios and preferred futures. With the latter being said, it is vital to deepen the future of the South African automotive industry by probing into underlying assumptions, narratives, worldviews and metaphors and social causes, regarding the automotive industry in South Africa.

Causal layered analysis is done on issues which are deemed to be of strategic importance in the attainment of sustainable development and progress in the automotive industry in South African. CLA divulges what becomes imaginable when the metaphors and worldviews underlying the first two levels of analysis are shifted (Talebian & Talebian, 2018).

Issues selected by the researcher for the causal layered analysis are:

- The South African automotive industry's contribution to long-term sustainable economic progress
- Investigate the education system and support factors to technology
- Understanding unemployment in South Africa
- Understanding the readiness of private and public sector for the Infrastructure uncertainty

4.3.1. CLA: Long-term growth

Table 5: CLA Application- Long-term growth

CLA Dimension	Issue
Litany	• South Africa's reliance on the automotive industry for economic growth. • Uncertainty about the automotive industry's contribution to societal development beyond the lifespan of projects
Systemic	• Considerable loss of employment and income when manufacturing operations are suspended or closed down. • An uncertain regulatory environment which is detrimental to automotive industry stability and growth.
Worldview	• Success of the automotive industry is measured by short-term financial contributions while long-term benefits and progress are overlooked. • The South African automotive industry is considered to be one of the country's mainstream economic drivers.
Myth/Metaphor	• People value only money and material goods; believing this leads to success and progress

Litany Level. A variety of problems have been identified at the litany level, including the country's dependence on the automotive industry for economic development and progress. A solution to this dependence in order to alleviate pressure from the automotive is to improve long-term progress and economic growth through increased investment in rural communities through infrastructure development, such as housing, schools and industrial zones. This can assist the sector to introduce more industry 4.0 drivers to improve efficiency and maximise profits.

Systemic level: At the systemic level the previous regime did infrastructure development in concentrated areas which favoured the minority. This legacy is presently hampering the country's growth as there had been no development in areas where the majority resided. Thus, a new culture of self-sustenance and identity has to be adapted by to by the residents of the nation. Encouraging entrepreneurship amongst the youth could lead to long-term sustained growth. As Intra-Africa trade begins to open up, trading manufactured goods as opposed to selling commodities will encourage more growth in the nation.

4.3.2. CLA: Poor education system

Table 6: Poor education system

CLA Dimension	Issue
Litany	• South Africa's poor education system rendering labour force unemployable • 30 % pass rate inexcusable
Systemic	• Education system is as young as the new regime • Benchmarking against world standards could prove to be detrimental
Worldview	• Technology education in South Africa for preparing students for a high- tech economy.
Myth/Metaphor	• Previous regime transferred inferior education to the majority • Trial and error

Litany layer. Education is constantly about the formation of identity. Lawmakers or others who formulate educational policies always have in mind certain objectives that can be political, social or cultural. Historically, education cannot be seen as a neutral act; it is always political. South Africa comes from a past where apartheid education was used as an instrument for dividing society by building certain identities amongst pupils. Schools were divided by race during apartheid education and education enhanced the divisions in society.

These divisions strengthened the disparities in a divided society. Many people saw the prospectus as irrelevant and monocultural, as it strengthened the citizenship of one race over others. In the early 1990s, the educational transformation in South Africa overhauled the old apartheid education system. The nation's racial divisions engineered by the apartheid government to ensure that segregation between black and white was made eminent and that black people were perceived as less intelligent and incapable of thinking. South African Black people were subjected to a Bantu education system from 1953 to 1992 (Thobejane, 2015). The divisions of the past in South Africa cannot be fully understood without a proper understanding of the effect of Bantu education on the majority of black people for a period of nearly 60 years (Thobejane, 2015).

Systemic layer.Adendorff (2013) argues that investment in education is important in reducing disadvantages such as child labour, gender equality and protecting girls ' rights. The skills of basic education like reading and writing are key to national development. Education is also associated with improved nutrition, health, population control and productivity (Adendorff, 2013).

The Bantu education system was designed specifically for the Black population. The majority were to be relegated to the firmly segregated work-related structures and were excluded from all job profiles except that of unskilled labourers (Thobejane, 2015). The ideal of Bantu education was to exclude access to an educational system that would enable black people to compete with White people in the same job categories.

Bantu education in South Africa propagated hierarchical structures of society and promoted a philosophical consciousness of superior-inferior, master-servant, and ruler-ruled structure among all groups in South Africa (Thobejane, 2015). Predominantly black political officeholders and business people must always deal with a white minority which is deeply sceptical of majority government. The white minority have resources, are well connected and thus able to express doubts misleading the general public whenever government performance is seen to be inadequate (Haggard et al., 2009). According to Friedman (2018), South African business's biggest obstacle may not be government corruption, economic radicalism or skills shortages.

It may be deep-rooted race and gender biases in the mainstream economy – which are more damaging because those who hold them do not know that they do. Bantu education added to the notion of this deep-rooted attitude, which assumes certain races are more capable and knowledgeable than others.

With nearly 30% of the population engaged in some form of education, the system's efficiency is vital(Simkins, 2013). However, in some areas – in particular mathematics, languages and the problem of unqualified and underqualified teachers –there are crucial weaknesses and inadequate coordination of their various levels and components(Simkins, 2013). There are significant differences in standards at the provincial and local level, and although some provinces take steps to address them, they are only minor. It will take a great deal of effort to overcome the problems and collecting more accurate and detailed data is a prerequisite. Education and economic growth are intertwined. Armstrong (2015) describes development as the ability to choose the way one lives one's life and the ability to function at a certain level. The development process is therefore the process of improving the freedom people must live the life of their choice(Armstrong, 2015).

Economic development encompasses comprehending how economic growth facilitates development characteristics–health, life expectancy, sanitation and education –and how per capita income growth leads to long - term social shifts(Armstrong, 2015). Therefore, the traditional concept of economic development needs to be extended to include the idea of Armstrong's development as freedom. Education's role in economic development is very important. Access to education is to some extent regarded as one of the results of economic development.

World view. Access to basic education has been accomplished in most countries around the world and the challenge facing governments worldwide is to improve the quality of their citizens ' education(Leibowitz, 2014). Education, however, is also a necessary driver of economic growth. The literature on economic growth documents the function of ' human capital' in economic development, outlining that human capital is made up of knowledge and experience and that human capital needs to be generated and accumulated(Armstrong, 2015). Innovation and productivity are supported by higher human capital levels, this also applies at an individual level. The human capital model assumes that investment in education (and higher levels of education) increases individual productivity and labour market profits. (Leibowitz, 2014).

Education is one of the largest components of government expenditure, given its importance in achieving a decent standard of living and economic growth. Teacher salaries are the largest expenditure item in education. Personnel expenditure (primarily teacher salaries) accounted for approximately 78 percent of education expenditure in South Africa in 2010(Armstrong, 2015). Education is therefore valuable and important from an economic point of view, and the role of teachers is fundamental to education(Armstrong, 2015).

The transformation from apartheid schooling to the current system of education in South Africa was not without challenges (Msila, 2007). South African education in the past mirrored the deeply divided society it was founded on and hardly created conscientious, critical people. Bantu education as a tool of oppressive social control created people who were not only briefly changed but also racially and culturally divided (Msila, 2007).

The system also failed to adhere to the democratic principles of exposure, participation and equality towards all racial groups. However, education is currently seen as a transformative weapon. The Revised National Curriculum Statement (RNCS) views education as an instrument that is capable of rooting out the values of South Africa enshrined in the Constitution. Amongst the central values of the South African education system is democracy, social justice, non- racism, equality and reconciliation.

Market requirements, on the one hand, emphasize the necessity to empower pupils in science related studies, as this can improve the economy. Education, on the other hand, must empower learners to achieve effective social responsibility and an entrepreneurial mind set. The new focus will then be on how the existing RNCS increases the full participation of students in society. The educational hurdles in South Africa are enormous and complex and require research from multiple perspectives and professions to come up with appropriate policy responses. Education in South Africa continues to be a vehicle for social and political transformation. Enhanced education, for instance, will lead to higher employment and earnings, while faster economic development will create opportunities for all and the resources needed to improve education (NDP, 2012).

Sustainable employment growth will require a rapidly developing economy and the elimination of structural barriers, such as poor education or spatial settlement patterns that exclude the majority (NDP, 2012). These are crucial in order to help increase investment rates and attractiveness and to increase production and exports. Corporate, labour, societies and government must collaborate to accomplish faster economic growth.

Myth/ Metaphor. The first was post- industrial globalization of education. In this context, the intelligent state wanted to see education as a resource to prepare it for the change of biotechnology and net- led futures. This shift from a commodity- driven economy to a manufacturing-driven economy to a knowledge- driven economy for South Africa" Smartness" ensures that new technologies are integrated into all processes, production, delivery and education in this future. Education is seen as learning continuously**.**

4.3.3. CLA: Preparing labour force for Industry 4.0

Table 7: Preparing labour force for Industry 4.0

CLA Dimension	Issue
Litany	• High unemployment rates
Systemic	• Larger number of individuals unemployable due to unavailable of necessary skills
Worldview	• Technology based education for competitive advantage
Myth/Metaphor	• Youth are our future; Smartness is

Litany layer. South Africa has one of the world's highest unemployment rates. The fight against unemployment in emerging markets continues to rage sharply (Kasvosve, 2017). This is mainly due to the number of young people entering the labour market in Africa in the next 15 years. One of the major socio- economic challenges South Africa still faces to date is the insistently high level of joblessness, despite numerous measures and interventions by the government to control it. Given the current unemployment levels in South Africa and the potential disruptions that could be caused by technological advances, it is arguable that South Africa could be in a position to meet the NDP's full employment target. South Africa 's unemployment has an unquestionable structural or systemic nature (Cloete, 2015). Statistics South Africa categorizes unemployment as strict and expanded.

Unemployed persons are those who, according to the strict definition:

- 15 years of age and older
- Not in paid or self- employed employment
- During the seven days preceding the interview and for paid employment or self – employment were available
- Take specific steps to find paid employment or self - employment during the four weeks prior the interview

On the other hand, the expanded description does not contain the third stipulation of the strict definition. The Nation Development Plan states that high numerical targets

for sustainable and all-encompassing growth comprise a reduction in the strict unemployment rate of 25 percent in 2011 to 14 percent in 2020 and 6 percent by 2030 (NDP, 2012). This goal appears unrealistic, as the unemployment rate in South Africa does not decrease

Table 8: Unemployment Rates in South Africa

	Official unemployment rate					Expanded unemployment rate				
	Apr-Jun 2017	Jan-Mar 2018	Apr-Jun 2018	Qtr-to-qtr change	Year-on-year change	Apr-Jun 2017	Jan-Mar 2018	Apr-Jun 2018	Qtr-to-qtr change	Year-on-year change
	Per cent			Percentage points		Per cent			Percentage points	
South Africa	**27,7**	**26,7**	**27,2**	**0,5**	**-0,5**	**36,6**	**36,7**	**37,2**	**0,5**	**0,6**
Western Cape	20,7	19,7	20,7	1,0	0,0	24,6	22,5	23,2	0,7	-1,4
Eastern Cape	34,4	35,6	34,2	-1,4	-0,2	44,5	46,0	45,8	-0,2	1,3
Northern Cape	30,5	29,5	28,9	-0,6	-1,6	45,3	41,0	42,4	1,4	-2,9
Free State	34,4	32,8	34,4	1,6	0,0	40,5	38,4	40,1	1,7	-0,4
KwaZulu-Natal	24,0	22,3	21,8	-0,5	-2,2	40,4	40,6	40,9	0,3	0,5
North West	27,2	25,8	26,1	0,3	-1,1	42,0	41,8	43,4	1,6	1,4
Gauteng	29,9	28,6	29,7	1,1	-0,2	32,9	33,6	34,4	0,8	1,5
Mpumalanga	32,3	32,4	33,2	0,8	0,9	41,4	42,5	41,7	-0,8	0,3
Limpopo	20,8	19,9	19,3	-0,6	-1,5	37,1	37,6	37,4	-0,2	0,3

Source: Stats SA, 2018

Table 8 shows the official unemployment rate figures for 2017-2018. The official unemployment rate in Q2: 2018 was 0.5 percentage point higher than in Q1: 2018. According to the Stats SA (2018) the official unemployment in five of the nine provinces has increased. The Free State (up by 1.6 %) recorded the biggest rise in the unemployment rate, Gauteng (up by 1.1 %) and Western Cape (up by 1.0 %). The official unemployment rate decreased by 0, 5 percentage point year - on - year. The highest decreases were observed in KwaZulu-Natal (2.2 %), followed by Northern Cape (1.6%) and Limpopo (1.5%). With Comparison to Q1: 2018, the expanded unemployment rate in Q2: 2018 increased by 0.5 percentage point to 37.2 percent.

In Free State (1.7 %) the biggest recorded increase and, followed by North West (1.6 %) and then lastly Northern Cape (1. %). The expanded unemployment rate also increased by 0.6% compared to Q2: 2017, with Gauteng recording the biggest increase of 1.5%.

Systemic Layer. Structural unemployment means that an economy cannot provide jobs for the total labour force, even at the peak of its economic cycle. For certainly, structural unemployment is the hardest to deal with due to its nature. Joblessness

among the poor is also much higher and is therefore acknowledged as one of the four poverty traps intrinsic to the socio- economic situation since 1994.

Cloete (2015) argues that, though the South African economy has steadily risen since the implementation of the neoliberal economic system, it has not created jobs. One of the reasons why employment has decreased is the increase in demand for skilled labour, which means a reduction in demand for unqualified or unskilled labour, in order to achieve an international competitive position.

The racially segregated past of South Africa has affected most facets of life, including the labour force and the education system (Burger & Von Fintel, 2009) . The imbalances of the past have been addressed on the political front in order to provide equal opportunities for all racial groups in relation to the entry of the labour market and access to similar education. These policies, however, haven't had the desired affect (Burger & Von Fintel, 2009). While education in the most recent birth cohorts gradually converges across demographic groups, the previously impoverished stay the most seriously affected by rising unemployment.

Burger and Von Fintel (2009) argue that the increase in unemployment, which corresponds to a robust economic increase since 1999, has led to allegations of “jobless growth “among policymakers and labour unions. However, on the other hand, several analysts maintain that tight labour laws protecting the interests of the disadvantaged have had unintentional consequences on businesses ' preparedness to absorb more labour.

World View/Myths. According to (Eberhard et al., 2017), in advanced economies, 47 percent of jobs were at high risk of automation in the coming decades. Innovative technological trends such as Big Data Analysis, digitisation and robotization are responsible for automating an increasing number of jobs and replacing people in many areas. Automation on labour markets will lead to a decline in jobs in routine and labour - intensive tasks. In the past, automation has only supported routine tasks involving explicit rules- based activities, but new Big Data algorithms are now rapidly entering fields depending on pattern recognition and replacing human labour in a wide range of non- routine tasks. For example, advanced robots can perform a wider range of tasks that lead to radical job changes across the industry.

The World Economic Forum indicated that 65% of children entering primary schools today work in occupations that do not yet exist. Furthermore, due to connectivity, the future workplaces are not just in office spaces but rather in interconnected workplaces involving virtual applications. Conference, comprehensive and constant connection and portability will be developed. Because of the fourth industrial revolution and all its drivers, the labour market is undergoing dramatic changes; jobs are becoming obsolete and new jobs are being created that require new skills. Higher education is designed to enable students to work not only in one industry, but also to provide students with knowledge of the processes in different sectors

In the next two decades, 42 percent of all manufacturing jobs in Germany will be at risk. However, intelligent factories offer more opportunities for manufacturing controllers and planners (Eberhard et al., 2017). The application of industry 4.0 will tremendously change the labour market by digitizing jobs and requiring new skills.

4.4. SCENARIOS

4.4.1. Worst case: Fourth Industrial revolution rejected

South Africa did little to change current regulatory, economic and technology infrastructure in 2033. The political and economic elite of the nation has become more self-serving as we continue to contend that South Africa deserves special attention because of our past regime. This narrative has seen the nation fall into the nightmare of its own dystonia.

The education system has failed to provide adequately qualified work force in the as needed by the labour market in the automotive industry. The majority are technologically analphabetic, a deficiency that effectively makes them unemployable in the automotive industry during 2033. South Africa's high data and technology costs, which exclude many small companies from global markets, further hamper its efforts to compete globally. This minimises an enormous source of potential employment for the nation.

The emphasis on automation was largely driven by a regulatory framework that remained extremely restrictive as trade unions opposed automated systems. Firms continue to have very little flexibility in the management of non- performing workers and have mobilised to make things worse for unions to protect the interests of their diminishing amount of members. Protest worsen, these protests are almost always

unruly and halt production for days. These protests also lead to wages that go beyond productivity gains, thus making South African labour force relatively more expensive against international standards. The jobless look from outside, barred from the ability to earn a living and from access to social safety networks. As a result, social disruption occurs with greater frequency and is intensifying dramatically.

Unemployed youth are a significant cause of this instability. Disappointed by a system that they consider to be hopelessly corrupt and defective, frustrated by a political regime that continually serves its political elite instead of the greater masses, and they take to the streets and burn cities destroying everything on their way.

In the meantime, the political and economic elite remain isolated from the instability in the streets, supported by their assets and high position. South Africa really has become a “starved" society, frustrated by a hunger for stability and advancement. The distinction between black and white is no longer valid, instead, it is between the educated and technologically skilled individuals who can compete in the international economy and access global markets through online cooperation, and the undereducated masses (most often rural) that cannot compete in the digital economy and remain barred, underprivileged and hungry. The automotive sector dies a slow and painful death as investors’ moves to other countries that are advancing in technology infrastructure

4.4.2. Best case: Embraced

South Africa is a successful country in 2033, the South African automotive industry flourishes. Few can believe that this country has transformed from a destructive path that seemed bound to end up on the stack of dust as another failed state. Beginning in 2019, a process of transition takes place as the government aims to correct the basics, making sure efficient provision of basic services aimed at increasing the lowest third of the population. Better unity and collaboration have combined with successful economic policies and new business models to bring about an unexpected flourishing of South African society, which has faced the challenges of the fourth industrial revolution.

The IT systems are being upgraded on a continual basis; basic education is being smartly upgraded and resources are being redirected to infrastructure projects to prepare cities for the projected increase in numbers towards 2033 Government

specifically targets technology education and ensures that all citizens have fair access to technology.

Acknowledging that the government cannot deliver the services and growth that the economy needs by itself, the government undertakes a consultative process with large companies and NGOs. Such partnerships lead to more efficient resource allocation, less complicated regulation and a more collaborative approach to economic and social development.

The South African automotive industry finds its competitive global niche. And even with breakthroughs in robotics and artificial intelligence, there is a major disruption in employment throughout the world, South Africa has succeeded in creating a small but intelligent base for youth who can recognise and exploit opportunities on the global market. They have a genuinely entrepreneurial mentality and a diverse base of skills and are eager to explore new business models. They provide a basis for adaptable growth and also provide jobs for millions by small start- ups.

As profit margins for firms increase because of cost reduction as a result of automation, the government taxes these organisations at considerably higher rates. This income is complemented by the reduction of government institutions and the saving of efficiency, allowing the state to pay a fairly modest universal basic income to fight poverty. In fact, South Africa found a way to include social costs in its calculations by 2033 and found ways to ensure that all sectors of society were integrated into an inclusive social system due adaptation of the fourth industrial revolution. South Africa is regarded as one of the greatest success stories in the world about how to steer the new world of work for all its residents.

4.5. CHAPTER SUMMARY

In the course of the period leading up to 2033, any of the above different scenarios could potentially materialise. These pictures of the future are representative of the possible courses that the South African automotive industry could take from as a result of the fourth industrial revolution. This chapter attempted to answer a number of research issues raised in chapter one. This research should be understood in the context that the usefulness of CLA is not to predict the future of the South African automotive industry, but to create transformative spaces to create alternative futures that are desirable for the country as we move to 2033.

CHAPTER 5: TRANSFORMING THE FUTURE

5.1. INTRODUCTION

The preceding chapter addressed the application of CLA. In order to provide relevant suggestions that different stakeholders need to adopt in order to capitalize on the trends that shape the automotive industry in South Africa, the country's readiness should be established. The world is at the heart of a new revolution, the Fourth Industrial Revolution, which promises more impact than any other revolution. This is an opportunity for the African continent to advance development, because it requires the use of intelligence and everyone has the ability to think, thus enabling Africa to leapfrog. This is a provocative idea, but industry 4.0 needs more than just skills, but also requires infrastructure which includes internet and electricity, good leadership for attracting foreign direct investment and dynamic innovative systems.

Nevertheless, industry 4.0 offers Africa an opportunity to mould a different future. In this future, the developing countries of today leapfrog over the wealthier nations by being less invested in today's technology and leading to the creation of new Internet futures. This was demonstrated by the introduction of smart phones. First, developing countries were not as vested in the traditional telephones and thus jumped to mobile and smart phones developing their own Banking model with innovations like M-Pesa. Industry 4.0 technologies give traditional societies the ability to remain coherent in that they no longer need to move to the big city. The movement of people from rural to urban areas in industrialised countries has created tremendous problems (e.g. traffic congestion, crime, and housing issues) that could be solved by working from home or creating community workstations.

5.2. PREFERRED FUTURE AS RESULT OF THE FOURTH INDUSTRIAL REVOLUTION IN THE SOUTH AFRICAN AUTOMOTIVE INDUSTRY

As previously stated, **Preferable futures** are concerned with what we "want to" happen; in other words, these futures are largely emotional rather than cognitive (Voros, 2015).Futures approach involves systematically exploring, creating and testing both the possible and desired futures. The primary objective of the methodology is to improve decision making (Kasvosve, 2017). Future studies take into

consideration analysis of the policies and the consequences of the implementation of those policies and actions (Kasvosve, 2017)

5.2.1. Using resources and optimizing processes

The possibilities for improving processes and material consumption when utilising Industry 4.0 concepts are versatile. Material costs can be reduced by less defective goods and processes can be optimized (in speed or yield) by using cyber- physical systems that allow process observation in real time. By using these technologies, it will be possible to react automatically and quickly to events in the physical world. According to Mckensey (2015) improving production processes, including optimizing material consumption, will drive value and enable productivity to be increased by 3- 5 percent.

Realised through the use of the IoT and CPS, processes can be observed in real time. The connectivity of machines products and human beings and the omnipresent information on everything enables us to react very swiftly, efficiently and fully automated to all circumstances during manufacture. If everything is traceable, the consumption of resources in these advanced production processes becomes increasingly transparent. It will therefore be possible to measure exactly the amount of resources required for each manufacturing phase. Wasteful resource consumption processes can be identified, optimised or removed. By incorporating “intelligent materials" armed with sensor and actuator technologies, resources can be observed not only during the manufacturing process but also throughout the product's entire life cycle.

By utilising RFID technology, observation of the condition and location of valuable materials will reduce waste and increase the reuse of scarce resources. This will allow or at least facilitate the maintenance of technical and biological nutrients in their cycles. The assessment of process conditions in real time is not only concerned with the consumption of classical input materials. It also makes it possible to trace water and energy consumption during each production stage. In addition, processes can be reviewed in detail depending on the time required for each stage of production. In addition to optimizing manufacturing costs, not only time is saved, but also shorter production processes usually consume less energy. Processes in Industry 4.0 can monitor, know, predict, optimize and do automatic reconfiguration. Processes can

therefore be designed more sustainably and easily to achieve a most efficient system. This improvement in the production processes, along with the optimisation of material consumption, will drive value and enable productivity to be increased.

5.2.2. Utilization of assets

The optimal use of the machinery park of a company is supported by Industry 4.0 based technologies that allow predictive maintenance. It is possible to reduce machine downtime or changeover times by early detection of possible breakdowns and continuous maintenance by permanent remote monitoring of machine conditions. Therefore, avoiding and correcting defects early can save costs and drive production throughput, thus driving value and obtaining a competitive edge. According to Mckensey (2015), the use of predictive maintenance allows the total machine downtime to be reduced by 30- 50% and the machine life to be increased by 20- 40% as illustrated in Figure 28. Manufacturing equipment in most plants is one of the most valued capital with a long service life of up to 20 years or more.

Revamping assets makes it easy to upgrade existing production equipment with sensors, actuators and related control systems. This is a cost- effective way of using industry 4.0 technologies and making assets “smart". Retrofitting allows the realization of CPS with existing manufacturing equipment throughout a value creation module, such as a plant. By making use of Industry 4.0 innovations, knowledge, location, condition and availability of the assets can be gathered.

The knowledge about the location and availability of an asset is especially important for companies with mobile assets that enable them to use their assets more effectively. It is also an important facilitator for the sharing of models, which contribute to the sustainable use of resources. Data collection to monitor the condition of an asset will allow users to set requirements or rules for initiating strategic actions or notifications that enable condition- based reactions. This enables for example predictive maintenance and replacement of missing components and reduces downtime.

The use of Industry 4.0 technologies therefore enables the use phase to be extended and facilitates the use of manufacturing equipment in a new use phase in accordance with the ecosystem principles. This can therefore contribute fundamentally to the economic and environmental aspects of sustainability, which means that intelligent assets already present solutions to many resource challenges.

5.2.3. Labour productivity

Increasing labour productivity can materially drive value. The increase of labour productivity can be achieved using the new Industry 4.0 technologies, which make it possible, for example. Reduce the waiting times between various manufacturing steps or speed up the R&D process. In addition, the burden or complexity of the tasks can increase the speed of manual production processes carried out by employees. The German company Festo, where human - robot cooperation works closely, is an example of such assistance in production processes (Werthmann, 2017).

Within the fourth industrial revolution, people still organize the creation of value. However, the skills requirements are changing, and different competencies are important. Routine jobs will disappear, and new functions will become more complex and new occupational areas will arise through the acceleration of digitalisation. In order to meet the social challenge of Industry 4.0, it is possible to improve the training efficiency of workers by combining new information and communication technologies in a sustainable way.

5.2.4. Management of inventories:

Good inventory management is very vital, as too much inventory equates to large capital costs. By using industry 4.0 levers, excess inventory drivers can address problems such as unreliable demand planning and excess production. This is possible e.g. Optimization of the supply chain in real time. Technologies such as systems that automatically reconfigure themselves if necessary, can reduce inventory costs by 20-50 percent see Figure 28.

5.2.5. Quality improvement

Industry 4.0 drivers enable product and process quality to be improved by using real - time problem - solving techniques, advanced process control systems or real - time error corrections to reduce unstable production processes, reworks and consequently additional costs. Using these approaches, costs associated with suboptimal quality could be saved by approximately 10 - 20 percent as shown in Figure 28. For example, by using advanced technology Siemens has been able to reduce the defect rate to a minimum.

Improving the quality of products and processes through the use of real - time problem solving, advanced process control or correction of errors in real time also hides the

potential for more sustainable production. As described above, production sequences can be designed more resource-efficient for material, water and energy consumption through optimization of processes. Therefore, using Industry 4.0 technologies can minimize the consumption of these resources. In addition to process optimization, increased product quality results in less processing and less waste during the manufacturing process. This also reduces waste and production time. In addition, high - quality products can be kept much longer in the operating phase, which means that the product life cycle (PLC) and its use phase can be extended. New products are less commonly needed by customers

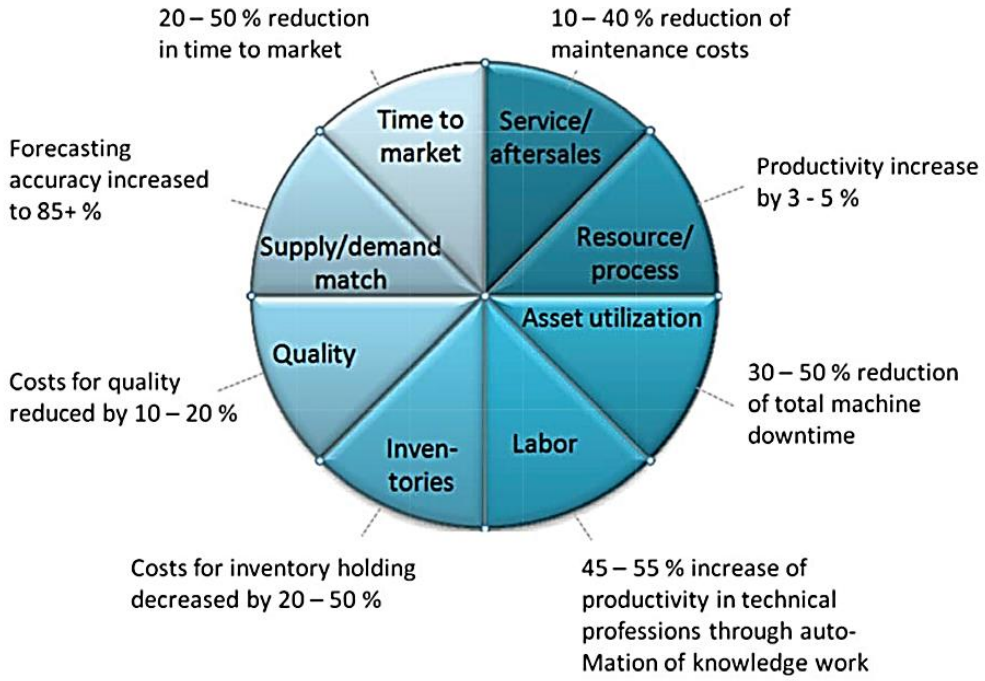

Figure 28: Eight Value Drivers as a result of industry 4.0

Source: Werthmann, 2017

5.2.6. Match of supply and demand

To avoid waste from unneeded inventory and storage costs, an ideal understanding of customer demand in terms of quantity and product characteristics leads to an even better certainty through new options such as crowd forecasting based on advanced analytics. The use of these technologies can increase the precise demand forecast to over 85% as depicted in Figure 28. As mentioned in the “Inventory management " sub-item, Industry 4.0 technologies can reduce inefficient demand planning and excess supply. More precise demand projections, as enabled by Industry 4.0 applications, lead to waste reductions, because the required input materials can be projected more

accurately and overproduction can be reduced. This reduces the need for large quantities of raw material in the supply chain and transportation, as only spare parts are created on demand. Exact demand forecasts will also facilitate the implementation of the ecosystem principles, as the reuse and preparation of materials already used can also be planned more accurately. If firms can meet actual demand through the cycling of materials already used or the reuse and re- production of goods, fewer resources will be extracted for the production of completely new products.

5.2.7. Reducing time to market:

Being first to market with new products can create more revenue and less competition. New Industry 4.0 technologies that enable cheaper and more efficient R&D processes, for example rapid prototyping facilitated by 3D printing can reduce time to market significantly. The use of such technologies can reduce market time by 30% to 50% see Figure 28.

New Industry 4.0 technologies allow research and development processes to be faster and cheaper. This can be achieved by means of procedures such as rapid prototyping, also known as additive production, using 3D printing. Additive production can create geometrically complex parts that require a high degree of customization, use less material and produce less waste. The ability of additive production to construct components directly from a digital image makes it an excellent alternative to traditional methods. In addition to the fact that additive production produces less waste because parts are stamped or sculpted from larger material pieces, no special tools or fixtures are needed. This makes the method compared to traditional processes largely material efficient. In addition, the material used has a lower impact on its life cycle, leading to a lower carbon footprint and lower energy levels. In addition to the more sustainable technologies used to reduce time to market, quicker learning also means that a product or process is less ideal for an ecosystem. This means that the continuous cycles of improvement are sped up to the advantage of the latest technology and practices for implementing an ecosystem.

5.2.8. Service and aftersales

Innovative services lead to better alternatives for repairing products and the opportunity to keep them operational longer. Component production can be more cost - effective if the machines are running longer. This is possible, for example. Remote

maintenance or virtually self - service guidance. In this case, it is possible to diagnose errors and even repair them without the need of a visiting technician. By using remote and predictive maintenance, maintenance costs could be reduced by approximately 10- 40% on average this can be viewed in Figure 28.

New business models will emerge through Industry 4.0. These models bring manufacturers or service providers closer together with customers. There are models in which products or services are only leased or borrowed rather than purchased. As a result, service and after-sales are becoming increasingly important in these models. The potential for sustainable improvements is also hidden. On the one hand, the supplied products can be kept longer by means of maintenance and repairs. On the other hand, it will be easier for the supplier to return products after their use, because products and parts can be traced throughout the entire PLC by the supplier. Products can therefore be recycled or re- produced, and parts can be reused and retained in a circular economy. Figure 29 shows a concept for a smrat factory supported by the fourth industrial revolution drivers changing traditional manufacturing relationships

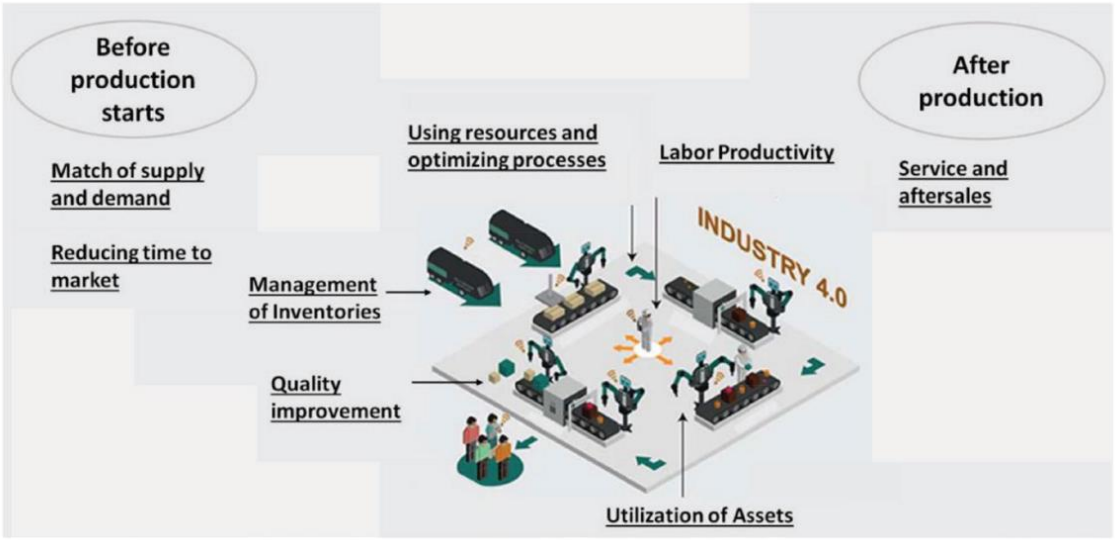

Figure 29: New Manufacturing Concept enable by Industry 4.0

Source: Werthmann, 2017

All 8 value drivers have a high potential for improvement in existing manufacturing systems, enabled by Industry 4.0. In order to activate these value drivers and really

exploit their potential, the company must be prepared to take part in the fourth industrial revolution.

5.2.9. Horizontal integration

Horizontal integration throughout value creation networks / supply networks means that the value chain also includes external functions such as suppliers and customers. In order to achieve the objectives of Industry 4.0 and increase competitiveness, the characteristics of all three dimensions must be employed. Horizontal integration describes the cross- company and company- internal intelligent networking and digitisation throughout the PLC value chain and between neighbouring PLC value chains.

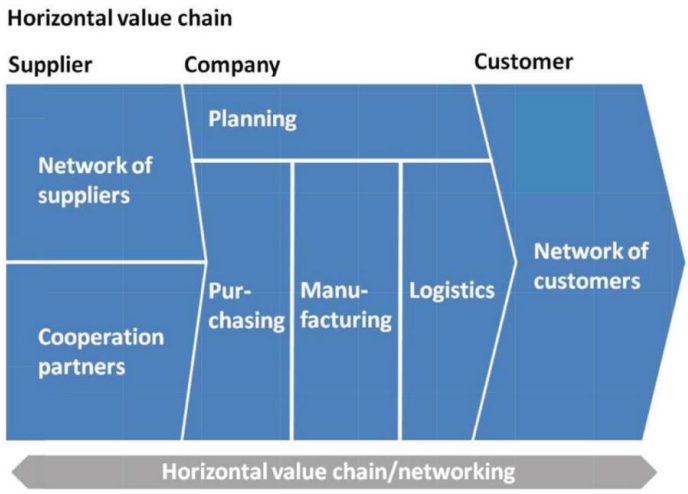

Figure 30: Horizontal Integration

Source: Werthmann, 2017

The digitisation of the horizontal value chain integrates seamlessly and optimizes the flow of information and goods from the customer to the supplier and vice versa throughout the company. In this approach, all internal areas of the company (e.g. Purchasing, production, and logistics) and all external partners are linked and regulated foresight is part of value creation, see Figure 30. Within Industry 4.0, horizontal integration enables the intelligent factory to constantly adapt to new conditions, e.g. Order volume or material availability. Therefore, it is possible to optimize production processes automatically by integrating suppliers and customers in the value chain.

5.2.10. Vertical integration

Vertical integration specifies the intelligent interconnection and digitization of the various hierarchical levels of the value chain. This enables digital order processes and customer - specific product development, where data can be automatically transferred to an integrated planning and production system. In addition, the related value chain activities such as marketing and sales or the development of technology are integrated. Within vertical integration, flexible and re-configurable production structures can be adapted to each customer's specific order or even to changing market demands. These characteristics are significant factors that enable manufacturers to remain competitive in highly volatile markets and enable them to achieve fast and faultless production

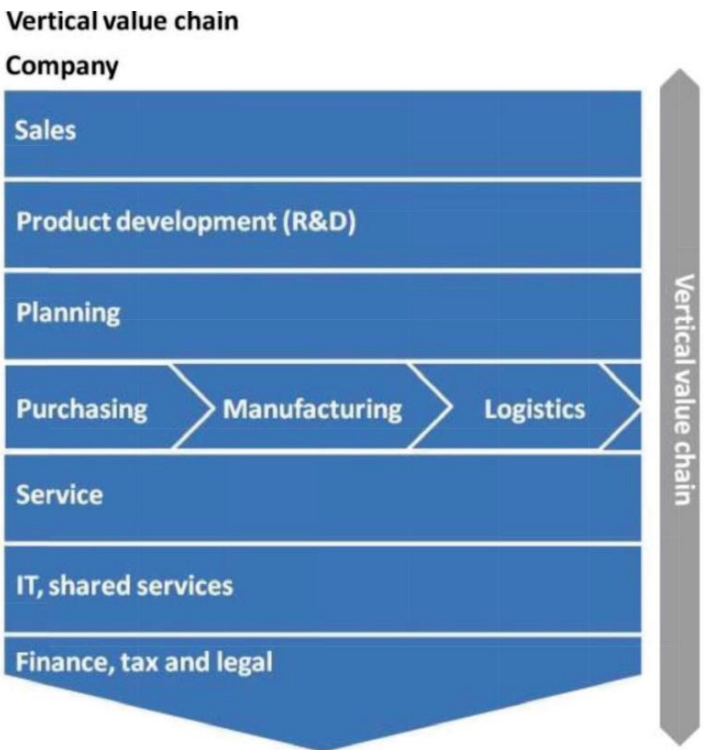

Figure 31: Vertical Integration

Source: Werthmann, 2017

Vertical integration and connected production systems involve the integration of all functions along the vertical value chain of a firm as illustrated by Figure 31 . End - to - end engineering throughout all stages of a PLC depicts the intelligent cross-linking and digitization throughout the PLC, from raw materials procurement to the use of the product until its end of life. This integrated engineering across the entire value chain

promises a great potential for optimisation. In this way, all entities involved in the engineering process will be provided with real - time training. The advantage is that it encompasses both, the manufacturing process and the manufactured product, when engineering the associated manufacturing system at same time as product is engineered see Figure 32 below.

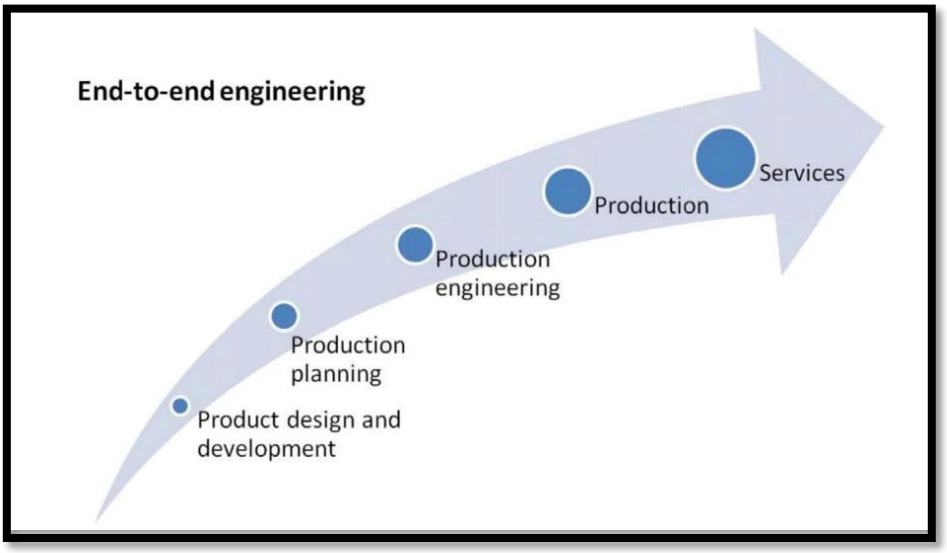

Figure 32: End-to-end engineering

Source: Werthmann, 2017

RECOMMENDATIONS FOR A BETTER SOUTH AFRICA

5.3. IMPLEMENTING ENTREPRENEURIAL ECO SYSTEMS IN SOUTH AFRICA

On the African continent South Africa is a leading entrepreneur in sub - Saharan Africa. The country has made significant progress in overcoming structural economic factors. Some of the most successful and innovative companies in the continent come from South Africa (for example Famous brands, SAB ltd and Aspen Pharmacare).The nation has credible institutional support structures which are essential for businesses to emerge and be successful. The policies of the government have tried to put more focus on closing historical gaps. This to a degree has hindered the growth of entrepreneurship in the country. With the addition of targeted, coordinated policies to

address remaining bottlenecks, the country is poised to achieve greater growth through entrepreneurship (Global Entrepreneurship and Development Institute, 2017). South Africa is second to Mauritius in the African continent to have a economy, this can be depicted in Figure 33. If an economy is diversified, it generally means that if one industry falls and collapses, the overall impact on the economy in the region is reduced diversified (Leke, Wamelen, & Lund, 2011).

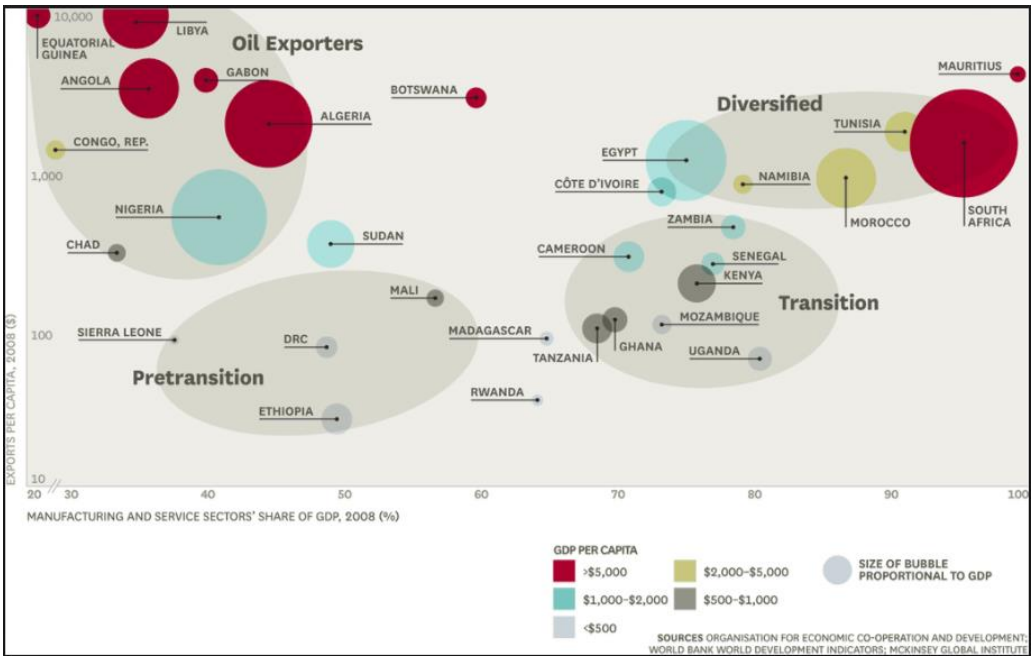

Figure 33: Diversification Chart for Africa

Source: Leke et al., 2011

A diversified economy promotes a sustainable cycle of economic activity in which industries constantly feed each other. (Hales, 2016). Diversification could be a sign of a healthy entrepreneurial ecosystem. In order to grow productive entrepreneurship in the South Africa, three tactics are proposed. The first one is to put more emphasis on entrepreneurial education, second improvements in bank financing models and lastly technological embracement

5.4. ENTREPRENEURIAL EDUCATION

Entrepreneurial education at early stages of schooling (from primary level) is critical because it transforms individuals into entrepreneurs who are aware of future opportunities to make a career by creating profitable companies. Promoting entrepreneurship in primary and secondary schooling will enable individuals to choose entrepreneurship as a career choice. The education system of the country needs put

emphasis and encourage entrepreneurship as it is key to sustainable economic growth.

5.5. BANK FINANCING MODELS

Access to finance from the banking sector in South Africa is one of the most difficult tasks accomplish. The country is still in a developing stage thus most people suffer from unemployment and poverty. If the banks in collaboration with the public could offer solutions tailored to support small businesses development especially in the rural areas where poverty strikes the hardest. Rural communities have limited access to basic services which make the life of an entrepreneur better.

South Africa is a dual economy,33% of the working class are effectively omitted from the formal economy(Global Entrepreneurship and Development Institute, 2017). Most entrepreneurs come from disadvantaged groups, this results in lack of resources (Telecommunications infrastructure, roads infrastructure, and technology) due to their community's being underserved. This underdevelopment makes it more probable for start-ups to fail, this failure causes communities to be discouraged and opt for employment type of revenue generation.

Current market structures are not favourable for new market entrants. There are structural barriers to market access for new entrants and small businesses which are put up by existing players. One of the strategies to improve entrepreneurial ecosystem in South Africa would be to work with banks to provide a sustainable solution that will enable both parties to benefit. Banks interrogate entrepreneurs, they want then to be knowledgeable about money. Financial functions can be delegated to freelance accountants and bookkeepers. Financial acumen is one of the critical factors which needs to be understood by borrowers. Thus, banks can put measures to ensure that education individuals seeking financial assistance. Partnerships between private and public sector to introduce new lending systems should be explored. Successful strategies like the micro-financing implemented in Bangladesh could have a positive impact on the entrepreneurial ecosystem in South Africa.

5.6. TECHNOLOGICAL INNOVATIONS

Embracing technology will increase the competitiveness of the country as a hole. Technology reduces barriers for entry into new markets. New business models as a result of technology emerge. The country needs to take advantage of the fourth

industrial revolution. The fourth industrial revolution is the next level of autonomous systems whereby digitisation of the entire value chain in the production environment is realised. In areas where the is no existing broadband infrastructure the government must put equipment that support the fourth industrial revolution, in areas with existing infrastructures, upgrades must be done. The fourth industrial revolution will eliminate cross border barriers, this will allow information to be more available and encourage international trade which in turn open new market for firms.

The principles of enterprise ecosystems are widely discussed in the scientific literature. The entrepreneurial ecosystem is an economic model that can be used to strategize, to provide guidelines for shared relationships between the stakeholders involved and to define the desires of the targeted customer, which can ensure an increase in the value proposition in the future. (Erina, Shatrevich, & Gaile-Sarkane, 2017). Adopting one feature of this complex ecosystem, such as an effective university technology transfer will not duplicate the other factors, actors, and institutions that make it up. The entrepreneurial ecosystem approach has been presented as a new framework for these dynamic changes.

5.7. CONCLUSION

Integrating education with science and public policy, i.e. ensuring that education and the accumulation of knowledge are based on science. In addition, the collaboration, technological innovation and co- inspiration of all industry stakeholders moving decisively towards an automotive industry of the Future Vision will require the collective South African automotive industry to be more closely involved, working together as an inclusive stakeholder group to ensure a collective, trust- based effort to realize the ambitions and vision of the sector.

Technology education in South Africa for preparing students for a high- tech economy to support the manufacturing industrial areas in general is a necessity. The automotive industry needs to compete and prepare for a dynamic and uncertain future, that is, work more intelligently and being smarter.

Coordinate government activities to bring about a competitive advantage in a developing knowledge economy. Development of citizens-based community consultation to express a shared vision of the preferred future for the nation. The successful implementation of a preferred future for the South African automotive industry needs more than just scenario planning as a method that develops new

insights and understanding about the sector and its future; it needs human commitment and dedication to effectively alter the industry's future through the formulation of a development plan and a strategy to realise the vision of the industry in order to achieve global competitiveness.

During the research, it was observed that there are a number of key drivers that shape South Africa's employment future. In this study it was also noted that the 4th Industrial Revolution will have the greatest impact on the future of employment in the manufacturing sector. These drivers have been dealt with in detail.

In recent decades, the intensity and complexity of discontinuous change has increased considerably, and today's South African automotive industry, already under threat from a myriad of disruptive forces, is facing an uncertain future. Difficulties such as the fight against commodity prices, an uncertain regulatory environment, increasing production costs, dwindling productivity and rising social pressures hamper the profitability of the industry and its ability to remain competitive globally. Through researching and embracing uncertainty, the automotive industry recognizes familiarities when moving towards the future; the practice of developing new insights through the application of future studies is central to this process, enabling an organization and, in this case, the South African automotive industry to engage in the creation of knowledge and wisdom.

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