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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
**Table of Contents**

1 List of Abbreviations ............................................................................................................. 4

2 Exhibits ................................................................................................................................... 4

3 Introduction ............................................................................................................................ 5
   3.1 Relevance and Problem .................................................................................................... 5
   3.2 Aim of the Work and Outline .......................................................................................... 7

4 Literature Review ................................................................................................................... 8
   4.1 Concept of Business Model Innovation .......................................................................... 8
      4.1.1 Definition according to the Literature ...................................................................... 9
      4.1.2 Definition according to Practice ............................................................................. 10
   4.2 The Business Model Canvas - A Tool of Business Model Innovation ......................... 12

5 Disruption of the Automotive Industry through Autonomous Driving ................................ 13
   5.1 Methodology .................................................................................................................... 14
   5.2 The Evolution of Autonomous Driving – A Status Quo .................................................. 15
   5.3 Competitive Environment – The Automotive Landscape .............................................. 16
   5.4 BMW – Internal Analysis and Current Efforts in Autonomous Driving ....................... 18

6 Discussion .............................................................................................................................. 20

7 Conclusions .......................................................................................................................... 23
   7.1 Recommendations .......................................................................................................... 24
   7.2 Suggestions and Final Thoughts for Further Research ................................................... 25

8 References .............................................................................................................................. 26

9 Appendices ............................................................................................................................ 29
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 Mobility, Automated driving, Digital experience, and Electrification – 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 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 focusing 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 SAE 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 focusing 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).
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 Autonomous, Connected, Electrified, and Shared/Services (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.
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

\(^2\) 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)

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

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)

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Proposition</th>
<th>Customer Relationship</th>
<th>Customer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Supply Chain Partners</td>
<td>- Sales, Marketing, Production</td>
<td>- Premium</td>
<td>- LOVE Brand as Emotional Hook</td>
<td>- Performance-driven,</td>
</tr>
<tr>
<td>(around 100 network suppliers globally)</td>
<td>- Driving Experience</td>
<td>- Ultimate Driving Experience (“Sheer Driving Pleasure”)</td>
<td>- Premium Customer Services &amp; CRM</td>
<td>quality-minded people</td>
</tr>
<tr>
<td>- Tech Companies (5G connectivity, security, IoT, big data, AI, sensors)</td>
<td>- Development of Future Mobility Solutions</td>
<td>- Sportiness &amp; Design</td>
<td>- Driver Assistance</td>
<td>- Urbanities and conscious</td>
</tr>
<tr>
<td>- Other OEMs (e.g. Daimler, Toyota)</td>
<td>- Services</td>
<td>- 1, 2, 3, 4, 5, 6, 7, 8, X, M Series</td>
<td>- Over-the-air updates of outdated software and safety packages</td>
<td>people (sports, lifestyle)</td>
</tr>
<tr>
<td>- Dealership</td>
<td>- Extending Ecosystem</td>
<td>- Fully electric i3, SUV, and i8 (Hybrid)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Software providers (Apple, Google, etc.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mobility Solution</td>
<td></td>
<td>- (Next)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Companies companies (e.g. Uber, Lyft, DiDi)</td>
<td></td>
<td>- Level 3 AD from 2021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Ecosystem Partners</td>
<td></td>
<td>- Level 4 AD from 2025</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Level 5 AD from 2030</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exhibit 4 – BMW’s “new” Business Model Canvas (aMaas)

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Proposition</th>
<th>Customer Relationship</th>
<th>Customer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Tech Companies (5G</td>
<td>- Marketing &amp; Sales</td>
<td>- Design</td>
<td>- Premium Customer Services &amp; CRM</td>
<td>- Career-driven, quality-minded</td>
</tr>
<tr>
<td>connectivity, security, IoT,</td>
<td>- Development of Future Mobility Solutions</td>
<td>- Quality (Premium &amp; Exclusivity)</td>
<td></td>
<td>people (lifestyle)</td>
</tr>
<tr>
<td>big data, AI, sensors)</td>
<td>- Riding Experience</td>
<td>- autonomous Mobility as a Service (aMaas)</td>
<td></td>
<td>- Premium service-oriented</td>
</tr>
<tr>
<td>- BMW (as manufacturer of vehicles)</td>
<td>- Services</td>
<td>- Ultimate Riding Experience (“Sheer Riding Pleasure”)</td>
<td></td>
<td>- Dependence on speed and convenience of service</td>
</tr>
<tr>
<td>- Mobility Solution Companies companies (e.g. Uber, Lyft, DiDi)</td>
<td></td>
<td>- Speed &amp; Convenience</td>
<td></td>
<td>- No vacancy for self-driving</td>
</tr>
<tr>
<td>- Software providers (Apple, Google, etc.)</td>
<td></td>
<td>- Anywhere, anytime</td>
<td></td>
<td>- Chauffeur services</td>
</tr>
</tbody>
</table>

Exhibit 3 – BMW’s “old” Business Model Canvas (adapted)

<table>
<thead>
<tr>
<th>Cost Structure</th>
<th>Revenue Structure</th>
<th>Customer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Production</td>
<td>- New Car Sales</td>
<td>- Performance-driven,</td>
</tr>
<tr>
<td>- Sales &amp; Marketing</td>
<td>- Used Car Sales</td>
<td>quality-minded people</td>
</tr>
<tr>
<td>- Research &amp; Development (e.g.</td>
<td>- Car Leasing</td>
<td>- Urbanities and conscious</td>
</tr>
<tr>
<td></td>
<td></td>
<td>people (sports, lifestyle)</td>
</tr>
</tbody>
</table>

Exhibit 4 – BMW’s “new” Business Model Canvas (aMaas)

<table>
<thead>
<tr>
<th>Cost Structure</th>
<th>Revenue Structure</th>
<th>Customer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Marketing &amp; Sales</td>
<td>- Vehicle leasing to fleet operators</td>
<td>- Career-driven, quality-minded</td>
</tr>
<tr>
<td>- Research &amp; Development</td>
<td>- Aftersales</td>
<td>people (lifestyle)</td>
</tr>
<tr>
<td>- Exploration</td>
<td>- Usage fee per use (kilometer/time)</td>
<td>- Premium service-oriented</td>
</tr>
<tr>
<td></td>
<td>- Big data</td>
<td>- Dependence on speed and convenience of service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No vacancy for self-driving</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Chauffeur services</td>
</tr>
</tbody>
</table>

24
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.
8 References


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.)

<table>
<thead>
<tr>
<th>Unbundling Business Model</th>
<th>Context (Before)</th>
<th>Challenge</th>
<th>Solution (After)</th>
<th>Rationale</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>An integrated model combines infrastructure management, product innovation, and customer relationships under one roof</td>
<td>Costs are too high. Several conflicting organizational cultures are combined in a single entity, resulting in undesirable trade-offs.</td>
<td>The business is unbundled into three separate but complementary models dealing with infrastructure management, product innovation, and customer relationship</td>
<td>IT and management tool improvements allow separating and coordinating different business models at lower cost, thus eliminating undesirable trade-offs</td>
<td>Private Banking, Mobile Telco</td>
<td></td>
</tr>
</tbody>
</table>

| 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 proposition “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) | 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 (Razer/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 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

Source: https://strategyzer.com/canvas/business-model-canvas / (Osterwalder et al., 2010: 18 ff.)

<table>
<thead>
<tr>
<th>Key Partners</th>
<th>Key Activities</th>
<th>Value Proposition</th>
<th>Customer Relationship</th>
<th>Customer Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key Resources</th>
<th>Channels</th>
</tr>
</thead>
</table>

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 (RS) 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 block describes 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:
- High exit barriers
- Few competitors (BMW, Daimler, Audi)
- Modestly high customer loyalty
- Huge market size (489 billion Euros, Statista 2017)

Threat of New Entry
LOW

Degree of Rivalry
VERY HIGH

Threat of Substitution
MEDIUM

Supplier Power
LOW

Buyer Power
MODERATELY HIGH

- 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

https://www.hbr.org/2015/03/the-five-forces-of-industry-competition/

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.” (Deloitte 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
(cf. Christensen et al., 2015: 7)

**Appendix 6 – Catalogue of Questions**

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>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?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>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?</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>What new business models do you think will arise from the change that the AV-technology will come along with?</td>
<td></td>
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<tr>
<td>7</td>
<td>Where do you currently see the greatest potential or need for OEMs to review their business models? Why?</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>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?</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 7 – Automated Driving Levels (SAE 2014)

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

<table>
<thead>
<tr>
<th>SAE* Level</th>
<th>Name</th>
<th>Narrative Definition</th>
<th>Execution of Steering and Acceleration/ Deceleration</th>
<th>Monitoring of Driving Environment</th>
<th>Fallback Performance of Dynamic Driving Task</th>
<th>System Capability (Driving Models)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>the full-time performance by the human driver of all aspects of the dynamic-driving task, even when enhanced by warning or intervention systems</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Human driver</td>
<td>n/a</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>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</td>
<td>Human driver and system</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving models</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>the driving mode-specific execution by one or more driver assistance systems 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</td>
<td>System</td>
<td>Human driver</td>
<td>Human driver</td>
<td>Some driving models</td>
</tr>
</tbody>
</table>

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


<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Driver Assistance: driver assistance systems support the driver, but do not take control.</td>
</tr>
<tr>
<td>02</td>
<td>Partly Automated Driving: systems can also take control, but the driver remains responsible for operating the vehicle.</td>
</tr>
<tr>
<td>03</td>
<td>Highly Automated Driving: in certain situations, the driver can disengage from the driving for extended periods of time.</td>
</tr>
<tr>
<td>04</td>
<td>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.</td>
</tr>
<tr>
<td>05</td>
<td>Full Automation: the vehicle assumes all driving functions, the people in the vehicle are only passengers.</td>
</tr>
</tbody>
</table>
### Appendix 9 – The Main Statement of the Interviews

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

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
</tr>
</thead>
</table>
| 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 adjust 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, Head of Brand & Communications at DriveNow, 27.03., 20:00 – 20:30

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
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</table>
| 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 OEM 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, Brand & Communications Manager at BMW AG, 29.03., 16:30 – 17:00 (translated from German)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
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<tbody>
<tr>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td>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</td>
</tr>
<tr>
<td>In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?</td>
<td>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</td>
</tr>
<tr>
<td>Do you think fully autonomous</td>
<td>YES, BMW is currently offering level 2 (partly automated)</td>
</tr>
</tbody>
</table>
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 à 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, Principal Automotive Digital at Capgemini Consulting, 06.04., 18:30 – 19:00 (translated from German)

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
</tr>
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<tbody>
<tr>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td>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</td>
</tr>
<tr>
<td>In your opinion, what are the threats</td>
<td>Threats: technical (car crashes/how close can you get to avoid</td>
</tr>
</tbody>
</table>
and opportunities for OEMs in regards to autonomous driving? Why? 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

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you consider the autonomous driving technology a disruptive</td>
<td>YES, disrupting our life in terms of mobility</td>
</tr>
<tr>
<td>Questions</td>
<td>Answers (excerpt of the main statements)</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td>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</td>
</tr>
<tr>
<td>In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?</td>
<td>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</td>
</tr>
<tr>
<td>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?</td>
<td>YES; accidents more or less than human error; within next decade; legal and ethical issues (website); 2nd amendment: right to drive a car</td>
</tr>
<tr>
<td>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?</td>
<td>Not innovating enough; electric cars behind the curve; digital transformation;</td>
</tr>
<tr>
<td>What new business models do you think will arise from the change that the autonomous driving technology will come along with?</td>
<td>Trying to catch up even though highly regulated industry; startups being suppliers or being acquired as such main drivers of industry; evolution;</td>
</tr>
<tr>
<td>Where do you currently see the greatest potential or need for OEMs to review their business models? Why?</td>
<td>Insurance, sharing economy, aerial vehicles (drones) for personal usage</td>
</tr>
<tr>
<td>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?</td>
<td>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</td>
</tr>
<tr>
<td>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?</td>
<td>Tesla taking lead to grow market share; disruption of Tesla by incumbents, Daimler owns part of Tesla</td>
</tr>
</tbody>
</table>

6. Nicolas Faber, M&A and Business Development at Flixbus, 12.04., 20:30 – 21:00
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. 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 |
review their business models? Why? 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.

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

<table>
<thead>
<tr>
<th>Questions</th>
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<tbody>
<tr>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td>Private ownership of vehicles is shifting towards 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.</td>
</tr>
<tr>
<td>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?</td>
<td>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.</td>
</tr>
<tr>
<td>What role does business model innovation play for OEMs in the autonomous driving segment in the long run? Why?</td>
<td>Uber, myTaxi, Apple, Huawei; 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.</td>
</tr>
<tr>
<td>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?</td>
<td>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.</td>
</tr>
<tr>
<td>What new business models do you think will arise from the change that the autonomous driving technology</td>
<td>Need to limit to one business model: SELLING to end-customers and fleet customers (ab 35:00); CEO agenda.</td>
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**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, with 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 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

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers (excerpt of the main statements)</th>
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<tbody>
<tr>
<td>Do you consider the autonomous driving technology a disruptive innovation? Why?</td>
<td>Yes, it is a change in driving behavior and its technology</td>
</tr>
<tr>
<td>In your opinion, what are the threats and opportunities for OEMs in regards to autonomous driving? Why?</td>
<td>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</td>
</tr>
<tr>
<td>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?</td>
<td>I do not believe autonomous driving will be ready for the market within the next 10 years</td>
</tr>
<tr>
<td>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?</td>
<td>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</td>
</tr>
</tbody>
</table>
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.

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**Appendix 10 – The Self-Driving Vehicle Revolution**

The self-driving vehicle revolution

An illustration of potential growth

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

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)
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