TRADE & INDUSTRIAL POLICY STRATEGIES

INDUSTRY STUDY

TECHNOLOGICAL CHANGE IN SOUTH AFRICA'S AUTOMOTIVE INDUSTRY

MAY 2024

TIPS industry studies aim to provide a comprehensive overview of key trends in leading industries in South Africa. For each industry covered, working papers will be published on basic economic trends, including value added, employment, investment and market structure; trade by major product and country; impact on the environment as well as threats and opportunities arising from the climate crisis; and the implications of emerging technologies. The studies aim to provide background for policymakers and researchers, and to strengthen our understanding of current challenges and opportunities in each industry as a basis for a more strategic response.

This report on technological change presents a comprehensive overview of the global technological trends impacting the automotive industry.

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ABBREVIATIONS

AI	Artificial Intelligence
AIS	Automotive Investment Scheme
APDP	Automotive Production Development Programme
BEV	Battery Electric Vehicle
dtic (the)	Department of Trade, Industry and Competition
EU	European Union
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
FDI	Foreign Direct Investment
HEV	Hybrid Electric Vehicle
ICE	Internal Combustion Engine
IoT	Internet of Things
LIB	Lithium-Ion Battery
MaaS	Mobility as a Service
merSETA	Manufacturing, Engineering and Related Services Sector Education and Training Authority
ML	Machine Learning
NEV	New Energy Vehicles
PHEV	Plug-in Hybrid Electric Vehicle
R&D	Research and Development
SAAM	South African Automotive Masterplan
SMS	Smart Manufacturing Systems
UK	United Kingdom
US	United States

INTRODUCTION

Globally, numerous technological changes are taking place simultaneously, significantly influencing various industries. These technological advancements are coming together to incorporate sustainability in industrial manufacturing operations. This integration is important in transforming how industries approach production, energy use and waste management, ensuring that sustainability becomes a core component across industries. In the manufacturing sector, increased automation, digitisation and new business models have transformed industry practices, with the automotive sector a key example. This technological shift is complex as it has brought about changes not only in the built-in components of vehicles, but also in the structure and governance of the automotive industry's value chain. It has altered relationships and ownership structures among various key stakeholders, including vehicle manufacturers, component suppliers, software companies and battery producers.

Artificial Intelligence (AI), Internet of Things (IoT), big data and smart manufacturing are some of the key technologies transforming global automotive value chains and their governance structures, and ultimately changing how we think about mobility (B&M Analyst, 2019). These technological advancements are driven by stricter environmental policy regulations, government incentives, geopolitical shifts, and changing consumer preferences. As a result, the global automotive industry is witnessing disruptive trends that are shaping the future of mobility as electrified, connected, shared and autonomous (PwC, 2018). These developments offer opportunities to reduce carbon emissions, decarbonise the transport sector, and contribute to sustainable products and economic growth.

Successfully navigating the integration of technologies and transitioning to a sustainable automotive industry necessitates strong collaborative governance and a strategic policy framework that is geared towards addressing and adapting to technological developments within the industry and the country. Adopting technological changes is essential for achieving the objectives of the South African Automotive Masterplan (SAAM) 2035. The SAAM 2035 underscores the need for the South African automotive industry to develop a technology and skills development roadmap (the dtic, 2021a). In addition, SAAM 2035 recognises that the technology roadmap should extend beyond vehicle components to include advancements in additive printing, safety technologies, material composites and smart manufacturing (the dtic, 2021a). However, South Africa's technological transition is facing challenges, such as a restrictive fiscal policy space, limited investment in digitisation and innovation, and a shortfall in innovative skills and digital literacy needed to adapt to future technological changes. Despite these challenges, the structural shift presents opportunities for new and emerging businesses within the value chain and has led automotive producers to invest in digital and smart manufacturing capacities as well as adopting renewable energy technologies on a large scale.

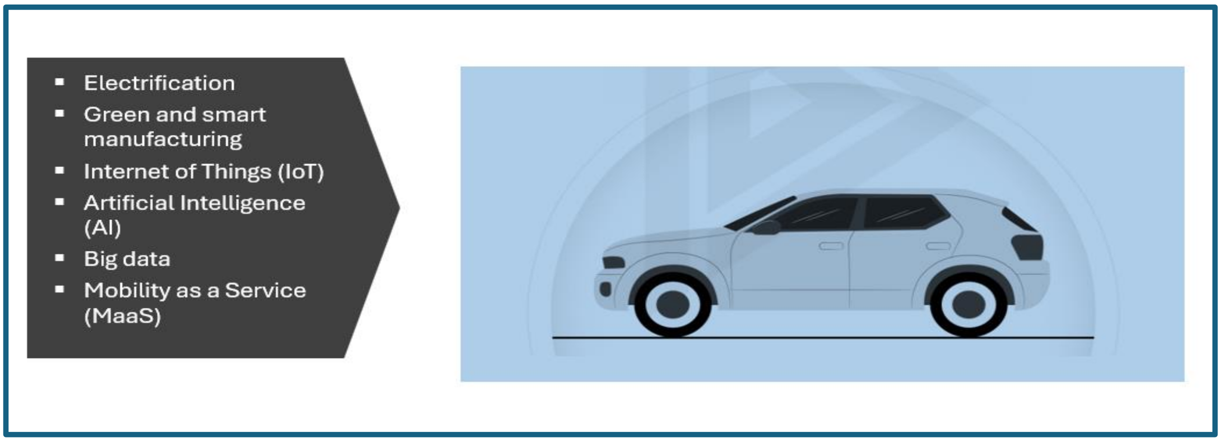
This report presents a comprehensive overview of the global technological trends impacting the automotive industry. For the scope of this report, the analysis is limited to the automotive value chain. However, while the report primarily addresses the automotive industry value chain, these technological developments extend beyond vehicle manufacturing, emphasising the importance of focusing on the concept of mobility, which involves integrating transportation, technology, infrastructure and services to enhance the movement of people, goods and information (Smith, 2021; UNECE, 2021). This comprehensive understanding would ensure a well-rounded approach to understanding and managing the impacts of technology on various aspects of mobility. A broader perspective is essential for leveraging technologies to meet national goals of decarbonising the transport sector, reducing emissions, and providing accessible, affordable, integrated and sustainable mobility solutions for all (Smith, 2021).

The first section looks into the range of technologies influencing the automotive industry, highlighting electrification as a major technological trend and assessing the extent to which the local industry has adopted this trend. Section 2 discusses how local firms in the automotive industry are adopting these technologies, while also identifying challenges that have impacted progress. The third section concludes with policy implications and recommendations.

SECTION 1: TECHNOLOGICAL TRENDS IN THE GLOBAL AUTOMOTIVE INDUSTRY

This section identifies six emerging technologies that are transforming the automotive industry: electrification, digital and smart manufacturing, IoT, AI, big data, and Mobility as a Service (MaaS), as illustrated in Figure 1. The section also examines the key enablers of these technologies and their transformative effects on the automotive value chain. Advanced technologies are increasingly being adopted to improve vehicle connectivity, cost efficiencies, safety and the development of technologically sophisticated and fuel-efficient vehicles (Javaid et al., 2022). While some of these technologies primarily support process manufacturing, including IoT, robotics, AI, and smart manufacturing, others enhance product development, such as electric vehicles (EVs) and autonomous vehicles. These new technologies can be highly complementary, so it is important to consider how they can support each other to benefit both consumers and manufacturers.

Figure 1: Technologies driving change in the automotive industry



Vehicle image source: TechnoBrains, 2023

Factors influencing technology adoption can be classified into technology-push, regulatory push and market-pull mechanisms. Technology-push is driven by R&D activities, focusing on the creation of new technologies and products through scientific research, engineering and advancements in materials and processes (Deonarain, 2019; Lubik et al., 2013). Market-pull results from factors that drive the adoption of technological systems, such as shifts in consumer preferences and market trends, leading to developing products that meet evolving demands (Deonarain, 2019). This includes growing consumer awareness of sustainable products and the benefits of EVs for consumers, such as lower total operating costs (Potter and Favour, 2024). Regulatory push involves government policies, regulations or legal mandates that enforce specific standards or technologies. In the automotive industry, regulatory push is a key driver for reducing carbon emissions in the manufacturing sector, safety regulations, and fuel efficiency mandates (Deloitte, 2023). For example, several governments are imposing rules that require a certain percentage of new vehicles to be EVs by a specific year to reduce carbon emissions and meet net-zero targets,[1] thus pushing manufacturers to invest in and expand their EV offerings. Each of these forces plays a crucial role in directing the industry, influencing both the speed and nature of technological developments and their adoption in the market. Table 1 provides a descriptive overview of the six technologies along with their primary driving factors.

[1] Norway is banning the sale of ICE vehicles by 2025, while the United Kingdom (UK) and several European countries, including Germany, France, and Poland, have set a ban for 2035.

Table 1: Description of technologies influencing the automotive industry

TECHNOLOGY	DESCRIPTION	KEY ENABLERS
Electrification	Electrifying vehicles means substituting traditional internal combustion engines (ICE) with new energy vehicles (NEVs) to lower carbon emissions and air pollution. Currently, there are four categories of NEVs: battery electric vehicles (BEVs), hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and fuel cell electric vehicles (FCEVs).[2]	The electrification of vehicles is driven by a combination of technology push, regulatory push and market demand factors.
Green, smart and digital manufacturing	Sustainability has become a priority for the automotive industry, driven by the need to reduce the environmental impact of industries and adopt green and sustainable manufacturing practices. Growing concerns about climate change are prompting vehicle producers to rethink their practices and implement sustainable measures. This involves not only reducing emissions during vehicle use but also addressing the entire value chain—from the mining and extraction of raw materials, manufacturing to end of life. Smart manufacturing technology leverages interconnected machines and tools to enhance smart manufacturing systems (SMS) and optimise energy use. Benefits include cost reduction, increased productivity, product customisation, reduced wastage, resource efficiency, and minimised environmental damage (SAP, 2024). Achieving SMS involves deploying advanced technologies such as IoT, AI, cloud	Green manufacturing in the automotive industry is being driven by a combination of technology push, regulatory push and market demand factors. Smart manufacturing is primarily driven by technology push but also influenced by market pull and regulatory push factors, through government incentives for the adoption of advanced manufacturing technologies.

[2] HEVs combine an ICE and an electric motor. The PHEV has a similar structure but includes a smaller ICE and a larger lithium-ion battery (LIB). BEVs store energy in LIBs, while FCEVs generate electricity through a reaction between oxygen and hydrogen.

	computing and additive manufacturing in automotive plants. The integration of digital technologies into manufacturing processes is transforming the way products are made, using a wide range of technologies such as computer-aided design, computer-aided manufacturing and digital twins (Potter and Favour, 2024).	
Artificial Intelligence (AI)	AI encompasses a range of technologies such as machine learning (ML) and robotics, that enable machines to sense, comprehend, act and learn (Soori et al., 2023). AI is making vehicles safer, more efficient and more intelligent vehicles, as well as better manufacturing and maintenance processes. Examples of AI in the automotive industry include industrial robots constructing a vehicle and autonomous vehicles navigating traffic with ML (Soori et al., 2023; Schroer, 2024).	In the automotive sector, technology push is evident in the integration of AI in autonomous vehicles, the development of battery technologies, and improvements in materials that lead to lighter vehicle components.
Internet of Things (IoT)	IoT enhances vehicle production, use and the aftermarket. In vehicle manufacturing, IoT helps by using sensor alerts to check equipment accuracy, reducing costs, improving performance and increasing machine uptime (Chauhan, 2024). IoT can ensure high-quality products pass through the inspection belt by detecting dents, defects and missing components. IoT in the automotive industry integrates internet-connected devices and sensors into vehicles to collect and exchange data (IoT Business, 2023). These sensors communicate with each other, the vehicle, and external networks. IoT-enabled vehicles share performance data with the cloud, allowing manufacturers to assess risks and communicate	Advances in technology enable enhanced quality products in manufacturing, and the creation of smarter, more interconnected devices and systems. However, IoT is also further enabled by market pull because of the increasing demand from consumers and businesses for smart and connected devices, encouraging the adoption of IoT technologies.

	maintenance updates to consumers, addressing issues before breakdowns occur i.e. predictive maintenance, management systems, analytical services and software updates (IoT Business, 2023; Cunningham, 2022). The integration of IoT and AI technologies in the automotive industry has enabled the development of autonomous vehicles.	
Big data	In the automotive industry, big data encompasses a wide range of information, including consumer behaviour, preferences, driving patterns and locations collected from vehicles. Many AI applications depend on big data, highlighting the importance of automotive engineers being skilled in data analytics (Shinde, 2024).	Big data in the automotive industry is mainly driven by a mix of technology push and market pull factors. Advances in technology facilitate the collection and analysis of extensive data, while market demand for improved vehicle features and personalised services encourages the industry to use big data.
Mobility as a Service (MaaS)	Shared mobility involves using shared vehicles instead of owning a car, through car-sharing, ride-hailing, or bike-sharing services (Mouritidis, 2023; Narayanan and Antoniou, 2023; Deorarian, 2019). As these services grow in popularity, demand for private car ownership will decrease, requiring vehicle manufacturers to adapt by developing shared mobility solutions. This shift will also drive innovation, increasing the demand for vehicles specifically designed for shared use (Narayanan and Antoniou, 2023).	There is growing consumer demand for convenient, cost-effective, and flexible transport options, driven by changing consumer preferences toward private car ownership. Technology has also enabled MaaS through the development and deployment of shared mobility platforms and services.

1.1. How electrification technology is redefining the local automotive industry

Table 1 shows that electrification has had the most immediate and notable impact on both the global and South African automotive industries due to regulatory pressure from developed countries. Many automakers are setting EV targets, with some aiming for a complete shift to EVs by 2030.[3] Concurrently, green manufacturing has gained prominence as automotive factories implement clean production techniques to ensure that the vehicles they produce are environmentally friendly, with minimal waste and adhere to circular economy principles. Automakers are actively reducing the use of fossil fuelled products in their supply chains to meet regulatory and investor expectations as they transition to EVs. The implications are significant for global vehicle assemblers, their component manufacturers, and countries with a major automotive industry.

Electrification in the automotive industry will be explored in greater detail, with a specific focus on its impact on the local industry.

1.2. NEV adoption and manufacturing in South Africa

Developing the NEV market development

To maintain and grow the local automotive industry and meet the goals of the SAAM 2035, the South African automotive industry must adapt to the current technological transition to NEVs. With tightening global vehicle emissions regulations and associated costs, the industry is shifting towards NEVs and eco-friendly vehicles. The demand for NEVs is primarily driven by government incentives and the imperative to combat climate change in the European Union (EU), the UK, the United States (US) and other developed countries such as Japan, South Korea and China, which have committed to achieving a zero-carbon economy. Since 2020, developments in these key export markets have accelerated the NEV landscape in South Africa, supported by government efforts to green the economy and position the country as a centre for green manufacturing (AIEC, 2022). In 2023, the Department of Trade, Industry and Competition (the dtic) released the South Africa White Paper for EVs, designed to guide the automotive industry from producing ICE vehicles to developing a production and consumption mix which includes EVs, aiming to position the country as a favourable location for vehicle and component manufacturing in emerging technologies (the dtic, 2023). The EV White Paper also proposes support for EV related components, including incentives for local battery production.

The current EV White Paper lacks consumer incentives for EVs, but the dtic indicates that these may be introduced in the second phase of the EV strategy. EV adoption in South Africa is generally low, primarily due to the high upfront purchasing cost. This significant barrier is further compounded by the effects of value-added tax (VAT), ad valorem excise duty, import tariffs, and issues related to range anxiety, electricity supply security and limited understanding of the technology (Montmasson et al., 2020). Additionally, the high interest rates associated with vehicle financing in South Africa further penalise EVs (Montmasson et al., 2020). Despite this, the local market is seeing a slow but steady increase in EV adoption, although it still lags behind the global average of 5% of vehicle sales. Markets that have reached this average typically have consumer incentives in place, although in most markets incentives were implemented as temporary measures.

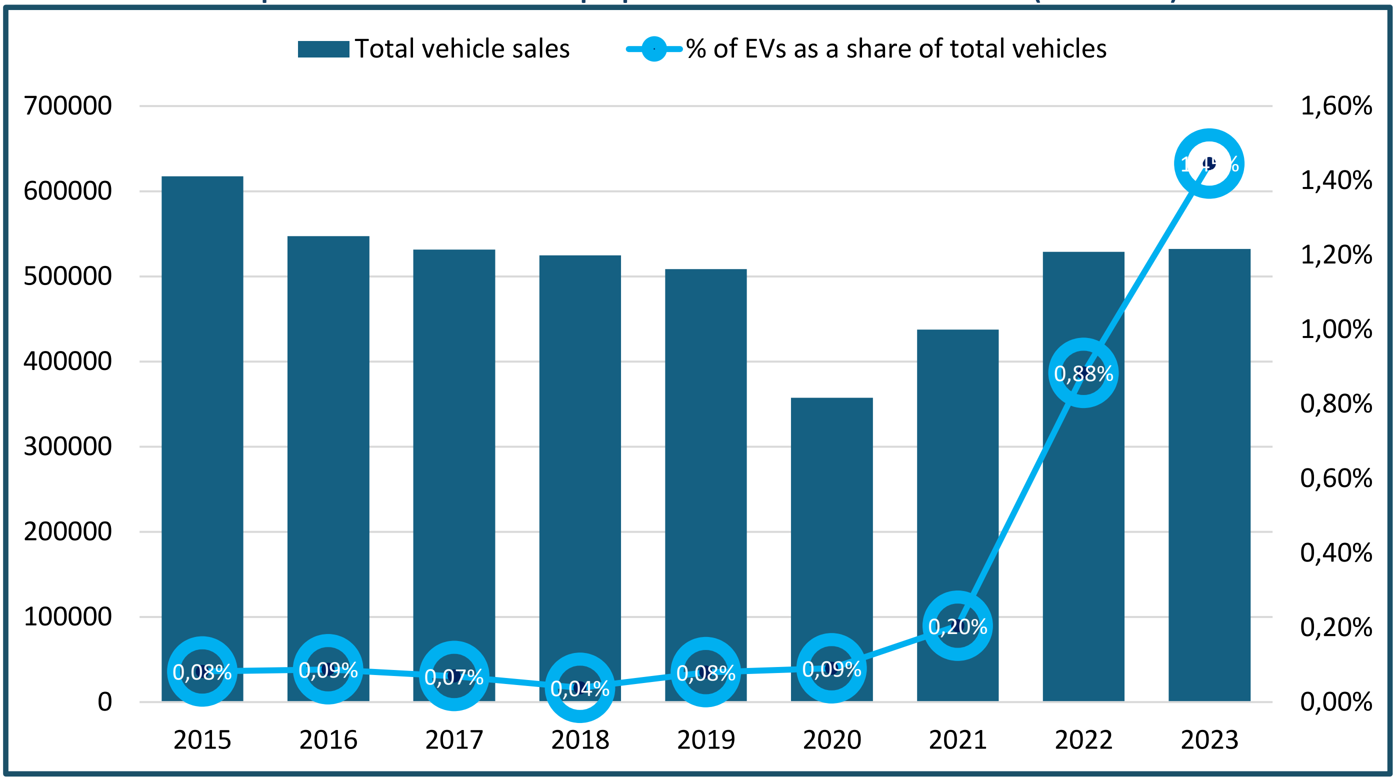
In 2021, sales of NEVs, comprised of both BEVs and PHEVs reached 6.6 million, accounting for nearly 10% of new global vehicle sales, four times the market share in 2019 (IEA, 2022). By 2023, 14 million new NEVs were sold, bringing the cumulative total of NEVs sold to 40 million units. NEV sales in 2023

[3] The Volvo Group has announced its goal to transition into a fully EV company worldwide by 2030.

were 3.5 million higher than in 2022, showing a 35% year-on-year increase (IEA, 2024). NEVs made up about 18% of all vehicles sold in 2023, up from 14% in 2022 and 2% in 2018 (IEA, 2024).

China led the market, accounting for approximately 60% of global NEV sales. Europe was the second-largest market, followed by the United States, where sales reached an 8% share in 2023. According to Graph 1, NEV sales in South Africa have increased over time reaching just over 1% of total vehicle sales in 2023. The increase is primarily driven by BEVs and HEVs. BEV sales rose by 85.4%, from 502 units in 2022 to 931 units, while HEV sales grew by approximately 60.4% (Droppa, 2023).

Graph 2: NEV sales share as a proportion of total new vehicle sales (2015-2023)



Source: Data source from the AIEC export manual (various years); naamsa, 2024; and Droppa, 2024.

Currently, EV manufacturing is still in its early stages in South Africa. Out of the seven vehicle manufacturers based in South Africa, only Mercedes-Benz and Toyota produce NEVs locally. Mercedes-Benz manufactures the C-Class PHEV at its East London plant exclusively for the export market, while Toyota manufactures the Corolla hybrid in KwaZulu-Natal, for both local and international markets. Both manufacturers benefit from the Automotive Production Development Programme (APDP), which has a technology-agnostic approach, supporting ICE as well as PHEV and HEV manufacturing. In November 2023, Ford announced a R5.2 billion investment in its Silverton plant to produce the Ranger PHEV and build a battery assembly line for the PHEV. The new PHEV Ranger will be exported to Europe, Australia, and New Zealand (ITWeb, 2023).

Questions about localising battery technology production have become important for the manufacturing of BEVs. Since batteries account for over 50% of a BEV's total cost, local production offers advantages in terms of logistics, cost, maintenance and a lowered carbon footprint. Many countries with an automotive manufacturing base, including South Africa, are facing challenges in securing the essential critical minerals for cell production, acquiring the necessary skills, substantial investment for battery gigafactories, R&D and strategic partners needed for local battery production.

As part of the global automotive value chain, South Africa produces a limited range of automotive products and has a relatively small market. Consequently, the industry has struggled to rely on local demand and has had to depend heavily on the additional economies of scale provided by exports, making competitiveness crucial to its success. Both NEV and battery production require economies of scale, which presents challenges for the South African industry. To make large-scale NEV production profitable, it is essential to explore opportunities in new markets and assess the viability of regional integration. However, regional integration comes with its own challenges, such as the limited demand for new vehicles in Africa, where most cars are second-hand cars and demand is typically for smaller vehicles—these are vehicles that South Africa largely imports. The importance of regional integration for the success of the South African automotive industry is discussed in more detail in the automotive industry report on international trade and foreign direct investment (FDI).

Vehicle manufacturers in South Africa, like those in other countries, must now produce globally standardised vehicles and adhere to specific performance targets set by their parent companies to remain competitive (Barnes and Morris, 2008). It is essential for South Africa to increase its NEV production not only to maintain market access but also to stay competitive and keep pace with the latest global NEV industry technologies. Despite having a successful automotive industry, South Africa is still a small producer in the global industry, contributing less than 1% of global production. The positive policy signals and support for NEVs align well with the SAAM 2035 goals and represent a crucial step toward maintaining a sustainable and competitive automotive industry.

To maintain access to major export markets like the EU, UK, and US, South Africa must invest in NEV and NEV-related component production. However, the lack of NEV-specific incentives had been identified as a barrier by vehicle manufactures, especially for BEV manufacturing. In a recent budget speech in February 2024, South Africa's Minister of Finance announced that to encourage the production of EVs in South Africa, the government will introduce an investment allowance for new investments starting on 1 March 2026 (South African Government, 2024). This incentive will allow manufacturers to claim 150% of qualifying investment spending on BEVs and FCEVs in the first year. This new incentive will be implemented alongside the existing support for the automotive industry under the APDP. The APDP includes the Automotive Investment Scheme (AIS), which provides cash grant incentives of up to 30% for manufacturers producing EVs, energy efficient vehicles and related component manufacturers (compared to the 20% cash grant incentive for ICE vehicles) (the dtic, 2021b).

SECTION 2: TECHNOLOGICAL CHANGE – SOUTH AFRICAN DEVELOPMENTS AT THE FIRM LEVEL

Table 2 below illustrates the progress made by South Africa's automotive industry in adopting key technologies and identifies some barriers they face. Vehicle assemblers and their component manufacturers are exploring the emerging roles of additive manufacturing, advanced robotics, and AI, which are significant disruptors across the entire automotive value chain. The report uses secondary sources to assess the readiness of South African automotive firms in adopting new technologies. According to the TIPS/merSETA study by Nyakabawo et al*.,* (2022) and a policy brief by Mokoena (2022), technologies such as encryption and cybersecurity are widely integrated frontier technologies in manufacturing subsectors, followed by cloud computing, AI and the IoT.

Table 2: The adoption of new technologies in the South African automotive industry

Technology	Progress in technology adoption	Challenges in implementing new technologies
Advanced Robotics	Advanced robots surpass traditional robots and conventional automation with superior perception, integrability, adaptability and mobility. They excel in inspecting components, detecting defects, and improving product quality, leading to reduced scrap rates, cost-effectiveness, and enhanced efficiency. According to Engineering News (2020), the automotive robotics market in South Africa is one of the leading industrial robotics markets globally. Advanced robotics are also valuable in other South Africa industries, such as pharmaceuticals and food manufacturing (Yaskawa, 2023; Cunningham, 2023. Volkswagen South Africa and Ford South Africa have invested in robotics for their automotive manufacturing. In Uitenhage, Volkswagen's plant uses over 600 robots to assemble around 3000 units of cars. These technologies enabled 24/7 operations at full capacity in 2018, resulting in 300 additional employees (Deonarain, 2019). In 2021, Ford announced an investment of R15.8 billion to enhance the production of the Ford Ranger. Ford plans to introduce new technologies, including advanced robotics and a new stamping facility (Bubear, 2023).	Cost factors significantly hinder the adoption of advanced robotics for many South African manufacturers. Programming advanced robotics requires highly skilled professionals which are often in shortage in South Africa. Additionally, robotics could potentially replace both low- and high-skilled jobs in South Africa (Cunningham, 2023). Some categories of jobs are at risk in the automation of routine processes across skill levels, while automation creates employment in other areas. Adopting technologies increases complexities in production in terms of managing technologies, and this will require the upskilling and re-skilling of the labour force.
Additive manufacturing (3D printing)	Additive manufacturing is transforming production for vehicle manufacturing and aftermarket component supply. According to Barnes (2020), large Tier 1 automotive component suppliers are heavily investing in new materials development and additive manufacturing. The Department of Science and Technology (DST, 2019) reported that over 300 additive manufacturing systems have been established locally through government, academic and industry collaboration efforts. This approach has developed an infrastructure base that supports innovative research, enabling designers and engineers to create complex designs without needing individual tooling components. Additive manufacturing has evolved from a prototyping technology to a fully-fledged manufacturing technology, widely used in the medical, automotive, jewellery and aerospace industries.	The material data for additive manufacturing in South Africa is limited. Ongoing research aims to develop new materials and expand this data. However, the relationships between printing processes and material properties are still being researched, resulting in low 3D-printed components applications (Dzogbewu and De Beer, 2023).

AI	The South African automotive sector is set to leverage AI successfully, not only in manufacturing but also in retail and insurance across the value chain. Barnes (2020) highlights Atlantis Foundries as a successful AI adoption case in South Africa. This company, which produces commercial vehicle engine blocks for major international brands, uses AI to predict and prevent sub-surface defects. As a result, internal scrap and rework rates have been reduced by up to 90%.	AI is still developing, and most businesses and industries face similar challenges, including a shortage of skilled workers, the need for collaboration across different business departments, the support of appropriate organisational structures, fostering a data-driven culture, and accessing relevant data pools to achieve commitment and relevance organisations and across products (Dremel, 2017.

The TIPS/merSETA study (2022) investigates technological changes and adoption across six the Manufacturing, Engineering and Related Services Sector Education and Training Authority (merSETA) chambers: metal and engineering, retail motor and aftercare, plastics, automotive components, automotive manufacturing and new tyre manufacturing. This study was conducted through interviews with key industry stakeholders. The report reveals that automotive manufacturing and related chambers are adopting a broader range of technologies and integrating them into more business processes compared to other chambers (Nyakabawo et al., 2022). Automotive manufacturing and related chambers are mainly adopting sensor technology and IoT, cloud computing, and AI, as well as encryption and cybersecurity. In addition to these widely integrated technologies, companies in the motor retail chamber are exploring 3D components, tooling and moulds and advanced and nano materials. About 27% of companies across the six chambers indicated they are integrating sensor technology and IoT into a single business process, while 13% reported company-wide integration of these technologies (Mokoena, 2022).

Unlike the other sectors, where a high proportion of companies are integrating technologies into a single business process, Nyakabawo et al., (2022) find most automotive manufacturing companies are integrating these technologies into multiple business processes. Additionally, automotive companies are incorporating e-commerce, digital trade, clean energy and transmission technologies into their product lines and business operations (Nyakabawo et al., 2022).

The TIPS/merSETA study (2022) notes that 75% of companies in automotive manufacturing reported moderate displacement of some functions due to technology, while 50% reported substantial addition of new functions. According to the study's anecdotal evidence from industry stakeholders, it finds that several companies are focused on staying open and retaining jobs rather than tracking technology changes. When asked about their strategic priorities for the next decade, many companies prioritised reducing costs, increasing output, and becoming more environmentally sensitive. High costs of replacing old equipment were found to also deter smaller manufacturers, who often cannot afford such investments. Larger vehicle manufacturers and Tier 1 suppliers generally have bigger budgets, while small and medium-sized component suppliers face financial, skills, and R&D investment limitations. For example, 3D printing is not widely adopted by small and medium-sized enterprises due to affordability issues, but adoption is expected to increase as costs decrease (Nyakabawo et al., 2022). Additionally, companies are hesitant to upgrade equipment due to uncertainty about future volumes in the current economic climate and tend to wait for new technologies to become established and mature before adopting them (Levin, 2018).

2.1. Technology adoption on skills development in the auto's industry

Vehicle manufacturing is capital-intensive with limited job creation potential. However, the automotive industry plays a vital role in employment generation through its multiplier effect and is important for skills development and technology transfers. Technological advancements in the industry will create new jobs while eliminating or changing existing ones, having a significant impact on low-skilled workers.

According to the TIPS/merSETA study (2022) , most automotive companies are importing skills in areas like robotics and laser welding (Nyakabawo et al., 2022). A recent skills gap analysis study by TIPS (Moshikaro, 2023) analysed emerging, at-risk and transitioning occupations within the automotive value chain. The report identified several key occupations in BEV and PHEV assembly, including electrochemical equipment assemblers, electrician and electronic equipment assemblers, electric propulsion engineers, EV test engineers, high voltage technician and electric vehicle architects. Many of these occupations are either limited or unavailable in South Africa, as BEVs are not yet manufactured locally. Therefore, it is crucial for the South African automotive industry to focus on reskilling and upskilling the local workforce instead of relying on importing these skills. Additionally, maintenance and aftermarket service occupations, such as mechanics will require upskilling for EV battery repair or replacement, advanced software knowledge and expertise in high voltage The EV White Paper 2023 emphasises the importance of minimising job losses through sufficient investment in reskilling and upskilling workers in the automotive value chain (the dtic, 2023).

Additional to skills development and training, South Africa needs to develop its IT infrastructure and ensure energy security to support this transition. Cunningham (2018) argues that the exponential rise in digital technologies will necessitate increased government focus on cybersecurity challenges, data security and privacy, among other concerns.

SECTION 3: POLICY IMPLICATIONS AND RECOMMENDATIONS

Barnes (2020) notes that adopting new technologies presents significant challenges for smaller automotive economies like South Africa. Barnes (2020) further details that smaller economies have minimal influence over these changes, and therefore need to adapt rapidly to the shifting market and production dynamics within global value chains, although they often might have limited resources to anticipate future developments. The domestic industry's marginal global position makes it highly vulnerable to technology disruptions, yet it also presents opportunities for testing or piloting emerging technologies (Barnes, 2020). South African industrial policy must also be continually reviewed and adjusted in alignment with national policies for technological change. To reposition itself in response to these changes, South Africa needs substantial investments in educational systems providing both basic and technical training, skills of firms to innovate, IT infrastructure, and incentives provided by economic, political and legal frameworks and the support of technology-oriented state departments.

Innovation flourishes in an ecosystem of collaboration and partnership within a national innovation framework. The South African automotive industry actively fosters relationships with stakeholders across multiple sectors. From academia and research institutions to government agencies and international partners, collaboration is key to unlocking new opportunities and overcoming complex challenges to adopting new technologies (Barnes, 2020). By pooling resources, sharing expertise and leveraging diverse perspectives, both private and public stakeholders could be able to drive innovation and continue to position South Africa as an automotive success story. In the automotive sector, there is a shift from merely assembling mechanical components to focusing on R&D, software and the materials used in vehicle manufacturing and related EV components. This transformation underscores the need for strong coordination and collaboration among various stakeholders. The dtic, the Department of Science and Innovation), the Department of Basic Education, Department of Transport, and the Department of Mineral Resources and Energy all play crucial roles in the future of the automotive industry.

It is also important to ensure that technological advancements are not confined to a single industry but are spread across various industries and sectors. There must be a robust framework that creates a national enabling environment for these technologies to thrive. Although challenges persist for South African firms and the automotive value chain, there has been progress that has yielded positive results and improved competitiveness for local firms and industries, with support and collaboration from various stakeholders.

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