DIGITALIZATION IN THE AUTOMOTIVE INDUSTRY

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Abstract: *Digitalization is disrupting the automotive industry and in particular the established business models of well-known OEMs (Original Equipment Manufacturer). New legislations, technological trends, the omnipresence of digital devices like smartphones and changing customer preferences towards sustainability and mobility on demand have stimulated the digital transformation in the automotive industry. This process affects the entire value chain, from product design and manufacturing to supply chain, marketing and sales. New market players like Tesla, Uber and Blablacar have identified the huge potential of digitalization to create new revenue pools and have already entered the market with their interconnected solutions. Other tech. giants like Apple and Google but also smaller start-ups have started investigations around new mobility solutions. Those new competitors with their high innovation power have one strategic advantage. They do not have to carry the burden of an analogue set-up with its high fix cost structure compared to traditional car manufacturers. Therefore, established car manufacturers are forced to transform their analogue business models to the digital age. This research paper will analyze the prerequisites of a successful digital transformation. Furthermore, it will describe the potential to create business model innovations.*

Keywords: *Digitalization; Disruption; Value Chain; Digital Transformation; Business Model Innovation; Operating Model; Automotive OEM*

1. Introduction

Since decades car manufacturers in the automotive industry have enjoyed times of continuous success. Their business model of producing and selling innovative automotive vehicles to b-2-b enterprises but also private end consumers paid off. The following graphic shows the complete value chain of the automotive industry.

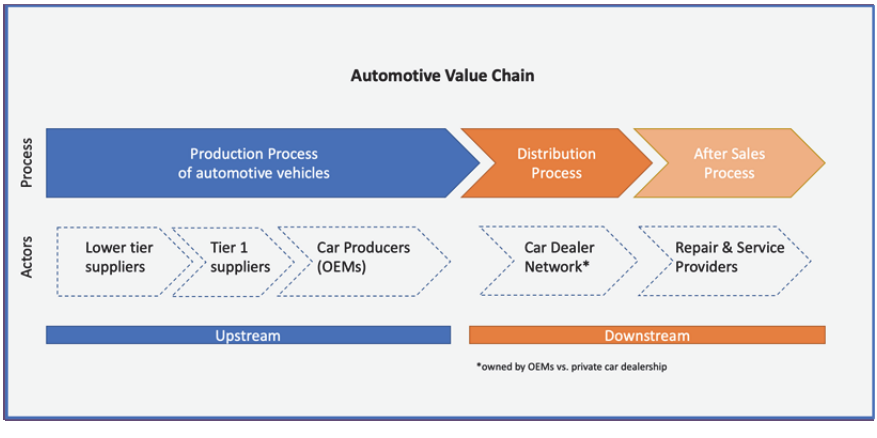

Figure 1. Value Chain in the Automotive Industry

The number of new cars which were produced and sold to the marked increased year by year. Due to the increasing prosperity in the world economy more and more consumers could afford a car. The global car sales statistic published by statista.com recently demonstrated that almost 70 million new cars will be sold in 2022. (statista, 2022)

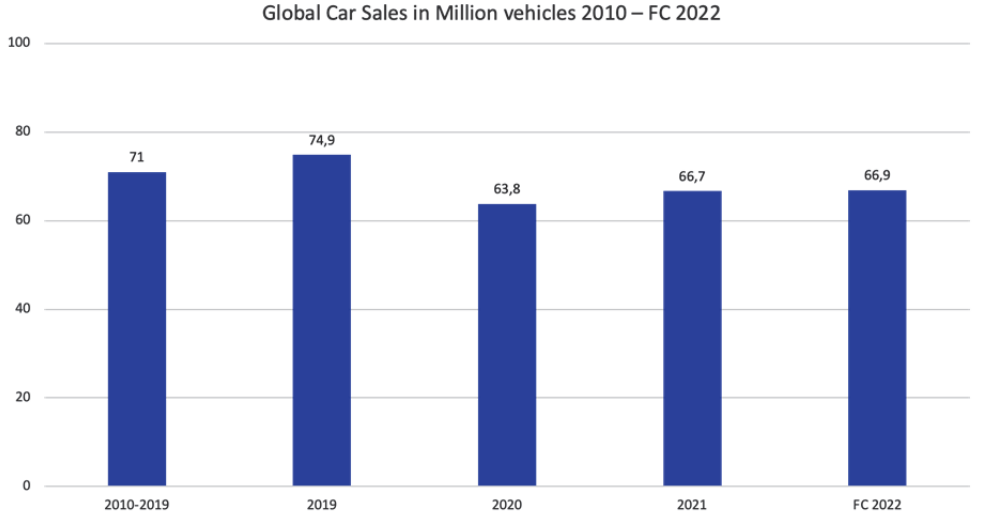

Figure 2. Global Car Sales in Million Vehicles

In the past, most of the car owners were extremely proud of their car and treated it as a status symbol with love and care. Car manufacturers invested billions of dollars in the last 50 years for R&D, product innovations and efficiency programs to make cars even better, faster, safer and more convenient. The visionary improvements started every time from the vehicle itself. It was the aim of car manufacturers to increase competitiveness by being best in class in innovation, technology and production. Nowadays, ecosystems are dramatically changing due to new market conditions, digital technologies and trends.

Today the Automotive industry is facing the biggest challenges since the first automobile vehicle was built by Carl Benz in 1886. **Six major trends** are disrupting the entire value chain of this industry simultaneously and set the established business models on risk. (Winkelhake, 2021)

1. **Legislations and sustainability policies** like the green deal defined by the European Union set clear emission targets for the automotive industry. Car manufacturers have to reduce CO2 emissions of their products down to zero by 2050. In addition the European Union has decided in June 2022 that vehicles with traditional gasoline engines cannot be sold as of 2035 onwards. To achieve this goal, car manufacturers need to reinvent themselves and develop sustainable vehicles with ecofriendly engines.
2. **New technologies** like the *electrification* of cars, *autonomous driving and diverse mobility* concepts change the habit of traditional car manufacturers and impact all areas of the established business.
3. **Changing customer preference** towards sustainable products and ownership are visible. Customers strife to reduce their ecological footprint and therefore demand cars with eco-friendly engines. In parallel customers demand *new mobility*

solutions like car-sharing. They have adjusted their mindset from owning a car to requesting mobility on demand. A case study developed by McKinsey forecasts that one out of 10 cars sold in 2030 will be a shared vehicle. (Gao, et al., 2016)

4. Such mobility solutions demand new ways of **connectivity**. The importance of data collection, data storage and data sharing will become super important. The traditional car needs to evolve from an analog vehicle to a so-called Internet of Thing (IoT).
5. **New competitors** like Tesla with pure focus on e-mobility define new market standards. Built in 2003, Tesla demonstrated a true success story. The company became the most valuable car manufacturer in the world with a 882 billion market share in march 2022. (Dilmegani, 2021) Other established car manufacturers are far behind and struggle with the transformation of their traditional set-up. Besides Tesla there are additional new competitors which have recently announced their motivation to enter the automotive industry with highly innovative mobility solutions. Well-known ITC (Information and Communication Technology) giants like Apple, Google and Alibaba have raised their ambitions. After initial corporations around connectivity and info-tainment solutions, Google has already started investigation in self-driving cars. (Coldewey, 2015) Apple has even implemented a dedicated automotive team working on car-specific projects. (Painter, 2021) Other examples with new and innovative mobility solutions are start-ups like Uber, ZipCar and Blablacar. The impact of these new competitors on the automotive industry is tremendous and will lead to an increase of competitive pressure, new alliances, business model transformation and the innovation of new business models. (Peters, et al., 2016)
6. The overarching game changer can be truly seen in **digitalization**. The industry is evolving from technical developments to digital transformations. The associated digital transformation is disrupting the entire value chain of the automotive industry and is stimulating the transformation of established business models but also the creation of business model innovations. (Fichman, et al., 2014)

Automotive car manufacturers are confronted with the challenge to merge new digital technologies with traditional values and assets of the physical world. Even though common literature and the dedicated research community have created certain insights around digitalization and digital transformation, it is still not clear for the majority of care manufacturers, how such new digital technologies will force them to transform their established business model. Furthermore, it is elementary to find the right transformation approach which means in particular to identify the success factors and key enablers for the right digital transformation. The right mix between components of the traditional world and the digital world will be key. (Hanelt, et al., 2015) This paper will shade light into the area of digitalization and digital transformation of established business models in the automotive industry. In particular the research question of how to manage the impact of digitalization on companies' business models in the automotive industry will get answered. The research topic will be explored via an intense literature review combined with an exploratory research approach. Dedicated business experts of the automotive industry will be interviewed. Output will be a transformation guideline which enables car manufacturers to measure their individual digital readiness. Furthermore, this guideline will provide clear recommendations of how to transform the individual business model, which digital parameters do adopt and how to orchestrate the digital technologies with the traditional assets.

2. Research Methodology

The aim of this industry paper is to analyze the impact of digitalization on the automotive industry. In this regard it is important to understand whether and how the digital transformation in this industry takes place, whether and how established business models as well as its operating models are affected and what kind of success factors and challenges for companies in the automotive industry come along. A mixed methods-approach has been used to analyze the relevant parameters in the evaluation phase.

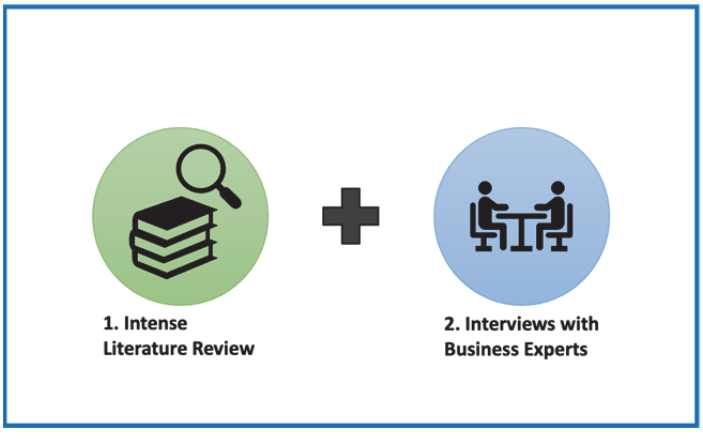

Figure 3. Research Methodology - mixed methods-approach

On the one hand an extensive literature review has been conducted where various industry paper, case studies, business analysis and consulting reports have been reviewed. On the other hand, exploratory research via qualitative interviews have been conducted. Over a period of one month, dedicated Business Experts have been interviewed to explore the impact of digitalization on the automotive industry. The interviewed Business Experts hold senior positions at well-known automotive companies or suppliers. They have multiple years of business experience in the automotive market. A questionnaire of 17 dedicated questions has been designed for the interview sessions. Basis for the design of the questionnaire are the below listed general research questions and their subordinate questions which consequently reflect the research gap in this industry:

Primary Research Question:

How to manage the impact of digitalization on companies' business models in the automotive industry?

Subordinate Research Question 1 on Business Model Transformation

- What are the goals based on strategy and structure to digitalize a business model?
- How to transform an existing business model to the digital age?
- What are the key success factors when transforming an existing business model to the digital age?

Subordinate Research Question 2 on changing Operating Model

- How to successfully transform established processes with focus on Marketing and Sales?
- How to manage internal resistance and how to ensure digital readiness?
- How to orchestrate digital technology and services to optimize the outcome and to avoid cannibalism effects

Subordinate Research Question 3 on Business Model Innovation

- Do you see the potential to design a business model innovation based on digitalization in your industry? And if so, how would this business model look like?
- In which areas of your business model could digitalization bring the most opportunities for sustainable growth?

A Digitalization Manager who works for one of the top 10 automotive manufacturers in EMEA verified the structure and the content of this questionnaire. This validity check ensures the right quality and consistency of the survey. Due to the pandemic situation, the interviews had to take place via phone calls as no physical meetings where possible. Each interview lasted approx. one hour which gave sufficient time for dedicated answers.

In a first step of the interview phase, each interview got documented/transcripted via MS Excel format. In a second step, the generated data was analyzed with the qualitative content analysis method of P. Mayrings. Following this state-of-the-art analysis method, it was the aim to reduce the captured data to the relevant content while defining certain criteria. With this approach it got ensured that all important aspects of the interviews are still captured but at the right level of detail.

Excursus: The analysis phase got executed through eight steps: (Mayring, 2015)

1. Definition of Material: What kind of material/data/objective needs to get analyzed?
2. Context: What was the context of the evaluation? (how was the material/data evaluated? Who was interviewed; timeframe of the interviews; under which circumstances took the interviews place?
3. Characteristics: preparation of the evaluation output as prerequisite for the analysis
4. Analysis approach: inductive vs. deductive method to build categories
5. Coding: cluster the data based on the selected analysis approach
6. Reliability Check
7. Execution of the analysis
8. Interpretation

After the interview phase was completed, the collected insights of all questions have been consolidated while following the analysis method of P. Mayring. After clustering the input per question, a set of categories has been deducted to cover the most relevant aspects of each question. With this procedure it was possible to consolidate and to reduce the entire input to the relevant context of the evaluation.

Afterwards the evaluation result has been afterwards enriched with the output of the literature review. Therefore, it was possible to challenge but also to complete the initial findings to a comprehensive picture. Both methods together created the basis for the following evaluation phase.

3. Literature Review

3.1. Digitalization in the automotive industry and the impact on business model transformation

The digitalization is a fundamental game changer for consumers, companies and complete ecosystems. The ongoing digital transformation is impacting all industries and is changing entire value chains. This is also true for the automotive industry. (Fichman, et al.,

2014) The automotive industry is shifting from technical developments to digital transformation. (Pham, 2021)

Car manufacturers have realized this trend years ago and have already adopted various digital technologies to optimize production plants, logistics, supply chain processes but also marketing and sales operations. However, established automotive car manufacturers are struggling to keep track with the innovation speed of new competitors like Tesla and other IT giants e.g. Google, Apple, Alibaba, Uber and Blablacar. In addition, the reaction on increasing customer demands towards new mobility solutions and connectivity keeps challenging for OEMs.

In the recent years, common research community has analyzed the various aspects of digitalization and the ongoing digital transformation. Hanelt et al. (2015) for example described four different types of business model transformation and how new digital trends impact established business models of automotive car manufactures:

1. **Business Model Extension:** The extension of a business model can be described as minimal change of the core logic of an existing business model. One example related to the automotive industry can be seen in new ways of customer interaction. Especially the younger generation the so called “digital natives” which grew up with tools like smartphones are used to communicate via social media channels or even chat bots. Therefore, car manufacturers also started initiatives in this direction. Such digital communication types allow automobile manufacturers to respond much faster on customer requests than via traditional communication forms. This new digital way of interaction with customer groups brings benefits for all. It increases the response time, lowers communication costs and therefore helps to reach out to customers more efficient than in the past. Another example can be seen in the new connectivity of cars. Based on digital trends like mobile technology and cloud computing, car manufacturers have developed ways to connect smart phones and other mobile devices with the car. This gives customers the possibility to connect their personal data but also digital tools and services with their car. With this, the established business model of car manufacturers gets connected to the enhanced customer demands for connectivity and availability.
2. **Business Model Revision:** The revision of a business model can be described as a substantial change of the established business model. One prominent example of a revision can be seen in the mega trend of autonomous driving. This new trend demands intense digital technology as well as a large amount of data, internet, sensors and GPS technology. With this new trend, the core values of the business model get substantially changed. As customers do not need to drive the vehicle anymore in future, they can spend the driving time for more efficient tasks. For b-2-b customers that means they can plan their next customer visit or communicate with other colleagues while the car is driving by itself.
3. **Business Model Termination:** The termination of a business model is described as fundamental elimination of certain parts of a business model. Examples of such terminations are virtualization activities. Such digital virtualization technologies help in the design phase of new vehicles or when building a new production line or plant. Another interesting example is the installation of virtual show rooms as new way of introducing and selling cars. Car manufacturers like Volkswagen, Mercedes and Audi are using such virtual show rooms already to configurate new cars and to present them to their customers or prospective customers. While using such new digital technologies, car manufactures can reduce the planning time and development costs. Furthermore, they meet the demands of the younger customer generation, the so called „digital native” and can influence their buying behavior much better than they have done it in the past with traditional show rooms.

4. **Business Model Innovation:** A Business Model Innovation can be described as visionary new way how business is carried out and revenues are generated. Hereby the business model innovation in the digital manner is an interconnected ecosystem where value creation, value delivery and value capture are newly defined by e.g. established market auteurs or new stakeholders.

A prominent example in the area of new mobility solutions can be seen in companies like Uber and Blablacar. Those new market players started their journey in the automotive industry as tech. start-ups without any knowledge about the automotive industry. For them it was not necessary to know how cars are built. They identified a demand for new mobility and developed a smart and interconnected digital solution which makes public transportation simpler and more convenient for customers.

Chanias and Hess have developed a case study to analyze the aspect of digital transformation in the automotive industry more deeply. Their findings show that the digital transformation process on OEM side starts usually with a multitude of unconnected activities and via a bottom-up perspective. In particular it means that even without having a central strategy or road map defined, digital tools get developed and implemented by the various departments. (Chanias & Hess, 2016) This approach is obviously not the most sustainable and effective one as the missing interconnection between such isolated solutions cannot create the expected value. Nether for the respective car manufacturer nor for the customers.

Piccinini published a delphi study with dedicated business experts to highlight upcoming challenges around the digital transformation of business models in the automotive industry. They recommend established car manufacturers to partner with new start-ups and relevant external market players who offer intelligent IT-based solutions. The approach of joint forces and cooperation can bridge the situation of missing inhouse solutions. Furthermore, it helps to keep the R&D costs for such new solutions under control. (Piccinini, et al., 2015).

Henfridsson and Lind confirm the incorporation of external digital know how as prerequisite for OEMs to ensure a successful digital transformation. The integration of external know-how can be done via corporation with e.g. hidden champions or via M&A. (Henfridsson & Lind, 2014) Hildebrandt verifies a positive impact of such cooperation on the creation of digital innovations. (Hildebrandt, et al., 2015) Keller and Hüsing echo that these digital innovations have a positive impact on the business performance and a better result in customer experience. (Keller & Hüsing, 2009)

In addition, Remane et. al. spent time on analyzing the business models of relevant startups in the mobility area. While doing so, they anticipated crunch-base data to cluster startups by business model types following the concept of Weill et al. (2005) 27 different business model types were identified and organized in four clusters: creator, distributor, landlord and broker.

3.2. Reasons why digital transformation is so important especially for automotive manufacturers in the b-2-b context

Whereby the research community has spent a lot of attention to digital transformation in the area of b-2-c, the impact on the b-2-b environment is rather less explored. Due to new technologies like the internet and the availability of smartphones, mobile devices have been interconnected. This phenomenon offers the availability of information at any time and everywhere for everybody. The new customer generation the so called “digital natives” are used to such digital technologies. They grow up within a connected world of smart homes,

smart phones, and digital services from well-known companies like Google, Apple, Uber, Airbnb and Amazon. It is a natural prerequisite for them to consume data in a smart, digital and connected way when communicating with family and friends, planning holiday, buying clothes or booking a hotel. The „digital natives" expect such smart and connected solutions also when using a car. However, for them it is not essential to own this car. It is rather important to have a smart, fast and convenient mobility solution available. This is especially true for the b-2-b business. Due to a fully connected environment in private live, b-2-b customers expect the same digital standard also when doing business. The new digital solutions offer a lot of benefits for b-2-b customers. Companies can for example reduce their working capital while renting a mobility solution instead of investing in an own fleet. A fully connected vehicle with autonomous driving technology for example offers the possibility to plan the next customer visit while being on the road from one customer to another. This saves time and money and makes processes more efficient.

The changing demand from owning a physical vehicle to booking a new mobility solution on demand has disrupted the traditional rules of the game in the automotive industry. A market study developed by McKinsey shows a significant growth potential based on new mobility concepts and services. The following overview published by McKinsey shows the trend from using an automotive vehicle for every trip purpose to a mobility solution on demand for each specific purpose. Instead of owning one single car for each purpose, the new mobility solutions offer the possibility to book various vehicles per purpose and whenever needed.

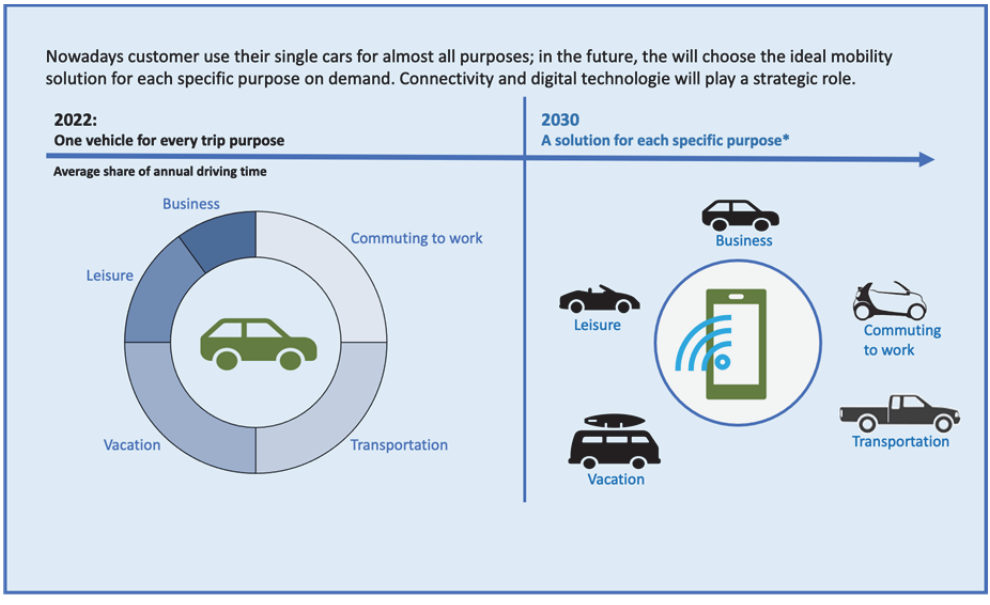

Figure 4. Development from car ownership to new mobility solutions

Following the outcome of this study, the revenue pool for automotive vehicles will significantly increase and diversify towards new mobility solutions, feature upgrades and services. Those new solutions will be available on demand and can be flexibly booked via smart phones or the web-based car computer. This effect could generate up to USD 1,5 trillion additional revenue potential in 2030 (+30%) compared to USD 5,2 trillion in 2015.

Those companies who meet such new customer demands and who are capable to adopt their product offering to the new market circumstances fast and pragmatically will benefit from additional revenues.

The increase in the automotive revenue pool due to now mobility demands and digital technologies motivate new stakeholders to enter the industry and to monetarily benefit from these new trends. As already indicated before, well-known IT giants like Apple and Google have started their investigation. Tesla as specialty OEM is already seen as an established new market player. But also other start-ups and technology driven companies like Didi Kuaidi, Zipcar, Uber and Blablacar have started their journey in the automotive industry. The paradigm shift from car ownership to mobility as a service will fundamentally force the traditional car manufacturers to change their habits and to transform their business model towards the new market standards. Their challenge will be the transition from a car manufacturer to a mobility provider. Shifting market positions consolidation effects and new forms of partnerships between established car manufacturers and new “digital players” are most likely. If they miss the train of digitalization, traditional car manufactures will most probably lose their current market share. The following graphic shows the shift from OEMs competing with one another to competing in a complex market landscape. (Mohr, et al., 2016)

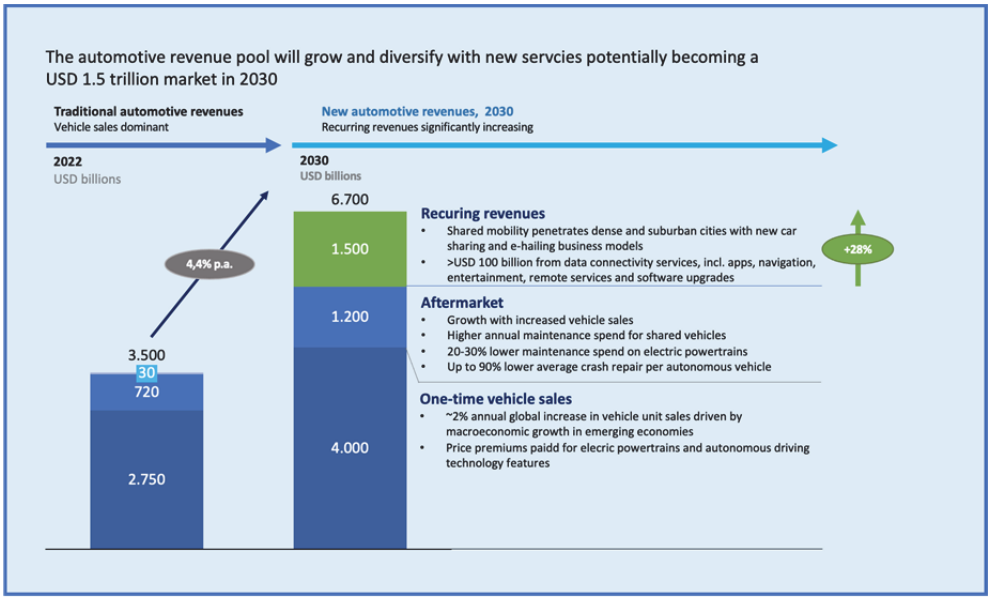

Figure 5. Development of revenue share in the automotive industry - forecast 2030

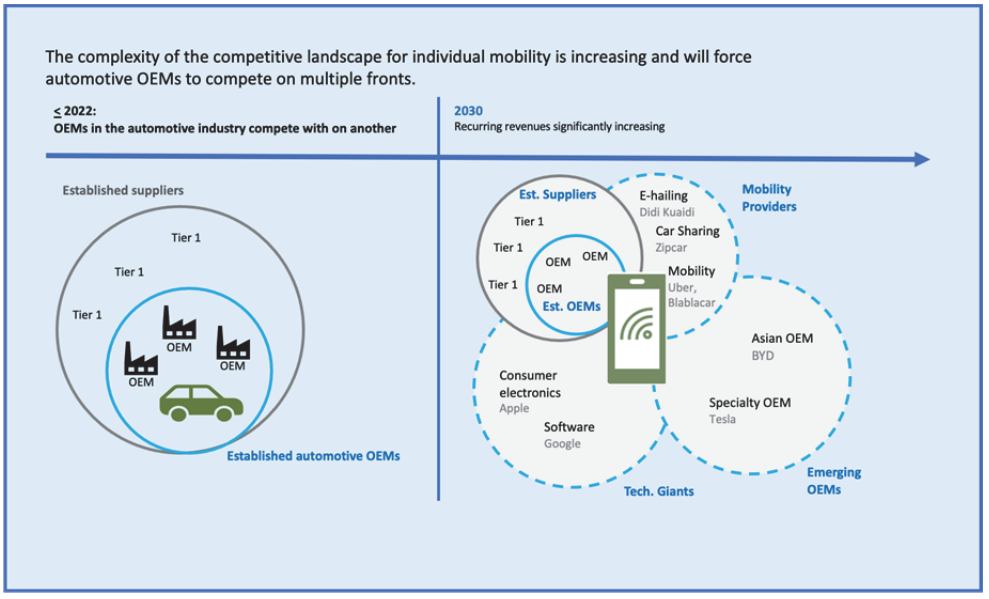

Figure 6. Develoment of the eco system in the automotive industry

3.3. Challenges of digital transformation for automotive car manufacturers

The most relevant question for automotive car manufacturers is how they can survive and stay profitable in times where the entire industry gets disrupted and the established business model has to be transformed. The route course of how to drive the digital transformation is by far not clear to all of the established car manufactures. Even though the automotive industry has investigated high efforts into this topic and already started various initiatives around digital transformation, there are still many challenges to overcome. Whereby the automotive industry is confronted with a whole bunch of challenges, the below listed challenges can be seen as most important for the automotive industry. (Dilmegani, 2022)

Complexity: the transformation process towards digitalization requires a change of the well-known habit with its traditional processes and behaviors. It means the change of the established business model. To drive such transformation projects internally can set the car manufacturers under extreme pressure as this complex approach requires the right entrepreneurial mind-set, know-how, capability and financial power.

Investment: on the one hand the digital transformation requires a significant amount of capital as entire organizations and operating models need to be shifted and re-designed. On the other hand, it requires a long breath with regards to ROI expectations. Llopis-Albert et. al analyzed the impact of digital transformation non the automotive industry. They echo the above findings that OEMs are somehow reluctant to spend the right investment budgets for digital transformation. Digitalization projects do not pay off from day one. Companies might face several uncertainties along the transformation process. Success is not a given fact. (Llopis-Albert, et al., 2020)

Impact analysis: Car manufacturers need to identify the right digital set-up for the future. Not every new digital technology does fit to each company. Additionally, companies need to be fast in identifying the most relevant trends and start corporations with the right partners to be frontrunner. Otherwise, competition will outpace those who are too

restrictive and reactive on the way of digital transformation. A competitor in this regard does not need to be another car manufacturer. It is also likely that a new start-up or a tech. giant like Apple or Google with the perfect mobility solution for the future will become the most relevant competitor.

Data security and protection: digitalization requires connectivity and connectivity requires information management. To fully utilize digital technologies like applications or on-demand services, car manufacturers need to collect and consume customer and vehicle data. The data management comes along with various security aspects. Car manufacturers need to ensure that all processes and systems are in line with compliance regulations and data security standards of the respective countries and regions. To do so, car manufacturers have to be up to date with regards to defense and safety standards. (Pham, 2021)

Additional challenging parameters have been analyzed by P. Adams (Director of Customer Engangement by GE Digital). Following his analysis of digital transformation in the automotive industry is gets obvious that beside the already mentioned challenges also the aspect of internal capability and digital readiness is important. The changing market conditions towards new digital solutions require the right skill set of employees.

Car Manufacturers need to ensure that the existing employees are capable to enrich their skill set towards new digital technologies. On the other hand car manufacturers need to hire young talents of the group of digital natives to stay competitive. (Adams, 2022)

3.4. How to manage the digital transformation successfully

As described in the previous chapters, the disruption of the automotive industry due to digitalization is a given fact and cannot be stopped anymore. The point of no return has been reached years ago. Even though car manufactures cannot predict the future scenario 100%, they need to take the necessary strategic decisions now to start the digital transformation of their business model. A case study developed by McKinsey recommends a transformation approach based on five strategic parameters: (Mohr, et al., 2016)

1. **Prepare for uncertainty:** Car manufacturers should be aware of upcoming market trends like new mobility business models. To do so, they need to analyze and understand the changing consumer preferences of their target groups. This includes also a differentiated view on city types and regions. OEMs also need to observe changing demographics in key markets. An advanced prediction of potential scenarios as well as a flexible ability to react on the changing conditions are key drivers for a successful business model transformation.
2. **Leverage Partnership:** Due to the changing market conditions, car manufacturers are forced to start the digital transformation process while in parallel they need to keep their current operations up and running. To be successful on this digital journey, car manufacturers need to partner with the right service providers e.g. start-ups or tech. companies. Such strategic alliances across and beyond industries can leverage a lot of synergies. Collaboration partners do have the right digital know how. A joint approach can reduce the time to market. Furthermore, it helps to share the investment costs.
3. **Adapt the organization:** The digital transformation of the existing business model requires also a modification of the established organizational set-up. All resorts need to be interconnected to ensure the best internal collaboration. Established job profiles need to be adjusted and new profiles need to be integrated. Car manufacturers need to ensure the right capability and digital readiness. Therefore, they must find the right fit of internal know how and external support.
4. **Reshape the value proposition:** As part of the transformation approach towards a new business model, automotive car manufacturers need to adjust their product and service

offering towards new technologies. The new product portfolio should be oriented on the new customer focus groups and their demands. OEMs need to evolve their value proposition from a car manufacturer to a mobility and service provider. This radical change includes also a new definition of product life cycles and an end-to-end customer experience. In future it is rather less important to be best in car engineering than being frontrunner with the best mobility service along the complete customer journey. Based on the fact that new fleet operators of shared vehicles will more and more enter the market, new b-2-b sales potential need to be captured as well as the increasing after sales services of such businesses.

5. **Reshape the operating model:** In addition, it is crucial for car manufacturers to review and shape their operating model based on the new digital requirements of customers. Being able to promote and sell digital mobility solutions on demand instead of physical vehicles, OEMs have to establish an operating model which meets the new customer demands. This includes digital sales and marketing channels as well as interconnected platforms where customers can navigate and book services. It also requires the elimination of organizational barriers which can hinder the digital transformation process. It might also require a radical change from indirect sales where existing car dealers sell the products towards a new infrastructure where OEMs sell directly to their customers. (Schertler, et al., 2022)

A study developed by Gyimesi, et al. echo the recommendations with regards to the changing operating model. The operating model of car manufacturers can be realigned to ensure that customer demands trigger every activity in the sales funnel. This requires that all business related parameters and data gets optimized and interconnected. (Gyimesi & Berman, 2011)

3.5. The potential to design a business model innovation in the automotive industry

When looking at the impacts of digitalization on business models in the automotive industry described in capter 3.1, it got obvious that some trends like the usage of chatbots or online sales funnels lead to a transformation of existing business models. Whereas some other trends like the increased customer demands towards new mobility solutions lead to business model innovations. Such new mobility concepts can turn a complete ecosystem upside down and can make established stakeholders irrelevant. The automotive industry is a predominant example where the established OEMs need to reinvent themselves. New mobility providers like Uber and Blablacar have identified the new customer demands towards smart mobility solutions and have developed customized services. While doing so, they have not just developed a singel stage product but an interconnected solution with the right infrastructure and e.g. payment options which guarantee a positive end-to-end user experinece. The new mobility solutions together with other digital services create a new type of revenue. (Hanelt, et al., 2015)

3.6. Outcome of the literature review

In essence, there is a common understanding among the research society about the impact of digitalization on business models. The evolving new technologies developed and provided by new market players outside of the automotive industry together with the increased customer demands towards digitalization, sustainability, autonomuos driving and mobility on demand have put high presure on the established car manufacturers. However, there are also a lot of new benefits in terms of efficiency gains and new revenue pools to participate from the new technologies. Being able to laverage those benefits and to stay

profitable in future requires a new mindset, the right entrepreneurial attitude and financial power. Established OEMs need to find solutions to consequently transform their existing business model to the digital age. Even though, the established car manufacturers have started to transform their business models, there are still urgent questions to be answered. (Solberg, 2021) Which are the right new technologies to onboard? Who are the right tech. partners to start cooperations with? How should the new business model look like to create value?

How can this value be captured and developed to ensure sustainable growth? Car manufacturers need to prepare for the unexpected. They cannot win the race by themselve. They need strong partners. Whatever they do, they need to keep the customer in the focus and act fast.

4. Explorative Research

Complementary to the extensive literature review, an exploratory research approach via expert interviews was conducted to verify the initial findings of the literature review around the impact of digitalization on business models. Overall, eight interviews with dedicated Business Experts of the automotive industry took place. The selected Business Experts are a diverse group of characters with various years of automotive expertise. Most of them hold senior management positions at global acting OEMs in Marketing, Sales, Strategy and Digitalization Units.

Group of interviewed Business Experts					
Company Size in no. of employees	Geographical Scope	Company Type	Job Description	Age	Gender
>10.000	global	Car Manufacturer	Manager International VIP & Special Sales Operations	44	W
>10.000	global	Car Manufacturer	Global Director Digitalization Commercial Vehicles	50	M
>10.000	global	Car Manufacturer	Head of Digital Transformation	41	M
>10.000	global	Car Manufacturer	Director Marketing	45	M
>10.000	global	Car Manufacturer	Head of Portfolio Management	38	W
>10.000	global	Car Manufacturer	Head of Strategy	42	M
>10.000	global	Car Manufacturer	Senior Manager Digital Transformation	35	M
>10.000	global	Car Manufacturer	Head of global production Truck & Bus	40	M

Figure 5 - Group of interviewed Business Experts

Each interview was executed via phone call and took approx. 60 minutes. The participants were informed that their participation is voluntarily and that the interviews got transcribed. Furthermore, they have been informed upfront that the interviews are anonymous and that no personal data will be collected nor further used or published. After the evaluation phase was completed, all insights of the interviews have been cumulated and analyzed by following the qualitative research analysis approach of Mayring. Based on this research methodology, various themes and similarities could be clustered. Additionally, it was possible to identify inconsistencies between the different OEMs. The following sub-chapters will shade light into the different clusters and will further describe the most important findings.

4.1. Impact of digitalization on the automotive industry and on bussiness models in particular

There is a common understanding among the interviewed Business Experts that digitalization has a huge impact on the automotive industry in general and on the business model as well as on the operating model in particular. In average the impact was ranked with a value of 4 (1 = low; 5 = high). Most of the interview partners confirmed that a successful digital transformation of the existing business model is a prerequisite for OEMs to survive.

4.2. Vision and Mission

The interviewed Business Experts stated clear visions with regards to digitalization and digital transformation. An interesting aspect could be observed around those vision statements. The respective OEMs clearly differentiate between the B-2-C and the B-2-B market. With regards to the B-2-C market, they have recognized the changing customer demands towards smart and innovative mobility solutions. The trend towards new mobility solutions comes along with a change of ownership. B-2-C customers will in future more and more request those mobility services on demand instead of buying a car. This change will have a huge impact on the current value chain and especially on the cooperations of OEMs with their car dealer network. The established car dealers with its physical show rooms might become obsolete. To meet those new demands, the OEMs envision to design a business model innovation which means to develop from a car manufacturer to a mobility provider.

This ambition is a quite dramatic change as it requires to leave the well-known habit and to reinvent themselves. The development will go beyond a pure transformation. As described under section 3.1 this development will be visionary new way how business is carried out and revenues are generated. The business model innovation will be an interconnected ecosystem where value creation, value delivery and value capture are newly defined by the established market auteurs.

In terms of the B-2-B market the picture looks a bit different. Business customers demand more and more services and functions combined with autonomous vehicles which help to make the transportation process more efficient and safer. However, the topic of ownership in the B-2-B context will most probably remain as it is. B-2-B customers will still buy and own their commercial vehicles in future. To cover the demands of the B-2-B customer, OEMs need to transform their existing business model towards new technologies. This also requires a digital transformation of the established operating model. OEMs have to shift their mindset from product oriented to customer focused.

4.3. Digital Readiness of OEMs

The evaluation shows that digital readiness is seen as one of the important prerequisites for OEMs to start the digital transformation journey. The readiness covers various aspects e.g. a clear strategy, a positive internal spirit together with a future-oriented mindset of employees and management. Furthermore, it requires dedicated resources with the right digital know-how to develop the right solutions, a robust IT infrastructure to manage and utilize the massive amount of customers data. Last but not least the digital readiness requires a sufficient budget to cover investment costs. Even though the OEMs have done their homework in terms of developing strategies and digital roadmaps, none of the interviewed Business Experts could confirm to be fully ready. Three aspects could be observed during the interviews:

a) spirit and mindset of employees are seen as quite positive. The majority of employees among the different departments have understood the route course and the importance to adopt digital technologies. The transformation will of course require additional efforts and a proper change management but digital spirit and the right mindset are obviously not seen as blocking points.

b) when it comes to internal digital know-how, the picture is changing. The evaluation shows that digital know-how is not on an adequate level yet. Even though OEMs have started to investigate in trainings and have started to implement digital units who should work on digital solutions, still the aspect of digital know-how needs to be improved. It seems to be quite challenging to upskill employees with digital know-how.

c) all interview partners confirmed that the budget which OEM spend on digitalization is by far too low. OEMs invest only 2-5% of their annual turnover for digitalization. This budget only covers the costs for individual initiatives like setting up a web shop or developing an order application but it cannot cover a holistic transformation process or even the development towards a provider of mobility solutions.

4.4. Goals to digitalize the business model

The strategic goals around digital transformation of existing business models are closely linked to the vision statements of each OEM. The interviewed Business Experts have shared a common picture with regards to goals and ambitions. Two perspectives could be observed during the interviews:

1. On the one hand, OEMs look from the internal perspective and aim to use digital technologies for creating efficiencies on all levels. This includes e.g. the automation of processes via bot technology or the usage of e.g. augmented reality tools like google glasses to establish ergonomic workflows or to reduce failure rates in production processes. Furthermore, they aim to reduce internal complexity to be more agile and to make it easier for customers to do business with them.
2. On the other hand OEMs start thinking from the customer perspective when developing new services and products. This phenomenon is quite interesting as in the past they were used to think from the product point of view and how to make automotive vehicles even better. Nowadays they have learned that a successful transformation of the business model requires a customer-centric view. They need to identify new customer demands and find the right way to develop smart and digital solutions to cover those demands. This requires the collection and management of massive customer data.

To achieve these goals, car manufacturers need to basically reinvent their existing business model. From a concept point of view it sounds reasonable but in fact the digital transformation is quite challenging for OEMs. It is still not clear yet, which technology will be the leading and preferred one and how OEMs can earn money with new digital services or smart mobility concepts. Furthermore, they do not know if such new revenue pools can compensate the business losses of their traditional business model.

4.5. Digital transformation approach

To start the digital transformation approach within the individual organization, most of the car manufacturers have implemented digital units and innovation hubs to steer the digital transformation process. The digital units have initiated various digital projects and follow a step-by-step approach. New digital services get tested via intense simulations and pilot cases before they get activated. Within such complex organizations like care manufactures have in place it is a huge challenge to develop a solution which covers all

geographical, commercial, legal and technological aspects. That might be the reason why the different resorts within those organization have started their own digital initiatives. The interviewed Business experts mentioned a kind of digital transformation competition among the resorts. These effects can potentially lead to several negative impacts. They can eat up innovation budgets, lead potentially to cannibalization effects an can most probably interfere the overall change management process within an organization.

As inhouse capability and digital know-how is rather limited within each organization, OEMs have jointly investigated into new technologies together with cooperation partners inside and outside of the automotive industry. Those cooperation partners are ether start-ups who already developed such digital technologies or tech. companies like Microsoft, Google and SAP. Such cooperations offer several benefits. They enable access to new technologies and know-how which could not be reached by the OEMs internally and in parallel it helps to share the huge investment costs between both cooperation partners.

The Business Experts see more benefit in cooperating with strategic partners than in onboarding support by management consultancies. Furthermore, the OEMs spend parts of their budget also for increasing inhouse knowledge and capabilities.

Beside the transformation of the business model the Business Experts see it also as important to transform the operating model and especially marketing and sales processes. There is a common understanding between the interview partners that the transformation of marketing and sales processes need to be closely linked to the new customer demands and new digital technologies. It might be that virtual show rooms and online platforms will replace the local car dealer network. Test drives could be done in future by e.g. virtual test drive simulators and marketing campaigns will be steered via a central marketing cloud.

To ensure that all those technical innovations are perfectly orchestrated, most of the Business Experts mentioned to have a digital transformation program in place to manage interdependencies between the various tools and applications. The Business Experts see a huge benefit in implementing a central customer interaction platform with a central data hub where each digital tool or app can be onboarded and consume the relevant data. It could be observed during the interview session that all interview partners do not see a cannibalization of the different tools and applications. All of the involved OEMs follow a multi-channel approach where the customer can choose between various sales and marketing options. The transformation progress is rather slow. All interviews Business Experts ranked the progress with an average value of 1.6 (1 = low; 5 = high). This result demonstrates that OEMs are just in the starting phase of the transformation. In comparison to the ambitious targets it shows that OEMs are far behind their expectations.

4.6. Key success factors

When asking the Business Experts about key success factors, there are plenty of parameter which need to work together. In essence it is the combination of producing high quality vehicle and equipping them with smart and innovative digital services embedded in a solid infrastructure. Additionally, the OEMs need to manage the complexity of transforming the existing business model while in parallel bridging the time in between and keeping the existing processes up and running. Furthermore it is crucial to ensure the right priority within the organization and across all resorts. Plan the right budget to be able to execute the transformation from A-Z. Ensure the right internal capability and know how - have the right people and experts available to execute the digital strategy consequently in time and on budget. Focus on core competencies and onboard digital know how via start-ups or tech. companies where internal know-how is missing. Be entrepreneurial and fast in

decision making and adaptation accordingly. Ensure the right internal commitment; decide what not to do and where not to invest; don't try to by everything for everyone; a planned and aligned approach with the commitment of all internal stakeholders; no one-size-fits-all approach but incorporate regional differences; standardization and automatization of tools and interfaces to reduce complexity; manage complexity; fast decision making process; integrated solutions to book mobility a la Amazon. Manage the data structure and data complexity; know the most burning customer demands and future trends in customer's business to react and define the right customized solutions; rather upskill internal people than onboarding management consultancies; be smart agile and dynamic while carrying the old organizational structure; know the right partners and start the right cooperations while managing M&A or investment costs.

Digitalization needs to become a board resort at each of the OEMs; the right budgets need to be planned and invested; clear prioritization and clear roles and responsibilities; top down decisions to rebuild the organizational structure and to redefine processes; right change management is key.

4.7. Challenges along the digital transformation process

The challenges around digital transformation of existing business models are manifold. For car manufacturers it feels like they need to reinvent a vehicle while the vehicle is moving. The observed challenges can be categorized into three main clusters:

1. **Technological challenges:**
   - OEMs need to be fast in finding the leading technology of the future as well as the right cooperation partner etc. but in fact they are too slow. Internal complexity is slowing down the innovation process.
   - consequently think from the customer and not the product perspective to define new solutions. Change the old mindsets where the product was in focus towards a customer-centric approach.
   - understand the real value of data. data integrity and consistency is a huge topic. Most of the OEMs struggle with data collection, data management and turning data into valuable information
   - OEMs do not have all customer and user information at hand to develop customer-centric solutions. They depend on tech. giants like Google, Apple, Amazon to enrich their data structure. Finding the right cooperation partners will be key for OEMs.
   - missing infrastructure to utilize new technologies. Best way would be to jointly develop a common ecosystem together with all relevant stakeholders inside and outside of the industry like the „CANTENA-X” approach
   - interdependencies with other stakeholders outside of the industry create certain challenges as each stakeholder has different priorities, different speed, different understanding and interests with regards to digitalization.
2. **Organizational challenges:**
   - too many people who are involved in decision making process on OEM side
   - less accountability for digital topics. Digitalization is not the prio 1 topic
   - missing internal readiness and capability
   - less internal digital know-how
   - less resources who are responsible to drive the change

- internal competition - each resort is optimizing itself. While doing so, several island solutions get implemented
- OEMs try to be front runner in digitalization while in parallel they still have to carry the burden of the analogue business model with all related fix costs and organizational complexity
- Geographical differences lead to additional complexity. One size fits all vs. regional/local specific offerings
- established organizational structures which are hard to change and transform;
- internal resistance towards change
- get active across all resorts and centrally turn concepts into the right operations
- manage the organizational change and bridge the time from analogue to the digital age

3. Commercial challenges:

- Internal budget restrictions. OEMs invest only 2-5% of their annual turnover for digital transformation.
- be able to monetarize new digital services while parts of the established business model will disappear over time
- ensure the right product portfolio mix to generate profit
- manage the complexity of two different product lines in parallel (gasoline engines vs. electric engines)
- keep the existing model up and running and bridge the situation from now onwards until the new digital set-up is ready to generate profit; this requires the capability to transform the existing business model while onboarding step-by-step digital solutions. Further on, OEMs need to design and set-up the business model innovation of the future to turn from a car manufacturer to a mobility provider.

The various challenges demonstrate even more the need for joint forces. Car manufacturers cannot win the race by themselves. They need to have the right cooperation partners. Otherwise, complexity will block each and every innovation step.

4.8. Potential to design a business model innovation

Most of the established OEM see the potential to design a business model innovation in future for the B-2-C business segment. In particular, they envision to become the mobility provider of choice, offering sustainable mobility solutions with high quality electric vehicles and digital technologies. They see functions on demand as super important to meet new customer demands. The vehicle of the future need to become an IoT (Internet of Things). Some cooperations around digital services and developing new types of vehicles with electric engines have already started together with cooperation partners. The business model in the B-2-B segment will almost remain as it is in future as the topic of car ownership will not change like for the B-2-C segment. OEMs of course foresee a major impact of digital technologies on their existing business model but expect rather an enrichment and a partial transformation than a creation of a business model innovation. The observation during the interview sessions lead to the finding that we need to differentiate between the digitalization and transformation of the existing business model in B-2-B and the development of a business model innovation in the B-2-C segment.

4.9. Outcome of the explorative research part

In essence, the evaluation shows a quite homogeneous picture with regards to the impact of digitalization on the automotive industry. There is a common understanding

among the interviewed Business Experts that digital technologies are disrupting the entire automotive industry and with this also the business model of the respective OEM. It seems that the OEMs have somehow understood the necessity to transform the established business model as well as their operating model to meet the changing customer demands. Therefore, they have defined digital strategies with vision statements and have set themselves ambitious targets. Two perspectives could be observed. To meet the new customer demands in the B-2-C segment towards new mobility solutions and changing car ownerships, car manufacturers envision to develop from a car manufacturer to a provider of smart and innovative mobility solutions. In this case, the evolution can be seen as business model innovation. The evolution in the B-2-B segment is rather different. B-2-B customers will still buy and own their fleet of commercial vehicles in future but require vehicles with autonomous driving technology and interconnected functionalities to make the transport process safer and more efficient. This evolution can be seen as business model transformation.

Both developments whether it is the design of a business model innovation in the B-2-C segment or the business model transformation in the B-2-B segment will require a high level of agility, innovation ability and entrepreneurial decision taking power. It will be interesting to observe the development steps in future. However, when comparing those visions and targets with the real progress it shows that car manufacturers are just at the beginning of this digital journey.

5. Discussion

As already indicated in the second chapter of this research paper, a mixed method approach has been conducted to shade light into the defined research gap of this dissertation. Initially, an in-depth literature review of the most relevant industry journals, case studies and business analysis took place. Complementary to the literature review, a comprehensive and qualitative interview session with dedicated Business Experts of the automotive industry was executed to further enrich the initial findings. This section will now compere the outcome of both methods and validate the comprehensive insights to answer the defined research questions of this dissertation.

In general, there is a common understanding among the actual research literature and the interviewed Business Experts that digitalization is strongly impacting the automotive industry. It has been observed that the entire industry is impacted by digitalization which includes the established business models of the automotive car manufacturers and its operating models. This effect has been indicated already in the proposal of this dissertation under chapter 3.2.1. Hereby, digital technologies like online channels, virtual show rooms or augmented reality tools offer a lot of opportunities but also challenges for the various market players.

Three sets of subordinary research questions have been defined in this dissertation to collect and provide comprehensive insights for exploratory research:

1. **The first subordinary set of questions deals with the goals and success factors of automotive companies to digitalize their business model. Furthermore, it is of interest how those companies are planning to transform their established business model to the digital age. The following table shows the common aspects of both research methods and in addition the new findings of the qualitative interviews.**

Criteria	Literature Research	Qualitative Interviews with Business Experts	Validation
Goals	Optimize production plants,	Optimize production processes; use augmented reality tools to establish ergonomic workflows and make production processes safer;	validated
	Automatize logistic and supply chain processes;	Increase efficiency on all levels;	validated
	Digitalize marketing and sales operations (e.g. set up digital sales channels);	Install a multi-channel sales approach; offer customers a perfect customer experience; develop state-of-the-art online sales channels and car configurators as well as virtual show rooms to meet the target customers at the right place with the right tools and channels. develop a mobility platform where customers can book mobility and transport services on demand	new findings
	Identify new revenue pools;	Gain new market shares while other revenue pillars of the established business model e.g. after sales market or one-time-sales will disappear; monetarize new digital solutions to compensate business losses in other areas;	validated + new findings
	Reduce internal complexity;	Reduce complexity; simplify the way of doing business; make it easier for customers to consume products and services	validated + new findings
		New business models need to create value for the customer. This value needs to be delivered into revenues and captured by the OEMs to ensure a positive return on invest (ROI)	new findings
		Speed up the return on invest process for innovation projects	new findings
		Protect the existing market share where possible and find a bridging solution to develop from status quo to the new business model setup;	new findings

Success Factors	Right entrepreneurial mindset;	Ensure the right entrepreneurial mindset and the right priority as well as the internal commitment within the organization;	validated + new findings
	Prepare for uncertainty: understand the changing consumer preferences and turn from product focused to customer centric;	Analyze and understand the new customer demands; develop customer-centric solutions based on the demands;	validated
	Increase digital know-how; ensure the right fit between internal know-how and external support;	Upskill internal employees rather than onboarding management consultancies;	validated + new findings
	Ensure internal capability;	Ensure internal capability; focus on core competencies and onboard digital know-how via cooperation partners where internal capacity and know-how are missing;	validated + new findings
	Plan sufficient budget for the transformation;	Plan sufficient budget for the transformation;	validated
	Identify the leading technology of the future;	Identify the leading technology of the future;	validated
	Leverage Partnership: find the right cooperation partners;	Decide what not to do! Don’t try to be everything for everyone;	new findings
	Reshape the value proposition: adjust the product and service offering towards new technologies;	Reshape the value proposition: adjust the product and service offering towards new technologies;	validated
	Proper data management;	Central management of data structure; collection of new customer and user data	validated
		Install a change management process to overcome internal resistance;	new findings
		Incorporate geographical and market-specific aspects. No one size fits all solution;	new findings
		Central steering and central empowerment to ensure alignment across all resorts;	new findings
		Use modern project management methods like “SCRUM” to ensure lean management and fast decision taking processes;	new findings

Digital Transformation Approach	Car manufacturers are shifting from technical development to digital transformation;	OEMs need to transform from a product centric car manufacturer to a customer centric service proficer of smart mobility solutions	validated
	Car manufacturers follow bottom-up approach and usually start to create island solutions;	Car manufacturers follow bottom-up approach and usually start to create island solutions;	validated
	Step-by-step approach;	Step-by-step approach;	validated
	Adopt various digital technologies to optimize plants, logistic and supply chain processes as well as marketing and sales operations per division;	OEMs start the transformation process in areas where they see the direct impact like in producton and supply chain	validated
	Various market studies recommend car manufacturers to start cooperations with start-ups and tech. companies to participate from the digital know-how when developing new digital solutions;	OEMs realized the lack of resources and know how. They start first cooperation projects with start-ups and tech. Companies to fill the knowledge gap and to participate from the innovation spirit of those partners.	validated
		Utilize digital units and innovation hubs to steer the digital transformation process;	new findings
		Break down the digital roadmap into concrete actions (WHAT & HOW);	new findings
		Benchmarking to observe competitive developments;	new findings
		The Business Experts mentioned a kind of internal competition among the different resorts which can most probably lead to negative impacts like eating up scars budgets;	new findings

Table 1 - Subordinary Research Question 1

The evaluation phase has provided more in-depth information compared to the literature review on the aspect how automotive companies are dealing with digitalization and digital transformation of business models. Even though, there is a common understanding between the research literature and the Business Experts that the changing market conditions will lead to new revenue pools, it was still not clear how this change will look like. The interviews have provided clear information that it will be key for car

manufacturers to find new ways of monetarizing the new mobility services. Only if the new services will create value for the customers and in parallel generate revenue, OEMs will be able to compensate business losses in other areas of the business due to the ongoing change.

Besides the already known success factors, Business Experts mentioned that upskilling of internal resources will be more relevant and valuable for OEMs than adopting the support of management consultancies. Additionally, the right prioritization of digitalization within the organization is seen as highly important. OEMs still do not spend enough attention and budget for this topic. Business Experts mentioned a kind of internal competition with regards to digitalization. Each resort has started their own initiatives and try to be frontrunner in developing digital tools and applications. That might be one of the reasons why transformation progress is rather low. Being able to speed up the transformation and bridging the situation between the status quo and a fully transformed business model, OEMs need to focus on the relevant core competencies.

They should rather onboard the right cooperation partners instead of trying to do everything inhouse. If they aim to be everything for everyone, they might end up being nothing.

2. **The second subordinary set of research questions covers the digital readiness and capability of automotive companies. Especially the way how the operating model needs to get transformed with focus on marketing and sales. Furthermore, it is of interest how internal resistance can be minimized and how digital solutions need to be orchestrated to deliver a solid output. The following table shows the common aspects of both research methods and in addition the new findings of the qualitative interviews.**

Criteria	Literature Research	Qualitative Interviews with Business Experts	Validation
Digital Readiness	The established car manufacturers are struggling to keep track with the innovation speed of new competitors;	OEMs are observing the market an run various benchmark studies. They have realized that innovative competitors like Tesla but also mobility providers like Uber are much faster in developing innovative solutions	validated
	Internal know-how and capability is still on a low level;	Internal know-how and capability is still on a low level;	validated
		OEMs confirm a positive internal spirit and mindset with regards to digitalization;	new findings
		OEMs do not have sufficient resources in place to execute the digital transformation and in parallel develop a business model innovation; in addition to the capability also the digital skill-set is seen as weak point;	new findings

		Trainings are needed to upskill employees;	new findings
		Digital readiness is seen as prerequisite to ensure a proper transformation process;	new findings
Transformation of the Operating Model	Reshape the operating model: consequently digitalize marketing and sales operations to meet customer demands; this includes digital sales and marketing channels as well as the development of a central customer experience platform;	Reshape the operating model: offer a state of the art multi-channel approach for the customers; transformation will be linked to the new customer demands and new technologies. It can be that virtual show rooms and online platforms will replace the local car dealer network and traditional show rooms. Test drives could be done by e.g. virtual reality solutions in so called service offices; in future we need to convince customers to order a mobility solution - not to buy a car.	validated + new findings
	VW, Mercedes and Audi have started to install virtual show rooms who can replace car dealers in the field;	Develop and use digital marketing and sales tools to support the launch of new products;	validated
		Offer incentives and training offerings to upskill employees - especially the analogue older colleagues.	new findings
		Define new marketing and sales processes based on the digital roadmap (structure follows strategy approach); focus on value creation, value delivery and value capture	new findings
Digital Orchestration	The right orchestration of digital tools and technologies is seen as quite challenging by the research community;	The right orchestration of digital tools and technologies is seen as quite challenging by the research community;	validated
	Due to the used bottom-up approach various island solutions get created which are not interconnected to each other;	Due to the used bottom-up approach various island solutions get created which are not interconnected to each other;	validated

		OEMs make use of digital transformation programs to manage interdependencies between the various tools and applications;	new findings
		Installation of a central customer interaction platform enable a central data management and the possibility to connect new tools and applications;	new findings
		Business Experts do not see cannibalization effects. All of the involved OEMs follow a multi-channel approach where customers can choose e.g. between the various sales funnels; however, the mentioned internal competition around digitalization among the different resorts and departments can potentially lead to negative impacts. OEMs need to be aware of this aspect and need to find ways of corporate solutions;	new findings

Table 2 - Subordinary Research Question 2

The research literature has provided a rather negative picture around the digital readiness of car manufacturers. When comparing the findings with the insights of the interview sessions it got obvious that internal spirit and the mindset of employees toward digitalization is seen as quite positive. The critical aspect around digital readiness is the missing internal know-how and the low number of resources which are allocated to manage the digital transformation approach properly. To achieve the ambitious targets it is extremely important to train and upskill all relevant employees. Additionally it is crucial to orchestrate the digital activities. OEMs have implemented digital transformation programs to coordinate the interdependencies between the different tools and applications.

3. **The third subordinary set of research questions is dedicated to growth aspects and the potential to develop innovative business models based on digital technologies. The following table shows the common aspects of both research methods and in addition the new findings of the qualitative interviews.**

Criteria	Literature Research	Qualitative Interviews with Business Experts	Validation
Major Growth Areas	Gain efficiencies in production process;	Gain efficiencies in production process; Logistics and Supply Chain	validated
	Optimize Marketing and Sales operations;	Major growth areas are seen in Marketing and Sales; focus on customer touch points and a „perfect customer journey“;	validated
		Digital services and functions which are accessable in the vehicle offer the biggest growth potential;	new findings
		The new customer interaction platform where customers can book mobility and transportation services on demand will create new revenue pools	new findings
		Data will be the new asses in future	new findings
Business Model Innovation	OEMs aim to evolve from a product oriented car manufacturer to a customer oriented provider of innovative mobility solutions	OEMs envision a business model innovation for the B-2-C segment to become a mobility provider of choice, providing mobility and transportation as a service; offer functions on demand;	new findings
		In the B-2-B business segment OEMs envision a business model transformation of the existing business model with a fully digitalized operating model;	new findings
		Investigate in new types of vehicles like e-bikes, scooter and drone taxis to create a solution of mixed vehicles dedicated for the future purposes	new findings

Table 3 - Subordinary Research Question 3

The interviewed Business Experts echo the findings of the research society around the need for a business model innovation. Both methods have identified the tendency of OEMs to evolve from a regular car manufacturer to a provider of innovative mobility and service solutions. However, the interview partners have created a more comprehensive picture and have stated that OEMs follow a two-step approach. With regards to the **B-2-C** segment they envision a business model innovation to meet changing customer demands towards new ownership alternatives and mobility as a service concept. Concerning the **B-2-B** segment, OEMs start to transform the existing business model. Their target is to fully digitalize all relevant marketing and sales processes. In particular they aim to provide transport as a service solution to their commercial customers who still buy and own their automotive vehicles in future.

6. Recommendations

The established car manufacturers in the automotive industry need to realize that due to the evolving digital technologies and changing market conditions, the entire automotive value chain gets disrupted. Automotive OEMs need to evolve their value proposition from a car manufacturer to a service provider of innovative mobility solutions. Accordingly to this phenomenon, revenue pools are shifting towards new business models. Growth within traditional markets and customer segments is not a given fact anymore. New mobility solutions, transport as a service offerings and functions on demand are just some examples of revenue pools which will replace traditional revenue pools like after sales services. In future, automotive OEMs need to generate growth from several new sources.

To do so, they need to act fast and explore new types of business models. On this digital journey they need to move in two directions in parallel. On the one hand, they need to evolve from a car manufacturer to a service provider to meet the changing customer demands around car ownership and mobility solutions in the **B-2-C** segment. On the other hand OEMs need to transform their existing business model in the B-2-B segment to a fully digitalized set-up because the topic of car ownership will not significantly change in the commercial segment. **B-2-B** customers will require smart autonomous driving solutions instead.

This is a quite complex move for OEMs. In order to be successful, they need to consequently analyze consumer preferences. Additionally, they need to observe the technological trends and need to find the right cooperation partners across and beyond the automotive industry. This will help to overcome the lack of internal readiness and capability. Such cooperations also help to cover the intensive investment costs to develop and implement new mobility solutions.

To utilize revenues from those new mobility concepts it is important that the mobility concepts are embedded in the right infrastructure. Therefore, it is important for OEMs to engage with governments and stakeholders across other industries.

In parallel, OEMs will need to adopt their internal organization. Internal structures, processes and IT architecture need to be adjusted to the new digital setup. The collection, storage and management of data will play a prominent roll in this regard. It requires also a consequent investment in resources and internal know-how. In order to cover all those investments, OEMs need to plan the right budget and need to follow the right prioritization based on their digital roadmap.

7. Conclusion

Generally, it can be summarized that the digitalization in the automotive industry is by far the most complex topic since the first cars were built 140 years ago. Over decades car manufacturers were focused on the next innovation step in terms of engineering to make the vehicle even more efficient an competitive. The competitive race took place between the car manufacturers directly while focusing on product specific parameters. Henry Ford stated at one point in time with regards to innovations “if I had asked people what they wanted they would have said faster horses!” This statement perfectly describes the traditional way of thinking among the automotive car manufacturers which worked well in the past. Nowadays, market conditions have changed completely. Due to the evolution of digital technologies like mobile devices, customer demand not just a vehicle to drive from A to B but a fully digitalized and interconnected mobility solution. The topic of car ownership has started to change and will dramatically change in the next years to come. This is especially true for new customer groups like the so called „digital natives”.

Innovative mobility concepts will be crucial to meet the new customer demands. New market players like Uber as well as tech. giants like Apple, Google and Amazon have recently identified those trends of changing revenue pools in the automotive industry and have started to investigate into new mobility concepts. Also Tesla with its fully electric vehicles offer integrated digital services embedded in a fully digitalized ecosystem.

In essence the car manufacturers will still continue to develop innovative automotive vehicles. But in future, these vehicles will be equipped with digital technologies and will become a so called IoT (Internet of Things). The way how cars will be introduced and sold to customers will dramatically change thanks to virtual show rooms, digital sales funnels and customer experience platforms. Many customers will no longer own their car but will book a mobility solution on demand.

Car manufactures cannot win the race as single acting organization. They need strong cooperation partners who bring the needed innovation power. Cantena-X was mentioned during the interview sessions by several Business Experts as lighthouse approach where several car manufacturers, tech. giants and IT companies work together in a joint approach to develop a complete new eco-system for future mobility. Such cooperations are crucial to ensure a proper development of interconnected solutions which could not be developed by a single actor.

Only if car manufacturers are fast in consequently implementing their digital strategy, they will be able to participate from these changing revenue pools. As the journey has just started, it will be interesting to observe how the established car manufacturers will utilize the digital technologies for transforming their business model and developing a business model innovation in parallel.

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