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Autonomous Driving and its Disruptive Effects on Business Model Innovation of German OEMs:

Reshaping Business Models Today for the Technology of Tomorrow on the example of BMW: From "*Sheer Driving Pleasure*" to "*Sheer Riding Pleasure*"?

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Abstract.

This thesis investigates the effects of the autonomous driving technology's disruptive character on the BMW brand's business model. Autonomous driving is considered one of the most impactful innovations in terms of disrupting end-consumers' lives as well as car manufacturers' business models. To suggest a potential scenario for BMW, its current business model has been reviewed and two solutions have been proposed based on expert interviews and secondary literature research. It is recommended that BMW should adapt its current business model and introduce a new one offering '(autonomous) mobility as a service' in the premium segment.

Keywords: *Autonomous driving, disruptive innovation, business model innovation, business model canvas, BMW*

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1 List of Abbreviations

ACC	Adaptive Cruise Control
ACES	Autonomous, Connected, Electrified, Shared/Services
AD	Autonomous Driving
ADS	Automated Driving System
aMaaS	autonomous Mobility as a Service
aVaaS	autonomous Vehicle as a Service
BCG	The Boston Consulting Group
BM	Business Model
BMC	Business Model Canvas
BMI	Business Model Innovation
BMW	Bayerische Motorenwerke
GM	General Motors
MADE	Mobility, Automated Driving, Digital Experience, Electrification
MaaS	Mobility as a Service
OEM	Original Equipment Manufacturer
OES	Original Equipment Supplier
PCP	Personal CoPilot
R&D	Research and Development
US	United States of America
SAE	Society of Automobile Engineers

2 Exhibits

Exhibit 1 – BMW's Business Model Canvas (current)

Exhibit 2 – Basic BMs for OEMs in regards to autonomous Mobility as a Service (aMaaS)

Exhibit 3 – BMW's "old" Business Model Canvas (adapted)

Exhibit 4 – BMW's "new" Business Model Canvas (aMaaS)

3 Introduction

"The disruption of the automotive industry derives from the convergence of electrification, automation, and sharing economy". This is a statement from Dr. W. Bernhart, senior partner and global head of automotive at *Roland Berger* (please refer to interview 7 in appendix 9), captured during an expert interview asking whether he thinks that autonomous driving is considered a disruptive innovation. Expectations were a straight answer like *Yes* or *No* in the very beginning. Yet, the topic is not as simply put into context with definitions and theory as assumed. Complex developments occur with such speed that theories and practices are forced to catch up and review themselves continuously. By the end of this paper it is to be determined whether BMW's brand slogan "Sheer Driving Pleasure" will have to be adapted to "Sheer Riding Pleasure" (as a passenger).

3.1 Relevance and Problem

The mentioned speed equally forces companies to adapt and review themselves in terms of operation. "In disruptive and quickly changing environments, seeing the whole picture and acting upon it can be a matter of corporate survival." (Zott & Amit, 2017: 23). Traditional Original Equipment Manufacturers (OEMs) like *BMW*, *Daimler*, *Volkswagen* in Germany, *General Motors* and *Ford* in the United States, and *Toyota* in Japan to name a few major players as well as Original Equipment Suppliers (OES) alike have one thing in common: They will face major disruptions due to autonomous driving technology. As Hill (2018) states, autonomous vehicles present the biggest entrepreneurial opportunity for established brands and disruptive newcomers. In its first issue of *Automotive Disruption Radar* (Berret, Bernhart, Dr., Winterhoff, Seyger, Kirstetter & Riederle, 2017: 3), the authors describe the automotive industry as followed: "Over the last 130 years, the automotive industry has followed a very 'linear' development path. But due to the parallel emergence of the four megatrends **M**obility, **A**utomated driving, **D**igital experience, and **E**lectrification – short MADE – in the last two years, the industry is likely to be reshaped in the next ten to 15 years". Autonomous driving is currently the hottest topic in the mobile society (cf. Gladbach & Richter, 2016: 4, 8) While *Silicon Valley* giants like *Google*, *Apple*, *Tesla* among others are the pioneers in the public

perception, the established and traditional car manufacturers are investing heavily into research in order to keep up with the highly agile tech companies. The race for market share has officially started. According to *Detecon Consulting* (cf. Gladbach & Richter, 2016), especially German OEMs find themselves lagging behind in that race. The opportunities for end-consumers seem vast: mobility for the old and disabled, meaningful use of hundreds of hours lifetime, and saving lives through avoiding traffic accidents to only name the most obvious (cf. Stephan, 2018: 57 f.). The profit for companies is yet to be determined. However, Dr. Wolfgang Bernhart – senior partner and global head of automotive at *Roland Berger* – states that 40% of the automotive profit pool with a rough worth of 350 to 500 billion Euros will be reallocated by 2030. Therefore, Bernhart sees a shift from traditional OEMs to "mobility as a service" (MaaS). Since companies in the automotive sector nowadays feel the pressure to innovate and invest, the need for business model innovation is more relevant than ever. According to the *Boston Consulting Group (BCG)* (Lindgardt, Reeves, Stalk & Deimler, 2009: 3) business model innovation is "especially valuable in times of instability", allowing companies to avoid severe competition and as such the threat of imitation, strategies becoming more congruent, and "sustained advantage is elusive". Beyond *BCG's* statement DeBord (2017) in his *Business Insider* article summarizes the major advantages of both, traditional OEMs and software providers specializing in self-driving technology. "At the moment, the world's automakers are pursuing a blend of in-house self-driving efforts and acquisition efforts. The thinking is that some enthusiastic technology specialists can make rapid progress, free from the bureaucratic layers and distractions that plague big car companies. But those very car companies also have the manufacturing capabilities to bring self-driving cars to market at scale". This comment draws a very detailed picture on what to expect throughout this work ranging from understanding the concept of business models and its innovation, looking at the autonomous driving technology, how *BMW* and incumbent players in this segment handle the progress of the autonomous technology and, ultimately, discussing the effects the evolution might have on a OEM's business models. The final output seeks to merge all

thoughts and findings into two conclusive recommendations for *BMW's* business model, respectively, *BMW's* business model canvas.

3.2 Aim of the Work and Outline

On the one hand, the aim is to find out whether autonomous driving (AD) is in fact disrupting the automotive industry. On the other hand, it is crucial to highlight how traditional OEMs need to adapt and rethink their business models. Specifically, this paper will look at the business model of *Bayerische Motorenwerke Aktiengesellschaft* (*BMW Group*) to discuss business model innovation for established and traditional OEMs. Whenever it is being refereed to the *BMW Group* it includes all the brands owned (*MINI*, *Rolls Royce, Motorrad*) while *BMW* brand is considered the car manufacturing and selling business only. *BMW (Group)* in this work will be acting as representative of the automotive sector and its business model as example to be reviewed. While writing the paper, the author worked at *BMW* for six months in order to gain deep insights about the automotive industry, to connect to different experts in the industry, and to get an understanding about employees' and customers' expectations for decades to come. This work will come across the concept of business models (BM) and its more recent studies and knowledge of business model innovation (BMI) (chapter 4.1), whether in theory (4.1.1) or in practice (4.1.2), as well as a major tool (4.2) currently being applied in multiple situations in the business world. Further, this work will discuss the disruptive character of AD based on the ideas and research of Clayton M. Christensen (5), introduce the methodology of expert interviews (5.1) (please refer to **Appendix 9Appendix 9** for an overview of the main statements of the expert interviews), briefly give an overview of the current status of autonomous technology (5.2) as well as the competitive environment (5.3), and a snapshot of the *BMW Group* (5.4). The implications and results of the interviews as well as of the secondary research findings will be debated in the concluding discussion (6). Finally, this work will propose two recommendations: an adapted version of the current *BMW* business model canvas (BMC) as well as a whole new one (7.1) solely focussing on personal automobiles for the end-consumer and based on 'Business Model Generation' by Alexander Osterwalder and Yves Pigneur (2010). Ultimately, this

paper will provide input for future thoughts and research (7.2). Due to complexity issues, this paper solely focuses on a single BM of the traditional OEM business: the manufacturing and selling of automobiles to end-consumers (B2C) for personal mobility purposes excluding selling (B2B), leasing (B2B/B2C), and renting out (B2B/B2C). The term 'traditional' is used throughout this work to draw a line between established players like *BMW*, *Daimler*, *GM*, *Ford*, and *Toyota* and newcomers to the car manufacturing (e.g. *Tesla*) and automotive mobility solutions industry (e.g. *Uber*).

4 Literature Review

Before diving into the threats and opportunities AD might bring to the traditional competitors of the automotive industry and to technical as well as operational details of the autonomous technology, it is of high importance to develop common ground on the concept of BMs and their innovation (chapter 4.1.), discuss the definitions according to theory (4.1.1) as well as practice (4.1.2), and introduce the business model canvas (4.2) – the tool to draw a situational picture (5.4), discuss the implications (6), and, finally, conclude with two recommended BMCs (7.1).

4.1 Concept of Business Model Innovation

According to Dodgson et al. (2014) the BM has been an increasingly important topic of analysis in innovation studies in the past fifteen years. Further, the authors state in what ways BMs may nurture innovation: on the one hand by being the "vehicle of innovation" through linking new products and technology and on the other hand by being the "source of innovation in and of itself" meaning that it is able to gain momentum and, thus, enhance. But where does the BM actually have its roots? According to Teece (2010: 174) the concept of a BM has no established theoretical grounding in economics. One can say that this implies companies have only unconsciously been using the concept of BM. As reported by Dodgson et al. (2014) the concept is based on four simple dimensions: (1) who the customer is, (2) what the customer wants, (3) how to generate revenues with idea, and (4) how it is possible to manage the costs that come with delivering what the customer wants. For a holistic understanding of the concept, the research requires to distinguish between the creation of new

BMs – the "BM *design*" – and the adaptation or change of existing BMs – the "BM *reconfiguration*" – in order to understand the whole concept. The distinction of these terms helps to draw a line between organizations that are new or established players to the game (cf. Dodgson *et al.*, 2014: 420). The following parts of chapter three seek to dive into the literature talking about BMs and, specifically, BMI where the differences between theory (4.1.1) and practice (chapter 4.1.2) are and how the business model canvas as a tool (4.2) can support the evolution of the automotive business world. To forestall some interview insights, the experts statements coincide on the importance of BMI: Zejnilovic (interview 1, appendix 9) claims that "BMI is key" in terms of profitability, P. Stangner (interview 2, appendix 9) says BMI is "very important" to meet the high expectations of Generations Y and Z, Tschoederich (interview 4, appendix 9) states that BMI is a "decisive factor" to finding a solution where the customer pays for the mobility experience paired with the user world, Faber (interview 6, appendix 9) argues that BMI is "unavoidable" when OEMs need to decide either becoming suppliers to fleet managers, or becoming fleet managers themselves, and Schuermann (interview 8, appendix 9) asserts that it plays a "crucial role" since every OEM needs to find approaches on how to monetize the '*25th hour*' as they refer to it at *Audi*.

4.1.1 Definition according to the Literature

Numerous strategy and innovation experts and theorists have looked into the BM topic from which the concept of BMI emerged as a logic consequence. As a result, numerous definitions for the concept of BMs have been formed. Foss and Saebi (2017) in their recent work on BMs and BMI provide a very detailed collection and overview of the research and as such the definitions that colleagues and precursors have compiled: To differentiate, BM is the "design or architecture of the value creation, delivery, and capture mechanism" of a firm as Teece (2010: 172) stated while "a new source of innovation that complements the traditional subjects of process, product, and organizational innovation" is referred to as the definition of the concept of BMI by Zott et al. (2011: 1032). Since research about BMI has evolved over the last decade, Foss and Saebi (2017) collected a total number of 150 articles about BMI, which have been reviewed by their peers over five years. Due to content

reasons, this paper will not review each and every of the 150 papers, but focuses on the definitions by other scientists and researchers. As Santos et al. (2009: 14) state BMI is "a reconfiguration of activities in the existing BM of a firm that is new to the product service market in which the firm competes". Casadesus-Masanell and Zhu (2013: 464) go even one step further and describe BMI as a mean "to search for new logics of the firm and new ways to create and capture value for its stakeholders; it focuses primarily on finding new ways to generate revenues and define value propositions for customers, suppliers, and partners". Furthermore, Khanagha et al. (2014: 324) mention that "BMI activities can range from incremental changes in individual components of BMs, extension of the existing BM, introduction of parallel BMs, right through disruption of the BM, which may potentially entail replacing the existing model with a fundamentally different one". Concluding from the ideas of researchers, BMI can be seen as the progression of BM, a modification of the status quo towards the intended result. In a nutshell, the BM as the vehicle of innovation is sought to be innovated itself through BMI. The next paragraph (4.1.2) aims to assess the actual application in practice to be able to observe whether the theory in fact finds its implementation.

4.1.2   Definition according to Practice

Besides the theoretical background about BM and BMI, it is crucial to reveal how firms and respective mangers act according to it. Is there any difference to be discovered from the theories found and discussed above? The following chapter will look at hands-on approaches of the consulting business and the corporate world that aim at implementing BMI. There are many examples in history where companies were able to review and as such adapt their BM in order to either stay competitive or simply just to stay alive. One of the most popular examples is Apple between the 1990s and 2001 (please refer to **Appendix 1** for example's detailed information). A *BCG* paper (cf. Lindgardt *et al.*, 2009: 2) describes how certain situations, also in terms of *Apple* in the 90s, require radical actions: "When the game gets tough, change the game" as the source puts it. Regarding this, Lindgardt, Reeves, Stalk, and Deimler elaborate that innovation, disruption, and dislocation lead to quicker and shorter business model lifecycles. Hence, firms need to be the game

changer, not the ones changed by the game. As consequence, it is vital to discover new ways to rethink approaches towards sustaining or regaining competitive advantage and "reigniting growth in this challenging environment" (Lindgardt *et al.*, 2009: 1, 3). In another *BCG* source it is affirmed that in the past 50 years, the average BM lifespan has decreased by about 15 years to less than five. This means that BMI is no longer one of many ways to gain a competitive edge, but it is a necessary core capability to respond to – and capitalize on – a changing world as the *BCG* website (2018) on BMI claims. *BCG* has created its own approach on how to split BMI into components. It is divided into two major dimensions – the *value proposition* and the *operating model*. Additionally, both dimensions are subdivided into three components in order to answer questions for oneself regarding all six components: the value proposition consists of the (1) *target segments* - asking which customers are chosen to be served and which needs are sought to be addressed – the (2) *product or service offering* – requesting what is offered to satisfy the customer's needs – and the (3) *revenue model* – inquiring how the money is actually earned. The operational model, however, is split into the (4) *value chain* – asking how the customer demand is met and delivered and as such what is done internally and what requires external resources – the (5) *cost model* – questioning how assets and costs are deployed in order to meet the value proposition as promised lucrative – and, finally, the (6) *organization* – demanding how employees and partners are positioned to nurture and foster the competitive advantage (cf. Lindgardt *et al.*, 2009: 2 f.). A similar, but most likely simpler approach to take on BMI has been worked out by Alexander Osterwalder and Yves Pigneur (2010: 14) who started from a theoretical point of view applying the gained knowledge into practice. Both outline, "a business model describes the rationale of how an organization creates, delivers, and captures value". They highlight that a BM needs to be understandable and intuitive for everyone in order to simplify the complex structures and functions of enterprises (2010: 15). The authors discuss multiple facets of the BMI process including possible patterns, which companies may choose as a business model (please refer to **Appendix 2** for detailed Patterns Overview). Osterwalder et al. (2010) highly stress the significance of the design and how to build a BM, which is not further elaborated on. Rather, this

work will look at how *BMW's* current BM may be restructured for the battle of market share (cf. Bernhart, Dr., Olschewski, Burkard & Yoon, 2018: 2) in the AD segment that is intensifying according to *BCG*, *Roland Berger*, *Strategy& (PwC)*, *McKinsey* among highly acknowledged others. All in all, BMI is supposed to facilitate the reviewing of a BM in an illustrative and hands-on approach. For this paper the Business Model Canvas introduced by Osterwalder and his colleagues is applied (chapters 4.2, 5.4, and 7.1).

4.2   The Business Model Canvas - A Tool of Business Model Innovation

This section introduces probably the most common tool for companies to apply and visualize their BM yet to adopt the concept of BMI: the Business Model Canvas (BMC). While Osterwalder et al. (2010: 15) describe the BMC as a blueprint for a strategy to be implemented through organizational structures, processes, and systems visualizing the whole concept in nine building blocks (Osterwalder *et al.*, 2010: 16), Dodgson et al. (2014: 432) state that it acts as a graphical framework, which builds up on each other and forms a scaled-down representation (Dodgson *et al.*, 2014: 432) of the discussed concept (click **Appendix 3** for blank visualisation as well as a definitions of each building block). Osterwalder and his colleagues (2010: 48 f) were able to create a model, which mirrors human brain activity. The half being responsible for the logic – in canvas terms the 'efficiency' necessary to operate a business – while the right half controls or triggers the emotions – in canvas terms the 'value' created for the customer. Consequently, the BMC is the ideal tool to shift the perspective towards a more customer-centric approach including environment, daily routines, concerns, and aspirations instead of only investing in market research. This is due to the nine blocks of which each one contributes its purpose to foster the value proposition, ultimately, adding value to the BM. However, a customer-centric approach can not be hold accountable for innovation processes. Innovation can only be truly innovative, if customers understand its value, possibilities, and existence. As one of the great pioneers in the automotive industry, Henry Ford, once said: "If I had asked my customers what they wanted, they would have told me 'a faster horse'". Osterwalder and colleagues bring this quote in line with the methodology of their canvas tool. They see it as a

challenge to recognize which customers to focus on and which customers not to target in order to design a relevant offer. As such they highlight the importance of solely concentrating on existing customer segments and instead try to broaden the horizon on emerging and unexplored segments. Take *DriveNow* as an example: It is a car sharing provider in urban areas, fully owned by the *BMW* (cf. Holder, 2018), which provides *BMW*, *MINI*, and *BMWi* cars and services on-demand without the hassle of owning a car. As such *DriveNow's* BM is established "at the periphery under the incumbent model of traditional car rentals" as Osterwalder and his colleagues (cf. 2010: 128 f.) visualize the explanation on why it may be important to look beyond existing BMs. In conclusion it can be said that the BMC is a helpful tool to push the customer back to the very centre of attention. By analysing what he or she values through a simplified visualization, the focus can be readjusted towards making the customer understand the value added, even though he or she never knew it existed – as such breaking existing patterns through disruptive innovation.

5   Disruption of the Automotive Industry through Autonomous Driving

When the work talks about the innovation of business models, one thing that cannot be avoided is the concept of disruptive innovation. For this work it is specifically interesting since all nine experts interviewed answered that autonomous driving will disrupt both, mobility for end-consumers and how companies in the automotive segment will do business. Faber from *Flixbus* (interview 6, appendix 9) even replied throughout the interview: "The switch from current to autonomous cars will be like the switch from horse-drawn carriages to fuel-powered cars". In order not to anticipate too much, further details of the interviews will be discussed in chapter five. Instead, it is briefly to be determined whether autonomous driving is a sustaining or disruptive innovation (please see **Appendix 5** for an explanation of the two different concepts of innovation). In a nutshell, the autonomous driving technology can neither be described as a pure disruptive nor a sustaining innovation, but an ambivalent one uniting characteristics of both. On the one hand it shows clear attributes of sustaining innovations as described in **Appendix 5** since it is the logic advancement in an evolutionary mobility process. On the other hand it clearly introduces new market foothold by

revolutionizing the way mankind may use mobility as well as the way OEMs earn money. From examples like *Uber* it can already be observed that experts do not always agree on the meaning of disruptive innovation: While Clayton M. Christensen and colleagues (2015) declare *Uber* not to be a disruptive innovation based on their reasoning in the article 'What is Disruptive Innovation?', *Deloitte* Israel (2018) on its website state *Uber* to be one of its favourite examples for disruptive innovation. Since this work's aim is not to evaluate who is right and who is wrong, all the thoughts and practices discussed in this work are based on Clayton M. Christensen's research to simplify the reasoning. The following chapter will lead through the methods used (chapter 5.1), where it stands with autonomous driving (5.2), the competitive landscape in the AD segment (5.3), and how *BMW* fits into that context (5.4).

5.1 Methodology

In order to gain deeper insights into the automotive industry and current trends and developments of the AD technology collected throughout secondary literature research, semi-structured interviews – also referred to as qualitative research interviews (Saunders, Lewis & Thornhill, 2009: 320) – have been conducted as primary research (please also see **Appendix 4** for Porter's 5 Forces of the premium segment within the automotive industry). These types of interviews require a catalogue of questions (please refer to **Appendix 6** for catalogue of questions) still allowing the interviewer to adapt the order of the questions, the questions themselves according to the respondent, or adding further questions if vital for the understanding. In order to collect as many different views on AD and BMI in the automotive sector, a diverse portfolio of nine experts from the consulting, automotive, and other mobility segments have been chosen. All interviewees show great experience in their field of work with most of them being high-ranked executives and managers. The range covers professors for Technology, Strategy, and Digital Transformation at *Nova SBE*, a Senior Partner and Global Head of Automotive at *Roland Berger*, a former Senior Partner at *Ernst & Young*, a Managing Partner at *LITS ebusiness*, a Principal Automotive at *Capgemini*, a Brand & Communications Manger at *BMW*, a Head of Brand & Communications at *DriveNow*, a Product Manager Connected

Car at *Audi*, and a M&A and Business Development Manager at *Flixbus*. The results of the interviews are discussed in chapter six while the following paragraphs provide some basic understanding vital for an effective discussion as well as recommendations.

5.2   The Evolution of Autonomous Driving – A Status Quo

To be able to put the AD technology into context, this chapter gives an overview of the different levels towards full AD as defined by the *Society of Automobile Engineers (SAE)* from a practical driving point of view. The *SEA* divides autonomous driving into six stages, stage zero being 'no automation' and stage five being 'full automation'. The four levels in between describe the stages of increased support of automated driving systems (ADS) throughout which the driver continuously reduces his or her actions or engagement in the actual driving process (please refer to **Appendix 7** for detailed definitions and level of involvement of either driver or ADS). Furthermore, Litman (cf. 2018: 4) states that Level One to Three still require a licensed driver, whilst Levels Four and Five enable driverless operation, which is key for predicted benefits as well as of great importance for current developments and innovations in the automotive industry. Equally, *BMW* differentiates between five levels of automation (excluding 'No Automation') in order to inform consumers about the characteristics of AD (please refer to **Appendix 8** for detailed illustration). Based on the same website and based on the interview with one of *BMW's* Brand & Communication Managers in charge of autonomous efforts, *BMW* currently offers automation Levels One and Two in its current fleet with Levels Three, Four, and Five industry-wide being tested. Interestingly, all of the experts agree that AD will become mainstream, even though the time horizons in which it supposed to happen slightly varies between five years but no later than by year 2030 (please refer to **Appendix 9** for interview statements). According to the *BMW* employee, whose name will remain disclosed, *BMW* will offer Level Three AD by 2021 (interview 3, appendix 9). Tschoederich (interview 4, appendix 9), Bernhart (interview 7, appendix 9), Schuerrmann (interview 8, appendix 9), and P. Stangner (interview 2, appendix 9) expect autonomous mobility to be on the roads by 2023-2025. P. Stangner additionally points out that the time horizons named are not to be considered for the

German market as he considers it to be a (late) follower. All other experts give it ten to twelve years to arrive to our streets. However, the authors of a *McKinsey* article (Wee & Bertoncello, 2015) on the 'AD revolution' from June 2015, argue that neither of them may be right – at least from a point of view back in 2015. The article shows a possible roadmap for the automotive industry for the time ahead (please refer to **Appendix 10** for a depiction of 'The self-driving vehicle revolution'). Without judging the accuracy of the source, this comparison of the points of view over just three years shows how unbelievably fast the progress is occurring. In conclusion, it can be observed on an annual basis how developments advance and as such change the forecasts bringing AD even quicker and sooner to the streets. We may experience that AD advances exponentially as new breakthroughs are achieved (please also refer to **Appendix 11** for a Porter's 5 Forces analysis of the AD segment).

5.3   Competitive Environment – The Automotive Landscape

To take up again the subject matter of the automotive (r)evolution, this paragraph discusses the efforts and the progress *BMW's* competitors are making in order to position themselves in order to succeed in the battle for market share in the autonomous segment. The choice of competitors was based on Bernhart's (2018) article, which he will publish in July 2018 and kindly gave access to prior to the publication. Throughout that special issue for a German automotive-technical magazine, Bernhart compares the competition by country on a global scale, which is why this is not discussed in more detail (please see **Appendix 12**). However, the graph compares OEM activities from nine countries for availability of functions in serial vehicles and the stage of development for serial as well as prototype vehicles. Interestingly, Germany according to *Roland Berger* is currently the front-runner when it comes to autonomous functions already in use followed by the US and Japan. The graph has been recreated for this paper and added in the appendix for reference. Fact is that OEMs fear the speed of incumbents shoving into the AD segment. Consequently, OEMs push towards acquisitions, investments, tests, partnerships, and the introduction of new technologies and products. In the U.S. OEM it can be observed that *General Motors (GM)* acquired *Cruise Automation*, *Fiat Chrysler Automobiles* found a new partner in *Google/Alphabet's Waymo*, and Ford just invested an

incredible amount of $1 billion in *Argo AI*, which is start-up in the field of machine learning (cf. DeBord, 2017). European OEMs such as *Daimler* partnered up with *Bosch* testing "RoboCaps" (Edelstein, 2018) after its announcement back in 2014 to test its autonomous *Car2Go* fleet in California, US (Hucko, 2014). *VW Group* is mainly focussing on its truck divisions on the one side partnering with *Hino Motors* and *Toyota* for research matters (Kageyama, 2018) and on the other side creating a new software development unit (Alkhalisi, 2018). *VW Group's* affiliate *Porsche* – like *Ford* – invested into the Israeli artificial intelligence (AI) start-up *Anagog* (Globes, 2018) while *Audi* announced a service that allows its vehicles to communicate with traffic lights further boosting connected car offerings in the mobility service segment (Gitlin, 2018). *Volvo* with its value proposition to have the safest cars teamed up with *Uber* providing the hardware for fully autonomous vehicles both companies aim to create together (JDM Group, 2018). In the Asian market *Toyota* is the frontrunner when it comes to AD efforts: it joined "forces with *JapanTaxi*, *KDDI Corporation*, and *Accenture* to start piloting artificial intelligence-based taxi dispatch support system" (Automotive World, 2018) as well as a technology allowing inter-vehicle communication (Seppala, 2018). However, the industry is continuously facing setbacks deriving from vehicles equipped with AD technology involved in traffic accidents. The most famous examples are the ones from *Tesla* and *Toyota* resulting in the suspension of tests in *Toyota's* case (BBC News, 2018) and in decreasing trust of the public into the new technology. Apart from the manufacturers, *Uber*, *Lyft*, and *DiDi* have been stirring up the mobility industry with its ride sharing offers. Up until today ride sharing stood out with a "superior user experience, a digital-only strategy, and bypassing of regulations" (Ottoson, 2018). Yet, to be successful in the long-term companies in that segment need to vertically integrate and increase capital investments, which the ride sharing companies are not prepared to do according to Ottoson (2018). All these actions show that there is a lot of movement in that segment. Focussing solely on German OEMs with a side-glance to the non-OEM competitors, *BMW's* efforts and actions are evaluated in the next paragraph (5.4) as well as the subsequent discussion of the interview results (chapter six).

5.4   BMW – Internal Analysis and Current Efforts in Autonomous Driving

So, how does the premium car-manufacturing brand BMW with a 102-year-old history fit into that picture? This chapter will give a snapshot on the whole BMW Group since the annual report is not split up for every brand the group owns. According to the annual report published on April 21, 2018, the BMW Group's workforce showed a number of almost 130,000 employees at the end of 2017, which indicates a growth rate of 4,2% to the previous year and a constant growth over the last years. In addition, the BMW Group delivered almost 2.5 million cars in 2017 of which almost 2.1 million alone are BMW cars. This accounts for grown deliveries of 4.2% to the previous year and to the years prior to 2017 (BMW Group 2017, p.4). The Group reached a new record high with profit before taxes (EBT) of over €10.6 billion marking a change of over 10% to 2016 of which almost €8.7 billion account for the automotive segment (2017, p.5). As of now – and most likely for another three to five years – the numerical effects on the AD segment are only visible in the R&D expenses. BMW is pushing the topic behind closed doors with increasing R&D investments of €6,108 million, an increase of 18.3% versus 2016 (BMW Group, 2018a: 33). Harald Krueger (2017, p.19), CEO of the BMW Group, exemplifies the road ahead for the *BMW Group* in the Annual Report 2017 by stating that "progress is not possible without change. Change is a constant in all of our lives. The BMW Group charts its own course – with innovation, determination and foresight". Consequently, BMW introduced its new *ACES* – short for **A**utonomous, **C**onnected, **E**lectrified, and **S**hared/**S**ervices (BMW Group, 2018b: 3) – strategy as part of the *Strategy Number One > Next*. Krueger (2017, p.22) elaborates that AD is the future and *BMW Group* is stepping up its game by opening a new campus for autonomous driving, just outside Munich, in spring 2018 together with *Intel* and *Mobileye*. Based on the CEO's statement, this paper aims to reveal *BMW's* AD actions by applying the BMC. In order to do so, *BMW's* current BMC has been designed (please refer to chapter **4.2** and **Appendix 3** for introduction of the BMC). Due to content purposes and since *BMW* cars account for the major share of sales of the *BMW Group* (2.1 million cars out of 2.5 million overall), this paper focuses solely on the BM for *BMW* brand cars.

Exhibit 1 – *BMW's* Business Model Canvas (current)

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segment
- Supply Chain Partners (around 100 network suppliers globally *Brembo, Thyssen-Krupp, BorgWarner, Elringklingler, Bridgestone,* and *Mahle* among the biggest) - IT Companies (5G connectivity, security, IoT, big data) - Other OEMs (e.g. *Daimler, Toyota*) - Visionaries like Klaus Froehlich (Member of the Board and Head of Development Division) - Dealership	- Sales, Marketing, Production - Driving Experience - Electrification of Cars - Development of Future Mobility Solutions - Services **Key Resources** - *BMW* Brand - Patents - *Global Leader Development Programme* (Recruiting) - 31 production and assembly plants - 16 R&D locations - 43 subsidiaries and financial services locations	- Premium - Ultimate Driving Experience ("Sheer Driving Pleasure") - Sportiness & Design - 1, 2, 3, 4, 5, 6, 7, 8, X, M Series - Fully electric i3, SUV concept, and i8 (Hybrid) - Connected Drive: reaching destination in time and comfort incl. parking and charging - Stop&Go function - Remote Services (locate car, lock/unlock, comfort) - iNext	- Love Brand as Emotional Hook - Premium Customer Services & CRM - Driver Assistance **Channels** - Dealership - Online Rental Booking - 3rd Party Mobility Providers (e.g. *DriveNow*) - Showrooms (*BMW* World and museum) - Motor shows (e.g. Geneva) and fairs (e.g. IAA in Frankfurt)	- Performance-driven, quality-minded people - Urbanities and conscious people (sports, lifestyle)

Cost Structure		Revenue Structure	
- Production - Sales & Marketing - Research & Development	- Innovation (e.g. Autonomous Driving Campus) - People Training	- New Car Sales - Used Car Sales - Car Leasing	- Aftersales - Service & Maintenance - Rental - Digital Services

BMW's current BM of selling personal vehicles to end-consumers is shown in **Exhibit One**. The BMC has been created based on the primary and secondary research as well as from insights throughout the author's internship at *BMW*. From the expert interviews conducted with a *BMW* employee in *BMW's* marketing and communication department in its headquarters in Munich, some more detailed insights were gained according to which BMW currently offers Level Two AD (Intelligent Driving, Intelligent Vision, and Intelligent Parking[1]) aiming to offer Level Three by 2021. Namely, "*BMW* will introduce a test-fleet of about 400 BMW *iNext* vehicles in Barcelona and Toronto," says the brand and communication manager, whose name remains disclosed due to internal corporate guidelines. The *iNext* project is *BMW's* new product line originated from the *Next 100-*concept revealed throughout its centenary celebrations in 2016. *iNext* fully electric vehicles will start production in 2021 equipped with Level Three autonomous driving technology (Boeriu, 2017). On April 6, 2018 *BMW* started publicly communicating the *BMW i3 Personal CoPilot* (PCP). "Designed to show how fully automated driving technology can transform the future face of personal mobility, the *i3 PCP* has been equipped with an autonomous driving system that enables the car to drive itself" as the author outlines. From some of *BMW's* very recent activities it can be identified that a major

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[1] https://www.bmw.co.uk/bmw-ownership/connecteddrive/driver-assistance

resource was added to its portfolio – the already mentioned *Autonomous Driving Campus* outside Munich, which opened its doors just recently, on April 12, 2018. *BMW's* press release (BMW Group, 2018c) reveals that the decision to open the campus has been made 15 months ago in order to bundle *BMW's* and its partner's development expertise in the fields of vehicle connectivity and highly/fully automated driving at one single location. The campus provides space for 1,800 employees and is built closely to the Research and Innovation Centre as well as the nearby motorway network. On site, smaller and more agile teams work towards new mobility solutions independently from the corporation's structures. Simultaneously, *BMW* builds a database together with Intel for up to 500 petabyte[2] of autonomous test results (cf. Stephan, 2018: 56 ff.). Summing up, *BMW's* points of parity with the competition seem to be persistent with striving to lead in the AD segment. Returning to the remarks of chapter 5.3 it can be identified that BMW is equally making efforts like the competition: investing in R&D (18.3% more than in 2016) innovation (autonomous driving campus) and redefining itself (*ACES* strategy as part of *iNext*), working to extend its ecosystem by finding new partners (Intel and Mobile Eye), enlarging the product range of its electrified fleet (iNext fleet), and performing tests to collect data for AD (iNext fleet). As such it is stated that BMW seems to be geared up to fight for market share in the AD segment. Based on all these insights and the following discussion in chapter six, *BMW's* current BMC is on the one hand has been adapted in order to identify possible solutions to manufacture and sell autonomous cars in the future, while a second BM has been proposed seeking to offer autonomous mobility as a service (aMaaS).

6   Discussion

Chapter six discusses how *BMW* can adapt its current BMC in order to reveal how the brand can evolve in the future. Prior, this chapter will evaluate and compare as well as discuss the statements of the interviewees. Besides the disruptive character of AD, threats and opportunities for OEMs resulting from the AD technology, the importance of speed and time within that segment, the potential for OEMs to introduce new BMs, this chapter will asses and interpret which OEM or

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[2] 1 petabyte = 1 quadrillion byte

company has a clear advantage in comparison to others. Despite the fact that the literature review in chapter three revealed that AD technology is not a disruptive, but either a combination of "sustaining or evolutionary" and "disruptive or revolutionary" innovation as a result of mobility evolution, all interviewees view AD as a true disruptive innovation. Proportionately, all nine interviewees agree that AD will intervene and change mobility so drastically, especially when it comes to OEM's current revenue streams that both theoretical definition and facts regarding sustaining and disruptive innovation do not live up to the actual extent of AD's power to change everything. In that context, Tschoederich (interview 4, appendix 9) notes that OEMs will not only experience a major disruption of its current business, but they must also face that AD will intervene in every single process and structure. Bernhart (interview 7, appendix 9) identifies the source of disruption to be a different one. He says that disruption comes from the convergence of electrification, automation, and the sharing economy. All in all, one can say that the disruptive effect on the automotive segment will be multidimensional. In addition, threats and opportunities were discussed with the interviewees. The most mentioned threats were legal issues (Tschoederich, *BMW* employee, K-H Stangner) and new as well as increased competition (Zejnilovic, Schuermann, K-H. Stangner). While governments currently evaluate the legal issues connected with technical, infrastructural as well as ethical subject, this will presumably take more time for some highly bureaucratic nations than in more innovation-driven countries. Moreover, it will be crucial to observe the developments in e.g. the European Union, where regulations will require agreements across country members. However, competition plays a superior and dynamic role for *BMW* and direct competitors, especially when it comes to their BMs, because it forces to differentiate from incumbents and construct new revenue streams. The threat of competition in the opinions of two experts may embody the chance to differentiate faster according to Zejnilovic (interview 1, appendix 9) as well as a significant increase of the total size of the mobility market according to Faber (interview 6, appendix 9), ultimately, leading to a market expansion several OEMs may be able to benefit from if correctly implemented and positioned. Another strength of OEMs, especially against new entrants from the technology sector, is experience,

know-how, and the ability to deliver a safe and reliable product for different demands of global markets. As such Schuermann argues that (premium-) OEMs do not necessarily need to be the first ones to introduce AD technology. This is due to the sustainably gained trust over decades on which customers can rely when the product is finally introduced to the market. Based on the statements, one can say that threats can be transformed into opportunities and strengths need to be exploited in order to gain clear advantages against new entrants from other industries in the automotive industry. Due to BMI's importance, all interviewees have been asked about OEM's go-to-market strategies in terms of BMI. The inertia within the ecosystem of OEMs does not allow sudden change as Zejnilovic (please refer to interview 1) points out, while P. Stangner (interview 2, appendix 9) argues that a two-step-approach may be a promising way to overcome inertia: the "old" BM of selling cars (which finances the next steps) will adapt slowly, the "new" BM needs to be creative approaching technology with a new and agile mind-set. Organizational structures need to be reshaped in order to not react, but proactively act to rapidly changing market developments. Looking at the actual ideas towards new BMs in the autonomous vehicle, Zejnilovic (please refer to interview 1, appendix 9) identifies the 'trend of services' to be a decisive factor. Consequently, three interviewees (P. Stangner, *BMW* employee, Schuermann) suggested media content, advertising, and shopping as potential services to be the new revenue streams after self-driving has been eradicated. The data collected in terms of consumption of content (e.g. *Netflix*) during the drive, may even allow OEMs to enter the big data segment. In more general terms, Faber (please refer to interview 6, appendix 9) expects BMs to become more intermodal and asset-light while Zejnilovic and Tschoederich question whether the value of ownership for masses could decrease implying that transaction- or user-based services may become the BM-weapon of choice. Howsoever, these new BMs may look like they can or even must be set up from scratch in order to implement tenets and avoid mistakes of the "old" BM. **Exhibit Two** shows an overview on how this "new" BM could look like. The exhibit is based on the findings Bernhart (Bernhart, Dr., 2018) will publish in July 2018. It can be observed that *BMW* potentially has the resources and capabilities to take on any of the four basic BMs.

Exhibit 2 – Basic BMs for OEMs in regards to autonomous Mobility as a Service (aMaaS)

	Vehicle Manufacturing	"Autonomous Vehicle as a Service" (aVaaS)	Mobility as a Service (MaaS) 'Exclusive & Premium'	Mobility as a Service (MaaS) 'Mainstream'
Target Group	> aMaaS-Operator **UBER DiDi lyft**	> aMaaS-Operator **UBER DiDi lyft**	> Sophisticated and demanding end-consumers; vehicle for exclusive use	> Price-sensitive end-consumers; vehicle for shared or exclusive use
Performance Promise	> **Low-priced products** > Vehicles with high **quality** and **life cycle, efficient** and **service-oriented**	> Vehicles with high **quality** and **life cycle, efficient** and **service-oriented** > **Efficient fleet management** > Guaranteed **availability**	> 'Premium' product/ service: **brand differentiation** > **Quick, convenient, anytime, anywhere** > Vehicle **interior, speed, additional services**	> High amount of **coverage** > High **density** of vehicles, short waiting times > **Convenient booking** and payment > **Appealing prices**
Potential Competitors	> Foxxconn, LG Group, etc.	> Transdev, Siemens, etc.	> ...?	> Big aMaaS-operators
Activities	> **Manufacturing of RoboCaps** > No involvement in fleet services	> **Manufacturing** of RoboCaps, additionally 'White Label'-**fleet service with guaranteed level of service** (e.g. availability) for e.g. cities	> **Premium-vehicle'** as central product, additional premium-service-package incl. **premium aMaaS-offer** (comp. to Apple-BM)	> **Efficient aMaaS** as central product > **Manufacturing** of own RoboCaps
Revenue Streams	> Sales of products (single vehicle sale) to operator	> Usage fee by kilometer/hour to operator	> Income from product and service (sale or rental + usage fee)	> Pay-as-you-go (usage fee by kilometer)

As a manufacturer of hardware and the move into mobility solutions with *DriveNow* paired with its recent efforts as discussed, *BMW* is set to compete. Based on the interviewees' statements and secondary research, the conclusion will sum up what has been done throughout the paper and recommend two approaches *BMW* should undertake towards its new BMs.

7   Conclusions

The paper came across multiple suggestions on how to react to the disruptive character of the AD technology. Interview experts as well as secondary sources agreed that it will be crucial to answer to the challenge of quicker innovation cycles from the tech industry against long product life cycles of the automotive industry. Increased agility, boosted decision-making processes, leaner hierarchies and structures, and reduced time-to-market were the buzzwords that have been mentioned. It can be finally concluded that the concept of BMI will facilitate these changes. The solution for *BMW* will be to further reshape its or "old" BM and simultaneously create "new" one. This conclusive chapter will give the finishing recommendations and have a brief outlook into future research.

7.1   Recommendations

After primary and secondary research this work project concludes with two recommendations in form of two different BMCs for *BMW* to implement. The adaptations of the "old" model as initially presented in Exhibit One are shown in **Exhibit Three**, which is supposed to provide the capital required for the "new" BM positioned as 'aMaaS' in the premium segment and presented in **Exhibit Four** (all adaptations are marked bold and in colour).

Exhibit 3 – BMW's "old" Business Model Canvas (adapted)

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segment
- Supply Chain Partners (around 100 network suppliers globally - Tech Companies (5G connectivity, security, IoT, big data, AI, sensors) - Other OEMs (e.g. *Daimler, Toyota*) - Dealership - **Software providers (Apple, Google, etc.)** - **Mobility Solution Companies companies (e.g. *Uber, Lyft, DiDi*)** - **Ecosystem Partners**	- Sales, Marketing, Production - Driving Experience - Development of Future Mobility Solutions - Services - **Extending Ecosystem** **Key Resources** - *BMW* Brand - Patents - *Global Leader Development Programme* (Recruiting) - *BMW* **Ecosystem incl. manufacturing facilities, supplier network, and affiliates**	- Premium - Ultimate Driving Experience ("Sheer Driving Pleasure") - Sportiness & Design - 1, 2, 3, 4, 5, 6, 7, 8, X, M Series - Fully electric i3, SUV, and i8 (Hybrid) - iNext - **Level 3 AD from 2021** - **Level 4 AD from 2025** - **Level 5 AD from 2030**	- Love Brand as Emotional Hook - Premium Customer Services & CRM - Driver Assistance - **Over-the-air updates of outdated software and safety packages** **Channels** - Dealership - 3rd Party Mobility Providers - Showrooms (*BMW* World and museum) - Motor shows and fairs - **Online Retail**	- Performance-driven, quality-minded people - Urbanities and conscious people (sports, lifestyle)

Cost Structure		Revenue Structure	
- Production - Sales & Marketing - Research & Development (e.g.	Autonomous Driving Campus) - Innovation (e.g. Level 3 AD) - People Training	- New Car Sales - Used Car Sales - Car Leasing	- Aftersales - Service & Maintenance - Digital Services

Exhibit 4 – BMW's "new" Business Model Canvas (aMaaS)

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segment
- Tech Companies (5G connectivity, security, IoT, big data, sensors, AI) - *BMW* **(as manufacturer of vehicles)** - **Mobility Solution Companies companies (e.g. *Uber, Lyft, DiDi*)** - **Software providers (*Apple, Google*, etc.)**	- Marketing & Sales - Development of Future Mobility Solutions - **Riding Experience** - **Services** **Key Resources** - *BMW* Brand - Patents - *Global Leader Development Programme* (Recruiting) - **Autonomous Driving Campus** - **Ecosystem Partners**	- Design - Quality (Premium & Exclusivity - **autonomous Mobility as a Service (aMaaS)** - **Ultimate Riding Experience ("Sheer Riding Pleasure")** - **Speed & Convenience** - **Anywhere, anytime** - **Additional services (Concierge, Self-parking, entertainment, in-car shopping, media content)** - **Level 5 AD**	- Premium Customer Services & CRM - **Brand differentiation** - **24/7 Assistance** - **Over-the-air updates of outdated software and safety packages** **Channels** - **Direct Sales (online/ offline)** - **(a)MaaS Platform (incl. App)** - **Tech partners' platforms**	- **Career-driven**, quality-minded people - Urbanities and conscious people (lifestyle) - **Premium service-oriented** - **Dependence on speed and convenience of service** - **No vacancy for self-driving** - **Chauffeur services**

Cost Structure		Revenue Structure	
- Marketing & Sales - Research & Development - Exploration	- Innovation - People Training	- Service & Maintenance - Aftersales - **Vehicle sales to fleet operators**	- **Vehicle leasing to fleet operators** - **Usage fee per use (kilometer/time)** - **Big data**

From Exhibit Two, column three (MaaS Exclusive & Premium) it has been analysed that no competitor has currently occupied this segment. Hence, the choice for the "new" BM is made in favour of aMaaS in the premium segment since *BMW* is already present there (please refer to exhibits three and four for in-depth details). The term "autonomous" is still considered under reserve since the evaluation of the interviews revealed AD to take another ten to 15 years. However, the focus needs to be put on advancing the technology. Additionally, both BMs can be implemented already and simultaneously and be modified as the technology advances. Both BMs can co-exist, enhancing each other by implementing newly created, more agile, and leaner processes and structures. Confidently it can be said that BMW's brand slogan "Sheer Driving Pleasure" will have to be reviewed and eventually be replaced by the suggested slogan in the title of this work: "Sheer Riding Pleasure".

7.2   Suggestions and Final Thoughts for Further Research

Throughout the research for this paper one came across questions that may feed discussions for future thoughts. One of the major concerns is governmental involvement and regulations as all interviews show. The policy in Europe and Germany is required to act in threefold means: first, stronger incentives for education and training in the field of artificial intelligence are required. Second, a boosted implementation of regulatory parameters is necessary. And third, coherent innovation policies and –funding across the automotive industry need to take place. Personally, I came to the conclusion that *BMW* along other big established OEMs are in the most promising position to succeed in the autonomous driving segment in the long run. This is due to centuries of hard work, generated expertise, accumulated experience, and the potential ability to disrupt themselves and, continuously, being able to finance new operations with their traditional business model. Maybe the longer and slower product-life- and innovation cycles are not so bad after all. The disruption will occur, but probably much later than anticipated. Currently, we see new technologies, products, and innovations emerging in rapid speed. The future holds exciting developments, not only for the automotive industry, but also for our everyday lives. We live in an era, where *BMW* and others write history for mobility solutions in the future. To conclude, this accounts for true disruptive character.

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9 Appendices

Appendix 1 – Business Model Innovation on the example of Apple

Between the late 1990s and 2001, Apple launched a bunch of new products that became very successful after failing to create both, hardware and software, at a competitive price within its niche. It can be observed how BMI actions may speed up the internal innovation process and may lead to outperforming incumbents. Together with the help of its product innovation – the iTunes online music service and its iPod and iPhone products that formed the basis of the ecosystem is has created today – and its music download BM, Apple disrupted a whole industry and laid the foundation of its future successes.

Source: (cf. Lindgardt *et al.*, 2009: 2).

Appendix 2 – Patterns Overview

Source: (Osterwalder *et al.*, 2010: 118 f.)

	Context (Before)	Challenge	Solution (After)	Rationale	Examples
Unbundling Business Model	An integrated model combines infrastructure management, product innovation, and customer relationships under one roof	Costs are too high. Several conflicting organizational cultures are combined in a single entity, resulting in undesirable trade-offs.	The business is unbundled into three separate but complementary models dealing with infrastructure management, product innovation, and customer relationship	IT and management tool improvements allow separating and coordinating different business models at lower cost, thus eliminating undesirable trade-offs	Private Banking Mobile Telco
The Long Tail	The value proposition targets only the most profitable clients	Targeting less profitable segments with specific value propositions is too costly	The new or additional value proposition targets a large number of historically less profitable, niche customer segments – which in aggregate are profitable	IT and operations management improvements allow delivering tailored value propositions to a very large number of new customers at low cost	Publishing Industry (Lulu.com) LEGO
Multi-Sided Platforms	One value proposition targets one customer segment	Enterprise fails to acquire potential new customers who are interested in gaining access to a company's existing customer base (e.g. game developers who want to reach console users)	A value propositions "giving access" to a company's existing customer segment is added (e.g. a game console manufacturer provides software developers with access to its users)	An intermediary operating a platform between two or more customer segments adds revenue streams to the initial model	Google; Video game consoles from Nintendo, Sony, Microsoft; Apple iPod, iTunes, iPhone
Free as a Business Model	A high-value, high-cost value proposition is offered to paying customers only	The high price dissuades customers.	Several value propositions are offered to different customer segments with different revenue streams, one of them being free-of-charge (or very low cost)	Non-paying customer segments are subsidized by paying customers in order to attract the maximum number of users	Advertising, Newspapers, Metro, Flickr, Open Source, Red Hat, Skype (versus Telco), Gillette (Razor/blades)
Open Business Models	R&D resources and key activities are concentrated in-house: ideas are invented "inside" only and results are exploited "inside" only	R&D is costly and/or productivity is falling	Internal R&D resources and activities are leveraged by utilizing outside partners; Internal R&D results are transformed into a value proposition and offered to interested customer segments	Acquiring R&D from external sources can be less expensive, resulting in faster time-to-market; unexploited innovations have the potential to bring in more revenue when sold outside	Proctor & Gamble GlaxoSmithKline Innocentive

Appendix 3 – Business Model Canvas

Key Partners	Key Activities	Value Proposition	Customer Relationship	Customer Segment
	Key Resources		Channels	
Cost Structure			Revenue Structure	

"The *Customer Segments* (CS) building block defines the different groups of people or organizations an enterprise aims to reach and serve" (Osterwalder *et al.*, 2010: 20).

"The *Value Propositions* (VP) building block describes the bundle of products and services that create value for a specific Customer Segment" (Osterwalder *et al.*, 2010: 22).

"The *Channels* (CH) building block describes how a company communicates with and reaches its Customer Segments to deliver a Value Proposition" (Osterwalder *et al.*, 2010: 26).

"The *Customer Relationships* (CR) building block describes the types of relationships a company establishes with specific Customer Segments" (Osterwalder *et al.*, 2010: 28).

"The *Revenue Streams* (R$) building block represents the cash a company generates from each Customer Segment (costs must be subtracted from revenues to create earnings)" (Osterwalder *et al.*, 2010: 30).

"The *Key Resources* (KR) building blockdescribes the most important assets required to make a business model work" (Osterwalder *et al.*, 2010: 34).

"The *Key Activities* (KA) building block describes the most important things a company must do to make its business model work" (Osterwalder *et al.*, 2010: 36).

"The *Key Partnerships* (KP) building block describes the network of suppliers and partners that make the business model work" (Osterwalder *et al.*, 2010: 38).

"The Cost Structure (C$) describes all costs incurred to operate a business model" (Osterwalder *et al.*, 2010: 40).

Appendix 4 – Porter's 5 Forces – Automotive Industry, Premium Segment

Porter's 5 Forces.   Automotive Industry – Premium Segment, Germany.

**Threat of New Entry
LOW**
- High investments required
- High level of competition from existing brands
- Brand image and reputation
- Governmental regulations
- High safety and quality requirements
- Economies of scale
- Economies of scope

- High exit barriers
- Few competitors (BMW, Daimler, Audi)
- Moderately high customer loyalty
- Huge market size (489 billion Euros, Statista 2017)

**Threat of Substitution
MEDIUM**

**Degree of Rivalry
VERY HIGH**

**Buyer Power
MODERATELY HIGH**

- High prestige and convenience levels
- High costs for maintenance
- Several cheaper ways of transportation (public transport, car sharing)

- Moderate price sensitivity
- Low switching costs for fleet customers
- Low threat of backward integration
- High expectations in terms of quality

**Supplier Power
LOW**

- Low switching costs
- Low threat of forward integration
- Few big players

Michael E. Porter, 1979. *Harvard Business Review.*
https://www.cheshnotes.com/automotive-industry-five-forces-analysis/.

Appendix 5 – The Concepts of Sustaining and Disruptive Innovation

"Sustaining Innovation seeks to improve existing products. Meaning, it does not create new markets or values, but rather merely develop existing ones." (Deloittte Israel, 2018)

→ Characteristics:

- Maintains trajectory of **performance improvement** established in a market
- Gives customers **more and better** of the **attributes** they value

Disruptive Innovation as defined by Clayton M. Christensen (Christensen, 2016; Christensen *et al.*, 2015):

Disruptive innovation is originated in **low-end** or **new-market footholds**, and it is an innovation that describes a process whereby a **smaller company** with fewer resources is able to **successfully challenge established incumbent businesses**.

→ Characteristics:

- Introduces **different** packages of **attributes** to a market than the ones currently valued by mainstream customers

THE DISRUPTIVE INNOVATION MODEL

This diagram contrasts *product performance trajectories* (the red lines showing how products or services improve over time) with *customer demand trajectories* (the blue lines showing customers' willingness to pay for performance). As incumbent companies introduce higher-quality products or services (upper red line) to satisfy the high end of the market (where profitability is highest), they overshoot the needs of low-end customers and many mainstream customers. This leaves an opening for entrants to find footholds in the less-profitable segments that incumbents are neglecting. Entrants on a disruptive trajectory (lower red line) improve the performance of their offerings and move upmarket (where profitability is highest for them, too) and challenge the dominance of the incumbents.

(cf. Christensen *et al.*, 2015: 7)

Appendix 6 – Catalogue of Questions

1) Do you consider the autonomous driving technology a disruptive innovation? Why?
2) In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?
3) Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?
4) What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?
5) Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?
6) What new business models do you think will arise from the change that the AV-technology will come along with?
7) Where do you currently see the greatest potential or need for OEMs to review their business models? Why?
8) From your perception, which OEM (German and international) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?

Appendix 7 – Automated Driving Levels (SAE 2014)

Source: (based on Exhibit 1, Litman, 2018: 4)

SAE* Level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Models)
Human driver monitors the driving environment						
0	No Automation	the full-time performance by the human driver of all aspects of the dynamic-driving task, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the driving mode-specific execution by a driver assistance system of either steering or acceleration/ deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	Human driver and system	Human driver	Human driver	Some driving models
2	Partial Automation	the driving mode-specific execution by one or more driver assistance sstems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the human driver perform all remaining aspects of the dynamic driving task	**System**	Human driver	Human driver	Some driving models
Automated driving system ("system") monitors the driving environment						
3	Conditional Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene	System	**System**	Human driver	Some driving models
4	High Automation	the driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene	System	System	**System**	Some driving models
5	Full Automation	the full-time performance by an automated driving system of all aspects of the dynamic driving task under all roadway and environment conditions that can be managed by a human driver	System	System	System	**All driving models**

* SAE - The Society of Automobile Engineers

Appendix 8 – BMW's Five Levels of Autonomous Driving

Source: https://www.bmw.com/en/automotive-life/autonomous-driving.html

01 Driver Assistance: driver assistance systems support the driver, but do not take control.

02 Partly Automated Driving: systems can also take control, but the driver remains responsible for operating the vehicle.

03 Highly Automated Driving: in certain situations, the driver can disengage from the driving for extended periods of time.

04 Fully Automated Driving: the vehicle drives independently most of the time. The driver must remain able to drive, but can, for example, take a nap.

05 Full Automation: the vehicle assumes all driving functions, the people in the vehicle are only passengers.

Appendix 9 – The Main Statement of the Interviews

1. Leid Zejnilovic, Prof. Technology Strategy at Nova SBE; 25.03., 16:00 – 16:40

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	**YES**, AV will disrupt - How users think of our role in traffic - Perception of mobility and their role in our life - How the integration of AI will be accomplished
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	Opportunities: differentiate more and faster from the competition Threats: opportunity for technology companies to enter the automotive market and take a piece of the cake
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**, and there is no return from it (example of algorithms used at wall street - AI) - Autonomous driving partly exists already - **Scale is not going to represent a problem** - Level 5 still questionable due to legal system - Mainstream **level 5** AD in **10 years** depending on the density of competition
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	BMI is key and being aware of the change of the BM - OEMs need to be careful not to get run over by the competition and take their position in the food chain - **Importance for OEMs to achieve higher profitability** in order to boost innovation efforts - With the current BM: next 10-15 years OEMs will have their place but will just not going to have that much money
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	Depending on the time horizon you look at, it will rather develop slowly and steadily like in the last 15 years - Dramatic changes will appear afterwards - **BM shifts to subscription models** facilitated by AD - Shifts in ownership - Car is outdated by the time you purchase it (development-wise) - **Inertia in the ecosystem will not allow a sudden change**
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	- **Value of ownership for masses will decrease** - Vital to create and capture value - BMW and the **trend of services** - Review of the **maintenance** and **financial services** BM (greatest margins)
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	Need: - Understanding the customer - **Agility to address the shifting needs of the customers** - **Designing platforms that adjusts easily without huge investments for the OEMs to respond to the changing needs** - **Modularizing platforms allow to change the modules of your offer according to needs** - Price sensitivity Potential: - OEMs currently lack of the skill technology support - Adoption chasm

From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	The ones with the best **complementary assets** will win the race - Major market share vs. major benefit of the technology - Incumbents in the best position to catch up quickly

2. Philip Stangner, <u>Head of Brand & Communications at DriveNow</u>, 27.03., 20:00 – 20:30

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	**YES**, the way we think about and use mobility as well as the automotive industry - AV will sooner or later change the way how we as consumers get from A to B - **Shift towards mobility as a service** due to convenience - Broad mass will make use of **sharing economy** to save money
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	Threats: - Brands/products will fall in significance for mobility choice - Customers will want to move in the fastest, cheapest, most convenient way - **Value of brands will matter less while functionality gain in significance → brand positioning has to be reviewed** Opportunities: - High chances that OEMs will become an **alternative for public transport** and as such activate new customers - Mobility solutions and AD may **open up** e.g. BMW **to more price-sensitive customers**
Extra Question: Functionality and price sensitivity vs. Premium segment - which is to survive?	Brands will play less of a factor when choosing mobility, so in return BMW/Daimler will have to get into a price fight with Nissan and others eventually resulting in premium becoming niche
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**, it will become mainstream: - Timing depends on the global solutions in ethical and moral regards → how to address ethical issues on whether to hit the grandmother or the group of children when there is need to avoid an accident - **German market will be a (late) follower** - **2025 for full AV** more realistic than 2022 which a few OEMs currently propose
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	Very important: - OEMs need to adapt to **shorter innovation cycles** especially in terms of BM with the "new kids on the block" like Tesla, NEO (electric car manufacturer in China) - Customers' needs are changing faster than ever on many levels → **Gen Y/Z** who grow up with these technologies and as such have **high expectations** as well as **changing views on ownership of assets**
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the	In order to keep up the sales of cars it will be a two-step approach: currently cars are still sold to customers. At the same time OEMs need to **start a new/second BM, which dives deeper into service and software platforms** in order to keep

increasing speed of tech companies' innovation cycles? Why?	up with mobility providers. For the moment it is much less about the car but how to increase convenience for the customers. While the "old" BM, which finances the next steps, will adapt slowly, the "new" BM needs to be creative approaching technology with a whole new mindset meaning that **organizational structures** need to be reshaped to increase the speed with which to answer to market trends.
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	**Media and advertising** industry could benefit from it. The focus on driving will be shifted to working, socializing, and consuming media channels. With the trends as we consume media now this could open a new stream. BMW can profit from that through **relevant content** asking themselves what is consumed, what is he or she influenced by and as such **collect this data to create new revenue streams**. For **suppliers** this can mean to be cutting on the cost.
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	OEMs should start to appeal to software solutions (apps or human interfaces) with their products. Mass mobility will quickly adapt to those customers needs. **Digitalization** is key to further gain market share.
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	**Tesla** since they are **able to get the same resources as traditional OEMs, just in slimmer organizations and operations** (smaller capacity in terms of people). Tesla may have the same third party suppliers such as Bosch, Siemens etc. and the same know-how. Tesla is one step ahead when it comes to **speed in terms of decision-making, processes, and creating** something new, being **braver** and **bolder**. Additionally, the **location** may play a role as e.g. Tesla's HQ is located in **Silicon Valley with close proximity to Apple and Google who might move together solve the problem of staffing and human capability**
Extra Question: Where do you see DriveNow in that whole evolution?	DriveNow will be the **platform** where OEMs can offer their products and where end-consumers book an autonomous vehicle further improving convenience and the way people get from A to B for an affordable price

3. **Undisclosed, <u>Brand & Communications Manager at BMW AG</u>, 29.03., 16:30 – 17:00 (translated from German)**

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	**YES**, even though AV according to the theory is an **evolutionary innovation** emerging from driving assistance systems as progress → However, it is disruptive in terms of - Societal effects - Disposing the risk of human error - New BM opportunities
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	**Threats:** legal issues and permissions for **AD-testing** (level 3 functions like traffic assistant legally not permitted yet in Europe); bringing the technology up to a standard at which **trust and reliability issues** are solved; BMW engineers are critical about introducing higher levels of AV-technology to the streets; laser technology has to be further developed
Do you think fully autonomous	**YES**, BMW is currently offering level 2 (partly automated)

driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	and will offer level 3 AV-technology from **2021** onwards; everything beyond that is **still to be determined**, however, BMW will introduce a **test-fleet of about 400 BMW iNext vehicles**; from a personal point of view BMW has to go with the changes and developments and finally offer level 5 AV-technology (check *BMW co-pilots* from 6.4. onwards), however, BMW has **not yet communicated** anything in that regard; currently global appearance with level 5 showcase experience in Barcelona and Vancouver → use case: i3 can be ordered to pick up the passenger; digital touch points with the car, which authorizes the passenger to enter the vehicle; within the car itself the passenger can take over the wheel at any time over a "start right/pause right"-button
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	**No statement** because BMW's management board has not yet defined the next steps and business cases
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	Due to the **size of BMW's structure** we will not see any short-term changes in terms of agility and dynamics, however, the **engineering department is currently working intensely on solutions** according to which agility and dynamics can be boosted and as such react to trends of the industry; OEMs themselves do not necessarily need to adapt to the speed of tech companies due to the **history of longer lasting product cycles** but also **higher quality** and **safety reasons**; longer times of testing to sustain and further increase the safety
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	BMW could be a **provider of (media) content** (e.g. Netflix); several possibilities to use the gained time for working, leisure time, activities; such BMs are **currently under screening**
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	Trends of the 102-year old history have been exploited and used as a **source of innovation**; options that need to be taken into account: **changes in shifts of ownership**, **increased offer of shared driving**
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	BMW will only offer certain technologies to customers until they are - absolutely and without any doubt - **safe**; in comparison to that, **Tesla, seems to be playing with its customers' lives in order to push the technology into the market**; trust has to be built slowly and steadily; 2021 BMW iNext is the first step towards building trust; reliability and safety are still the major key for customers to trust into BMW (**Key words: self-determination, safety, freedom**)

4. **Sebastian Tschoederich**, <u>Principal Automotive Digital at Capgemini Consulting</u>, 06.04., 18:30 – 19:00 (translated from German)

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	**YES**, because OEMs will experience heavy changes; OEMs will see a shift **from selling cars to selling mobility**; new ideas on how to spend the gained time (entertainment, working, sleeping); **business as well as technology disruption**
In your opinion, what are the threats	<u>Threats:</u> **technical** (car crashes/how close can you get to avoid

and opportunities for OEMs in regards to autonomous driving? Why?	incidents) and **governmental** issues Opportunities: **selling an experience on how to spend the time while using mobility**
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**; from a technical perspective it is already possible; in about **5 years** we will see autonomous **mobility**; plus another **15 years to become mainstream**
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	BMI as a **decisive factor** on whether the OEM will be **relevant** in the future; **revenue streams**: selling new/used cars/leasing/ aftersales/connected and digital services/financial services; shifts in ownership; **challenge:** finding a solution **where the customer pays for the mobility experience paired with the user world**
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	**Return curve/duration**; convinced that the required BMs do not exist within the next year, which grants the OEMs some more time (advantage for them); but on the other side it is essential to understand the **customer needs and to test these** sooner than later; **cooperation** with third parties (Wi-Fi, etc.) meaning to **open up the ecosystem**; extending of the ecosystem; until these revenue streams are in place preparations have to be met now in order to be capable of acting when the time has come
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	From the end-consumer point of view: Do I actually need to **own** a car? What **value** does it add while it is not being used? On-demand model only? → **Basis for OEM**, which requires a **platform** over which such services are offered either via a **partnership** or offered **by OEM** itself (preferably); **transaction- or user-based services (mobility flat rate)**
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	Interesting **logistic BMs** for OEMs, which are not based on the end consumer centric but rather on the **supply chain** → how to best maintain your fleet (**predictive maintenance**) in order to have the most effective fleet; **matchmaker-approach for the topic: from B2C to B2B** → involving third parties decreases revenue
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	Hard to tell and I **currently do not see an answer** to that; you could either tell who is driving longest, safest, furthest from a technical point of view, or offers of a digital platform or mobility experience; I **do not see any OEM that offers the whole package**; however, I see an interesting approach by **BMW and Daimler** who announced a **partnership** of their mobility services these two are the **frontrunners in the German segment** before Volkswagen and Opel → not due to their technical abilities or BMs, but **due to their mobility offerings in multiple segments**

5. **David Bernardo, Prof. Digital Strategy and Transformation & Managing Partner at LITS ebusiness, 09.04., 18:15 – 18:40**

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive	**YES**, disrupting our life in terms of mobility

	innovation? Why?	

Questions	Answers
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	Opportunities: several things: remote work, possibility of having aerial vehicles, shared driving - high impact on real estate and cities, sharing economy, reduced need for parking and space, less traffic; work remotely, location- independent, connectivity; insurance-related issues; societal effects: truck driver in US biggest employer Threats: reduction in ownership
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**; accidents more or less than human error; **within next decade**; legal and ethical issues (website); 2nd amendment: right to drive a car
Extra Question:	Critical mass: slow evolution, progressively
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	Not innovating enough; electric cars behind the curve; digital transformation;
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	Trying to catch up even though highly regulated industry; startups being suppliers or being acquired as such main drivers of industry; evolution;
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	Insurance, sharing economy, aerial vehicles (drones) for personal usage
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	The way OEMs sell cars or a transportation service; buying a mobility solution not a product; switching between models, rest is waste due to standing around (privately); Uber Jump; end-to-end transportation solution
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	Tesla taking lead to grow market share; disruption of Tesla by incumbents, Daimler owns part of Tesla

6. Nicolas Faber, M&A and Business Development at Flixbus, 12.04., 20:30 – 21:00

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	**YES**; Defining disruption as an innovation that creates new markets and products, and destroys existing markets and products, I believe that autonomous driving technology is definitely a disruptive innovation. The **consensus among the industry appears to be that the switch from current to autonomous cars will be like the switch from horse-drawn carriages to fuel-powered cars**, which would certainly count as disruptive
In your opinion, what are the threats	Threat: Becoming a **commodity provider** of hardware, which

and opportunities for OEMs in regards to autonomous driving? Why?	has historically been a **lower margin business** than being a customer-facing OEM; Opportunity: Autonomous driving enables entirely new business models and, when implemented correctly, might **increase the total size of the mobility market significantly vs. today**. Such a market expansion could certainly benefit OEMs
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES;** Very limited knowledge about this, but from what I know level 4/5 autonomous driving is technically on the verge of being possible, but far away from being mainstream from a social and regulatory perspective. My best guess is **2030** for when it will become mainstream
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	I believe that the current business model of OEMs, **selling cars to private persons and companies**, will become **obsolete** in the long run and be replaced by **large-scale car ownership of fleet companies, who provide on-demand mobility services to customers and use the created data to optimize these services** à hence, OEMs can decide to either become **suppliers** to these fleet managers, or **become** these **fleet managers** themselves – either way, business model innovation will be unavoidable
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	A bit of both. I don't believe that cars are comparable to phones and TVs in terms of development times and costs (due to regulations, safety requirements, etc.), hence I believe that the **"fail fast" approach of the tech industry** will not translate completely to the car industry. However, as more of the value creation in mobility happens in software rather than hardware, the innovations cycles in the car industry will have to shorten dramatically
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	My best guess of the future of the mobility market is a market where personal mobility is much more **intermodal**, and **asset-light** from a consumer point of view, than today. This means that **OEMs will not sell to consumers** anymore, but rather to **fleet managers** who manage a range of autonomous vehicles (cars for short distances and for affluent consumers, busses for less affluent consumers and longer distances); Given this new setup, there will be a range of business models, with one company potentially occupying a number of them: Manufacturer: Building and developing autonomous vehicles, definitely from a hardware perspective, also from a software perspective Fleet manager; Customer facing entity which manages a fleet of autonomous vehicles with the goal of maximizing revenue through the highest possible **fleet utilization and yield**. Also plays a part in software development due to amount of data collected; Compared to the current value chain, the biggest business models that are **disappearing** are those of **suppliers** (done by manufacturers, far fewer components in electric cars), **car dealerships** and **maintenance** shops (both done by fleet manager)
Where do you currently see the greatest potential or need for OEMs to	As mentioned above, I'm not sure that all OEMs have made a decision on what part of the value chain to occupy in the

	future. Everyone wants to be a fleet manager, but given the **network effects** in this space, it seems very unlikely that everyone will succeed. OEMs should have an honest look at their **competitive advantages** and see where they can act **profitably in the value chain** of the future. For some this might mean becoming a **white labeler**, or specialized supplier, of mobility companies
review their business models? Why?	
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	**GM:** Good progress in production and business model, roll-out in 2019; **Mercedes:** technically very advanced with autonomous driving technology, but questions around willingness to adapt business model; **Tesla:** Integrated hardware and software company (Apple model), high ambitions but also significant risk of running out of cash before realizing vision
Extra Question:	**Flixbus** is currently assessing how AD may affect its business model; medium-term aim is to electrify fleet (buses); completely dependent on OEMs - currently pushing OEMs to intensify R&D on electrification of buses

7. **Wolfgang Bernhart, Global Head of Automotive and Senior Partner at Roland Berger, 13.04.2018, 18:15 – 19:00**

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	Private ownership of vehicles is shifting torwards B2B models; disruptive effect does not come from the automation of the vehicles but from the perspective of use of the vehicles (from exclusive to sharing); **disruption comes from convergence of electrification automation and sharing economy**
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**, From a regional perspective: from 2020/21 iPace, Waymo and others which are able to drive in certain test areas already and we will see other companies which will offer it by **2023/24/25**; Within in the coming decade automated driving will be available in greater numbers; comparison to the horse-drawn carriage: it took many years after the carriage became mechanical before we actually got an automobile → as such automated driving could develop
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	Uber, myTaxi, Apple, Huawai; **comparison to airline business**: no aircraft manufacturer (after Howard Hughes' TWA) runs an airline itself; airline equipment built in by third party; engines are paid by time of use
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	**Slowly**; OEMs are used to thinking growth on an annual basis, while the **IT/tech industry is used to exponential growth**; vehicle generations take place over 10-15 years; regulatory circumstances; OEMs depend on the development of cities/infrastructure; perspective of time plays a role since automotive development has been exponential, too, if compared to time horizons of hundreds or even thousands of years
What new business models do you think will arise from the change that the autonomous driving technology	**Need to limit to one business model: SELLING to end-customers and fleet customers** (ab 35:00); CEO agenda

will come along with?	
Extra Question: Shift of ownership	Careful with such a statement: **ownership trends highly depend on global regions** (China: car as a status symbol, Scandinavia: cost of upkeep too expensive -> sharing economy with shift of status symbols
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	Is it one of the current players? -> to be discussed; Daimler currently with very few vehicles on the road; GM by 2019 2,000 vehicles; Waymo by 2021 several thousand -> accumulating test kilometers on the roads will be key to succeed

8. Lorenzo Schuermann, <u>Product Manager Connected Car at Audi AG</u>, 30.04., 13:00 – 13:30

Questions	Answers (excerpt of the main statements)
Do you consider the autonomous driving technology a disruptive innovation? Why?	Autonomous driving technology will change the whole automotive industry and offer opportunities for new players in the market to **rise against the established OEMs**. I hence consider it to be a disruptive technology.
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	**Threats:** OEMs will face new competitors which are highly experienced in providing complex software solutions and often have strong financial backups, such as Waymo (Google) or Uber. As a result, OEMs may loose the race towards Level 4/5 autonomous driving and find themselves in the position of a hardware supplier, witch significantly lower margins. **Opportunities:** Thanks to decades of experience, OEMs developed a strong know-how in developing and testing the complex system "car" under various conditions around the globe in order to deliver a save and reliable product. As a result, OEMs may not be the first ones who introduce autonomous driving technology, but the ones with the reliable technology customers worldwide are more willing to trust.
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	**YES**, eventually autonomous driving will become mainstream, however it strongly depends on the respective markets, as the local infrastructure as well as legal framework have a huge impact on the possible progress. As for the leading countries USA and China, I expect **Level 4 from 2025** and **Level 5 from 2030** to become reality on the streets. This assumption is based on current announcements made by diverse OEMs, which say that the **development is not proceeding as quickly as expected.**
What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?	Business model innovation in the context of autonomous driving plays a crucial role. **Every OEM needs to find approaches on how to monetize the "25th hour", as we call it within Audi**. In addition to the new leisure time within the car, which could be used for example for **new advertisement concepts**, the focus on smart mobility solutions based on fully autonomous vehicles will be pivotal in the future.
Are the OEMs' business models	In my opinion we will face a **slow and steady evolvement** in

going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	the next years, as autonomous driving technology will not be able to quickly penetrate the market right away. This is due to the **high costs** at the beginning and **limited use cases** (e.g. only on the highway). **Once there is a Level 5 available on a relevant scale, the speed of evolvement may increase dramatically as this opens endless opportunities for third party companies to build business models** on that platform.
What new business models do you think will arise from the change that the autonomous driving technology will come along with?	First, there will be a rise of business models, which are based on the fact, that people do no longer need to drive and hence have time to do something else: for example **shopping**. So I think we will face more and more possibilities to experience **shopping within the car as well as exposure to advertisements**. Second, the availability of fully autonomous cars (Level 5) will lead to many new shared-mobility offerings.
Where do you currently see the greatest potential or need for OEMs to review their business models? Why?	Considering fully autonomous driving (Level 5) will still take a lot of time to become reality, OEMs should **focus first on ways to exploit Level 4 use cases**, such as a multiple hour highway drive. Possible approaches are **entertainment offerings**, as well as **access to Online Shopping** within the car. Also, offering relevant **advertisement (for example based on the local position)** could be an option.
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	I'd say the **Volkswagen Group** has the most promising position in the long term. Even though there are definitely faster moving and more aggressive competitors such as Tesla, Volkswagen can **faster roll out a new technology thanks to the huge market share in the automotive sector and diverse offering (volume, premium, super-premium)**.

9. Karl-Heinz Stangner, former Senior Partner at Ernst & Young, 04.04., 15:00 – 15:30

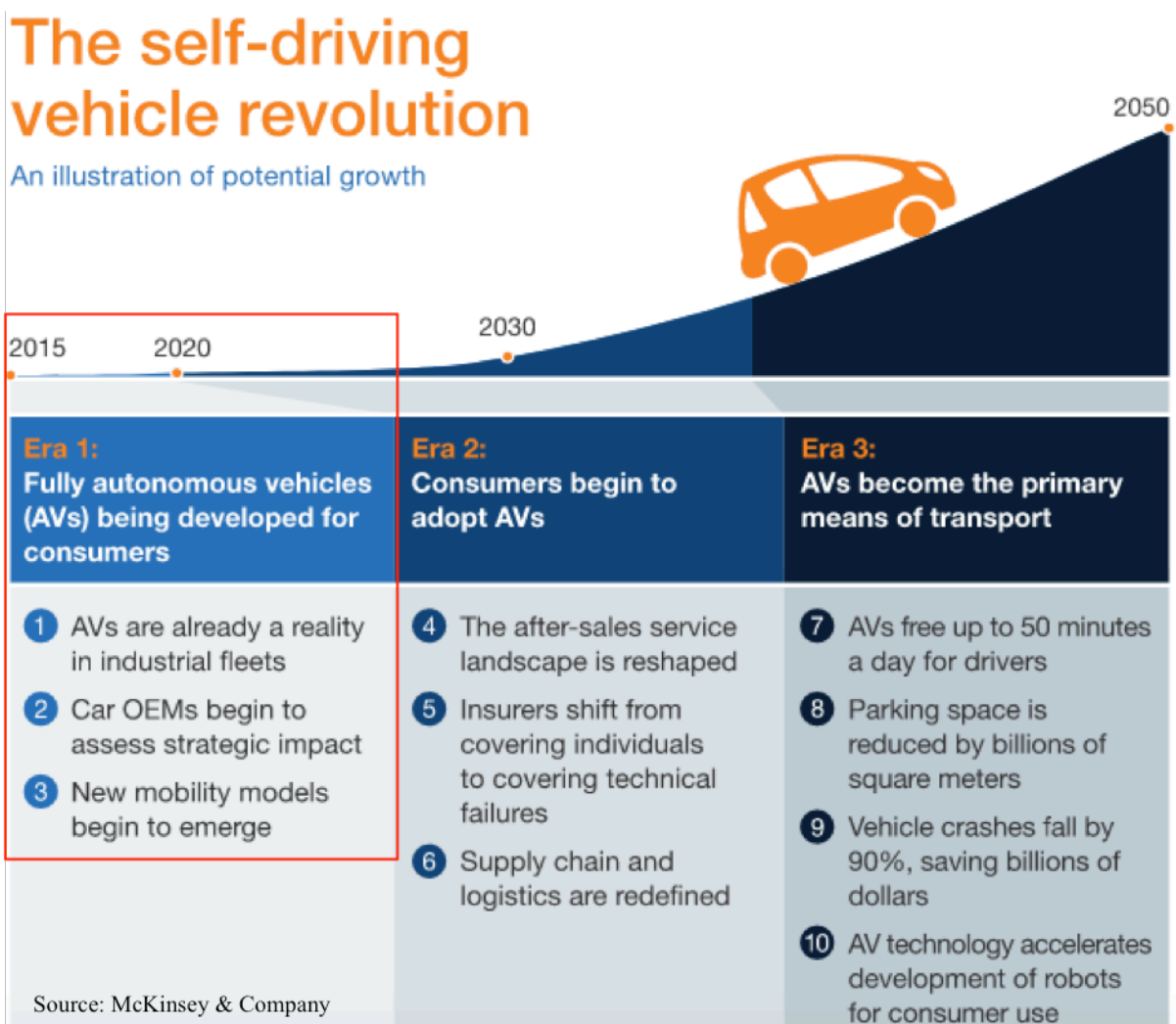| **Questions**	**Answers (excerpt of the main statements)**
Do you consider the autonomous driving technology a disruptive innovation? Why?	**Yes**, it is a change in driving behavior and its technology
In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?	Threats: **Environmental** issues, increased **traffic**, increased **competition** from other mobility providers such as train, etc. Opportunities: Because of the **financial power** they have to be always a frontrunner in technology change also by buying other technology-driving companies
Do you think fully autonomous driving (level 4/5) will become mainstream and if so in what time frame do you expect it to do so? Why?	I do not believe autonomous driving will be ready for the market within the next **10 years**
Are the OEMs' business models going to change dramatically and suddenly or are they going to evolve slowly and steadily considering the increasing speed of tech companies' innovation cycles? Why?	They have to **outsource** and **implement centers of excellence** in order to cope with the speed of other newcomers (e.g. Tesla, Google, etc.) I think the change process has already begun and **speed will increase consistently**

What new business models do you think will arise from the change that the autonomous driving technology will come along with?	I think AD-technology will require **complex mobility packages** consisting not only of the hardware and software but also risk covering such as **insurance**, **financial modeling** etc.
From your perception, which OEM (German and globally) do you currently see in the most promising position to gain a major market share in the autonomous driving segment? Why?	I don't know, due to lack of inside information

Appendix 10   – The Self-Driving Vehicle Revolution

The self-driving vehicle revolution

An illustration of potential growth

2050

2030

2015   2020

Era 1:
Fully autonomous vehicles (AVs) being developed for consumers

1. AVs are already a reality in industrial fleets
2. Car OEMs begin to assess strategic impact
3. New mobility models begin to emerge

Era 2:
Consumers begin to adopt AVs

4. The after-sales service landscape is reshaped
5. Insurers shift from covering individuals to covering technical failures
6. Supply chain and logistics are redefined

Era 3:
AVs become the primary means of transport

7. AVs free up to 50 minutes a day for drivers
8. Parking space is reduced by billions of square meters
9. Vehicle crashes fall by 90%, saving billions of dollars
10. AV technology accelerates development of robots for consumer use

Source: McKinsey & Company

Appendix 11 - Porter's 5 Forces analysis of the AD segment

Porter's 5 Forces.

Autonomous Driving Segment.

Threat of New Entry LOW
- Very few players from automotive and tech industry
- All players dispose of huge cash in reserve
- Short innovation cycles

- High capital requirements
- Expertise in soft- (IT, AI, etc.) and hardware (vehicle) required
- High governmental regulations
- High quality and safety requirements
- High requirements for trust from consumers
- Intense battle for market share
- Immense amount of data collection through tests
- High speed of innovation

Threat of Substitution LOW

Degree of Rivalry HIGH

Buyer Power LOW

- Autonomous public transport in short- and long-haul travelling (buses, trains)
- Public transport in short- and long-haul travelling (planes, buses, trains)

- Few players that dictate market and prices
- Limited offer
- Early adopters phase of the S-Curve with level 3 being implemented in the coming years

Supplier Power HIGH

- Very few players
- Most players still in development or testing phase

Michael E. Porter, 1979. *Harvard Business Review.*

Appendix 12 – Index "Automatisierte Fahrzeuge" Q4/2017: Functional Availability and Stage of Development of Automated Vehicles on an International Basis

(Bernhart, Dr., 2018; Bernhart, Dr. *et al.*, 2018)

OEM ACTIVITIES

COUNTRIES

High availability of automated driving functions in almost all vehicles categories; introduction of level 3 automation

Increasing dissemination of automated driving functions (e.g. traffic assistant, park assistant) in premium vehicles and SUVs

Focusing on specific functions (ACC Stop & Go with steering assistant, emergency brake assistant), instead broad offering in all vehicle categories

Increasing availability of automated driving function in the past year leading towards a significantly improved position in the market

FUNCTIONAL AVAILABILITY (serial)

STAGE OF DEVELOPMENT (serial & prototype)

Source: Roland Berger

Declaration of Honor

I do solemnly declare that I prepared this thesis independently and that the thoughts taken directly or indirectly from other sources are indicated accordingly. This work has not been submitted to any other examination authority and further not yet been published.

Munich, May 23, 2018

Moritz Guertler