Challenges in the Digital Transformation of the Automotive Industry

AUTHOR

Dr.-Ing. Uwe Winkelhake
is Managing Director Integrated Account Volkswagen Group at IBM Deutschland GmbH in Hanover (Germany).

The transformation in the automotive industry will turn out to be more comprehensive than it was thought. The fields of mobility services and connected services will have a huge influence on future business – alongside electric mobility and automated driving. Mastering the required digitization technology will be just one challenge, but it will be even more important to motivate all employees of an OEM to embrace progress, as an industry expert from IBM with many years of experience explains.

CHANGE WILL BE ALL-EMBRACING

The automotive industry is about to face a massive upheaval. Its transformation will be more comprehensive than ever before in its over 125-year history. Driven by environmental legislation, internal combustion engines will be replaced by electric drive systems. In the upper vehicle segment, information technology forms a significant component of a car, with more than 100 ECUs and a complex wiring harness that is more than 20 km in length. And its importance will increase even further in the future, as IT converts vehicles into “mobile computing centers” or “IP addresses on wheels.” Embedded IT in cars becomes even more complex. For example, it will take on responsibility for engine management, control the air conditioning, monitor wear and fuel consumption, adjust the seats to individual preferences, and will soon form the basis for autonomous driving. In addition to these automobile-related internal tasks, vehicle IT will become increas-

ingly connected with its surroundings, for example with car parks, other vehicles, gas stations, and service providers, as well as with the backend of the car manufacturers.

Many things will also change within the companies themselves. For example, extensively modified business processes will run automatically on the basis of intelligent solutions. As a result, the digital transformation is a key issue in all companies. The aim is to recognize the potentials of new digitized business models at the earliest possible stage and then to implement these while transforming the company itself. The future business of the automotive industry will be marked by significant growth in the fields of mobility services, connected services, digital products, and third-party business in cooperation with new partners [1-3].

TECHNOLOGIES FOR THE DIGITAL TRANSFORMATION

For car manufacturers, it is vitally important to define a reorientation of their corporate strategy and to rapidly implement it together with the digital transformation. Any consideration of digitization should begin by fundamentally questioning tried-and-tested business models, processes, and organizational structures. Based on a convincing vision and a business strategy that is derived from this, the digital transformation should then be addressed on the basis of a comprehensive plan and with sustainability – not as a one-time project.

The vitally necessary speed of implementation should be accompanied by a constantly increasing level of IT performance, which, for more than 50 years now, has virtually doubled every two years, as Moore already recognized with his law back in 1965 [4]. By using this IT development, various solutions, which can be used in companies have been established. A good overview is provided by Gartner's Technology Hype Cycle for innovative technologies, Figure1 [5]. This cycle assigns the technologies to their life phases, from the initial innovation trigger for the technology, through the phases of inflated expectations and the trough of disillusionment, followed by the first pilot projects and ultimately to the breakthrough.

Furthermore, **FIGURE 1** shows the time frame for each technology, during which their plateau of productivity is achieved. Not all of the technologies shown are equally relevant for the automotive industry. Based on the author's own project and industry experience, the development of a strategic digitization strategy will involve the following key topics for the automotive industry:

- IT solutions and architectures for cloud services, mobile solutions, apps, collaboration, machine learning, cognitive computing, big data, analytics, platforms
- Industry 4.0, edge computing, Internet of Things (IoT)
- 3-D printing, additive production processes
- virtual reality and augmented reality
- wearables, beacons
- blockchains
- robotics
- drones
- gamification.

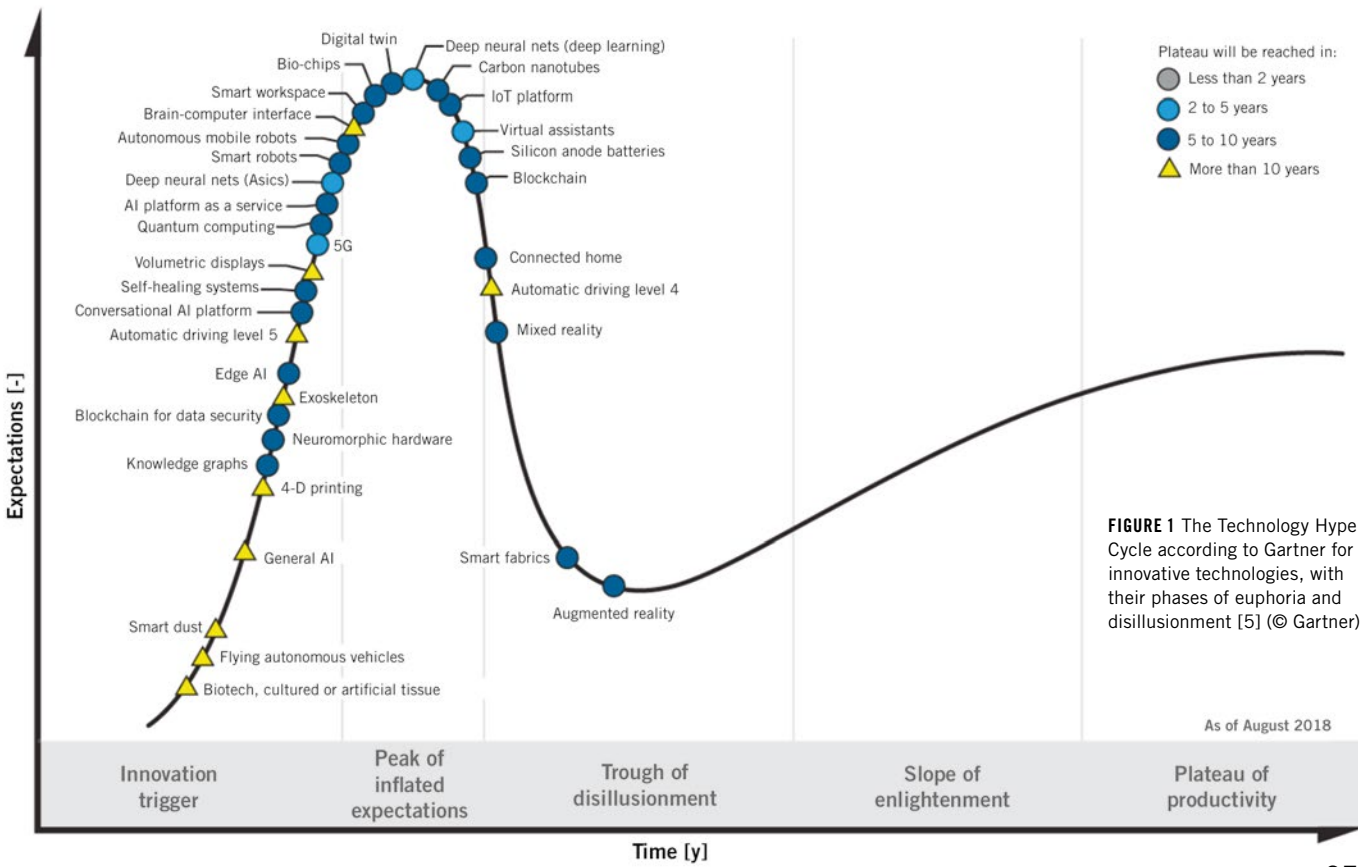

FIGURE 1 The Technology Hype Cycle according to Gartner for innovative technologies, with their phases of euphoria and disillusionment [5] (© Gartner)

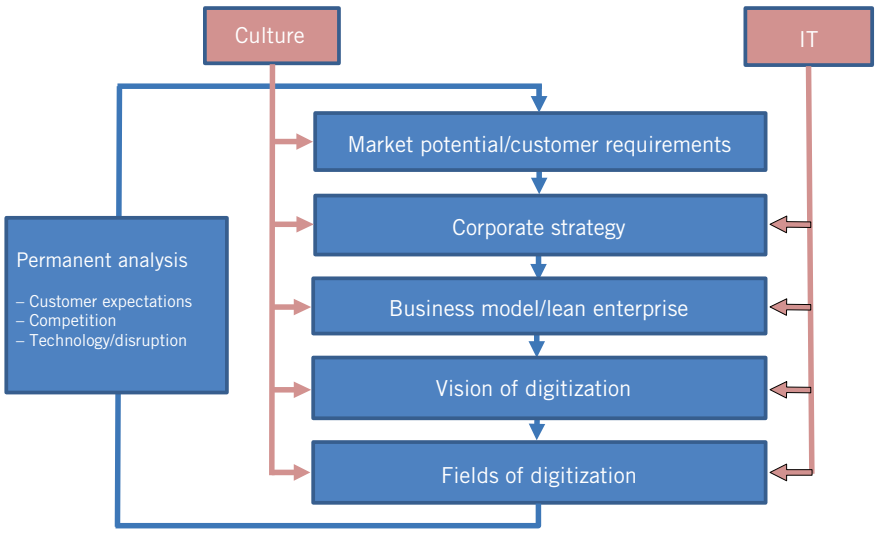

FIGURE 2 Development of a digitization strategy for a company in the interface between corporate culture and IT solutions [6] (© Springer Vieweg)

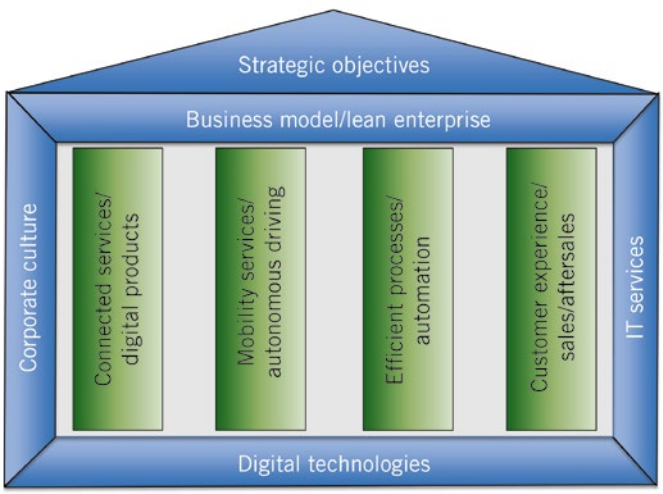

FIGURE 3 Overarching framework of action with four pillars for the digitization of a company in the automotive industry [6] (© Springer Vieweg)

DIGITIZATION STRATEGY AS A COMPONENT OF CORPORATE PLANNING

Digital transformation initiatives should be designed to address a company's business model as a cross-cutting issue and influence all key business processes. Therefore, a digitization strategy that encompasses all areas should not be treated in isolation, but should be developed as an integral component of a long-term, strategic corporate planning process, as shown in **FIGURE 2**.

In the first step, an understanding of the market situation and customer requirements form the basis for the subsequent strategic decision on which markets or customers should be addressed with which products and solutions. In order to implement the strategy, the business model, together with its corresponding processes, should then be designed to be as lean and efficient as possible (lean enterprise). Building on this optimized structure, a vision for the future direction and purpose of digitization must be developed. For implementation, the final planning step will define fields of digitization and the procedures involved. During this process, corporate culture and IT are not to be seen merely as a part of the individual planning steps, but are overarching topics whose involvement is a basic prerequisite for a successful transformation.

COMPREHENSIVE FRAMEWORK FOR A DIGITIZATION STRATEGY

Taking into account the specific interests of the automotive industry and building on **FIGURE 2**, an overarching framework of action can be recommended, **FIGURE 3**. Based on the strategic objectives defined in the corporate strategy, the cross-cutting business model with efficient business processes is established in the sense of a lean enterprise. Embedded in this are four digitization fields in which the initiatives are to be implemented:

- connected services and digital products, a field which also includes new digital products and new revenue opportunities, based on data
- mobility services as a new field of business due to massive impetus from technologies for autonomous driving
- improvements in efficiency due to the automation and digitization of business processes
- the areas of customer experience in sales and aftersales.

All four fields of action use the digital technologies relevant for the automotive industry in interdisciplinary projects. These are chronologically arranged in manufacturer-specific, integrated strategies [6]. In the following, some examples of references from the four fields are presented.

CONNECTED SERVICES – CREATING THE BASIS FOR AN INTEGRATION PLATFORM

All car manufacturers attach great importance to "connected services," the first pillar in **FIGURE 3**. These are services that are provided to the customer via the infotainment system in the vehicle or on a smartphone. Manufacturers are working intensively on developing such services. They see these innovative solutions as an opportunity to offer drivers more comfort and convenience, thus differentiating themselves from their competitors and also opening up additional sources of revenue. Examples of these services are systems that guide the car to the nearest available parking space, or restaurant guides that give recommendations that are tailor-made to the drivers' preferences, including the possibility to book a table directly. Other examples are predictive maintenance systems that continuously monitor the state of the

vehicle and proactively display any maintenance work that is required and make an appointment at the regular service workshop – also by integrating calendar functions.

In addition to providing services, digitization can also involve developing a concrete plan on how data – "the new oil" of the automotive industry – can be marketed and monetized. Some possible business fields are shown in **FIGURE 4** [7]. The operational data from vehicles are certainly of interest to gas stations, automobile clubs, and insurance companies. For example, even today insurance companies already offer tariffs that are tailored to the policy holder's driving behavior. Data from vehicle production are of interest to plant builders enabling them to improve their future services. Information on the wear characteristics of components can be used by OEMs in the further development of components for the next vehicle generation.

In the business field of connected services, the car's infotainment unit is becoming a strategic control center. This unit has long since ceased to be a mere control console for the radio, navigation system, and telephone and a display system for vehicle data. Instead, it has now become the control center for using and operating apps. At this point, for example, Google and Apple can have access to the driver through the car via mirroring solutions. This is where vehicle electrics and the mobile app world meet. Indeed, a competition to gain control over integration has emerged. Comprehensive smartphone integration, in other words the synchronization of the worlds of the smartphone and the vehicle, would be warmly welcomed by the customers.

Therefore, the mirroring solution should become part of an integration platform through a device management function, **FIGURE 5**. Details such as the functionality and building blocks of the integration platform are explained in [6]. On the subject of integration, two vehicles can be compared. The first vehicle, which represents the current generation, **FIGURE 5** (left), has a very heterogeneous embedded IT landscape with a large number of individual ECUs and complex connectivity. The second vehicle, a vision of the future, **FIGURE 5** (right), is equipped with a central and backup computer with simple connectivity, thus eliminating individual ECUs. The integration platform ensures that the vehicles are integrated into various services, something that is complex in a heterogeneous world and much simpler with a centralized architecture. The services are available for application development through Application Programming Interfaces (APIs).

MOBILITY SERVICES – HOW OEMS CAN POSITION THEMSELVES

Autonomous driving in particular will even further consolidate the second pillar of the digital transformation, the field of mobility services, **FIGURE 3**. Robo-taxis as self-driving cars can be ordered by customers to go to a specific location and can provide mobility as a product at a very low cost and very safely as there is no longer a driver who needs to be paid. This market is currently dominated for the most part by brand-independent start-ups: Uber and Lyft are established in the USA, while Didi has a firm base in China. Other providers are trying to position themselves. In this situation, automotive OEMs are being challenged to make up ground and to position themselves with attractive and innovative services, thus enabling them to have a share of this source of revenue.

One option is to become a special provider of mobility. For example, customers are interested in getting complete services that enable them to travel to their destination and back again also using different vehicles. For example, their journey might entail travelling by car, changing to ferry, and then continuing by bicycle, and these travel arrangements can be entirely organized in the background by a mobility service provider and offered to the customer for selection in a "one click shopping" process. Another option is "branded mobility", which is certainly interesting for manufacturers in the luxury and exclusive sports car segment. This luxury segment might also offer golf events or restaurant visits in keeping with their customers' preferences.

A further business opportunity in the field of mobility services is the higher-level optimized control of vehicles which are accessible to a platform – similar to air traffic control – to facilitate driving without traffic jams. A "digital mobility shadow" can serve as the basis for such guidance. For this

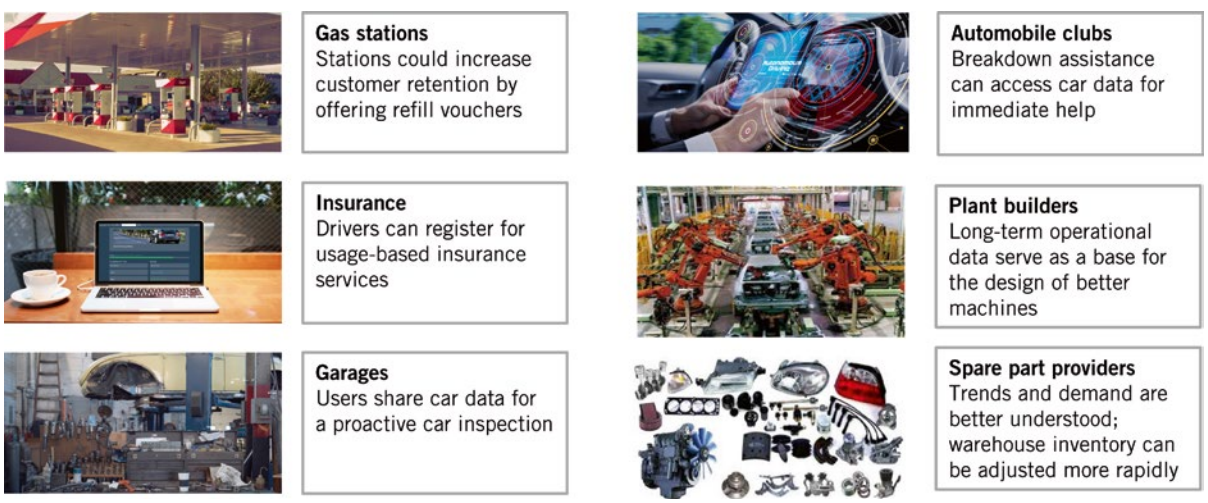

FIGURE 4 Business fields and target markets for the use of data from cars [7] (© IBM)

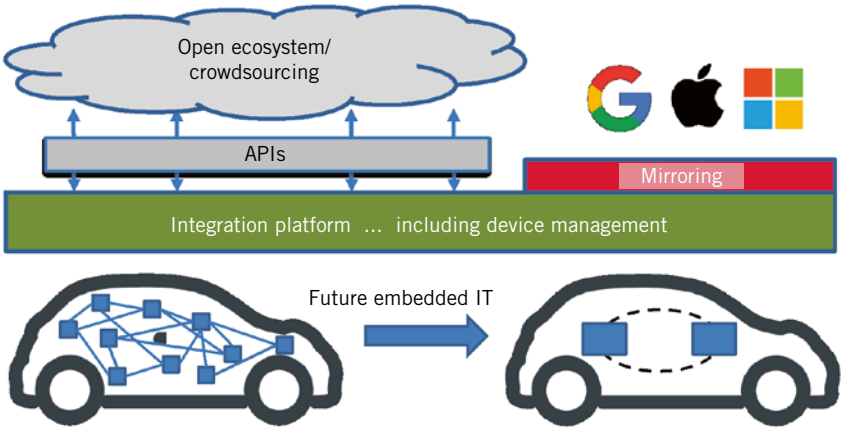

FIGURE 5 Integration platform: Application Programming Interfaces (APIs) and mirroring solution as the basis for an ecosystem with connected services [6] (© Springer Vieweg)

purpose, the positions and, if possible, also the planned destinations of all vehicles appear in highly precise maps and are integrated into a virtual model of the overall traffic situation of a geographical area. Taking into account the destinations and incoming enquiries from customers, forecasts for traffic development can be derived from this, and the traffic flow can be optimized by routing measures to avoid traffic congestion, thus shortening the travelling time. For autonomous vehicles, the avoidance of traffic congestion can also reduce the risk of collisions. Therefore, such high-level control offers considerable advantages both for individual drivers and for the traffic situation as a whole. Such a future model could be developed by manufacturers with a high market share, as they have access to all manufacturer-specific vehicle data and therefore have a model with the necessary statistical validity at their disposal [6].

EFFICIENCY IMPROVEMENT – PUTTING INDUSTRY 4.0 INTO PRACTICE

The third pillar of the digitization framework, **FIGURE 3**, concerns improving the efficiency of production processes, and even going as far as complete automation. In manufacturing, the corresponding projects come together under the term Industry 4.0. The objective here is to achieve horizontal and vertical process integration through digitization, and in this way to make companies more flexible and more efficient. In addition to improving responsiveness and customer orientation, considerable savings can be achieved in the automotive industry, according to a Fraunhofer study. The reduction of complexity through modular and standardized products and the simplification of processes and interfaces allows the highest savings potential of up to 70 %, while inventory reductions due to harmonized production processes and foresighted, tightly synchronized retrieval of supply materials will enable costs to be reduced by up to 50 % [8].

A simplified Industry 4.0 scenario can be illustrated by the example of a painting line, consisting of three stations, **FIGURE 6**. In the first processing step, the body is painted by robots, followed by manual assembly, and then final inspection for quality control. Located at the line are various robots as well as tablets for the workers. The various IT components are integrated into the business IT via a shop floor integration layer. On the software level, basic services are available, for example for communication and data handling. The layer can connect the modules of the entire painting line and other production areas, thus also enabling access to sensors and control units of other areas in order to perform data analyses. The layer provides standardized APIs, which have been successfully implemented at various vehicle manufacturers. Examples include supply chain tracking, with early identification of supply bottlenecks, early problem detection, or e-learning for workers, with learning modules provided on a tablet.

Such solutions can be effectively developed on the basis of the layer, as this simplifies application development by using basic services. Even more important is the fact that the exchange of machines can be easily represented in the layer and the application does not require any adaptations, which means that it can gradually continue to grow, also beyond organizational areas.

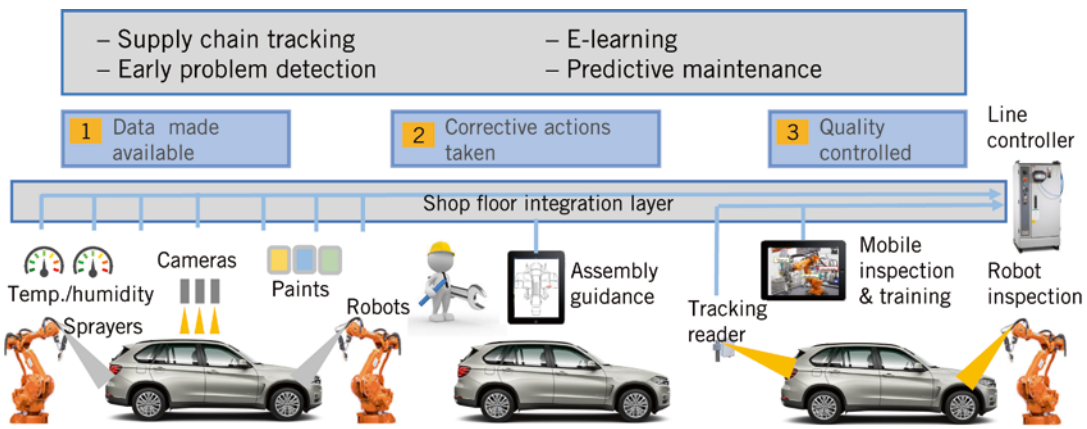

FIGURE 6 Industry 4.0 scenario: the shop floor integration layer illustrated by a painting line [6] (© Springer Vieweg)

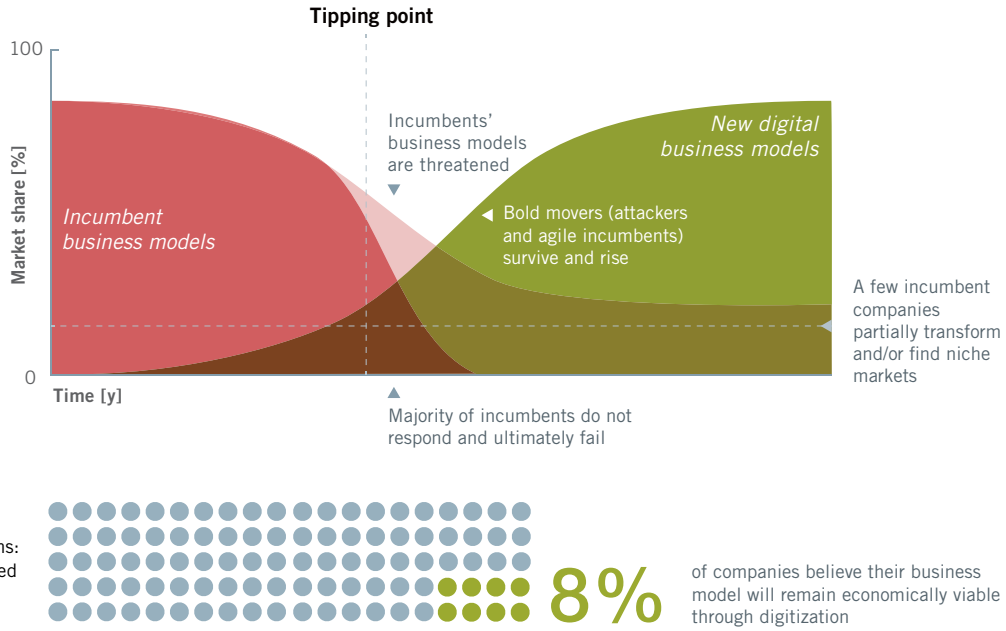

FIGURE 7 Breaking up encrustations: existing business models compared to energizing new enterprises [9] (© McKinsey)

CUSTOMER EXPERIENCE – SUCCESSFUL ACTION DUE TO MULTICHANNEL DISTRIBUTION

The fourth digitization pillar, customer experience, **FIGURE 3**, addresses the complete change in the sales and service structure for a car in the future. Today, several sales levels are established. The manufacturers supply the vehicles to importers or National Sales Companies (NSCs), who then pass them on to affiliated or free dealers, and these perform the sales and service with the end customer. This multi-stage structure will certainly change completely. Both the vehicles and the mobility services will then be sold for the most part by internet platforms. These platforms will often have several different manufacturers' brands available in their range.

The integration of the suppliers also takes place via trading platforms. The manufacturers supply their products in parallel directly to end customers via digital channels, and a so-called multichannel distribution scenario develops. In this environment, additional companies such as platform operators, service providers for autonomous vehicles, free mobility providers, and also new manufacturers are positioning themselves. The traditional manufacturers and in particular the dealers and importers will have to reinvent themselves if they want to continue to play a significant role in the future value-added system [1, 6].

START-UP CULTURE IS ESSENTIAL FOR TRANSFORMATION

Car manufacturers must establish new strategies and new business models with new offerings. As far as the impending profound changes are concerned, the challenges are not so much in the mastery and availability of the necessary digitization technologies. It will be much more difficult to motivate all employees of an OEM to actively participate in transformation and change and not to be skeptical and remain tied to old behavior patterns and procedures. Today's corporate culture at traditional manufacturers is often still marked by complex structures and traditional value systems.

Breaking up the associated encrustations and creating a spirit of optimism as the basis for change requires a new "digital culture," as has been common for some time now in the disruptive start-up scene. This is characterized by curiosity, readiness to change, and flat hierarchies.

FIGURE 7 clearly shows the dilemma in which the established car manufacturers find themselves. The majority of companies are in no doubt that their business model will change as a result of digitization. Only 8 % see no necessity to adapt. The challenge for established manufacturers is to react decisively and quickly enough to continue to protect their share of the business from new enterprises. The adaptation of speed, agility, innovativeness, and risk-taking are the prerequisites for successful digital transformations.

In view of the rapidly continuing development of digitization, the automotive industry must accelerate its implementation in order to maintain the competitiveness of the industry and eliminate the hesitant approach that is still quite common. Entrepreneurship must take priority over-cautious multiple coordination. Only with these qualities will the established manufacturers – the Goliaths – successfully compete against the new challengers – the Davids. This would hopefully mean that some predictions – that manufacturers faced with disruptive changes have no chance of success because they lack these very qualities and that David will therefore always win – may be turn out to be false [10, 11].

CONCLUSION

To summarize, it can be stated that the automotive industry is undergoing a radical upheaval. Electrically powered, autonomous vehicles are accelerating the trends towards mobility services which are quickly and conveniently available on demand via smartphone apps. The vehicles are linked by connected services and are guided efficiently through the traffic by a higher-level control system within the "mobility shadow," thus avoiding traffic jams. With these comfortable services,

the actual ownership of a vehicle will fade into the background, particularly in big cities.

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