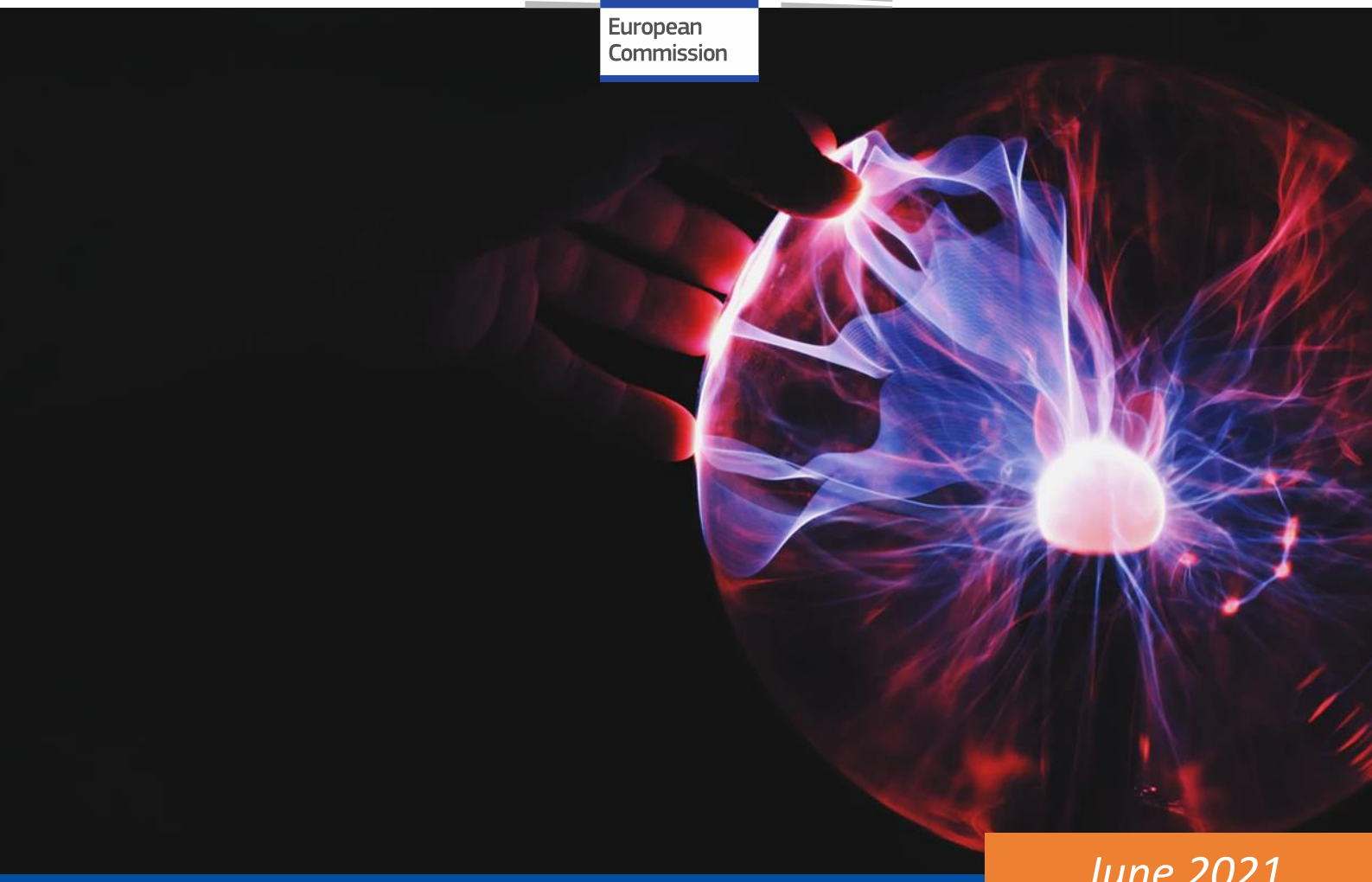
European Commission



June 2021

Advanced Technologies for Industry – AT WATCH

Technology Focus on Sustainability in the Automotive industry in Europe

This report was prepared by Vincent Bremer (Capgemini).

EUROPEAN COMMISSION

European Innovation Council and Small and Medium-Sized Enterprises Executive Agency (EISMEA)
Unit I-02.2 – SMP / COSME Pillar
E-mail: EISMEA-SMP-COSME-ENQUIRIES@ec.europa.eu

Directorate General for Internal Market, Industry, Entrepreneurship and SMEs
Unit D.2 – Industrial Forum, Alliances, Clusters
E-mail: GROW-ATI@ec.europa.eu

European Commission
B-1049 Brussels

LEGAL NOTICE

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of EISMEA or of the Commission. Neither EISMEA nor the Commission can guarantee the accuracy of the data included in this study. Neither EISMEA nor the Commission or any person acting on their behalf may be held responsible for the use that may be made of the information contained herein.

More information on the European Union is available on the Internet (http://www.europa.eu).

PDF ISBN 978-92-9460-774-4 doi: 10.2826/94114 EA-06-21-013-EN-N

Luxembourg: Publications Office of the European Union, 2021

© European Union, 2021

June 2021

Table of Contents

Section 1

1 Introduction

This Advanced Technology Watch report has been developed in the framework of the Advanced Technologies for Industry (ATI) project, initiated by the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and Small and Medium-Sized Enterprises Executive Agency.

As a part of a series of analytical reports on trends in advanced technologies, this report represents a comprehensive monitoring tool endowing policymaker, industry players, researchers and other relevant stakeholders with regularly updatable research. The ATI Watch report series is meant to play a complementary role to the other analytical, policy and statistical reports of the project, by focusing on the market, business and socioeconomic trends driven by technology innovation. This Advanced Technology Watch therefore encompasses a whole set of advanced technologies that are a priority for European industrial policy. These technologies enable process, product and service innovation throughout the economy, thus fostering industrial modernisation.

The qualitative and quantitative analysis included in this Advanced Technology Watch report is specifically designed to provide novel insight and up-to-date content to technology users across all European industries, with the aim of revealing potential opportunities emerging from the most recent applications of advanced technologies.

The ATI Watch report series targets:

- A primary audience of industry stakeholders, including SMEs and industry associations interested in learning about upcoming technology trends and business opportunities
- A complementary audience of national, regional and local policy makers interested in supporting industry in the exploitation of technology innovation and emerging business opportunities by removing barriers and creating favourable market conditions
- A complementary audience of research and technology stakeholders interested in the applied research challenges to be solved to capture emerging business opportunities

Each report is thus structured using two main sections:

- A brief overview of all uptake of advanced technologies and demand trends by industry (Section 1: Technology Landscape)
- A more in-depth analysis of one advanced technology, selected because of its relevance in terms of emerging business opportunities and disruptive potential (Section 2: Technology Focus).

This report focuses on digital transformation in the automotive industry and how this contributes to the competitive advantage and sustainability goals of automotive organisations.

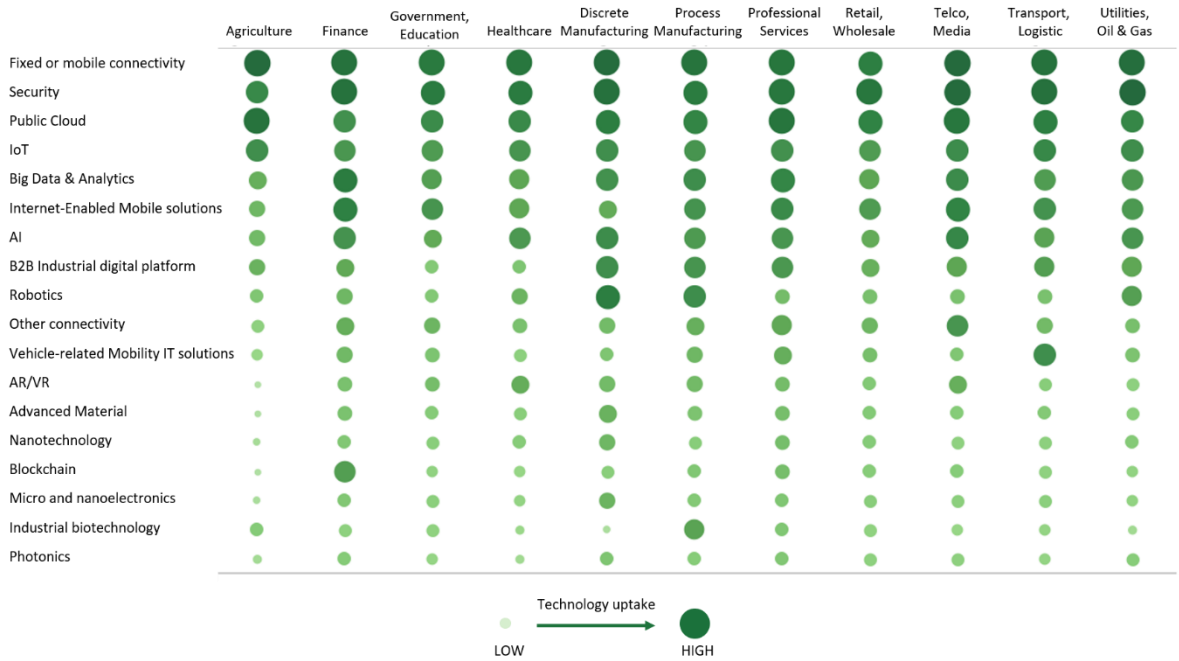
The targeted industry audience of this report are players in the European automotive industry. As described in section 2.2.8 the ecosystem of players in the automotive industry is diverse and not only limited to the traditional car manufacturers and Original Equipment Manufacturers (OEMs). The market trends in this report give an overview of the latest digital innovations that open opportunities for these players.

1.1 The Advanced Technologies for Industry landscape

The digitisation and industry modernisation process in Europe is progressing at different speeds across all industry sectors, driven by a whole set of changing priorities, challenges and use cases. Advanced technology adoption has been impacted by the pandemic, resulting in a slowdown necessary to allow companies to focus on more business contingency related initiatives. At the same time, the COVID-19 has sped up the adoption of some specific technologies through forced digitisation of customers and supply-chains interactions and all the related internal processes. These technologies are acting as 'return-to-growth' accelerators, making businesses and organisations as a whole more resilient for the future scenario. However, throughout the path to recovery, the focus will be more on safe bets than big bets.

The different mix of advanced technologies adopted by each industry is visualised in Figure 1. The figure shows the percentage share of enterprises in each industry adopting or planning to adopt each technology (the size of bubbles corresponds to the level of uptake, with the highest value being 85%). The data is based on the Advanced Technologies for Industry Survey (November 2020)[1] and on a sample of European enterprises from 7 Member States, representing more than 60% of the EU GDP in 2020. This is an updated version of last year the ATI Survey conducted in July 2019.

Figure 1: Advanced Technologies Uptake by European Industries, 2020



Source: Advanced Technologies for Industry Survey November 2020, (N=1 547).

Note: Bubble size represents the % of enterprises in the industry adopting the technology in the same row. The maximum value is 85%.[2] Technologies are ordered top-down based on the total sample average adoption.

The visualisation highlights how a distinct group of technologies **features a marked horizontal diffusion** across all industries (general purpose technologies Connectivity, Security, Public Cloud, Mobile solutions, Big Data & Analytics, Internet of Things (IoT) and Industrial Digital Platform): they represent the technology portfolio necessary (but not sufficient) for digital transformation. **Other technologies clearly display a niche or industry-specific orientation**. However, this does not mean that they do not provide opportunities for investments outside their main industry niche. Robotics is a very interesting example: the technology was initially developed in manufacturing, where it served as a substitute to human workforce in several time-consuming tasks, helping human to save time and speed up production. New areas of applications are now emerging, and multiple novel use cases proliferate in order to drive business value in other industries. For instance, in manufacturing, Robotics is used for a wide variety of tasks, from shop floor production automation to warehouse inventory management. Similarly, Robotics exhibits a great potential in the healthcare sector where it can be used to support the medical personnel enhancing procedures' safety, reducing operative costs, disinfecting

[1] The survey interviewed a sample of 1,547 enterprises with more than 10 employees in DK, DE, FR, ES, IT, PL, SE.
[2] The technology definitions can be found in the methodological report at https://ati.ec.europa.eu/reports/eu-reports/advanced-technologies-industry-methodological-report

rooms, preparing and storing medications and much more. Compared to the previous survey, industries show some similar technological patterns: connectivity, public cloud and security technologies are among the most adopted technologies, with small differences across industries, while advanced materials, nanotechnologies and industrial biotechnology represent a niche of few sectors, such as manufacturing and healthcare. Compared to 2019 results, IoT and AI show an interesting increasing pattern in Transport and Healthcare, while B2B industrial digital platform is quickly taking ground in manufacturing and agriculture. Firms in the finance sector are more and more interested in Robotics, which represent the highest increase in adoption rate across industries, proving the high potential this technology can provide to the sector. Referring to Robotics, respondents mainly referred to Robotic Process Automation (RPA), which finds very fertile ground in this sector. On the other side, some technologies are slowing down: while industrial biotechnology is increasingly adopted in manufacturing, it is decelerating in utilities. A similar trend is shown for the public cloud in healthcare and retail.

When looking at the European industries in more detail, we observe that:

- The operational excellence that the **manufacturing industry** is looking for will be achieved through the adoption of advanced technologies. This operational improvement will be of paramount importance in ensuring performance during the next normal. In fact, COVID-19 impact on trade caught many firms unprepared, with negative consequences on supply chains. This event drastically changed the focus from a low-cost country sourcing mantra to a more resilient and simple network. Implementing new technologies is turning supply chain processes and activities towards less uncertainty and complexity. Technologies like **Robotics, AI, IoT, Blockchain and Edge Computing** are the key drivers to achieve these goals, together with efficiency benefits and zero-touch production (ZTP) processes, the latter being pushed significantly during the pandemic and becoming a strategic asset for the future of enterprises. Efficiency is also fostered by **ARVR** solutions that allow experts to provide remote support to on-field operators and guide them through step-by-step instructions. **B2B digital platform** is also a key trend in the manufacturing industry, pushing for a more collaborative relation between colleagues, peers and employees. This opportunity is deeply connected to **Big Data/analytics** technology, which allows to track and analyse processes, improve operational visibility and understand improvements and trends. **3D printing** has shown its huge potential in creating and modifying manufacturing and healthcare products during the pandemic, proving to be a key trend in the next years. Product innovation is also driving the adoption of **Advanced Materials, micro and nanoelectronics, nanotechnologies and photonics** with the aim to improve products and reduce costs.
- In **finance,** besides operational efficiency, the other main business goal driving investments in advanced technologies is the need to attract and retain customers. This is pushing the industry towards piloting new service delivery models. **AI**, **Big Data** and **Blockchain** are among the most promising technologies for the industry as they enable automation of internal operations, improve customer service and enhance protection against security threats. To counter the uncertainty of the new reality and improve loan portfolio health, **Advanced Analytics** is making it possible to analyse every payment that a corporate or small business makes and receives. Key AI trends in the industry include automation of IT operations and opening new digital channels to improve customer experience leveraging voice banking and chatbots. Blockchain main applications include for example cross-border payments and settlements. **Robotics**, mainly in the form of Robotic Process Automation (RPA), is changing how banking and finance companies carry out business through fraud detection, auditing and reducing time-consuming workloads. To keep pace with the information security risks, **Security Technology** represents a key element for the financial sector. The industry has also been central to the emergence of a new digital economy, the open banking, which is connected to the European payment services directive (**PSD2**[3]). Customers will therefore look for more suitable and personalised products and services, not being obliged to use what the traditional financial institutions provide to them, and will drive the next wave of growth of the fintech sector.
- For **telecom and media** providers, new technologies and new customer behaviours are generating several opportunities to boost current income sources and generate new revenue streams. **5G technologies,** for example, are expected to provide many monetisation opportunities for telco, although the pandemic has led to a delay in the technology's rollout as a result of the post-crisis economic condition. **Robotic and Blockchain** reduce error rates, enhance data quality, improve customer service, ensure transparency and efficiency, while also significantly reducing operational costs. The provision of the necessary network infrastructure and **connectivity** for voice, data, media and other related services will become even more

[3] https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en

important in next years given that businesses have become more distributed than ever after the COVID-19 pandemic. To ensure that their infrastructure will meet the need for digital initiatives in the coming decade, enterprises and service providers are reconsidering how their networks are architected. The increasing volume of personal data gathered in this sector is pushing towards more and more sophisticated **Security** solutions, making it a real priority even among other high-risk industries. Interesting pockets of growth can be found also in investment in other advanced technologies, such as **Photonics** which are supporting the development of fibre optic network communications. As said at the beginning, media transformation process had been driven by changing customer needs and behaviours: innovation in the industry has been driven by new channels and platforms for distributing, accessing and producing content. Streaming, content-as-a service and new technologies for creating engaging entertainment experiences, such as wearables and **AR/VR** technologies, are major trends under the spotlight.

- **Utilities** and **Oil&Gas** show interesting opportunities in terms of many advanced technologies, but the pandemic outbreak inevitably cooled down European utilities' IT spending ambitions. In this context, **Artificial Intelligence** and **cybersecurity** competencies are more requested than ever as a fundamental asset to come out of the current crisis and be ready for the next normal. Hot spots in the industry are the **e-mobility revolution** and **AI-powered home energy management**. Electric vehicles are expected to be a mass-market revolution, driven by increasing sustainability concerns and blurring industry boundaries between power distribution and retail, transportation and automotive. The quest for **alternative and sustainable energy sources** is also paving the way to the use of advanced technologies such as **photonics** and **nanotechnologies** for power generation and for new and more efficient lighting solutions. **Robotics** and **IoT** are fastly spreading in these sectors, increasing productivity, lowering labour costs and, most importantly, keeping workers safe for dangerous tasks, providing a high degree of accuracy and efficiency. The second mass-market revolution is the smart home ecosystem where utilities can play a big role in providing advanced home energy management solutions and automation functionalities using devices such as smart plugs, thermostats and smart lighting for optimising energy consumption but also for getting insights into consumers' habits.
- The **healthcare industry** shows some interesting investments in **AI, Robotics, AR/VR, Nanotechnology and Advanced Materials**, compared to the other industries. Uptake of advanced technology in the industry is strictly linked to the need to innovate and improve patient care, providing integrated and personalised services. The outbreak of COVID-19 has put enormous pressure on many European healthcare systems but triggered an unprecedented demand for digital health technology solutions at the same time. **AI, Automation** and **advanced analytics** are not just solutions to put on top of a technology stack, but the intelligent core of a new enterprise platform. **Robots**, especially for surgery and logistics purposes, are becoming more affordable, and hospitals will start to invest more significantly in the upcoming years. Investments in **wearables, IoT and AI** are growing with the need to monitor patient behaviour and accidents for elderly people with medical conditions to provide prompt emergency help. **AR/VR** devices are helping doctors improve surgery and diagnosis and are also used for therapeutic purposes (e.g. rehabilitation).
- COVID-19 has disrupted the **retail** sector, with different impacts depending on several variables (brick-and-mortar versus online shops, essential versus non-essential stores, small versus large retailers). Overall, the industry impact has been significant although advanced technologies played a key role in supporting organisations in the industry along their COVID reaction initiatives. The **e-commerce** channel, where consumers can finalise their purchases using their PCs or **mobile** phones, remains a priority for retailers and a successful strategy during the COVID-19 pandemic crisis. A key focus of retailers as an immediate crisis response was accelerating the implementation of retail commerce platform capabilities, providing retailers with the foundations for the execution of new commerce everywhere business models. As more customers are switching to mobile commerce, customer assistance and support are also changing. Through **AI-enabled chatbots**, customers can contact companies on social platforms to track shipments, request product refunds or raise complaints. COVID-19 will have a long-lasting effect on customer experience, and in the years to come, it will push retailers to permanently integrate contactless solutions into their customer experience road maps. A growing opportunity in the industry is represented by **real-time contextual personalisation** for the customer, which allows retailers to shape the customer experience in relation to multiple parameters such as demographics, location, day/time, weather and purchasing patterns.

Advanced Analytics and Big Data are crucial to achieve this degree of personalisation. **Photonics** is also gaining ground compared to the other industries, helping for example retailers of Consumer Packaged Goods (CPG) and customers to judge the ripeness of fruit and vegetables, and so reduce the percentage of discarded food, or through more dynamic use of displays.

- The pattern of technology adoption by **Government** and **Education** is influenced by the national context and the coronavirus crisis. Public sectors of all countries tried to cope at their best with the current downturn, through massive injection of resources to support the economy and by putting in place multiple advanced technology-enabled emergency solutions. Governments are working to streamline internal bureaucratic processes through **automation** to speed up critical government work, resulting in more agile access services. **AI** solutions will support citizens with the right level of speed, quality and personalisation, while it will provide remote management of the workforce. After the emergency-driven experience of distance learning during the lockdown period, **Education institutions** in Europe are prioritising investments in **mobile solutions**, for example investing in the provision of mobile devices. Lesson are carried out via **distance learning,** with the development of online platforms and e-learning apps for students. At the same time, some changes accelerated by COVID-19 are likely to become permanent: governments are moving towards **permanent remote working**, where secure remote access to data and applications, and collaborative tools enable them to work across departmental silos. **Smart city** projects, combining **mobile, IoT and Big Data/Analytics** solutions, are expected to push investments in technology, especially for safety purposes (such as video surveillance) and for public transport optimisation. **Security** of digital services is therefore a top priority so that both citizens and civil servants can trust their reliability and the stewardship of sensitive data. Another driving trend in the industry is represented by the **open data portals**, with the aim to improve transparency, openness and interaction by sharing public data with citizens.
- Although the pandemic has significantly tested **Professional Services** firms, they reacted with agility, evolving their services and business models to cope with the changing environment. Despite considerable challenges, this sector performed quite well, mainly when they had an adequate technological infrastructure that allowed to continue their daily business processes and operations. Professional services are carrying out their activities in a more agile and flexible way, such as **working from home**, which is supporting investments in devices (laptops, smartphones, tablets), collaborative apps, video linking, cloud and content sharing. Tech providers in this industry will also be on high pressure to provide strong digital platforms and will be required to enhance their existing **cloud solutions**. As a data-intensive vertical sector, an important share of Professional services' investments in security will be driven by the implementation of GDPR (General Data Protection Regulation). This will drive the industry to raise technology barriers to protect client sensitive information and avoid data breaches. The pandemic has changed the relation between customers and services providers but **Big Data/analytics** together with **AI** and machine learning are providing deep analysis of customers, leading to more accurate customers intention prediction and competitive advantage. Digital technologies are changing the industry in their client-facing and back-end activities. For example, advanced technologies will be able to automatically process documents such as legal, shareholder and market reports, impacting positively on timing and freeing staff from tasks that can be automated.
- **Transport** has been one of the main affected industries from the pandemic, squeezed between safeguarding its workforce health and keeping a core transportation system operational. However, this crisis is expected to accelerate the digitisation of mobility. **Cloud** computing and **Big Data/Analytics** are playing a crucial role in collecting, sharing and analysing real-time data, providing an effective way to identify and quantify disruption. These data will also allow restoring adequate transport services accordingly to the increasing demand as we move towards a new normal. Mobility as a Service is offering people an available alternative to get around safely during the pandemic. Other technologies, such as **IoT** and **AI** will keep playing a key role in supporting industry companies to regulate traffic flows, streamline security checkpoints with biometrics such as facial recognition, and reduce the number of lost bags using electronic luggage tags. In logistics, heavy workloads can be eased by introducing solutions to create collaborative environments in which **humans coexist with robots**, with the latter taking over heavy, repetitive and time-consuming tasks.

- The pandemic has exacerbated the challenges **agriculture** was already facing, including increasing demand for food, and lack of workers. This is the reason why this sector has to rely even more on advanced technologies, which will increasingly play a fundamental role in addressing these issues. **Data-driven innovation** is transforming farm management through the so-called **precision agriculture** approach. By leveraging **satellites, drones and IoT sensors**[4] in farm equipment (such as tractors), an unprecedented amount of data can be collected to monitor the conditions of the crops, soil and other key elements for cultivation, as well as cattle. **Cloud computing** – that is finally taking ground in this sector, especially among large players - will help aggregating all the data gathered, allowing farmers to manage irrigation, fertilisation and all the farming processes in a scientific way, minimising costs and the use of pesticides and maximising outputs. Without a solid **Connectivity** infrastructure, a successful application of all these innovations is unthinkable. The digitisation of the farming processes represents also the first step for the emerging food track-and-tracing systems developed to guarantee quality and safety, highly appreciated in the food-agriculture value chain. Advanced technologies show interesting uses also in fighting **climate change and related risks** (such as the loss of arable land and increased urbanisation). For example, a growing trend is represented by **urban or vertical farms,** leveraging technologies to minimise the use of natural resources such as soil, water and energy. This is done by using **IoT** and **Photonics** to manage parameters such as humidity, light and irrigation to get the most out of crops. **Industrial biotechnology** shows also interesting promises for obtaining alternative healthy, protein-rich and nutritionally balanced food raw material responding to increasing population and food demand.

This overall picture of advanced technologies' deployment in the European industry is to a certain extent reflected by the analysis of the demand and supply of advanced technologies' skills carried out in the report on the General Findings within the framework of the present project[5]. In terms of skills supply, and based on the profile of registered users on LinkedIn, the share of advanced technology skilled professionals (vis-à-vis the total number of professionals) in selected industries reveals that Europe's manufacturing industry absorbs the highest number of skilled professionals. This is particularly true for the Automotive sector where technologies such as Advanced Manufacturing and IoT are clearly instrumental for the development of Industry 4.0 strategies.

Other industries such as Electronics and, to a lesser extent, Chemicals, employ a large amount of skilled professionals, especially for technologies like Advanced Manufacturing and IoT (in Electronics) and Advanced Materials and Industrial Biotech (in Chemicals), confirming that manufacturing as a whole remains at the forefront of the the digital transformation and modernisation processes in the European Union.

In terms of skills demand, manufacturing exhibits high levels of hiring positions measured by the number of online job advertisement requiring specific skills. Again, the Automotive sector requires specific skills in Advanced Manufacturing, AI and Robotics, just like the Electrical & Electronics exhibits strong demand of skills in Advanced Materials, Micro-nanoelectronics, nanotechnologies and Robotics. The prominence of the Manufacturing industry is challenged only by the Finance sector where, both in Banking and Financial Services, specialised skills for Big Data, Blockchain, Cloud Computing and cybersecurity are very much in demand across the European Union.

[4] ATI Product Watch (D3.6) "Satellites and drones for less intensive farming and arable crops", January 2021, https://ati.ec.europa.eu/reports/product-watch/satellites-and-drones-less-intensive-farming-and-arable-crops

[5] ATI General findings (D3.4), Section 5, June 2020, https://ati.ec.europa.eu/reports/eu-reports/report-technology-trends-technology-uptake-investment-and-skills-advanced. An updated version of this report including the AT skills analysis will be published this year (2021).

Section 2

2 Technology Focus: Sustainability in the automotive sector

2.1 Definition and scope

2.1.1 Automotive and Digital Transformation

The automotive sector is of much importance for Europe's economy, representing 6.1% of total EU employment and over 7% of EU GDP. Furthermore, the sector is an important link to other industries such as chemicals and steel (upstream), but also ICT and mobility (downstream)[6], bringing a multiplier effect to the Europe's economy. The automotive value chain consists of different companies that specialise and produce inputs as first, second or third tier suppliers. The original equipment manufacturer (OEM) defines the design that is used to assemble these inputs into the final vehicle.

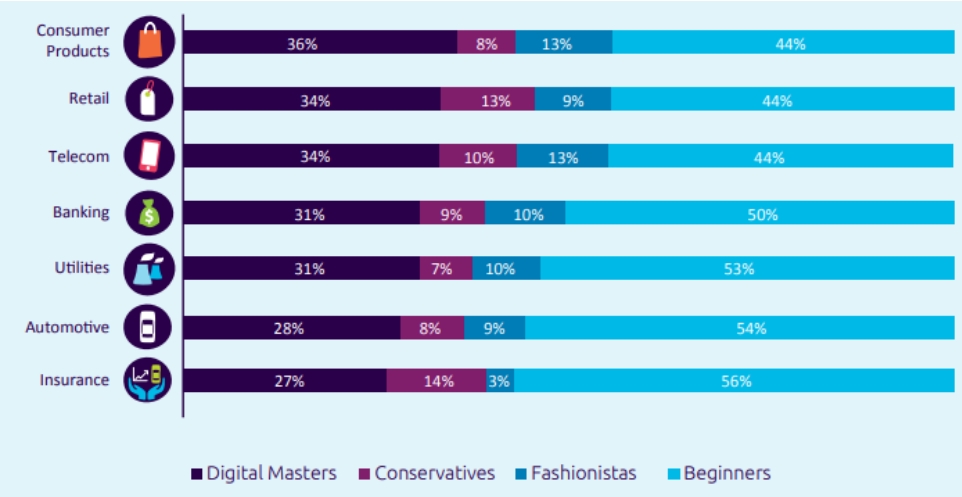
The EU automotive industry has been continuously growing since 1980 (with exception of financial crises of 1990s and 2009). This growth was enhanced by technical innovations such as fuel-efficient vehicles and alternative powertrains. However, while the European automotive production output accounted for 45% of the global production output in 1970, this decreased to 25% in 2018. The economic centre of gravity shifted to Asia, which now accounts for 55% of production output (20% in 1970)[7].

From a traditional point of view, the innovation philosophy of the automotive industry has focused on quality improvement and reducing costs, with an emphasis on continuous improvement and lean manufacturing.[8] This philosophy differs from the foundation of digital transformation, where learning, experimenting and allowing failure are central topics. In 2018, the level of digital mastery has been studied throughout 757 organisations, of which 11% operate in the automotive industry. Digital mastery is defined in two dimensions: The digital capabilities of the organisation and the leadership capabilities to drive digital transformation in the organisation. The study categorises the organisations based on these dimensions in four categories: **1. Beginners** - low mastery of both digital and leadership capabilities. **2. Conservatives** – mastery of leadership but not digital capabilities. **3. Fashionistas** – mastery of digital but not leadership capabilities. **4. Digital masters** – high mastery of both digital and leadership capabilities. Figure 2 shows the outcome of the study, where the classification of the organisation is broken down to the industries.[9]

The research showed that companies in the automotive sector are lagging behind in the mastery of digital innovation, compared to companies in other sectors. Although not a single automotive company would deny the importance of digital transformation, they do struggle to translate this into reality.

[6] https://ec.europa.eu/growth/sectors/automotive_en
[7] McKinsey & Company (2019). Race 2050 - a vision for the European automotive industry
[8] Capgemini (2018). The need for speed: Four recommendations to turbo-charge digital performance in the automotive industry
[9] Capgemini (2018). Understanding digital mastery today

Figure 2: Digital mastery breakdown by industry



Source: Capgemini, 2018

In section 2.2 of this report we will zoom in on the digital mastery of organisations in the automotive industry by elaborating on the newest digital innovations in the sector, including its current level of digital mastery and market potential.

2.1.2 Sustainability Issues

Although the automotive sector is such an important industry for economies, it has been under heavy pressure from governments in the last decades, as the concern on climate change and sustainability is ever increasing. The pressure on the automotive sector is understandable:

- According to the International Energy Agency (IEA), transportation accounts for over a quarter of total global emissions.[10]
- The Society of Motor Manufacturers & Traders (SMMT) concludes in the latest version of its annual Automotive Sustainability report that the energy and water used per produced vehicle has increased by 3.2% and 5.5% correspondingly.[11]
- The European Commission has published a study on the end-of-life waste of the automotive industry. In 2017, the total number of end-of-life vehicles reached 5.3 million, accounting for total of 5.7 million tonnes. Although the reuse and recovery rate (% of weight of vehicles) for the EU has risen from 85.3% in 2009 to 93.7% in 2017, this still means that the total, non-reusable waste of end-of-life vehicles is 0.36 million tonnes.[12]
- Although Electric Vehicles seem to be a sustainable solution, mining for materials used in these vehicles leaves its tracks in the environment.[13]

It is not only governments that are pressing organisations in the automotive industry to invest in sustainability, but also consumers and investors[14] are demanding for a change in their products and way of working. Sustainability has become a strategic priority for the industry, but organisations need to improve in the implementation of sustainability initiatives.

2.1.3 Impact of COVID-19 on Automotive

COVID-19 has impacted car sales enormously, but after an economic depth in spring 2020 the industry has rebounded over the year. In April 2020, the European automotive industry showed a -78% Year over Year (YoY) sales change, with an overall change of -23% in Q1-Q3 in 2020.[15] Although the sales have recovered somehow in Q3, there is still a lot of uncertainty around the economic and pandemic recovery.

[10] https://www.iea.org/reports/co2-emissions-from-fuel-combustion-overview
[11] SMMT (2020). 2020 UK Automotive Sustainability Report
[12] European commission, "Annual report the End-of-Life Vehicle sector observatory – 2017 data," February 2019.
[13] Washington Post (2020). In your phone, in the air
[14] BlackRock Investment Institute (2019). Sustainability: The future of investing
[15] BCG (2020). COVID-19's Impact on the Automotive Industry

But the impact of the virus can be expressed in more than just sales numbers. New trends emerged in the way that consumers look at the automotive industry,[16] driven by health and safety concerns:

- The use of vehicles is expected to increase, in comparison to other transportation method as consumers prefer individual mobility over public transport and shared mobility services.
- A new driver for purchasing cars is emerging: consumers want to gain control over hygiene by purchasing their own car. This trend reverses a growing preference to avoid vehicle ownership, a preference that was especially growing among younger consumers.
- The preference to buy vehicles through digital channels is increasing. This trend is not only driven by consumer preference, but also pushed by measures taken by governments to fight COVID.

2.2 Market Potential

2.2.1 Introduction

Digitalisation impacts the automotive sector as a whole. In the ATI sectoral report on the automotive industry[17] we distinguished three innovation levels: vehicle innovation, production innovations and new business models. In this report we use these levels to introduce the newest digital innovations. This section focuses on vehicle innovation and product innovation. We will elaborate on the new business models in section 2.3 Automotive Use Cases.

In this section we will look at the technologies that come into place in these two areas and at their market potential. Furthermore, we will look at the challenges of implementing these technologies in section 2.2.7 and the (new) players along the value chain in section 2.2.8.

2.2.2 Vehicle innovation

Not only the manufacturing process of the automotive industry is impacted by emerging technologies, also the car itself is shaped by digital innovation. We refer to four trends as CASE (Connected, Autonomous, Shared and Electric).[7,18] The following examples elaborate on the impact of these trends on the automotive market:

- About a quarter of all passenger cars in use worldwide will be connected in 2023. This means that the automotive product is changing with the increasing importance of electronics and software. In 2030, the software in vehicles is estimated to make up 30% of their value. Electronics and electrical components will comprise 25% of the vehicle value.[7]
- Digitisation provides the opportunity for car sharing initiatives and companies have already found ways to monetise this.[19] For example, in Stockholm the number of car-sharing cars has grown from 74 to 2 049 in the last ten years.[20] To give an idea of the market potential on a global scale: The shared mobility market exceeds €49.6 bn across the Chinese, European and the United States' markets. Furthermore, McKinsey predicts that in 2030 10% of cars sold could be shared cars.[21]
- Governments, customers and the public are pressuring OEMs to shift their portfolio towards electric cars. The growth in sales of electric cars is incredible. In 2018, 5 million electric passenger cars were sold, an increase of 63% compared to 2017. The sales of electric passenger cars is projected to be 23 million in 2030.[22]

2.2.3 Internet of Things & 5G

The Internet of Things (IoT) is transforming the automotive industry. As mentioned above, about a quarter of passenger cars in use worldwide will be connected in 2023. Last year, Gartner forecasted that the number of IoT endpoints in the automotive industry would grow to 470 million in 2020. The biggest endpoint electronics revenue is expected to be consumer connected cars with €64 bn in 2020.[23] The

[16] Capgemini (2020). COVID-19 and the automotive consumer
[17] https://ati.ec.europa.eu/reports/sectoral-watch/technological-trends-automotive-industry
[18] Capgemini (2019). Connected vehicle trend radar
[19] F. Bardhi, G.M. Eckhardt (2012), Access-based consumption: the case of car sharing
[20] Capgemini (2020). The sustainability impact of car sharing
[21] McKinsey Center for Future Mobility, Shared mobility
[22] IEA (2019). Global EV outlook
[23] Gartner (2019). Gartner Says 5.8 Billion Enterprise and Automotive IoT Endpoints Will Be in Use in 2020

goal of these IoT endpoints is to enable the concept of 'vehicle-to-everything' (V2X), which refers to the ability to wirelessly connect to multiple sources of information.

The connectivity between all these sources requires the transmission of large amounts of data. The 5G Automotive Association (5GAA) states that 5G is key to transmitting larger amounts of data, with more reliability, with lower latency and at faster speeds than other solutions and believes that this is the future of communication in the automotive sector.[24] Vehicles will benefit from this since better connectivity leads to better control, analysis and overall performance.[25]

2.2.4 Artificial intelligence

There is potential for AI implementation on all innovation levels of the automotive sector. In its whitepaper on AI the European Commission defines AI as a collection of technologies that combine data, algorithms and computing power.[26] AI technologies like machine learning enable machines to perform more complex tasks. Companies in the automotive industry leverage these technologies in their products to improve driver experience. The number of AI systems used in infotainment and advanced driver assistance systems (ADAS) systems will jump from 7 million in 2015 to 122 million by 2025, according to a new IHS Technology report.[27]

Companies are aware of the potential of AI. In the last five years, organisations have invested more than €8.3 bn in AI-led start-ups in areas of customer/driver experience and mobility services.[28] The research shows which countries are acquiring the most start-ups by amount invested. Germany is leading the way with over €3.3 bn, followed by Japan and the US. The US is the country that is targeted most by acquiring companies with €4.5 bn, followed by the Netherlands (€2.3 bn).

2.2.5 Electrified powertrains

Governments, customers and society are pressing OEMs to produce more sustainable vehicles. According to Capgemini research, 50% of fleet managers in Germany feels 'high pressure' or 'very high pressure' to replace powertrains (the group of components that generate power, e.g. engine or transmission) in the next decade.[29] For this reason, OEMs are investing considerable amounts in order to develop powertrains based on alternative technologies.

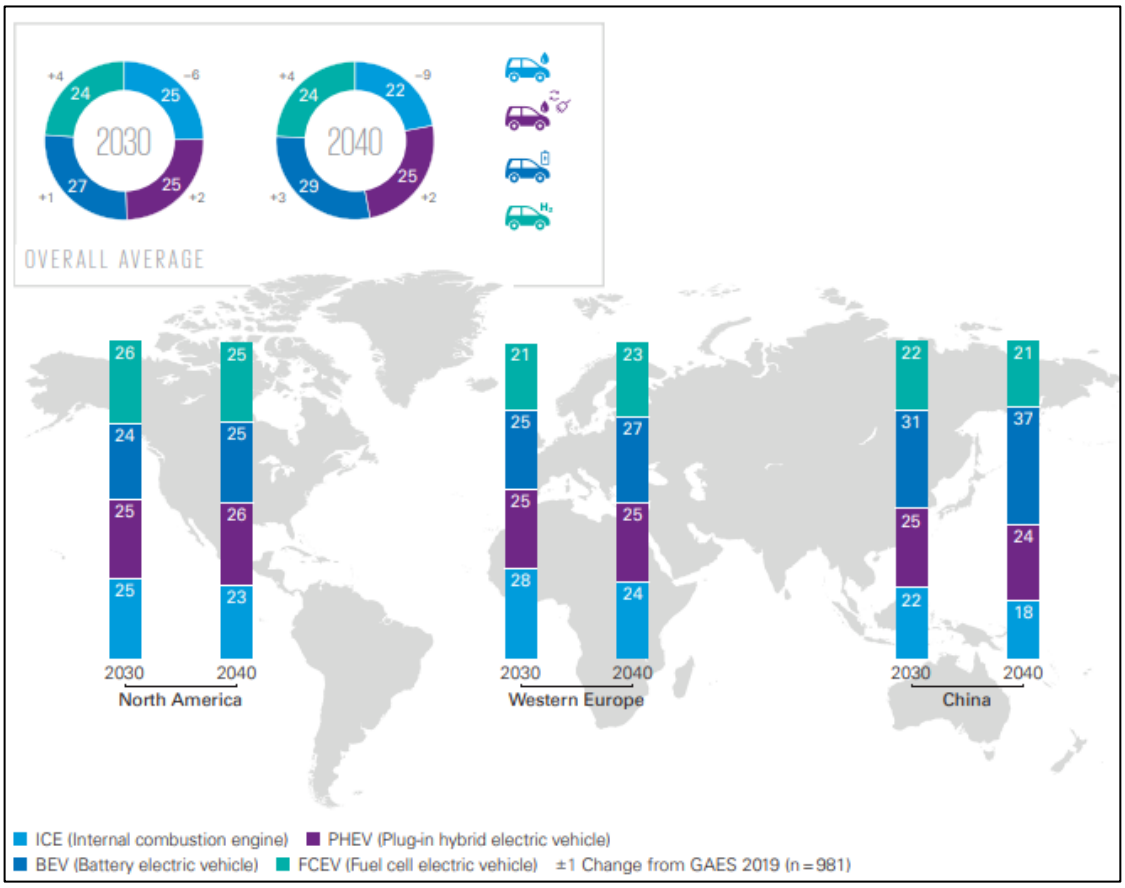
This year, KPMG's Global Automotive Executive Survey showed for the first time that by 2030 the majority of vehicles will not be powered solely by an Internal Combustion Engine (ICE) powertrain. Executives believe that Fuel Cell Electric Vehicles (FCEVs), Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs) and ICEs will coexist (explained in Table 1), as there is currently no solution for electric vehicles available to solve the challenges in long distance travelling or seamless refuelling. Furthermore, the executives from the research believe that the future will see a regionally differentiated mix of different powertrain technologies.[30]

Table 1: Powertrain types explained

Type of powertrain	Abbreviation	Explanation
Internal combustion engine	ICE	Powertrains that run on traditional fuels
Fuel cell electric vehicle	FCEV	Powertrain that produces electricity with oxygen and a suitable fuel (often hydrogen)
Battery electric vehicle	BEV	Electric vehicles that are powered by batteries
Plug-in Hybrid Electric Vehicle	PHEV	Vehicles that are powered by batteries (electricity) and a combustion engine

[24] https://5gaa.org/5g-technology/paving-the-way/
[25] Capgemini (2020). Perspectives from our Asia Pacific Junior Talents
[26] European Comssion (2020). White paper On Artificial Intelligence - A European approach to excellence and trust
[27] IHS (2018). Automotive Electronics Roadmap Report
[28] Capgemini (2019). Accelerating automotive's AI transformation
[29] Capgemini (2020). Taking the lead with sustainable transportation
[30] KMPG (2020) Global automotive executive survey 2020

Figure 3: The share between ICE, PHEV, BEV, & FCEV powertrains



Source: KPMG Automotive Institute

Market potential of vehicle innovations

Vehicle innovations bring opportunities for organisations in the area of connectivity, artificial intelligence and sustainable powertrains. The market potential for this area of innovation is huge and not only for the automotive sector. The European Commission estimates that in 2025 the total market size of connected and automated cars exceeds €620 bn for the automotive sector and €180 bn for the electronics sector[31].

2.2.6 Production innovation

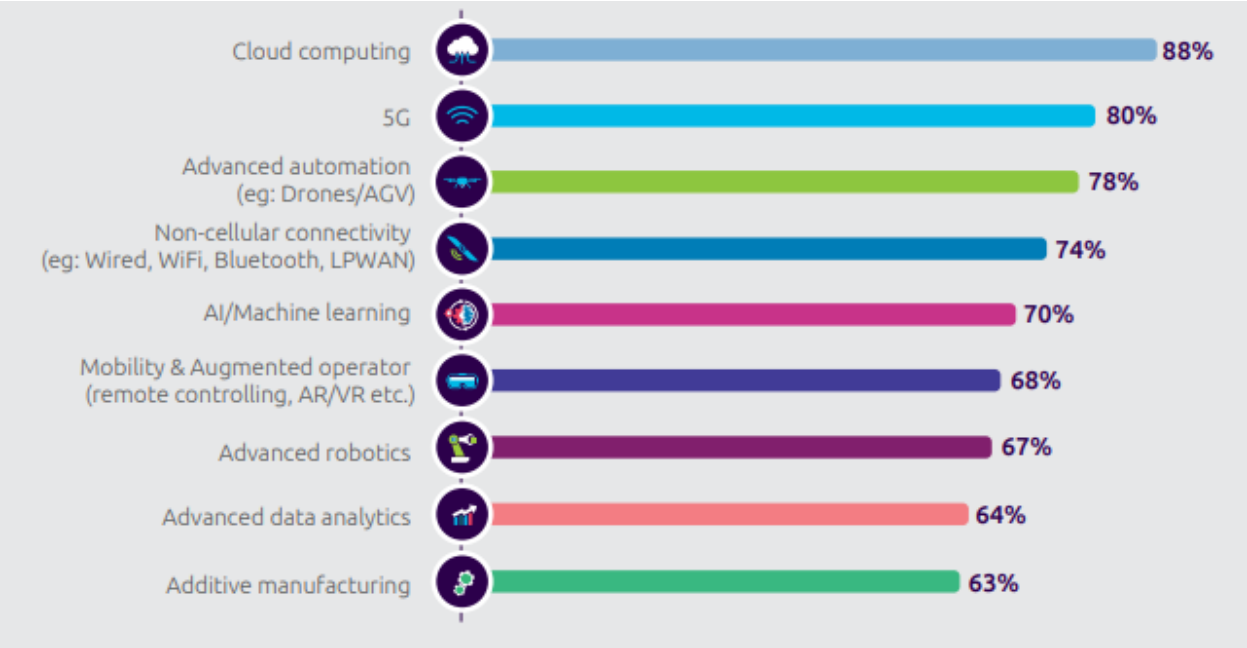
Production innovations affect the process of automotive companies. Although Figure 2 showed that automotive organisations are lagging behind in digital mastery, the automotive industry is a leader when it comes to production innovation.[32] For European organisations it is key to invest in production innovations, as 25% of value added in the automotive sector comes from digital innovations in the design and production.[33]

According to Capgemini research, automotive organisations have hit the accelerator on their advanced manufacturing plans. The research from 2019 shows that half of the automotive organisations believes they are making good process on their smart factory roadmap. In comparison, in 2017 this number was only 38%.[34] Smart factories leverage technologies to improve in productivity, quality, flexibility and service.

Figure 4 shows which technologies are perceived to be key for production innovations in the next five years according to 97 organisations from the automotive industry.[34]

[31] European Commission (2018). On the road to automated mobility: An EU strategy for mobility of the future
[32] Paunov, Caroline; Planes-Satorra, Sandra (2019). How are digital technologies changing innovation?
[33] European Comssion (2017). Digitisation research and innovation. Transforming European industry and service
[34] Capgemini (2020). How automotive organisations can maximise the smart factory potential

Figure 4: Technologies key to digital transformation in the next five years according to automotive executives



Source: Capgemini, 2019

5G

As Figure 4 shows, four out of five companies believe that 5G is a key enabler for digital transformation. The top automotive organisations have ranked this 5G above technologies as AI, robotics and additive manufacturing.[35] The reason for this is similar as why we mentioned it in section 2.2.2: 5G is seen as the connective engine for technologies like real time analytics and advanced automation. These two manufacturing use cases require massive data streams that can only be enabled by 5G.

This is supported by research that shows that 44% of industrial companies over the world believe that connectivity issues are challenging their digital transformation.[35] The study shows that 66% of 97 organisations in the automotive sector is willing to implement 5G initiatives for industrial operations within the first two years of availability. For some organisations, the roll out of 5G by network operators is taking too long: 32% of the interviewed automotive organisations is interested in applying for private local 5G licenses.

Artificial Intelligence

AI is transforming the automotive sector, not only inside the car but also on the factory floor. AI gives machines the power to understand unstructured data patterns,[36] which will be used in the manufacturing process to recognise quality issues, potential breakdowns or to enable smart robotics.

In a study on the adoption and scaling of AI implementation in the automotive industry, the number of organisations in the automotive industry that are implementing AI has increased marginally over the last years, from 7% in 2017, to 10% in 2019. In the overall manufacturing industry, we see that Europe is a leader in the implementation of AI initiatives. 51% of the top manufacturers are implementing AI initiatives.[28]

Market potential of production innovations

Digital transformation of production within the automotive industry is key to become or remain competitive. The study by Capgemini on the key technologies that will transform production in the automotive industry estimates a value addition of €86.5 bn up to €138.1 bn for the global automotive industry[34].

[35] Capgemini (2020). 5G in industrial operations
[36] McKinsey (2016). Building smarter cars with smarter factories: How AI will change the auto business

2.2.7 Main Barriers & Challenges

System integration

As many automotive companies have grown through a merger and acquisition strategy, it is not uncommon that a single company is using different, unintegrated IT systems across plants. This fragmentation of the IT landscape makes it really challenging to scale up digital initiatives from one plant to others. According to Capgemini research, deployment and integration of digital technologies is the top challenge for OEMs and their suppliers.[34] McKinsey suggests that organisations need to collaborate with external partners that can support with the intensive work of building and integrating applications.[36] An example of this is that Volkswagen is collaborating with Amazon Web Services to build an industrial cloud for the entire Volkswagen Group. This integration can bring benefits not to a single facility, but to the entire company.[37]

Quality of data

Without good data all information systems become unreliable and therefore, scaling new solutions across the company can only be achieved with advanced data capabilities. For example, a fragmented IT system landscape causes inconsistency in data structure or the availability of data. Only 45% of manufacturing organisations can access and analyse data from across their value chain. Also, fewer than one third (32%) of automotive suppliers have a complete view of data flows. [34] [38]

Talent war

As automotive organisations are going through their digital transformation, one of the main requirements is to have employees with the required digital skills and competences. Digital skills are increasingly in demand and they are in short supply. In our sectoral report on the automotive industry[17] we analysed the skills that are highest in demand in this sector, these include the following: Security, Robotics, Mobility, IoT, Cloud and Advanced materials.

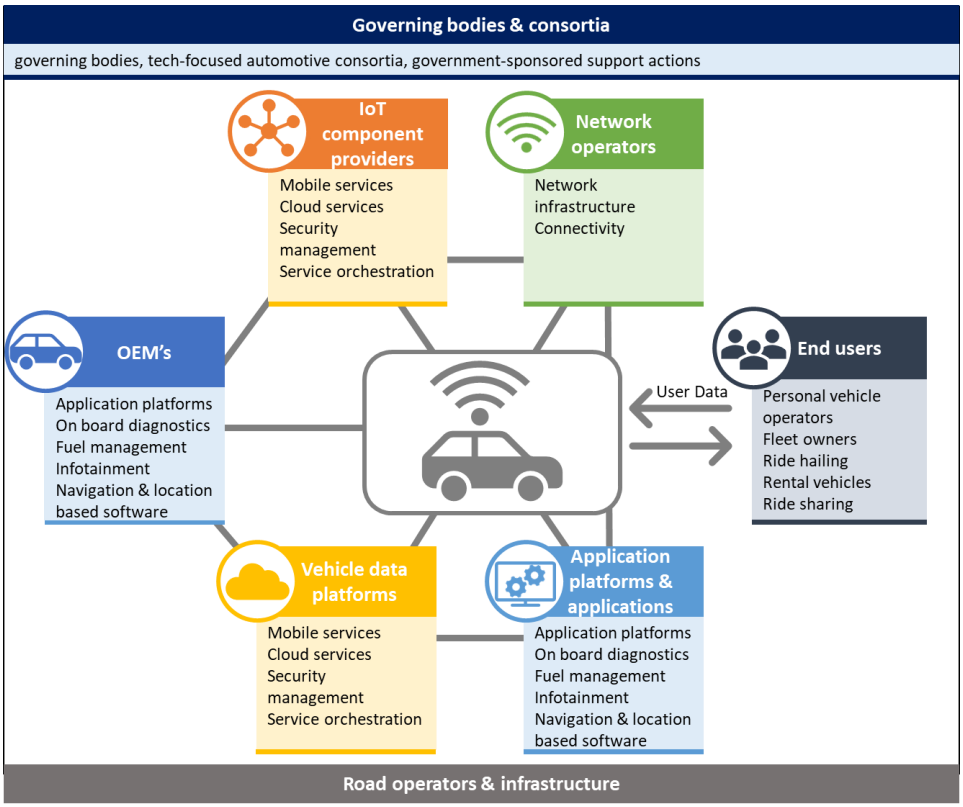
Organisations need to invest heavily to build the skills pool needed for digital transformation. Close to half of automotive organisations indicate that a lack of required capabilities is a challenge for digital transformation.[38] They are undertaking steps to bridge this gap by recruitment and training of internal employees. Organisations should start by mapping what skills are required in the future, by looking at digital initiatives that have already been planned.

2.2.8 New Players

The value chain for vehicles has changed. In the ATI report on components in connected and autonomous vehicles[39] we analysed the high-level value chain (Figure 5). Although traditionally the stakeholders for the automotive industry consisted mainly of OEMs, it is expected that total revenue in the value stream as well as the number of parties involved will grow, due to the rise of connected and autonomous vehicle related technologies and services. To illustrate: although in 2017, ~€3 000 bn global automotive revenues were mainly generated through traditional businesses (vehicle sales) and aftermarket services, it is expected that in 2030 global automotive revenues will increase to ~€5 500 bn.[7]

[37] Volkswagen AG (2019). Volkswagen and Amazon Web Services to develop Industrial Cloud
[38] Capgemini (2019) Smart factories @ scale
[39] https://ati.ec.europa.eu/reports/product-watch/iot-components-connected-and-autonomous-vehicles

Figure 5: Value chain of automotive industry



Source: Capgemini, 2020

For OEMs, gaining access to the required technologies, will require new collaborations or partnerships with the new entrants in the industry. The following six clusters of services in which new players in the automotive sector are involved can be distinguished:[18]

- **Telematics**: E.g. fleet management, virtual tachographs, emergency calling
- **Remote Services**: E.g. remote diagnostics, over-the-air software updates, theft alerts
- **Infotainment & Navigation**: E.g. music streaming, communication via instant messaging, parking lot locators
- **Hardware & Software**: E.g. devices such as diagnostic readers, SIM cards, microchips, hardware-plus-software products
- **Data platform**: E.g. operating systems
- **Safety & Security**: E.g. advanced driver assistance systems (ADAS), preventing hackers from remotely taking control of vehicles

Large players from industries such as technology (e.g. Google, IBM) and telecom (e.g. Verizon and Vodafone) are already active in the automotive market, in telematics, remote services, infotainment and navigation. Next to the existing players, also highly specialised startups are entering the automotive industry[18].

Although European enterprises are collaborating within the traditional value chain of the automotive industry, to remain competitive they need to build a more extended ecosystem of partners. To do so they should first explore in which clusters of services they want to invest in collaborations and then decide on which partners they want to approach.

2.3 Automotive Use Cases

2.3.1 Overview

In the previous chapter we discussed the most important technologies that play a role in the automotive industry of today, but even more in the future. In this chapter we will discuss the most relevant use cases that will come into play with a focus on sustainability. Sustainability is an important factor in the development of use cases for the automotive industry as governments, investors and customers are pressing them to become more sustainable.

2.3.2 Vehicle innovation - Use Cases

Sustainability is an important aspect of use cases that apply to vehicles itself. Customers are willing to pay more money for sustainable solutions. Capgemini research shows that 60% of customers believe that connected car services can contribute to the environment. Furthermore, 56% of the respondents indicated that their purchasing decision will be influenced by the positive impact on the environment of connected services. However, the research suggests that despite their interest in sustainability, customers need a personal incentive to be willing to pay for sustainable services.[40] Fortunately, the value added of sustainable use cases can also be expressed in economic (e.g. less fuel consumption), but also in other benefits for customers (e.g. less time in traffic or increased safety).

Smart Sensors

Artificial intelligence can be applied in numerous ways, but it can have most impact to use it in combination with sensors. They can be used to create or optimise the development of software to identify road markings, traffic signs and traffic lights. Even more interesting, smart sensors can recognise objects, pedestrians or cars to estimate risks and automatically keep a safe distance. These systems are referred to as Advanced Driver Assistance Systems (ADAS). In terms of sustainability this implies:

- Reduced congestion: traffic congestions leads to wasted fuels and one of the causes for traffic congestion are traffic accidents. When smart sensors help to reduce the number of traffic incidents, the number of wasted fuels will also be reduced.
- Smoother driving: higher levels of automation and driving efficiency will result in an increase in fuel efficiency.[41]

Navigation in real time, on lane level

In section 2.2.2, we emphasised the importance of 5G, as it is the enabler for V2X communication. One of the use cases that can be enabled by 5G is more advanced navigation. Extremely accurate positioning and real time updates will optimise vehicle routing, saving time, money and reducing CO2 emissions. 5G enables the communication of many data sources, such as traffic cameras and other vehicles to compare possible routes. Companies are already investing in this use case:

- Hyundai is already collaborating with South Korean telecommunication provider KT to develop real-time navigation updating.[42] Hyundai claims that this new solution is 100 times faster than the current 4G used. Besides navigation, the technology is going to be used to share data with traffic infrastructure, other vehicles and pedestrians.
- Qualcomm is using 5G for more accurate positioning to enable lane-level navigation.[43] Lane-level navigation is one of the requirements for autonomous driving.

Trusted car

There are many interesting use cases related to blockchain technology, as the exchange of data is becoming increasingly important. As blockchain has the ability of keeping data safe from cyber-attacks, its potential in the automotive market is growing as well. From a sustainability point of view, we believe the 'trusted car' is the most interesting use case.

The European automotive industry has lost customer trust in the light of the Diesel scandal. Blockchain can be applied to document a 'Car CV', that may contain distance driven, accident record and owner history.[44] This technology can also be applied to store environmental information. Because blockchain

[40] Capgemini (2020). Connected Vehicle Trend Radar 2
[41] Anderson, et al. (2016). Autonomous Vehicle Technology A Guide for Policymakers
[42] https://saemobilus.sae.org/automated-connected/news/2019/01/hyundai-mobis-teams-with-kt-for-5g-based-real-time-navigation
[43] https://www.qualcomm.com/news/onq/2019/01/09/vepp-more-accurate-and-affordable-automobile-position-location-technology
[44] https://www.disruptordaily.com/blockchain-market-map-automotive/

provides decentralised storage of data the information is stored in a tamperproof manner. This means that data will become more reliable for customers as it is protected from manipulation.[45]

2.3.3 Production innovation - Use Cases

Sustainability is becoming one of the key aspects of the manufacturing industry. According to Andrew Wyckoff, director at OECD (Organisation for Economic Co-operation and Development), sustainable manufacturing is no longer a nice to have, but a business imperative. Companies around the world face increased costs in materials, energy and compliance coupled with higher expectations of customers, investors and local communities. Sustainable initiatives also lead to profit-making and improved competitiveness.[46]

The lean thinking methodology on eliminating waste focuses on making more profit, but reducing this waste is also more sustainable. New digital solutions provide opportunities for further reduction of waste streams.

Quality Analytics

Quality analytics deals automatically with quality issues that are difficult to detect for humans. Artificial intelligence can be combined with sensors for more advanced analyses of quality issues. Doing so, quality issues or failures can be predicted with a much high precision than with conventional methods.[47] Additionally, AI allows not only the use of conventional sensors, but can also analyse unstructured data streams such as image or sound recognition.

Quality analytics contributes to sustainability as it identifies quality issues early, this reduces scrap waste and increases overall efficiency for production lines. Also, quality analytics can be used for predictive maintenance, reducing the number of breakdowns at a production line.

2.3.4 Business model innovation - Use Cases

Shared mobility is essential in the shift to a low-carbon economy. In 2016, the European Commission wrote its strategy for low-emission mobility.[48] Urban transport has been identified as one of the main polluting factors, accounting for 23% of the EU's greenhouse gas emissions. Shared mobility schemes is one of the key solutions to reduce these emissions. In this section we discuss two concepts: Car sharing and Mobility-as-a-Service.

Car Sharing

Car sharing refers to the concept mobility schemes where customers can use cars as needed. They usually come in two variants: free-floating, where customers can park the car anywhere within a certain area and station-based, where customers have to park the car in one of the designated stations.

Volvo Car Mobility has released its station-based car sharing service M in Sweden.[49] Customers pay for a membership and the time and distance driven. The organisation was established in 2019 and currently has 627 stations available and 100 000 customers. Volvo Car Mobility and Capgemini collaborated to determine the sustainability impact of M.[20] Although research from 2014 showed that a rental car replaced 4-6 privately owned cars,[50] this study determined that a Volvo Car Mobility Car replaces up to 8 privately owned cars.

Mobility as a Service

Mobility as a Service (MaaS) refers to the concept where customers can use multiple mobility providers from a single platform. This can include car sharing schemes, but also public transportation modes. With developed public transport, strong digital infrastructure and wealthy citizens, European cities are very interesting for MaaS platforms.[51]

OEMs are investing in MaaS solutions. Daimler has launched its MaaS platform REACH NOW (previously moovel) in multiple cities in Germany. REACH NOW gives customers access to many mobility options like car, scooter and bike sharing.

[45] Verdict (2018), Blockchain and the connected car: the perfect match
[46] OECD, https://www.oecd.org/innovation/green/toolkit/aboutsustainablemanufacturingandthetoolkit.htm
[47] https://acerta.ai/case-studies/engine-failure-modes/
[48] European Commission (2016). A European Strategy for Low-Emission Mobility
[49] https://m.co/se/en-US/
[50] Trivector (2014). "Effekter av Sunfleet bilpool på bilinnehav, ytanvändning, trafikarbete och emissioner"
[51] Autonomy, Capgemini (2020). The future of mobility as a service

2.4 Sustainability Impacts

Section 2.1.2 introduced the topic of sustainability in the automotive industry and elaborated on the need for change. Section 2.3 described use cases from the automotive industry that contribute to sustainability goals. This section dives deeper in the topic of sustainability in the automotive sector.

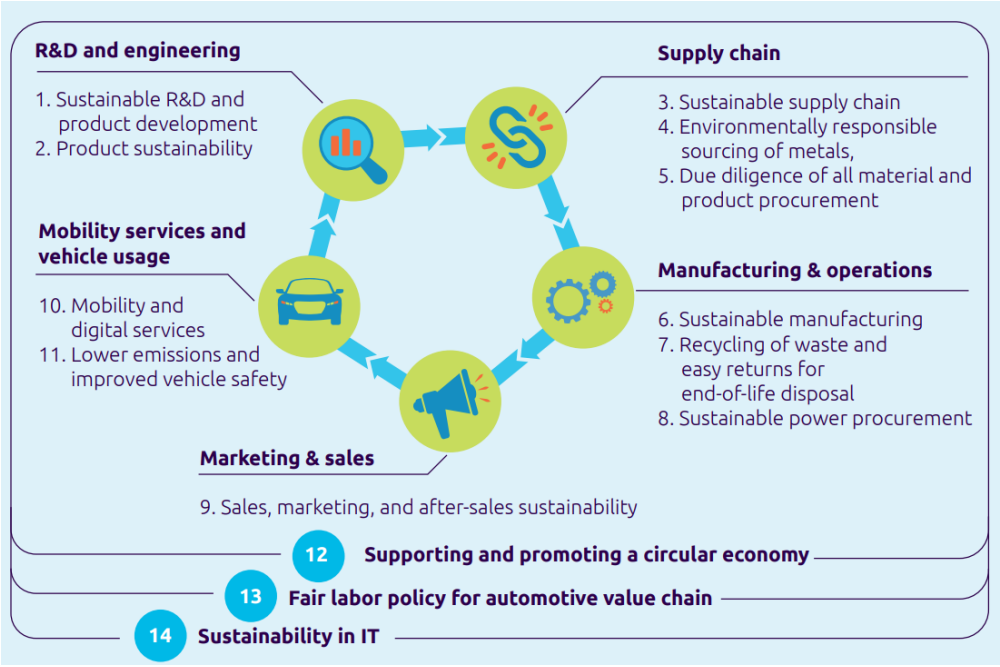
Automotive organisations need to invest in sustainability to remain competitive. They are under pressure from a variety of stakeholder groups:

- **Governments** are increasingly tightening regulations to reduce the environmental impact of the automotive sector, mainly by regulating on the emissions of vehicles[52]. This will be treated more extensively in section 2.5.
- **Customers and the general public** are becoming more aware about the impact of vehicles on the environment.[53] And because the transport sector accounts for such a high share of total global emissions, the automotive sector will keep being pressured to reduce vehicle emissions.
- **Investment firms** are pushing for sustainability as well. Large players in the capital investment market are shifting towards environmental sustainability.[54]

2.4.1 Sustainability in the value chain

Automotive organisations should strive for sustainability across all elements of the value chain. In its research on sustainability in the automotive sector, Capgemini distinguishes 14 areas of innovation areas within 5 clusters along the value chain and 3 more generic areas (Figure 6). Together, these areas can be used to get a comprehensive view of social and environmental impact on operations, processes, products and services.

Figure 6: Innovation areas with potential for sustainability improvement



Source: Capgemini, 2020

This framework is used to plot sustainable initiatives from automotive organisations in one of the 14 innovation areas. Doing so, they determined the strategic priorities of companies in the automotive sector on these areas. Table 2 gives a few examples of sustainable initiatives for the innovation areas mentioned above.

[52] Continental Automotive (2019). "Worldwide Emission Standards and Related Regulations
[53] The Guardian (2019). Across the globe, millions join the biggest climate protest ever
[54] CNBC (2019). Goldman pledges $750 billion for 'large opportunities' in sustainable finance

Table 2:Examples of initiatives in the innovation areas

Sustainability innovation area	Examples
Sustainable R&D	• Designing products to reduce environmental impact • Ensuring the recyclability of vehicles
Product sustainability	• Moving to different fuel sources • Making use of biodegradable components
Sustainable supply chain	• Environmental conscious operations in logistics, distribution, inventory management, etc.
Environmentally responsible sourcing of metals, materials and products	• Ensuring minimal impact on the environment in the mining and/or production of components
Due diligence of all material and product procurement	• Ensuring that processes and procedures comply with human and environmental guidelines
Sustainable manufacturing	• Implementing production, maintenance and quality processes that minimise production waste • Improving recyclability and reuse of products
Recycling of waste and easy returns for end-of-life disposal	• Giving consumers options to return vehicles or parts
Sustainable power procurement	• Building or leasing renewable energy assets
Sales, marketing and after-sales sustainability	• Improving efficiencies of older vehicles • Refurbishing old components
Mobility and digital services	• Encouraging car sharing, subscription models and connected services
Emission control and improved vehicle safety	• Ensuring that the lifetime emissions are accounted
Circular economy	• Maximising the use of resources by being restorative and regenerative by design and intention
Fair labour policy	• Ensuring that vehicles are produced under human guidelines (safety, no child labour, etc.)
Sustainability in IT	• Reducing energy consumption in data centres

Source: Capgemini, 2020

2.4.2 Sustainability as a strategic priority

Although sustainability has been on the agenda for years, it has achieved a new urgency and importance because of the increasing pressure of stakeholders mentioned above. And with success: in a survey of over 317 sustainability experts, 75% of the respondents state that automotive organisations are in line or ahead of regulations on sustainability. According to the Environmental Protection Agency, all (14) large manufacturers achieved compliance with the GHG standards through the 2018 model year.[55]

In the survey, 317 sustainability experts and 503 automotive executives were requested to prioritise the innovation areas from Figure 6. The top 3 are mentioned below:

Priorities according to sustainability experts:
1) Sustainable manufacturing
2) Recycling of waste and easy returns for end-of-life disposal
3) Supporting and promoting a circular economy

Priorities according to automotive executives:
1) Supporting and promoting a circular economy
2) Sustainable R&D and product development
3) Sustainable manufacturing

Although the industry executives express ambitious goals, the actual adoption of sustainability initiatives can be improved. To achieve these goals, the automotive industry needs to pursue the adoption of

[55] Environmental Protection Agency (2018). Automotive Trends Report

initiatives across all innovation areas mentioned in Figure 6. Currently, there is no consistent focus: for example, 52% of organisations have deployed initiatives in the area 'Supporting and promoting a circular economy', whereas only 8% of companies have deployed initiatives in 'Sustainability in IT'.

2.4.3 Use of technology to improve sustainability

The automotive industry is traditionally applying technology to reduce waste and developing innovative (and sustainable) cars. Most sustainability initiatives are close to their core competences (e.g. engineering and manufacturing). The industry can take a next step by learning from other industries to implement innovations in other areas. For example, Google has reduced the energy in data centres by 40% by applying an AI on its cooling centres.[56]

Another potential area for improvement is the governance of sustainability initiatives. Less than half of the organisations have a central governance body to oversee sustainability objectives and initiatives. Digital solutions can support in analysing, calculating and tracking the environmental impact to create a comprehensive overview of the sustainability progress of companies.

2.5 Policy Implications

The final section of this report provides an overview of the legislation and regulations regarding sustainability in the automotive sector.

The Green Deal is the European Commission's plan to transform the Union into a modern, resource-efficient and competitive economy by becoming climate neutral by 2050.[57] European Commission President Ursula von der Leyen launched the Green Deal to achieve "systemic modernisation across our economy, society and industry"[58]. Lately, the European Commission adopted a set of proposals to make the EU's climate, energy, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels[59].

Governments are involved as a regulator, but also as a supporter and promoter for sustainability in the automotive companies. They are involved as a supporter by developing agendas for innovating mobility[60] and by sharing knowledge on best practices in the automotive sector with regards to sustainability[61]. Governments are promoting sustainable transportation by providing funding to sustainable initiatives or declaring their vision on sustainability[62].

2.5.1 Policies on emissions

Emission performance standards

Since 2009, EU legislation has set mandatory emission targets for new cars and, since 2011, for new vans. It makes sense that governments are regulating on the emissions of vehicles. In 2017, road transport contributed 21% of the EU's total emissions of carbon dioxide (CO_2), the main greenhouse gas. Through these regulations, manufacturers are forced to start developing more sustainable vehicles. In its September 2020 State of the Union, the European Commission presented its plan to reduce EU greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This ambition will put the EU on a balanced pathway to reaching climate neutrality by 2050.[63] These regulations set new targets for CO_2 emissions for new cars.

The European Commission promotes the growth of the market for zero- and low- emissions vehicles. It seeks to ensure that citizens have the infrastructure they need to charge these vehicles, for short and long journeys. In addition, from 2026, road transport will be covered by emissions trading, putting a price on pollution, stimulating cleaner fuel use and re-investing in clean technologies. The Commission is also proposing carbon pricing for the aviation sector, which benefited from an exception until now.

Low emission zones

There have been restrictions on access limitations in urban areas for many years now in the form of environmental zones, but these regulations have developed quickly in the last years[64].

[56] https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40
[57] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[58] https://www.lifegate.com/european-green-deal-citizens
[59] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[60] European Commission (2018). Europe on the Move: Commission completes its agenda for safe, clean and connected mobility
[61] European Commission (2018). Best Environmental Management Practice for the Car Manufacturing Sector
[62] https://cop24.gov.pl/presidency/initiatives/driving-change-together-partnership/
[63] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1599
[64] https://ec.europa.eu/transport/themes/urban/urban_mobility/urban_mobility_actions/green_zones_en

- The German government introduced its environmental badges in 2007 to keep the most polluting cars out of most of its cities. Today, Germany has set up 57 environmental zones[65].
- France has established multiple types of environmental zones since 2016, with Paris as the first metropolitan area that established a low emission zone.[66]
- The Dutch government has committed to have zero emission zones in place in the 30 largest cities (for logistic transportation) in 2025 and for all cities in 2030[67].

2.5.2 Other policies

ARCADE

As part of their Horizon 2020, the European Commission set up ARCADE, a Coordination and Support Action. The aim of ARCADE is to share knowledge and align stakeholders across sectors to smoothen the development of Connected, Cooperative and Automated Driving (CAD) in Europe and beyond.

Data sharing

In 2017, the EU commission created a framework for a 'multi-modal travel information service', directing each EU country to create a National Access Point by December 1, 2019 with the goal to share travel data.[68] This framework contributes to the environment as it enables platforms for vehicle sharing and multiple public transportation providers.

2.6 Conclusions

Throughout this report, we have shown the importance of sustainability to the automotive sector. The automotive industry is one of the most important industries for the European economy, but global leadership in the market is shifting towards Asia. As regulations in sustainability are becoming stricter and will become even more strict, organisations are looking for innovations in this area. Digital transformation could be deployed by automotive companies to contribute to sustainability goals, while improving their competitive position as well. However, companies in the automotive industry are lagging behind compared to other industries.

This report discussed the impact of technologies on innovation in the automotive industry on three innovation levels: vehicle innovation, production innovations and new business models

Connectivity and the ability to process (unstructured) data streams are expected to have the most impact on the automotive industry, in all innovation levels. In production innovations, connectivity and advanced algorithms will improve efficiency by reducing waste. Vehicle innovations will lead to more sustainability by reducing traffic congestion, optimising navigation and avoiding traffic accidents. Business models innovations will benefit from technologies as consumers and vehicles can connect everywhere and anytime.

Not all companies are able to turn the opportunities of technologies into benefits. Connectivity within vehicles or in a production site requires massive amounts of data streams that currently can only be exchanged by a 5G connection, while artificial intelligence enables the analyses of unstructured data streams. Organisations are investing in these technologies, but the actual adoption of scaled initiatives is lacking. The major challenges they are facing are 1) integration of new digital solutions with their (fragmented) legacy systems, 2) having the required data quality and availability and 3) getting the right talent capabilities in house.

The value chain of the automotive industry is changing. Players from different industries such as technology (e.g. Google, IBM) and telecom (e.g. Verizon and Vodafone) have already entered the market, but also highly specialised startups are emerging. Traditional automotive companies should collaborate with the right partners to get access to new capabilities and gain competitive advantage.

Looking at the global automotive market, sustainability is not only a restriction, but it also provides an opportunity for European companies to regain competitive advantage. To achieve this, they need to invest in new technologies and overcome the challenges mentioned above. The European Commission and governments are not only regulating organisations to become more sustainable. They are also supporting organisations in adopting these technologies by creating frameworks and setting up knowledge centres on specific topics. Doing so, they provide an ecosystem for the automotive industry that enables digital transformation with the objective of becoming more sustainable and competitive.

---

[65] https://www.umwelt-plakette.de/de/
[66] https://www.lez-france.fr/en/french-environmental-zones-zcr/french-environmental-zones.html
[67] Rijksoverheid (2019). Klimaatakkoord
[68] European Comission (2020). National Access Points

Bibliography

Anderson, et al. (2016). Autonomous Vehicle Technology A Guide for Policymakers. Retrieved at https://www.rand.org/pubs/research_reports/RR443-2.html

Autonomy, Capgemini (2020). The future of mobility as a service. Retrieved at https://www.capgemini.com/resources/the-future-of-mobility-as-a-service-maas/

BCG (2020). COVID-19's Impact on the Automotive Industry. Retrieved at https://www.bcg.com/publications/2020/covid-automotive-industry-forecasting-scenarios

BlackRock Investment Institute (2019). Sustainability: The future of investing. Retrieved at https://www.blackrock.com/us/individual/insights/blackrock-investment-institute/sustainability-the-future-of-investing#:~:text=More%20granular%20data%2C%20more%20sophisticated,company's%20long%2Dterm%20growth%20potential.

F. Bardhi, G.M. Eckhardt (2012), Access-based consumption: the case of car sharing. Retrieved at https://academic.oup.com/jcr/article/39/4/881/1798309

Capgemini (2010). Understanding digital mastery today. Retrieved at https://www.capgemini.com/resources/understanding-digital-mastery-today/

Capgemini (2018). The need for speed: Four recommendations to turbo-charge digital performance in the automotive industry. Retrieved at https://www.capgemini.com/research/the-need-for-speed-four-recommendations-to-turbo-charge-digital-performance-in-the-automotive-industry/

Capgemini (2019). Accelerating automotive's AI transformation. Retrieved at https://www.capgemini.com/us-en/accelerating-automotives-ai-transformation/

Capgemini (2019). Connected vehicle trend radar. Retrieved at https://www.capgemini.com/resources/connected-vehicle-trend-radar/

Capgemini (2019) Smart factories @ scale. Retrieved at https://www.capgemini.com/wp-content/uploads/2019/11/Report-%E2%80%93-Smart-Factories.pdf

Capgemini (2019). 5G in industrial operations. Retrieved at https://www.capgemini.com/wp-content/uploads/2019/06/5G-in-industrial-operations.pdf

Capgemini (2020). Connected Vehicle Trend Radar 2. Retrieved at https://www.capgemini.com/news/connected-vehicle-trend-radar/

Capgemini (2020). COVID-19 and the automotive consumer. Retrieved at https://www.capgemini.com/research/covid-19-and-the-automotive-consumer/

Capgemini (2020). How automotive organisations can maximize the smart factory potential. Retrieved at https://www.capgemini.com/se-en/research/how-automotive-organisations-can-maximize-the-smart-factory-potential/

Capgemini (2020). Perspectives from our Asia Pacific Junior Talents. Retrieved at https://www.capgemini.com/careers/perspectives-from-our-asia-pacific-junior-talents/

Capgemini (2020). Taking the lead with sustainable transportation. Retrieved at https://www.capgemini.com/resources/transforming-the-commercial-vehicle-sector/

Capgemini (2020). The sustainability impact of car sharing. Retrieved at https://www.capgemini.com/resources/the-sustainability-impact-of-car-sharing/

CNBC (2019). Goldman pledges $750 billion for 'large opportunities' in sustainable finance. Retrieved at https://www.cnbc.com/2019/12/19/goldman-pledges-750-billion-for-opportunities-in-sustainable-finance.html#:~:text=Goldman%20pledges%20%24750%20billion%20for%20'large%20opportunities'%20in%20sustainable%20finance,-Published%20Thu%2C%20Dec&text=Goldman%20Sachs%20said%20that%20it,%E2%80%9CThere%20are%20large%20opportunities.

CNET (2018). Ford is turning to drones to keep human workers safe in the UK. Retrieved at https://www.cnet.com/roadshow/news/ford-dagenham-plant-drone-safety/

Continental Automotive (2019). "Worldwide Emission Standards and Related Regulations. Retrieved at https://www.continental-automotive.com/getattachment/8f2dedad-b510-4672-a005-3156f77d1f85/EMISSIONBOOKLET2019.pdf

Disruptor (2018). 12 Startups Using Blockchain To Transform The Automotive Industry. Retrieved at https://www.disruptordaily.com/blockchain-market-map-automotive/

Environmental Protection Agency (2018). Automotive Trends Report. Retrieved at https://www.epa.gov/automotive-trends/download-automotive-trends-report

European Commission (2016). A European Strategy for Low-Emission Mobility. Retrieved at https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/1-2016-501-EN-F1-1.PDF

European Commission (2017). Digitisation research and innovation. Transforming European industry and service. Retrieved at https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/dt_booklet.pdf

European Commission (2017). Best Environmental Management Practice for the Car Manufacturing Sector. Retrieved at https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/best-environmental-management-practice-car-manufacturing-sector-learning-frontrunners

European Commission (2018). Europe on the Move: Commission completes its agenda for safe, clean and connected mobility. Retrieved at https://ec.europa.eu/transport/modes/road/news/2018-05-17-europe-on-the-move-3_en

European Commission (2018). On the road to automated mobility: An EU strategy for mobility of the future. Retrieved at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0283&from=EN

European Commission (2020). IoT components in connected and autonomous vehicles. Retrieved at: https://ati.ec.europa.eu/reports/product-watch/iot-components-connected-and-autonomous-vehicles

European Commission (2020). Sectoral Report Automotive. Retrieved at: https://ati.ec.europa.eu/reports/sectoral-watch/technological-trends-automotive-industry

European Commission (2020). White paper On Artificial Intelligence - A European approach to excellence and trust. Retrieved at: https://ec.europa.eu/digital-single-market/en/news/white-paper-artificial-intelligence-public-consultation-towards-european-approach-excellence

Gartner (2019). Gartner Says 5.8 Billion Enterprise and Automotive IoT Endpoints Will Be in Use in 2020. Retrieved at: https://www.gartner.com/en/newsroom/press-releases/2019-08-29-gartner-says-5-8-billion-enterprise-and-automotive-io#:~:text=forecasts%20that%20the%20enterprise%20and,%2C%20up%2021.5%25%20from%202018.

IEA (2019). Global EV outlook. Retrieved at: https://www.iea.org/reports/global-ev-outlook-2020

IEA (2020). CO2 Emissions from Fuel Combustion: Overview. Retrieved at: https://www.iea.org/reports/co2-emissions-from-fuel-combustion-overview

IHS (2018). Automotive Electronics Roadmap Report. Retrieved at: https://autotechinsight.ihsmarkit.com/shop/product/5003061/automotive-electronics-roadmap-report-2018

KMPG (2020). Global automotive executive survey 2020. Retrieved at https://home.kpmg/la/en/home/insights/2020/06/global-automotive-executive-survey-2020.html

Lifegate (2020). The European Green Deal seen through the eyes of citizens. Retrieved at: https://www.lifegate.com/european-green-deal-citizens

McKinsey (2017). Building smarter cars with smarter factories: How AI will change the auto business. Retrieved at: https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/building-smarter-cars

McKinsey & Company (2019). Race 2050 - a vision for the European automotive industry. Retrieved at: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/a-long-term-vision-for-the-european-automotive-industry

Paunov, Caroline; Planes-Satorra, Sandra (2019). How are digital technologies changing innovation? Retrieved at: https://www.researchgate.net/publication/334593576_HOW_ARE_DIGITAL_TECHNOLOGIES_CHANGING_INNOVATION

Qualcomm (2019). Is VEPP a more accurate and affordable automobile position-location technology? Retrieved at: https://www.qualcomm.com/news/onq/2019/01/09/vepp-more-accurate-and-affordable-automobile-position-location-technology

SAE Mobilus (2019). Hyundai Mobis teams with KT for 5G-based, real-time navigation. Retrieved at: https://saemobilus.sae.org/automated-connected/news/2019/01/hyundai-mobis-teams-with-kt-for-5g-based-real-time-navigation

SMMT (2020). 2020 UK Automotive Sustainability Report. Retrieved at: https://www.smmt.co.uk/reports/sustainability/#:~:text=2020%20UK%20Automotive%20Sustainability%20Report&text=The%20automotive%20industry's%20commitment%20to,through%20a%20time%20of%20change.&text=During%202019%2C%20the%20industry%20recorded,water%20use%20(%2D8.5%25).

The Guardian (2019). Across the globe, millions join the biggest climate protest ever. Retrieved at: https://www.theguardian.com/environment/2019/sep/21/across-the-globe-millions-join-biggest-climate-protest-ever

Trivector (2014). "Effekter av Sunfleet bilpool på bilinnehav, ytanvändning, trafikarbete och emissioner". Retrieved at: https://resources.mynewsdesk.com/image/upload/t_attachment/tfxihvlceec8eohguxfk.pdf

Verdict (2018), Blockchain and the connected car: the perfect match. Retrieved at: https://www.verdict.co.uk/connected-car-blockchain/

Volkswagen AG (2019). Volkswagen and Amazon Web Services to develop Industrial Cloud. Retrieved at: https://www.volkswagenag.com/en/news/2019/03/volkswagen-and-amazon-web-services-to-develop-industrial-cloud.html

Washington Post (2020). In your phone, in the air. Retrieved at: https://www.washingtonpost.com/graphics/business/batteries/graphite-mining-pollution-in-china/

Internet sites:

5GAA. 5GAA: paving the way towards 5G: https://5gaa.org/5g-technology/paving-the-way/

Acerta. Engine failure modes: https://acerta.ai/case-studies/engine-failure-modes/

COP24. Driving change together – Katowice partnership for e-mobility: https://cop24.gov.pl/presidency/initiatives/driving-change-together-partnership/

European Commission. A European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

European Commission. Delivering the European Green Deal: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

European Commission. End-of-life vehicle statistics: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=End-of-life_vehicle_statistics&oldid=509146

European Commission. Automotive industry: https://ec.europa.eu/growth/sectors/automotive_en

European Commission. CO_2 emission performance standards for cars and vans (2020 onwards): https://ec.europa.eu/clima/policies/transport/vehicles/regulation_en

European Commission. Green zones: https://ec.europa.eu/transport/themes/urban/urban_mobility/urban_mobility_actions/green_zones_en

European Commission. Mobility and transport: https://ec.europa.eu/transport/themes/its/road_it

European Commission. National Access Points: https://ec.europa.eu/transport/themes/its/road/action_plan/nap_en

M: https://m.co/se/en-US/

McKinsey Center for Future Mobility, Shared mobility: https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/overview

OECD, About sustainable manufacturing and the toolkit: https://www.oecd.org/innovation/green/toolkit/aboutsustainablemanufacturingandthetoolkit.htm

Rijksoverheid. Klimaatakkoord: https://www.rijksoverheid.nl/documenten/rapporten/2019/06/28/klimaatakkoord

Umwelt-plakkette.de. Umweltzonen in Deutschland - Kommen jetzt auch noch Diesel-

Appendix A: Advanced Technology uptake

Figure 7: Advanced Technologies Uptake by European Union Industries – Question: Which of the following technologies is your organisation using or planning to use?

Technology	Financial Services	Gov/Edu	Healthcare	Manufacturing discrete	Manufacturing process	Professional Services	Retail, Wholesale	Telecom, Media	Transport, Logistics	Utilities, Oil, Gas	Agriculture
Fixed or mobile connectivity	84%	78%	81%	88%	82%	81%	75%	89%	84%	86%	88%
Security technology solutions	84%	78%	78%	84%	77%	81%	80%	88%	85%	89%	68%
Public cloud	63%	66%	68%	76%	71%	82%	72%	80%	75%	69%	83%
IoT	58%	55%	60%	64%	60%	63%	55%	66%	68%	65%	64%
Big Data and analytics solutions	77%	53%	48%	63%	65%	70%	47%	66%	55%	58%	41%
Internet-Enabled Mobile Solutions	74%	60%	47%	44%	61%	67%	55%	72%	62%	57%	36%
AI	61%	45%	57%	66%	56%	59%	44%	69%	49%	59%	34%
B2B industrial digital platforms	46%	24%	27%	64%	60%	58%	40%	47%	53%	47%	39%
Robotics	36%	25%	38%	76%	65%	33%	30%	29%	29%	52%	26%
Other connectivity	42%	37%	29%	33%	41%	46%	37%	59%	34%	31%	19%
Vehicle-related mobility IT solutions	35%	28%	19%	27%	36%	42%	30%	26%	65%	28%	14%
ARVR	29%	32%	42%	33%	34%	33%	24%	41%	22%	19%	5%
Advanced materials	29%	23%	21%	39%	28%	31%	24%	22%	24%	21%	6%
Nanotechnology	25%	21%	22%	36%	21%	32%	23%	18%	19%	23%	9%
Blockchain	53%	17%	15%	21%	25%	31%	22%	22%	18%	17%	6%
Micro and nanoelectronics	25%	20%	16%	38%	24%	26%	21%	20%	20%	17%	8%
Industrial biotechnology	19%	18%	13%	8%	49%	26%	18%	15%	16%	11%	23%
Photonics	23%	16%	11%	27%	22%	25%	19%	19%	16%	22%	10%

Source: Advanced Technologies for Industries Survey, November 2020

Legend: sum of % of respondents already using or planning to use the technology

Note: Some technologies are enablers for the other ones. Example: Photonics is an enabler for Robotics, Advanced Connectivity, Nanotechnologies and Micro and nano electronics.

About the 'Advanced Technologies for Industry' Project

The EU's industrial policy strategy promotes the creation of a competitive European industry. In order to properly support the implementation of policies and initiatives, a systematic monitoring of technological trends and reliable, up-to-date data on advanced technologies are needed. To this end, the Advanced Technologies for Industry (ATI) project has been set up. The project provides policymakers, industry representatives and academia with:

- Statistical data on the production and use of advanced technologies, including enabling conditions such as skills, investment and entrepreneurship
- Analytical reports, such as on technology trends, sector-based insights and products
- Analyses of policy measures and policy tools related to the uptake of advanced technologies
- Analysis of technology trends in competing economies, such as in the US, China and Japan
- Access to technology centres and innovation hubs across EU countries

You may find more information about the 16 technologies here: https://ati.ec.europa.eu.

The project has been undertaken on behalf of the European Commission – the Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and Small and Medium-Sized Enterprises Executive Agency (EISMEA) – by IDC, Technopolis Group, Capgemini, Fraunhofer, IDEA Consult and NESTA.

EA-06-21-013-EN-N

Publications Office
of the European Union