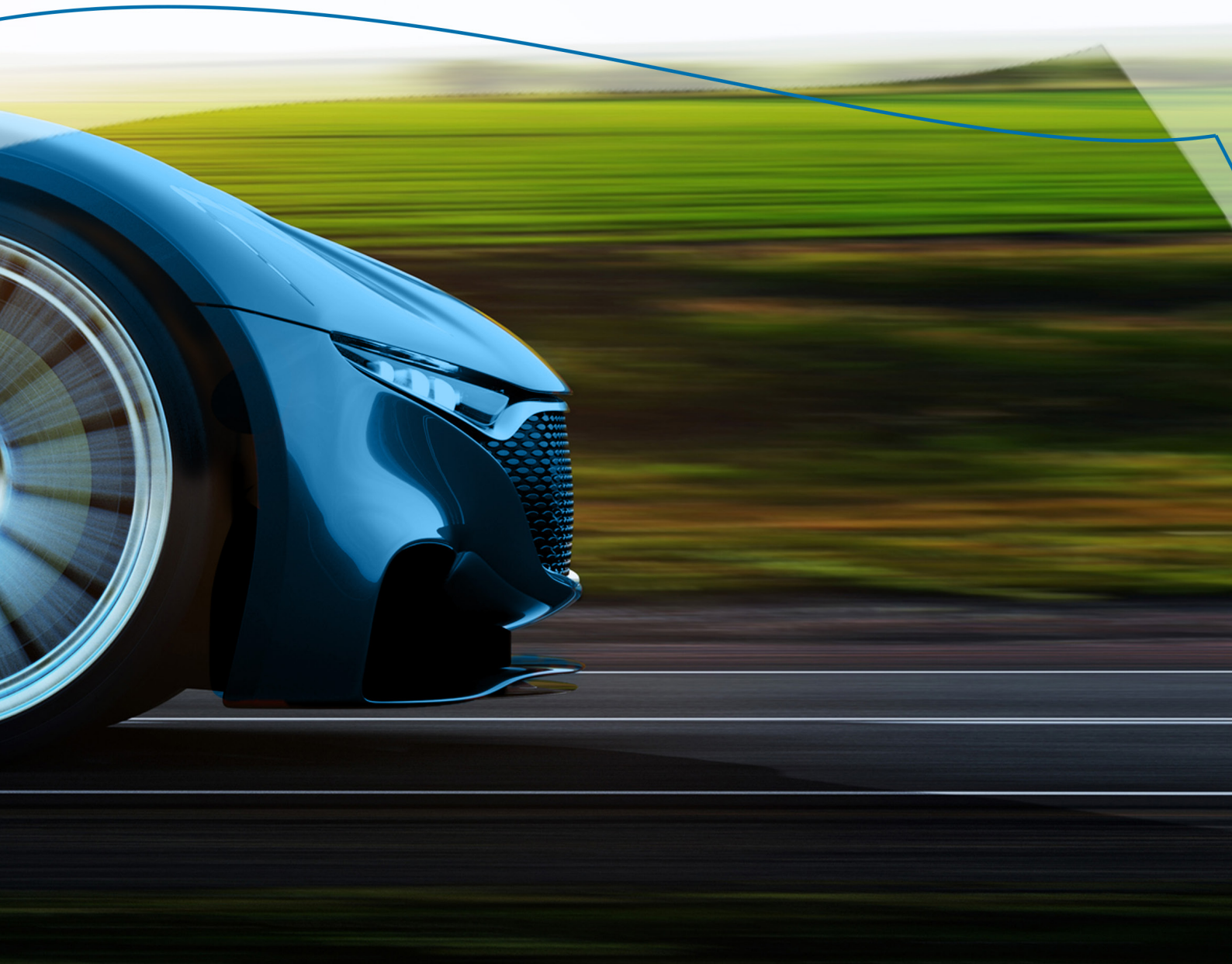
Capgemini

Finding a new balance in the automotive industry

Driving responsible innovation and transformation for the next decade



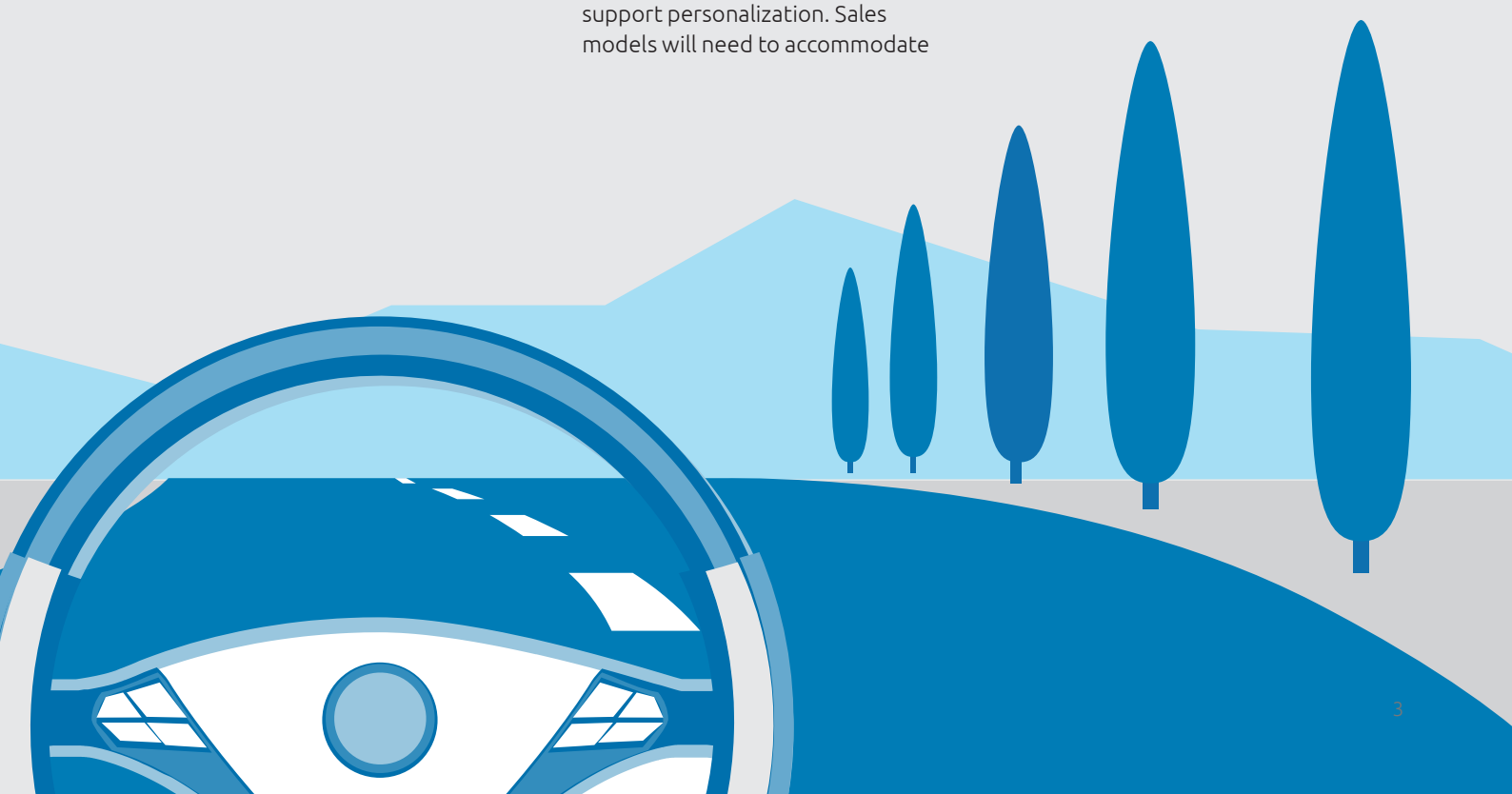
Executive Summary

The automotive sector's already dizzying pace of change is accelerating. This report gives Capgemini's perspective on the most important changes that can be expected between now and 2030, and the adaptations that automotive companies will have to make to ensure continued success.

Following eras of industrialization (1920s to 1970s), globalization (late 1970s to 2015), and digitalization, a new era of change is emerging, driven by three megatrends that automotive companies are recognizing as critical to their future:

- **Sustainability:** Societal and regulatory pressure means that companies need to adopt an end-to-end approach to sustainability that addresses not just the environmental impact of the vehicle, but that of every aspect of their operations and those of their partners. To tackle this issue adequately, Original Equipment Manufacturers (OEMs) will need to change their culture. They will also have to rethink the way they collaborate with their suppliers and partners to realize the concept of a circular economy.
- **Customer centricity:** Companies need to cater to changing customer preferences, such as younger individuals' requirement for personalization and online transactions. Connected services will play an increasingly important role as software proliferates inside and around vehicles, not least to support personalization. Sales models will need to accommodate these requirements: Subscriptions and agency sales will become more common, for example.
- **Intelligent Industry:** The next generation of digital engineering and manufacturing will build on technologies such as artificial intelligence (AI), cloud, and the internet of things (IoT) to create a data- and software-driven industry. Intelligent products and systems, operations, and services will improve uptime, reduce costs, and boost efficiency, and hence increase value for companies, their customers, and their partners. Software will play a crucial role in the automotive industry and influence it radically.

Increasingly, too, automotive companies need to operate and establish a clear position within a wider mobility ecosystem that includes providers of public transportation as well as enablers of mobility such as infrastructure and utility providers, and local and national governments.



Success within the mobility ecosystem depends on three main factors:

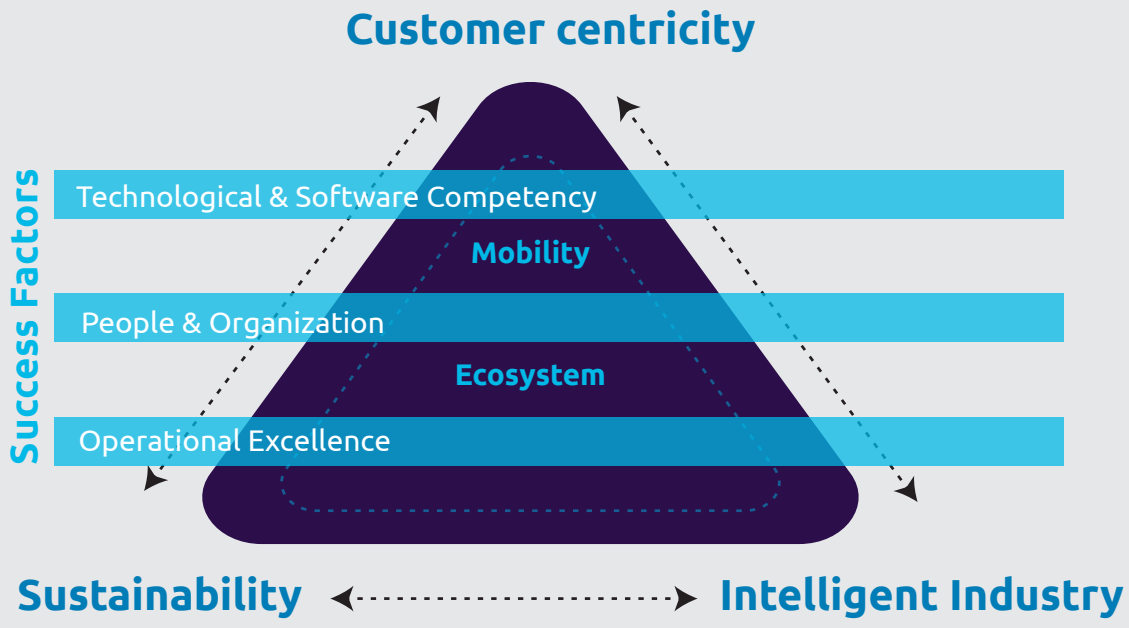
- **Technology & software competency:** To succeed within the mobility ecosystem, companies will have to focus at least as much on software as on hardware. Automotive companies will increasingly resemble technology companies such as Google, Microsoft, or Amazon. Topics that are likely to need high levels of competency include cloud, data and AI, and cybersecurity.
- **People & organization:** This new world will require new skills and competencies, both hard and soft, new styles of leadership, and new, more collaborative ways of working that increase agility.
- **Operational excellence:** A disciplined approach to the management of costs and efficiency will be vital and can be achieved by, for example, using analytics and AI to improve processes, developing a culture that facilitates continuous change, and aligning IT ever more closely with the business. Companies will also need to develop resilience, reacting to disruptions in a controlled and efficient way.

Building a position in the mobility ecosystem will imply adoption of new business models, for example around mobility services and digital mobility solutions. Any new model must, however, be aligned with the requirements of each company's customer base, and with the company's own core competencies and profitability objectives. Success in the mobility ecosystem also depends on complementing vehicles with the right range of services in the areas that customers value most: connectivity, flexibility, and convenience.

Our research indicates that the automotive industry is moving towards a new "**Responsibility Era**" where companies must shoulder responsibility for a whole range of environmental and social objectives. Even when new industry trends and preoccupations come along, these responsibilities will be here to stay, affecting every player in the mobility ecosystem, every stage of the automotive value chain, and every aspect of customer experience.

Automotive companies must demonstrate that they understand and accept their new responsibilities while balancing them against existing business priorities. By doing this, they can both build a credible position within the developing mobility ecosystem and safeguard their future profitability.

TRANSFORMATION FRAMEWORK FOR THE NEXT AUTOMOTIVE ERA



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Introduction

In recent Capgemini studies, such as our report on the Agency Sales Model[1] and our Connected Vehicle Trend Radar 2,[2] we analyzed specific topics within the automotive sector. But what does the big picture look like?

1 https://www.capgemini.com/wp-content/uploads/2020/11/Automotive-Agency-Sales-Model_POV_Capgemini-Invent.pdf
2 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2020/09/ConnectedVehicleTrendRadar_2_Report.pdf

How will the automotive industry as a whole evolve in the short and medium term? Will automotive players offer similar products and services to today's, or something completely different? Will they operate their businesses in the same way as they have done in the past decade?

This new study tackles these questions, looking into the future of automotive and analyzing the whole field of mobility – including not just vehicles but also mobility-related services – from the perspective of the automotive industry and from different angles of the value chain. Based on this analysis, we share our industry predictions for the period up to 2030.

To provide context for these predictions, we first discuss industry megatrends of both today and tomorrow, describing their impact, challenges, and meaning for industry players. Focusing on the effect of technology on key megatrends, we will not only assess the big picture from the perspective of automotive players, but also consider the implications for the most important component of the automotive ecosystem: the customer. Customers' dramatically changed behavior is the ultimate driving force for the transformation of the entire industry.

The industry's recent history and current status

The automotive industry has been in a state of constant change since the start of the "Industrialization Era" that began in the 1920s and lasted until the 1970s. Since then, manufacturing and production processes have been enormously improved in terms of their efficiency and effectiveness through automation of operations, reductions in the length of vehicle cycles, and increased specialization. Within this era, the industry had a clear product focus and specialized its operations with regard to the purchasing, logistics, engineering, and manufacturing phases of the product.

The "Globalization Era," from approximately the late 1970s until 2015, saw the end of geographic boundaries that previously constrained sourcing, logistics, manufacturing, and sales. By opening up world markets and establishing international trade alliances, products have been made available to customers all over the world and OEMs have benefited from local advantages through access to new talent, materials, and demand. This has given OEMs the chance to develop from national or international producers focusing on specific markets into global or multinational players.

The "Digitalization Era," which began around 2014 and continues today, is characterized by disruptive innovations in the automotive market. New technologies have affected not only the internal operating model of suppliers and OEMs, but also customers' use of products. A significant proportion of the portfolio has changed as the Digitalization Era has given birth to digital products and services. From this era onwards, OEMs and suppliers can no longer focus on engine-based vehicles but have widened and shifted their portfolio to focus more on product-related services. These services now represent an additional source of revenue for OEMs. Also in this era, the concept of the mobility ecosystem has emerged with new business models of its own such as car sharing, widening the scope of automotive players' operations and enlarging their battleground.

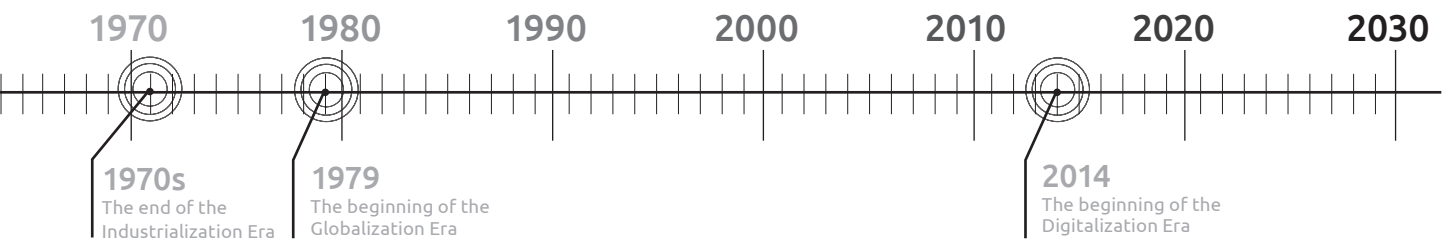
From even a brief look at the past few decades, it is clear that the automotive industry has been undergoing constant change, culminating in today's digital transformation. Throughout its history, it has been a profitable industry and major contributor to the global economy; outside times of crisis, it has grown constantly in terms of volume, revenue, and number of market players. With the COVID-19 pandemic, the digital transformation of the industry has been further accelerated throughout the entire value chain. Even more than after the 2008/2009 financial crisis, China as a leading market is pulling the automotive industry out of the crisis with a V-shaped pattern of development.

All transformation stages, from the Industrialization Era onwards, have brought significant new opportunities with them, always putting efficiency and adaptability at the forefront. Nevertheless, each evolutionary stage is also associated with challenges. Digital transformation is not an incremental innovation with minor changes, but a revolutionary one – at least when it comes to the impact on people and on the working methods of traditional automotive players.

With regard to digital transformation, certain companies are clearly leading the field. In every conference on digital innovation or panel discussion on digital capabilities, the same leading tech players are mentioned as state-of-the-art examples: for instance, Google, Amazon, Uber, Alibaba, and Tencent. Alongside innovative and successful startups, these same players are now entering the automotive market and challenging traditional OEMs and suppliers on their home ground. The boundaries between technology companies and other industries are fading away. New players are entering markets, both as competitors for established players and as their collaborators. In addition, virtually every automotive company nowadays seems to have the ambition of becoming a technology company – and probably rightly so, given the need for customer centricity and the increasing importance of software within their business.

As if these factors did not put enough pressure on automotive players, they also need to deal with clients' unprecedented expectations about sustainability, convenience, affordability, and personal experience among others. Customers do not perceive vehicles and/or mobility as standalone products, but as an essential part of their own ecosystem that needs to be seamlessly integrated and personalized. As people experience different customer journeys in other industries, they develop similar expectations about OEMs and mobility players in general. Offering an appealing and appropriate customer experience in the automotive world is currently one of the biggest preoccupations and challenges for OEMs.

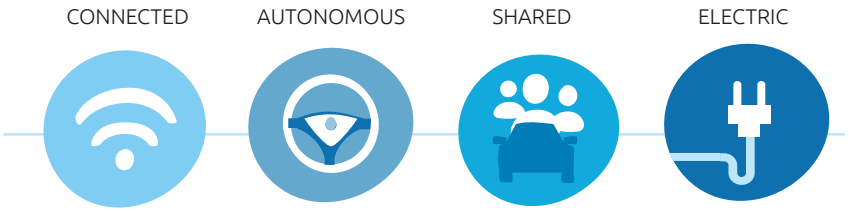
As always, the point of departure is clear, but the destination and roadmap are less so. Drawing on Capgemini's research and client experience, this report looks into the future to predict what the automotive industry's next major era will look like. But let's start by looking at the megatrends that will shape that era.



Three megatrends that are shaping the next automotive era

Alongside the challenges it has posed for the automotive industry, the pandemic has made positive contributions to its digitalization. Companies' agility and digital maturity have increased at unprecedented rates, as seen in the rapid introduction of contactless sales and flexible offers. By providing an impetus for more rapid transformation, COVID-19 has accelerated the digital transformation that was already under way. This transformation is enabled by new and still developing technologies, such as artificial intelligence (AI), analytics, and cloud platforms, and by the increasing levels – and growing importance – of software within the vehicle and in the underlying processes. This period of rapid change is bringing different megatrends to the fore.

CASE



Until now, the industry's main megatrends have been summarized by the acronym CASE, representing "Connected, Autonomous, Shared, Electric" vehicles.

Although CASE topics are still very much on the agendas of the board members and shapers of the automotive industry, companies' focus has shifted. While connected and electric vehicles are still on the priority list, autonomous driving vehicles and shared mobility are receiving less focus from traditional OEMs. For the "autonomous" category, the term automated driver assistance (ADAS) more accurately represents the current market direction.

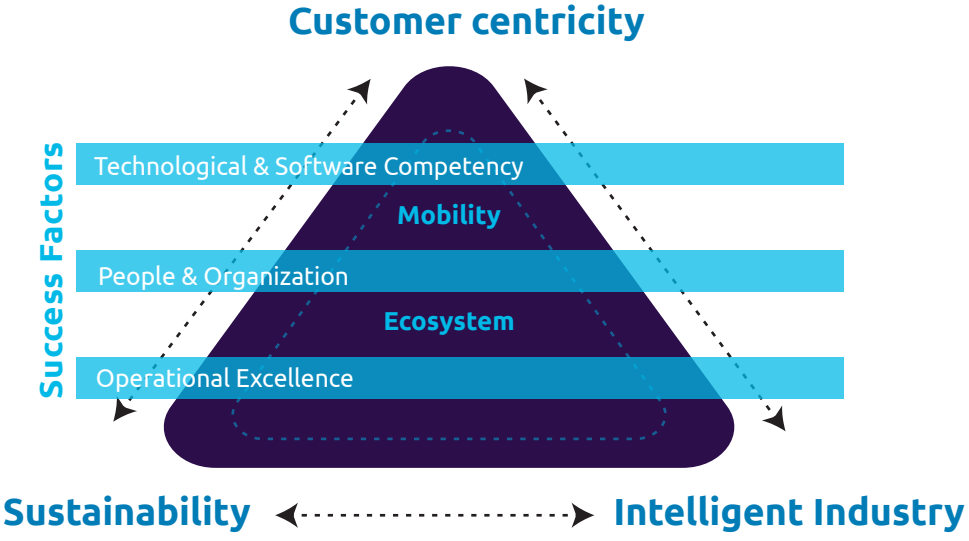
Rather than emphasize CASE, our research shows that automotive companies are increasingly recognizing three megatrends as critical to their future: Sustainability, Customer centricity, and Intelligent Industry. Companies know that they need to establish a position – and then remain relevant – in a mobility ecosystem that also includes providers of public transportation, together with mobility enablers such as infrastructure and utility providers, and local and national governments. Companies' ability to address the three megatrends will influence their ability to succeed in this mobility ecosystem.

To help companies tackle this transformation, we have developed a framework (see Figure 1) that incorporates the three megatrends, along with three success factors that will determine companies' ability to succeed in the mobility ecosystem: Technological & Software Competency, People & Organization, and Operational Excellence. In this framework, the megatrends broadly represent the "what" of the new era (what companies need to do) while the success factors represent the "how" (how companies can realize the megatrends). The megatrends are discussed below, and the success factors in the next chapter.

As we have seen, the three megatrends identified by our framework define the broad themes that automotive players need to understand and address. Only by dealing with these three megatrends sufficiently and equally can they remain competitive and secure their market position as mobility ecosystem players. Let's now look at each megatrend in turn.

FIGURE 1

TRANSFORMATION FRAMEWORK FOR THE NEXT AUTOMOTIVE ERA



1 MEGATREND Sustainability

With environmental awareness on the rise, nearly 80% of customers are now making sustainability-based purchase decisions, according to Capgemini Research Institute.[3] Companies from all industries are starting to react with comprehensive programs aiming at reducing their environmental footprint and reaching a net-neutral impact in terms of CO_2 and other greenhouse gases.

For the automotive industry, in addition to a general societal demand for sustainable behavior, there is a major regulatory aspect. In Europe, the first regulations regarding vehicle emissions were issued in the early 1990s and they have been repeatedly tightened ever since. In recent years, awareness has focused on CO_2, with increasingly strict requirements for fleet emissions.

We expect this trend to continue. A net-zero CO_2 impact for internal company operations will be the standard by 2030. Similarly, by then we expect all major OEMs to offer vehicles driven by mechanisms other than internal combustion engines across their model ranges.

Already today, battery electric vehicles (BEVs) are gaining customer acceptance, with companies such as Tesla showing the way. Rapidly improving battery technology provides a more reliable experience and instills confidence in this new way of driving, partially allaying concerns about charging infrastructure and reach. However, a variety of challenges remain regarding the sustainability of battery technology, ranging from the requirement for rare earths as ingredients for battery production to a lack of recycling solutions. All in all, BEVs will not become mainstream until customers are offered the usability, convenience, and affordability that conventional vehicles offer.[4]

It should be noted that increasing adoption of BEVs will ultimately have an impact on sales (different sales models, probably with leasing options for batteries) and aftersales (reduced service requirements due to decreased complexity of the whole powertrain), requiring adaption, at least, in these areas as well.

Against this background, other alternative power sources also look interesting. Apart from BEVs, advances in technology have paved the way for the development of electric vehicles powered by solar energy or hydrogen/fuel cells, as well as for vehicles whose engines can run on biofuel. These alternatives all have their attractions. The use of hydrogen as an alternative fuel is of interest because the energy released from hydrogen only produces water as a by-product. Solar roofs could take electric vehicles to another level of sustainability by leveraging the power of the sun, making them completely emission-free.

3 https://www.capgemini.com/us-en/wp-content/uploads/sites/4/2020/07/Final-Web-Report-Sustainability-In-CPRD-2.pdf

4 https://www.iea.org/reports/global-ev-outlook-2020

These alternatives would need further investment – for example, to set up the required fueling infrastructure in the case of hydrogen-powered vehicles. For hydrogen, there are also storage challenges, which have delayed adoption so far. A recent Capgemini report[5] discusses some of these issues in detail.

Returning to the overarching topic of sustainability, according to a Capgemini Research Institute report, 62% of automotive organizations claim to have developed a comprehensive sustainability strategy with well-defined goals and targets.[6] This is necessary, as sustainability in automotive goes beyond e-mobility. An end-to-end approach to sustainability needs to consider the entire impact of the value chain, ranging from product development, sourcing and logistics, manufacturing, and marketing and sales, to aftersales and recycling solutions. Improvements in terms of climate, environmental, and social impact are possible and required at each of these points.

To realize these improvements, transparency and culture change are required. Collecting and aggregating the right data about the sustainability footprint of all steps along the value chain provides a solid foundation for improvement. A culture of sustainability awareness can ensure that sustainability is not just a concept within operations and production, but rather a mindset and responsibility to be followed and lived by each player within the ecosystem.

In taking steps towards a more sustainable mobility ecosystem, the concept of a circular economy will become an increasingly important part of the CxO agenda. Emerging technologies can help to realize the resulting comprehensive sustainability ambitions. Examples include the attempts made by leading OEMs to use 3D printing to reduce manufacturing waste by eliminating scrap, AI to enable more efficient energy consumption, and data forecasting, analytics and green IT to help evaluate the environmental impact of operations.

62%

of automotive organizations claim to have sustainability targets

5 https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2020/12/Commercial-vehicles-study-Capgemini-Invent.pdf
6 https://www.capgemini.com/wp-content/uploads/2020/03/The-Automotive-Industry-in-the-Era-of-Sustainability.pdf

2 MEGATREND Customer centricity

Sustainability is not the only area where customer expectations are changing. With 59% of younger consumers (below the age of 35) considering buying a car, up from 35% in April 2020,[7] a generation change is happening among automotive customers and a reversal of their historical preference to avoid vehicle ownership. As a new customer base emerges, customer preferences are shifting from offline to online channels and from standard services to personalized customer journeys.

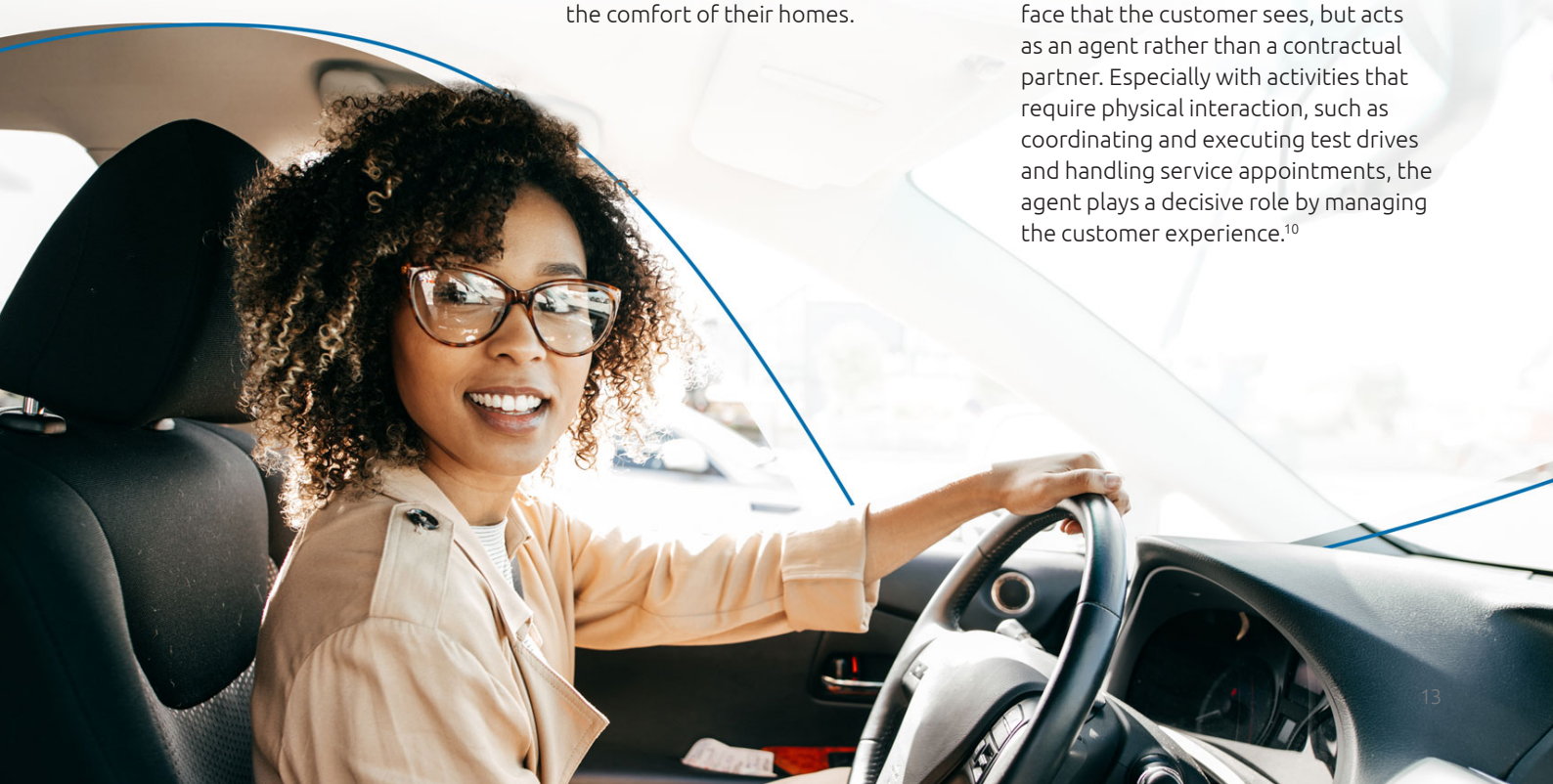
As a result, customer centricity is key, not only when talking directly to the customer, but in all communication channels, and also internally, during the development of new products and the setup of new processes. Customer centricity needs to be the main driver in the physical as well as the digital world, seamlessly integrated into both internal and external processes.

Furthermore, customers today are showing an increased sense of independence and self-determination. They want to decide for themselves which products to buy, which decisions to take, and which data to share with whom.

This has important implications for the development of future sales in the automotive industry. Improved use of technology will help to cater to customer expectations both in dealerships and at home. Especially during the pandemic, contactless sales, deliveries, and aftersales represent top priorities and objectives for automotive players[8] in order to satisfy the newest customer expectations. To realize distance commerce, immersive technologies such as augmented reality (AR) and virtual reality (VR) are key; they allow customers to explore vehicle features and even take test drives from the comfort of their homes.

A customer-centric approach to vehicle sales has also led to the emergence of subscription models, which provide customers with more flexibility. Various OEMs have been testing the benefits of a subscription model through small-scale programs such as Access by BMW or Porsche Passport. By 2030, vehicle subscription programs could account for nearly 10% of all new vehicle sales in the US and Europe.[9]

With regard to operation of the sales process, an important transformation lies ahead, affecting both the customer experience and existing roles in automotive sales. The agency sales model (see Figure 2) can be viewed as an evolution of traditional three-tiered sales towards an integrated online/offline sales model. OEMs interact directly with customers and take responsibility for the sales transaction. The dealer remains the face that the customer sees, but acts as an agent rather than a contractual partner. Especially with activities that require physical interaction, such as coordinating and executing test drives and handling service appointments, the agent plays a decisive role by managing the customer experience.[10]



Transformations in automotive sales will also encompass aftersales service. Using technology, the traditionally burdensome steps in the aftersales customer journey can be seamlessly and effortlessly integrated into customers' lives. As an example, AI will help OEMs monitor connected vehicles in real time to predict and prevent vehicle malfunctions. Additionally, over-the-air (OTA) updates will be a quick and effortless way to remotely update vehicle software.

In the past, the usage phase of the vehicle was characterized by a limited relationship and communication between the OEM and the customer. However, connected services and the entire in-car experience now represent a new battlefield for OEMs and a new revenue source. To succeed in this field, OEMs need to make sure they offer valuable services to customers, integrate third-party services, and monetize the data gathered. The high potential of secure and trusted vehicle data is reflected in global revenue predictions for 2030 ranging between $80bn and $800bn.[11]

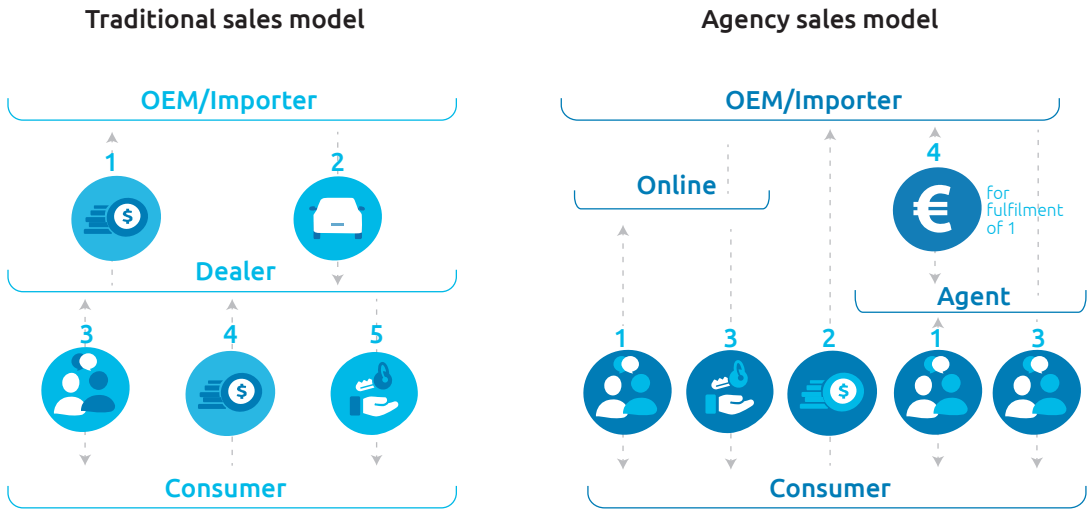
Many potential future use cases in aftersales rely on the connectivity features of vehicles. Additionally, data generated by connected vehicles is expected to increase, providing opportunities for OEMs to monetize digital insights. Technology adoption by other industries will enable a connectivity model that allows vehicles to communicate with almost all the physical assets in the surrounding environment (V2X).

Although connected services have great potential, it is not yet being realized. OEMs need to adjust their portfolio to take advantage of the fact that customers are often willing to pay for these services. Capgemini's Connected Vehicle Trend Radar 2[12] indicates that around 44% of customers do not yet have any connected services in their cars, and only about half of those that do use them frequently. Simplifying interfaces and promoting the capabilities of connected vehicles will not only help gain access to insightful data but also increase the value of vehicles for customers.

With the right technologies, organizational changes and partnerships, superior customer experience, personalized sales, and effortless aftersales, services will become key differentiators that help OEMs maintain a competitive advantage in automotive sales.

FIGURE 2

TRADITIONAL SALES MODEL (THREE-TIERED, MAINLY OFFLINE) VS AGENCY SALES MODEL



7 https://www.capgemini.com/wp-content/uploads/2020/04/COVID-19-Automotive.pdf
8 https://www.capgemini.com/wp-content/uploads/2020/05/Automotive-Sales-A-Bumpy-Road-to-Recovery-1.pdf
9 https://www.forbes.com/sites/sarwantsingh/2018/07/30/your-next-car-could-be-a-flexible-subscription-model/?sh=7ba8d7974ffa
10 https://www.capgemini.com/wp-content/uploads/2020/11/Automotive-Agency-Sales-Model_POV_Capgemini-Invent.pdf
11 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2020/09/CapgeminiInvent_VehicleDataMonetization_POV_Sep2020.pdf
12 https://www.capgemini.com/wp-content/uploads/2020/09/ConnectedVehicleTrendRadar_2_Report.pdf

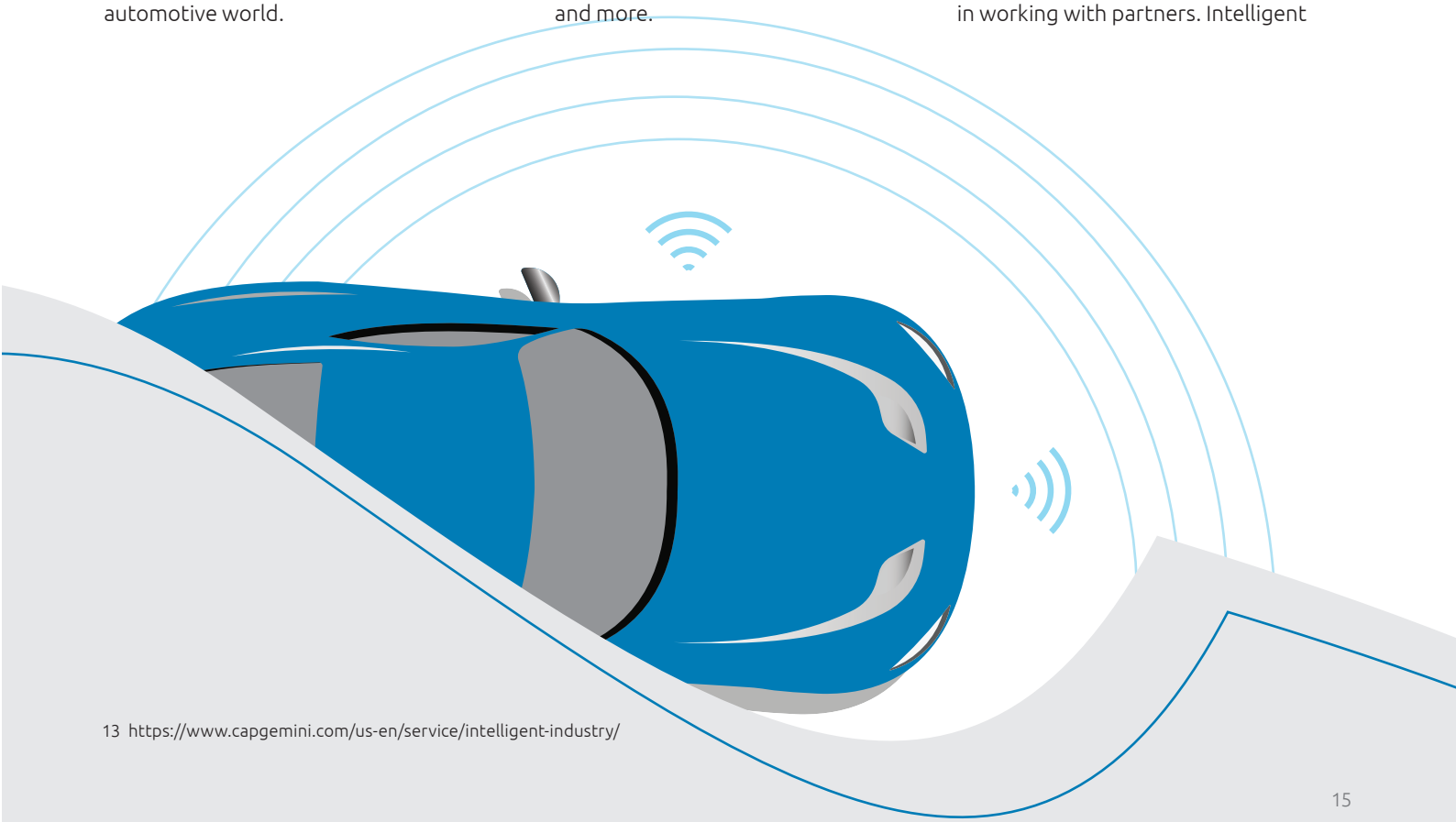
3 MEGATREND Intelligent Industry

Moving from the customer to the OEM perspective, new technologies have constantly been disrupting product development and manufacturing. Lately, an increased level of connectivity and automation was introduced under the heading of Industry 4.0. However, the future will rely not only on automated factories but also on closer collaboration between machines, workers, and customers to cope with the increased level of product complexity. The next generation of digital engineering and manufacturing, Intelligent Industry,[13] promises great shifts in industrial processes and in business and consumption models, and offers OEMs the opportunity to take the lead in the race to a data- and software-driven automotive world.

With the help of key technologies such as AI, cloud, and IoT, automotive players have the potential to address the topic of Intelligent Industry in a targeted manner. This can be realized via a threefold digital approach:

- **Intelligent products and systems**, being smart and connected, can now be continuously improved thanks to real-time feedback. This means greater uptime, reduced costs, and improved efficiency across product and system development. Intelligent products and systems span everything from product engineering (e.g. of powertrains and vehicle architecture) to software engineering (e.g. of embedded software or telematics) – and more.
- **Intelligent operations**, reflected in the digitalization and data-driven optimization of automotive core functions and processes, can reduce complexity and add efficiency through, for example, smart factories or digital engineering approaches.
- **Intelligent services**, ranging from connected services to monetization use cases based on data, can extend classic profit pools and provide value to customers and partners alike.

Highly automated processes, platforms, and procedures result from the threefold approach. They enable OEMs to create new digital business models, products, and services, and more efficient processes both internally and in working with partners. Intelligent



13 https://www.capgemini.com/us-en/service/intelligent-industry/

Industry brings potential business and efficiency benefits beyond those of Industry 4.0 and can help OEMs to remain competitive in the long run.

We believe that Intelligent Industry will be the norm for automotive OEMs by 2030. We are already seeing encouraging movements in this direction: For example, the percentage of organizations with ongoing smart factory initiatives increased from 43% in 2017 to 68% in 2019.[14]

This finding suggests that companies are evolving towards Intelligent Industry, for which data is the most important input. Together with AI-based analytics, readily available data creates the right conditions for realizing Intelligent Industry's primary benefit: flexibility in manufacturing and across the whole value chain. Intelligent Industry helps OEMs to adjust their business models in real time in reaction to change while still acting in accordance with regulations, such as safety or cybersecurity premises, and sustainability paradigms (including CO_2 emissions and reuse of materials).

As well as ensuring that they have the right data processing and analytics capabilities, automotive players aiming for an Intelligent Industry approach must not underestimate the transformation processes required. Throughout their journey towards Intelligent Industry, they will need to address issues such as management processes, employee enablement, and appropriate organizational structures.

While Intelligent Industry is facilitated by various technology enablers, including IoT, AI, and mobile communications, the following three enablers are particularly important:

Digital twin/ digital shadow

To enable end-to-end digital continuity, digital twins are now used across manufacturing and warehouse operations to manage material flow, complete order-to-delivery processes, and realize efficiency and quality improvements in vehicle production. Digital twins help in use cases such as what-if planning or the prediction of behavior under operational changes. Through IoT sensors, the twin can also receive continuous, real-time data from the object. Digital twins will therefore accelerate product development, reduce defects, troubleshoot equipment, increase uptime, and decrease manufacturing costs. The digital twin will be further extended into the usage phase of vehicles and beyond. Transparency of each component within a vehicle throughout its entire life cycle will be key to staying relevant in the future.

5G & edge

The right level of connectivity is crucial for fully realizing the benefits of flexibility in an Intelligent Industry setup. The above-mentioned sensor data is ideally transmitted and analyzed in real time to enable fast and effective reactions to unforeseen changes. 5G technology promises to provide this benefit with a previously unheard-of transmission speed and bandwidth.[15] The fact that 5G is a mobile communication standard brings additional benefits. Not only can a factory be fully connected, but vehicles in use on the road can also constantly feed live data about their status into predictive maintenance systems, for example. In use cases where very fast reaction times are required (e.g. autonomous driving), edge computing technology can add a further level of speed and efficiency by bringing relevant computing operations even closer to a vehicle or a production facility.

Automation & robotics

Intelligent Industry will make further progress with automation and robotization in the value chain. More and more, advanced algorithms are used to automate basic tasks and decisions. This increases efficiency and enables split-second decisions that can, for example, trigger actions to avoid interruptions in production. Robots can now accomplish an ever-growing number of tasks in production, and sometimes also in repair and maintenance. These robots of today usually have to be programmed to perform specific tasks, but tomorrow's smarter, data-powered robots will be able to carry out a whole range of tasks, so that for example the same production facility can be used flexibly for a variety of vehicle models and even for different types of powertrain.

The three megatrends described in this chapter reflect the topics that are clearly already on the agendas of automotive players. But it is not enough to just consider these aspects and integrate them into the product and service portfolio. Each player also needs to define its own business model around these megatrends and in the context of the mobility ecosystem. The next chapter explains how this can be done.

14 https://www.forbes.com/sites/dereknewton/2018/12/28/the-myth-of-jobs-that-dont-exist-yet/?sh=7590220270ec
15 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2019/06/Digital-Report-%E2%80%93-5G.pdf

INTELLIGENT INDUSTRY PROMISES GREAT SHIFTS IN THE INDUSTRIAL PROCESS LEADING TO A DATA-DRIVEN AUTOMOTIVE WORLD.

The mobility ecosystem of the future and its success factors

In the previous chapter, we discussed three megatrends – Sustainability, Customer centricity, and Intelligent Industry – which together are driving the next major transformation for the automotive industry. We outlined Capgemini's framework for helping automotive companies address the megatrends. Companies, we believe, must define their desired position in the evolving mobility ecosystem and then establish and strengthen this position by addressing three essential success factors: Technological & Software Competency, People & Organization, and Operational Excellence

In this chapter, we will start by considering what might constitute a viable business model within the mobility ecosystem, then analyze the three key success factors, and finally consider likely future developments in the mobility ecosystem itself.

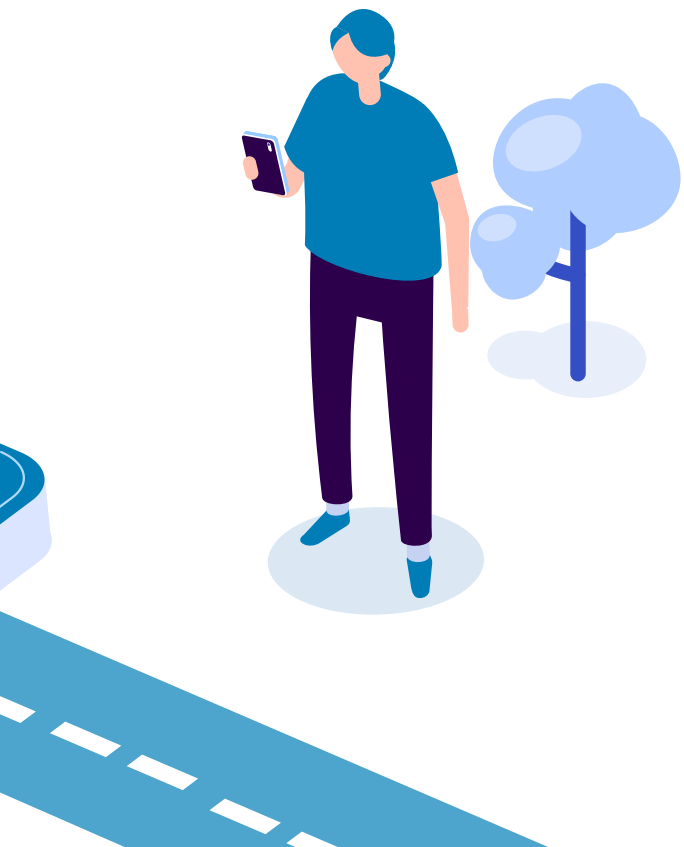
Business models in the mobility ecosystem

With the megatrends discussed in the previous chapter shaping future mobility, automotive companies will need to establish and protect their position in a constantly changing mobility ecosystem. This will necessitate new business models. Whereas a couple of years ago automotive companies were mainly just selling vehicles, they are now adopting business models around mobility services and digital mobility solutions. These models are as relevant to the established market players as they are to the innovative startups that often initiate them.

So far, though, these novel business models have seen varying degrees of success. The challenge is to find models that meet customer needs while at the same time offering a cost/revenue structure that allows profitable operations.

Car sharing services are a good illustration of this challenge. Although customer demand clearly exists, traditional OEMs seem to find the services difficult to run profitably. However, traditional rental companies such as SIXT are apparently more successful, and continue to target this market, along with Uber and other ride-hailing companies. The explanation may be that traditional rental companies, which are used to focusing on vehicle utilization rates, are better adapted to this new business model than OEMs, with their historic focus on engineering, manufacturing, and selling vehicles.

So, what does it take to define a successful and profitable business model in the mobility ecosystem of the future? Three criteria are key:



Customer demand

In an increasingly customer-centric ecosystem, customers' needs must be considered first. This means that the business model should define a position within the mobility ecosystem that is driven by customer demand, and not by technological possibilities.

Connection to core business and core competencies

As the car sharing example discussed above shows, it is worth considering which already-established core competencies a company brings to the table before deciding which business models to adopt. Being able to leverage those existing core competencies has apparently helped the rental companies to develop their new business model faster and to operate it more profitably.

Profitability

Establishing a new business model can bring high upfront costs as well as a persistently negative cashflow over the first couple of years. If the financial reality does not meet the upfront expectations, the result can be the early termination of the model. This is why it is essential to establish clear profitability requirements before starting out. Fundamental questions are: Where is the revenue coming from? How can we balance costs with revenue? What is the timeline for this? What are the investors' or shareholders' expectations?

The three success factors

To successfully realize their chosen business model, mobility ecosystem players need to be structured and organized internally in an appropriate way. The success factors that we are about to discuss represent this internal perspective, including the capability, talent, and operational dimensions. They all need to be tackled simultaneously if a company is to deal successfully with the megatrends.

Success factor 1: Technological & Software Competency

For vehicles to become smarter and more autonomous, the underlying technologies need to become more innovative. The shift from hardware to software excellence is currently one of the key challenges for the automotive industry. Over the past 100 years, product engineering and production achieved incredible progress with ever more sophisticated, well-designed, and high-quality vehicles. In recent decades, however, software components are increasing in relevance. Technological competency nowadays implies product and software excellence in equal measure, since both are needed to fulfill increasing customer expectations. As discussed below, this shift also has talent and organizational implications.

Furthermore, the shift also has an impact on ways of working. In line with agile methodologies from software development, both software and hardware need to be developed at an accelerated pace, frequently creating incremental value for the customers. Examples include the release of new hardware- and software-enabled services via over-the-air (OTA) updates to a vehicle that has already been sold.

Both internal and external perspectives are important here. As well as providing the right services to customers, IT and technology functions also need to achieve scalability and cost optimization. Collaborative platforms can help by making it easy for central and regional stakeholders to work together; this can drastically reduce time to market while ensuring almost instant scaling and global coverage.

Apart from the need for general software excellence, a variety of specific technologies are becoming increasingly relevant. In addition to those already mentioned in connection with Intelligent Industry, the following technologies are key:

- **Cloud**
  Cloudification (the migration of data and applications to the internet in order to enable cloud computing) is currently a hot topic in many departments of OEMs and along the whole value chain. Success stories here include the use of cloud-based software in operations (e.g., for ERP systems) and marketing and sales (e.g., CRM systems or customer interaction solutions). By taking advantage of cloud's configurability, adaptability, and scalability, and the pay-as-you-go commercial model, the OEMs concerned have reduced upfront investment, improved performance and resilience, and improved ongoing operating expenditure. We expect the trend towards cloud technology to continue and accelerate over the coming years, with further increases in flexibility and the emergence of a growing range of cloud-based solutions for the industry.

- **Data & AI**
  With more and more data being collected right along the automotive value chain, companies are realizing they need capabilities to analyze this data and use it to trigger intelligent actions. AI already plays an important role in this context and will increase in relevance in the future. AI technologies will be crucial in every part of the value chain, from design to aftersales services. Additionally, AI can strengthen driver assistance and driver risk assessment systems, both of which can have an impact on the customer experience.

  Though AI has been applied in many parts of the automotive value chain, there is a lack of integration, with most AI projects implemented selectively and not at scale. In the supply chain area, just 4%[16] of AI solutions get scaled up to be used by more than one function. The most successful AI implementations have tended to take place in functions

where workflow and processes are more standardized, such as manufacturing/operations.

Overall, however, the potential in this area is huge. We expect that AI will enable more and more use cases, especially in areas such as the automation and standardization of workflows in labor-intensive operations along the entire value chain. In parallel, "lighthouse" (i.e., high-profile) use cases for machine learning, blockchain, and quantum computing will become more common.

- **Cybersecurity**
  With the increasing prevalence of software components and connectivity features, a variety of risks need to be managed along the automotive value chain. Production and product development facilities have traditionally always been well protected, though they face the challenge of balancing the potential benefits with the risks of increased connectivity. But now other aspects of the operation are also at risk.

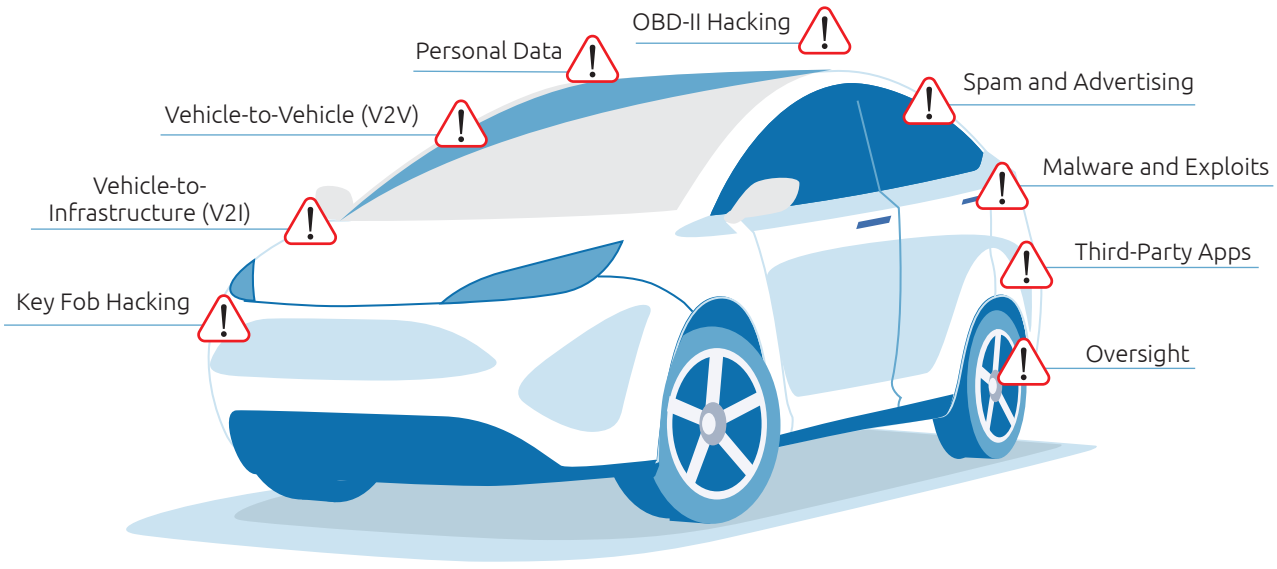
  Looking first at the product, future vehicles will be highly digital, and their in-vehicle and back-end systems will make them into data goldmines. With the adoption of 5G and IoT solutions, even more valuable vehicle and customer data will be generated; see Figure 3 for the cyberthreats that will arise. It will be imperative to implement strong cybersecurity measures to protect all this data. OEMs need to secure their electronic systems, communication networks, algorithms, software, users, and underlying data from unauthorized access and manipulation.
  Over and above the cybersecurity measures that OEMs themselves decide to put in place, other safeguards will be dictated by future cybersecurity regulations. These are likely to affect not only the manufacturing process but the entire value chain, including the finished product – the vehicle itself.

Technologies such as AI and machine learning will play a pivotal role in protecting vehicles against cybercrime

Technologies such as AI and machine learning will play a pivotal role in protecting vehicles against cybercrime. In the future, vehicles will be equipped with operational profiling mechanisms featuring machine learning and deep learning technologies to detect security anomalies. This will help OEMs detect and diagnose cyberthreats in real time.

FIGURE 3

VEHICLE CYBERTHREATS



16 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2020/11/Fast-forward_Report.pdf

Success factor 2: People & Organization

So far, we have emphasized technology and automation, especially with regard to the concept of Intelligent Industry. However, the automotive companies of the future will still clearly be driven by human talent. Having the right people to steer the organization through the ongoing transformation remains a crucial success factor. And attracting the right talent is no longer just about hard skills. Every function will require people with the mindset and soft skills to work unremittingly towards a superior customer experience in an ever-changing environment and as part of an interdisciplinary team.

For traditional companies that are oriented towards product engineering and organized in functional silos, this is an ongoing challenge that will have to be addressed in the coming years, both through recruitment and by transforming the corporate culture. However, as reflected in the Capgemini Research Institute study on Digital Mastery,[17] automotive organizations have in fact already made significant progress over the past two years towards achieving the digital and leadership capabilities required. Almost 69% of automotive players now believe they have the required capabilities compared to only 32% in 2018.

Organizationally, automotive players will find that they need to transform to achieve the total customer centricity of a technology company while also equipping themselves to cope with the constantly accelerating transformation of their industry. These major challenges will mean:

- Establishing new sets of values and shared beliefs across the organization, together with collaborative and agile ways of working[18]
- Introducing, and then living, a data-driven, change-friendly culture
- Implementing a structured, comprehensive change management approach

Most importantly, though, this is a leadership topic. The automotive company of the future needs a leadership that embraces change and drives transformation. The leadership team needs to embody the newly established values and to champion both technological excellence and customer focus. These two perspectives must be combined by driving collaboration between the technology-focused engineering and production departments on the one hand and, on the other hand, the customer-driven sales and marketing areas. This will be a key task for OEM leadership in the new era.

Beyond cultural and leadership aspects, the new wave of automation and digitalization makes it vital to train the workforce in the digital skills required to take advantage of the relevant technologies. Training and upskilling are already an ongoing challenge for automotive companies, requiring a structured and well-integrated approach to continuous learning and development. Gone are the days when employees might spend their entire working lives in the same job using the same tools. Automotive OEMs now need workers to be both continuously developing the hard skills required for their job and able to transition into other functional areas of the company, thereby enhancing a shared understanding and culture.

65%

of the jobs that Generation Z (born 1996 and after) will work in have not yet been invented[19]

With automotive companies becoming increasingly dependent on digital technologies, special attention needs to be paid to the IT function and its integration with the wider organization. It is crucial to ensure that the IT function is equipped to fulfill its purpose of providing software excellence for the entire organization. Doing this needs not only the right skills and people, but also a seamless integration between IT and business functions.

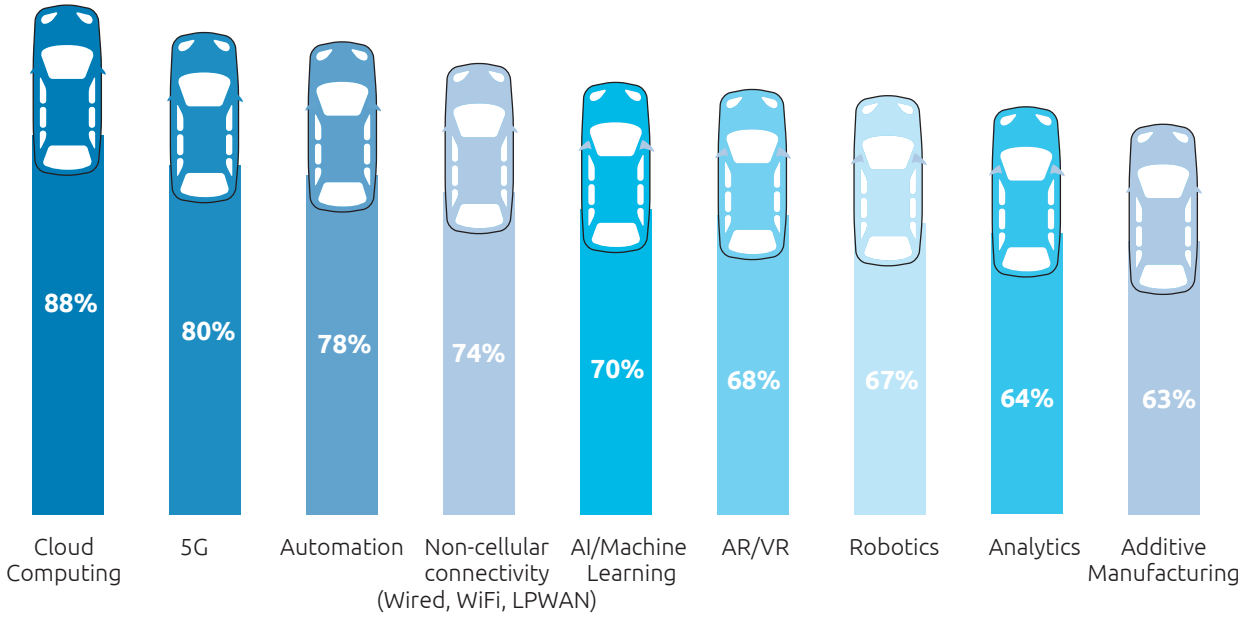
Success factor 3: Operational Excellence

The third and final success factor governing the transformation of the automotive industry for the new era relates to the discipline of operational excellence. This is primarily about doing more with fewer resources, i.e. better resource utilization, but it should be more than that: a holistic philosophy that makes it possible to improve and maintain an efficient and resilient automotive organization.

17 https://www.capgemini.com/wp-content/uploads/2021/01/Digital-Mastery-Report-1.pdf
18 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2019/02/Capgemini-Invent_Agile-Organization-PoV.pdf
19 https://www.capgemini.com/wp-content/uploads/2019/03/Ai-in-automotive-research-report.pdf

FIGURE 4

KEY TECHNOLOGIES FOR AUTOMOTIVE DIGITAL TRANSFORMATION



Source: Capgemini Research Institute, How automotive organizations can maximize the smart factory potential, January 2020[17]

Financials

Even before the start of the COVID-19 crisis, most OEMs faced increasing challenges such as changing buying behavior, and societal and political pressure towards greater sustainability. The past decade has also seen many missed opportunities to improve productivity or to supply missing links in the digital supply chain.[20]

To fulfill the growth and profitability goals that they have set themselves, OEMs now need to get the financials right. Faster, higher, stronger revenue ambitions have emerged as a business imperative over the past few decades.

Traditionally, automotive OEMs mainly relied on new vehicle sales and aftersales business to generate revenues. However, the portfolio has recently diversified, with new incumbents offering differentiating products and a wide variety of additional business propositions, ranging from digital service features delivered OTA to provision of high-voltage charging infrastructure. Many of these initiatives quickly gained customer acceptance, and traditional OEMs too are now adding these items to their agenda.

Stabilizing or increasing profitability through operational excellence is a challenge in many of these new business areas, however. For example, when offering shared mobility services such as car sharing, it is still difficult to achieve the utilization levels required to make a profit, even with strong customer take-up. Similarly, investments in fully autonomous driving technologies have recently come under scrutiny. Contrary to the expectations of a few years ago, level 5 autonomous driving is still not available in any regular vehicle – a fact that calls into question the rationale behind large investments in this technology (see Figure 4).

Resilience

Crucial though financials are, they represent only one aspect of operational excellence. Another major aspect is resilience, particularly (but not only) in the supply chain.

Change and disruptions are standard in a world of volatility, uncertainty, complexity, and ambiguity (VUCA). Therefore, value streams such as the supply chain and logistics processes need to be constantly ready to react to new circumstances. Resilience must be

20 https://www.capgemini.com/wp-content/uploads/2018/12/Report-–-Digital-Supply-Chain's-Missing-Link-Focus-Digital.pdf

comprehensively embedded in all value streams, including R&D, product design, and demand and supply planning. This will lead to continuous improvement in each stream while also preparing organizations for whatever the future may bring.

Steps to excellence

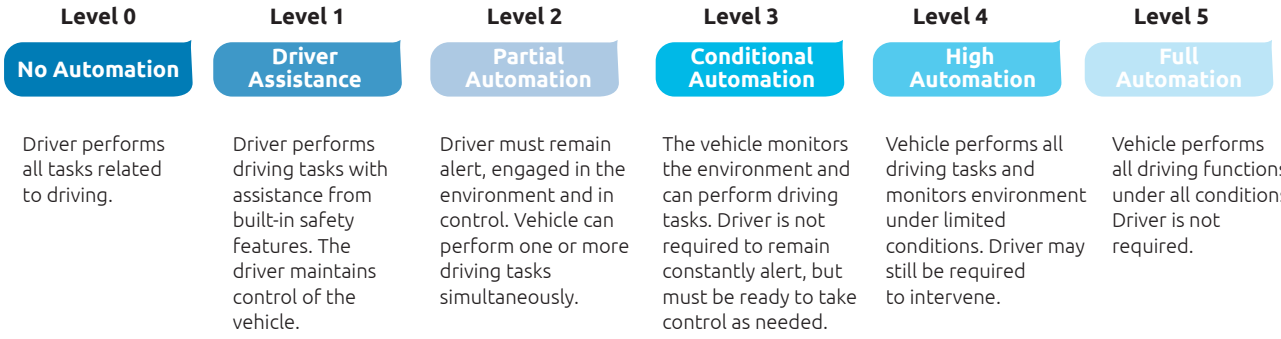
We expect a disciplined approach to the management of operational excellence in all areas of the business to be a key success factor for the automotive industry in the coming years. Investing in operational excellence will build process efficiency and improve capacity utilization across an automotive business's core value streams. Organizations need to take a number of steps to ensure that their investment pays off:[21]

- **Focusing on process efficiency through continuous improvement and cost reduction**
  Systematic process management, and the use of tools such as advanced analytics and AI technologies, can help to continuously identify areas for efficiency improvement, leading to cost reduction in all parts of the business.
- **Accelerating future change**
  To change established behavior, it is essential to build an organization where continuous improvement is the norm; this will make it possible to manage transformation faster and more efficiently. Customer centricity will result in a stronger competitive advantage, and a change- and data-driven organizational culture is also of great importance.
- **Aligning IT and business to create real value**
  Given that all parts of the business now have a strong technology component, alignments between IT and business are of critical importance. Building close and efficient collaboration will help to drive efficiency and productivity gains and avoid the disadvantages of working in silos. Individual IT departments will largely disappear because most departments will contain a substantial level of IT capability, seamlessly integrated to improve execution excellence.
- **Driving innovation with disruptive business and IT models**
  A disruptive and innovative organization requires the right business and IT models if it is to achieve operational excellence. Future work must emphasize continuous change and close internal and external collaboration while always retaining a clear focus on process and system efficiency. Companies must put in place an open learning culture to facilitate the necessary behavioral shift towards more innovation and idea creation.

21 https://www.capgemini.com/service/technology-operations/admnext/

FIGURE 5

AUTOMATION LEVELS



- **Strengthening resilience**[22]
  Organizations must determine the mix of resilience they want to build into the supply chain and other key areas, and make this into a strategic goal. Resilience targets need to be clearly defined up front so that performance can be measured. Developing continuous improvement and learning capabilities, and establishing a collaborative, problem-solving mindset, will make it easier to anticipate, resist, and recover from disruptions. New technologies such as AI should be used to create transparency through data and further improve contingency planning capabilities.[23]

If all this is paired with execution excellence, operational excellence will result. Both profitability and resilience will improve.

Shaping the mobility ecosystem

Let's turn our focus back to the heart of the future of automotive: the mobility ecosystem and its meaning for the automotive industry.

Especially in urban areas of the world, mobility options have recently diversified strongly. Where individuals previously only had a choice between walking, taking the car, or using public transport, many new services have now been added, ranging from ride hailing and car sharing to bike and e-scooter rental. While the pandemic has adversely affected new car sales, they increased again after early lockdowns. China's V-shaped sales development even led to better sales performance in the fourth quarter of 2020 than in the corresponding quarter of the previous year. During subsequent phases of the pandemic, these patterns continued, with consumers continuing to favor personal mobility over shared or public transport.[24]

Customer expectations have evolved accordingly. Accustomed to highly flexible, easy-to-use, and digitally enhanced experiences in many areas of their lives, customers expect the same in the area of mobility. This is why the hardware component of a vehicle is only part of the picture and why future mobility customers will not accept a vehicle just because it is a well-engineered hardware product. Connectivity, flexibility, and convenience are just as vital and are mostly provided in the form of services.

What exactly does this mean for the vehicles of the future? Most customer-focused use cases can be grouped under our three headings of connectivity, flexibility, and convenience:

Connectivity

A high level of general connectivity is a prerequisite for many use cases. Some do not require the active involvement of the user: For example, vehicles can communicate with one another and with relevant infrastructure to create a more convenient experience for the customer. Other use cases do need the customer's involvement: Examples that are already available include connectivity use cases such as remotely checking the vehicle's status, starting certain functions such as heating or charging, and opening or closing the vehicle. Future use cases will build on these ideas, as well as on infotainment and safety features enabled by connectivity services.

22 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2020/11/Fast-forward_Report.pdf
23 https://www.capgemini.com/de-de/wp-content/uploads/sites/5/2020/11/Report_Supply_Chain_Resilience.pdf
24 https://www.capgemini.com/wp-content/uploads/2021/01/Shifting-Gears-Automotive-Research-Note.pdf

Today's customers are already very interested in connectivity-enabled advanced safety features such as collision warnings and emergency calls.[25] Interestingly from a financial perspective, these are also the types of connectivity services that customers are most likely to be willing to pay for.

Flexibility

While flexibility is of course a key motivation for some customers to opt for a more multimodal mobility approach, there is also a range of use cases that enable a customer's own vehicle to become more flexible. In terms of purchase options, subscription models are a promising development; they may provide customers with the possibility of changing their car frequently, for example in order to adapt to changing seasons or changing mobility requirements.

The lines between car sharing and car ownership will be blurred further, for example by the option for car owners to provide others with a "sharing token" enabling them to open the car via a mobile phone app. That way, customers can easily and remotely lend their car to family and friends, or even potentially rent it out commercially.

Convenience

Beyond the possibilities of accessing and partially operating a vehicle remotely via a mobile app, driver assistance systems are a key convenience factor for the car of the future. With the ultimate goal of full automation, great progress has been made related to providing the convenience of a more assisted driving experience. While a large proportion of the cars currently on the road have no, or only very basic, driver assistance systems, Gartner expects that by 2030, almost 80% of new vehicles shipped globally will be equipped with at least level 2 autonomy (see Figure 5).[26]

Although this certainly represents great progress, it also indicates a modification of ambitions. While a couple of years ago, the hope was to have full (level 5) autonomy commercially available by now, many OEMs have re-evaluated the scale of the technological and legal challenges that must be overcome plus the magnitude of investments needed. Our current expectation is therefore that level 1–3 driver assistance systems will become available in most cars by 2030, providing a significantly increased degree of driver convenience while avoiding some of the obvious risks.

All the use cases mentioned above rely on a range of enabling technologies. Let's now look at two of the most important technological aspects, which provide the foundations for a range of use cases: first, a software-based approach, and second, connectivity features.

Software-based approach

Most innovative functionality in future vehicles will be software-based. This fact greatly increases the need for a comprehensive and consistent vehicle software architecture. Historically, a highly modular approach to in-vehicle software prevailed, with individual suppliers usually providing the software required to run their components. OEMs then engineered at least basic communication and interaction between components.

That level of integration will not be sufficient to realize the software-based use cases of the future: Instead, comprehensive and well-integrated software architecture will be required. This requirement will have to be approached in a similar way to the architecture of PCs or smartphones, where an underlying operating system provides a basic functionality and connectivity platform on which applications for dedicated use cases can run.

Developing this type of software architecture for vehicles is a major task for the next few years, requiring a drastically improved skill level and organizational setup within OEMs and even Tier 1 suppliers. Success may depend on collaboration or "co-opetition" between OEMs and suppliers.

Connectivity features

Second, most advanced vehicle use cases rely heavily on connectivity features allowing all types of communication: vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X). This communication is crucial to enable advanced driver assistance features as well as increased comfort and automation in areas such as charging or parking. To realize the necessary connectivity infrastructure, two main components are required: connectivity technology and a communication standard. With regard to connectivity technology, we expect 5G to play a major role, becoming the leading medium for communication among vehicles, and between vehicles and relevant infrastructure.

To leverage the full potential of connectivity, a standard that enables communication between vehicles and infrastructure components of various kinds and from various OEMs is required. So far, there are no clear trends observable in this regard, but

25 https://www.capgemini.com/wp-content/uploads/2020/09/ConnectedVehicleTrendRadar_2_Report.pdf
26 https://www.gartner.com/en/documents/3987644/hype-cycle-for-automotive-technologies-2020

we expect efforts to increase, with the first consortia around possible shared standards formed soon. History shows that success in establishing a shared standard (e.g., Bluetooth in the electronics industry) is possible.

Outlook

Looking at the mobility ecosystem overall, we expect to see constant change over the coming years. Because of the effects of the pandemic combined with increased environmental awareness, there is likely to be less long-distance travel than in the previous decades, and perhaps more complex patterns of local travel. Customers will appreciate the flexibility provided by a range of accessible mobility services and vehicles. If the parties involved get things right, the vehicle of the future will remain a highly relevant part of future mobility ecosystems worldwide.

Preparing for the Responsibility Era

Why a Responsibility Era?

We have analyzed the development of the automotive industry from the Industrialization Era, through the Globalization Era, and into the Digitalization Era. We've also looked at the key elements defining the further transformation of the industry, and introduced our framework explaining the megatrends shaping the mobility ecosystem and the success factors that OEMs must address to carve out and maintain a position in that ecosystem.

From this analysis, it is clear that the automotive industry is on its way to a new era. We call this the **Responsibility Era** because it will be characterized by a strong sense of responsibility and purpose. Social and environmental responsibility will be at the heart of companies' agendas; a focus on issues such as the carbon footprint will guide their internal and external initiatives and mindset.

The sustainability challenge

Above all, sustainability will represent a clear and lasting priority for the automotive industry. The sustainability movement is much more than a fashion. It will continue until sustainability becomes the standard at each stage of the automotive value chain and throughout the customer experience – and it probably won't stop there because the standard will get ever higher. OEMs and other automotive players will no longer be able to get rid of a problem in this area by transferring it to other countries – whether by exporting old vehicles, non-reusable parts such as batteries, or indeed the entire disposal process.

The sustainability challenge is a complex one that goes beyond company boundaries: It is of a societal and global nature. OEMs will need to join forces with other industry players, and maybe with players from different industries, to jointly find a sustainable, socially accepted, and environmentally friendly way to realize the concept of a circular economy. Tackling this challenge will require major investments by automotive players – financial investments, yes, but also less tangible ones such as investments of effort to transform their corporate vision and purpose.

Rethinking the business model around technology

Additionally, automotive companies will be driven to constantly rethink their current business models and value proposition. To benefit from newly emerging technologies such as AI, 5G, or IoT, and address radical changes happening in the VUCA world, companies will need to define and prioritize which fields are of strategic relevance and which need to be developed in-house. Companies will definitely not be able to implement the complete range of activities and topics by themselves, and so they will need strong partners with proven expertise in areas where the OEMs have less capability.

Given the increased importance of software within vehicles and along the value chain, OEMs will need to become technology companies to a certain degree. There are related organizational challenges in terms of new and different skills that need to be developed, new talent to be acquired, and internal movements of employees between departments. Automotive players are now competing with leading software and IT companies for scarce talent; however, by developing the right strategic partnerships with these companies, and then collaborating and co-innovating with them, they can gradually develop into digital masters in their own right.[27] Strategic partnerships will also be a vital tool for developing solutions efficiently and, even more important, scaling them successfully.

Keeping profitability center stage

The transformational directions and boundaries for the automotive industry's Responsibility Era may be clear, but the transformation journey will not end there. The industry will continue to develop, adapting to new state-of-the-art technologies, innovations, and customer expectations, with one era succeeding another. Throughout all these transformations, the key message is that profitability and cost efficiency must be optimized.

In order to remain competitive in the long term and to maintain a relevant market position, profitability is key, and should be the focus when evaluating possible investments. Of course, investment is virtually mandatory in certain areas. These might include the further development and improvement of electric vehicles and their batteries (including recycling processes); acquisition of resources to cope with the growing role of software in and around vehicles; creation of unified operating software architecture for vehicles; and initiatives to mature the sustainability of the value chain. But even in these mandatory investment areas, profitability goals should always be a priority.

A balancing act

To succeed in the coming Responsibility Era, automotive companies need to find the right balance between their core businesses and the new opportunities and challenges. In this way, they can ensure continuing relevance for their industry and a long-term competitive advantage for themselves.

The automotive industry now needs every single traditional OEM and new player, and all of their partners and stakeholders, to adapt to this new world. The challenges of the Responsibility Era need to be taken on board by each player within the mobility ecosystem, and to become part of daily life for all of us.

27 https://www.capgemini.com/wp-content/uploads/2021/01/Digital-Mastery-Report-1.pdf

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