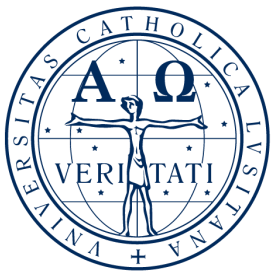

CATÓLICA LISBON
BUSINESS & ECONOMICS

Industry 4.0 and the global automobile context: the German situation and the specific BMW's case until the BMW and Daimler's Joint Venture.

Diana Rosa

Dissertation written under the supervision of the Professor Ricardo Ferreira Reis

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Abstract

The following thesis, to which was chosen a case study format, is focused on BMW, a successful German carmaker for the middle-high budget customers. Vehicles electrification, a pressure that came from some customers and also by strong intergovernmental legislation, has brought even more challenges than electrification itself since technology and mobility as a service emerged in the market thanks to the good it could do for the environment.

Thanks to all these developments, BMW and the automobile industry in a general way, felt the beginning of a crisis for which the Germans didn't bring a good reputation from the past, with the diesel scandal that occurred. Hereupon, BMW presents a very complete case of business adaptive strategies since it crossed huge difficulties and huge doubts when compared with any other carmaker non-german. Not expecting this kind of change, production solutions, strategic locations, strategic partnerships and governmental incentives had to be studied in order to satisfy a target that, at the beginning, BMW didn't know what the reactions would be.

Keywords: Industry 4.0; Electrification; Electric Vehicle; Services; IT; Business Model; BMW; Daimler.

Dissertation title: Industry 4.0 and the global automobile context: the German situation and the specific BMW's case until the BMW and Daimler's Joint Venture.

Author: Diana Rosa

Sumário

A tese que se segue, para a qual foi escolhido um formato de estudo de caso, é focada na BMW, uma fabricante automóvel alemã de sucesso para clientes de classe média-alta. A eletrificação de veículos, uma pressão que veio de alguns clientes e também por uma forte legislação intergovernamental, trouxe ainda mais desafios do que a própria eletrificação, já que a tecnologia e a mobilidade como serviço surgiram no mercado pelo bem que podem fazer pelo meio ambiente.

Graças a todos esses desenvolvimentos, a BMW e a indústria automobilística de uma forma geral, sentiram o início de uma crise para a qual os alemães não traziam uma boa reputação do passado, com o escândalo do diesel ocorrido. Com isso, a BMW apresenta um caso muito completo de estratégias adaptativas de negócios, uma vez que cruzou enormes dificuldades e enormes dúvidas quando comparada com qualquer outra fabricante não alemã. Sem esperar esse tipo de mudança, soluções de produção, localizações estratégicas, parcerias estratégicas e incentivos governamentais tiveram que ser estudados para atender a uma meta que, no início, a BMW não sabia quais seriam as reações.

Palavras-chave: Indústria 4.0; Electrificação; Veículo Eléctrico; Serviços; IT; Modelo de Negócio; BMW; Daimler.

Título da dissertação: A Indústria 4.0 no contexto automóvel global: A situação alemã e o caso concreto da BMW até à Joint Venture da BMW com a Daimler.

Autor: Diana Rosa

Acknowledgments

This thesis is the materialization of a promise that I made many years ago and, for that reason, my first thanks will have to start from there. I want to thank my grandfather, who apart from my father and mother, is the person I most loved in my life.

My grandfather always thought I was a "star on the horizon". When he died I thought all the spark I had, like a star, was gone forever. I survived a storm and after that I swore to myself that I would live as he taught me that would be right. Affection is not questionable and that is what I wanted to be superior to pain. I think that, in the end, I stopped being that star he told me that I was because I needed to be a rainbow, turning around and not forgetting that all the love I received would be enough source of color for me to show.

My grandfather told me many times that I didn't need to be a princess in this life, because fighters go the furthest in fulfilling their dreams. I think it was because of this philosophy that I got to where I am. My grandfather left but it's a big reason for me to live. Not being able to give a hug to express my affection, maybe all my dreams coming true make him happy wherever he is.

My grandfather was always the magnificence, my father was always the freedom. I have always found myself between what the two of them are. My grandfather taught me a lot about life but my father continues to show me the world, to open up my horizons. My grandfather taught me to face whatever comes, my father just wants nothing to bump into me so I can always flow in life. My grandfather was always my home, the intensity. My father always wanted to be my companion on the road on endless journeys.

From lightness to intensity, I think I want to travel and then miss my home. I think I want to flow in life but I also want to be prepared to face what may be necessary. Because all they are has adjusted to what I am, that's what I take with me where I go and with whom I relate.

List of Abbreviations

- **BRICS** Brazil, Russia, India, China and South African Republic
- **CPS** Cyber Physical Systems
- **EV** Electric Vehicles
- **IOT** Internet of Things
- **Maas** Mobility as a Service
- **NPE** National Platform for Electric Mobility
- **OEM** Original Equipment Manufacturer
- **R&D** Research & Development

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1. RESEARCH NOTES

Various are the reasons for companies to engage in a more sustainable modus operandi. *"Previous research has shown that firms engage in sustainable technologies as a response to environmental regulation, for instrumental reasons, or as a reflection of managers' green values"* (Dangelico & Pujari, 2010; Rennings, 2000; Sarasini & Jacob, 2014 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). These new technologies are materialized in a product that, since it is innovated, presents companies' choices and positioning dealing with the news. Acting first, companies may find some competitive advantage, however, innovation may be systemic. Product innovation manifests itself as autonomous, since it may happen by the *"discretion of a focal company*", however, *"the success of systemic innovation requires the industry as a whole to engage in a transition, otherwise chances for success of the individual company are limited"* (e.g., Planko, Chappin, Cramer, & Hekkert, 2019 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019).

Nowadays, it is important to know "*how companies start to engage in systemic innovation (...), given that many of today's large technical systems are unsustainable, but answers to why and how companies start to engage in this specific form of innovation are not straightforward"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019), especially if we focus on the automobile context. Changes may imply challenges that seem to be out of safe harbor for all the companies in the market that, seeing disadvantages in an uncertain future, tend "*to be cautious to not move too quickly and avoid costly investment failures"* (Rugman & Verbeke, 1998 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). The ones surpassing these difficulties may have found an opportunity to act instead of just waiting to see and so, we can predict an industry divided between frontrunners and followers. In automobile industry, as described by Bidmon, Bohnsack, Kolk & Pinkse (2019), *"copycat behaviour for more sustainable technologies only occurred after the first incumbents switched position"*, argumenting that *"the general evolution in an industry did not necessarily result from concerted, collective action or industry coordination"*.

Industry leads with concerns such as *"climate change, increasing regulation, and the ongoing need to meet environmental demands, also from consumers who attach much importance to fuel efficiency and environmental friendliness"* (Kolk & Levy, 2004; KPMG, 2014; McKinsey & Company, 2013 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019), and new ones related to new mobility services and technology that, being helpful with the environmental struggle may present new threats or opportunities.

Electrification was not a recent possibility. *" (...) During the initial development of automobiles, around 1900, an electric motor was an option, but at the time, it lost the race against gasoline"* (Bidmon, Bohnsack, Kolk, & Pinkse; 2019). The oil crisis in the 70's brought electrification once more, however, electric cars were at a disadvantage with the conventional ones. This time, the history changes and *"automobile companies know that their future depends on their ability to develop environmentally safer forms of mobility"* (Zadek,2004; appud Bidmon, Bohnsack, Kolk & Pinkse; 2019), however, all industry

suffered from the same doubts and pressures given their impractical vision of it. The thought that these cars could never replace the traditional ones was shared by the majority of manufacturers. Toyota predicted that *"there will be a market for this vehicle, but a limited one"* (Reed, 2009a appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). Ford's Vice President of Research and Advanced Engineering, affirmed that electric vehicles were *"tailored for city driving and a limited range",* believing that its sales would be *"significantly below 5 percent of the total new-car sales"* (Automotive News, 2008 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). Volkswagen, not thinking differently but trying to adopt changes that could be easily controlled, proposed the solution of using *"electric powertrains"* as a *"supplement to internal combustion engines"*, guessing *"a global share of 1.5 to 2 percent"* in 2020 (Guilford & Ciferri, 2009 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019).

All the resistance to change was supported by the disbelief in customer acceptance. The changes it would present even in the customers' day-to-day life, with the impractical necessity of charging them, also made the car industry feel reluctant. Honda manifested that *"it's questionable whether consumers will accept the annoyances of limited driving range and having to spend time charging them"* (Automotive News, 2010 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). Hyundai mentioned that *"the usage of that kind of 100 percent electric vehicle will be very, very limited. [...]"* showing concerns regarding the *"huge amount of batteries sitting in the car" (Greimel, 2008b appud Bidmon, Bohnsack, Kolk & Pinkse; 2019)* and it's affordance.

1.1. The first ones and the followers: convergent and divergent actuation

From doubts to actions, car manufacturers saw themselves forced to change. Tesla's apparition was a contribution to it, with its totally electric Roadster model in 2008, that received lots of attention. *"Many incumbents built concept cars or prototypes (44 in total)"*. From those, *"14 test cars were examined under controlled, real-world conditions to learn from and improve the technology. Companies clearly wanted to be prepared if EVs were to gain momentum"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019).

In majority, *"these cars were modified, conventional vehicles built in small series, or they were produced or modified through a third-party provider, that is, converted EVs"* (Bohnsack et al., 2014 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019), meaning this that incumbents are *"taking responsibility by developing technologies that could live up to norms set in the future but did not consider these technologies mature enough to warrant a massive move into electric mobility"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019).

When this actuation was needed, many were the positions in which we could find each producer and big may be the change they lived from that moment on. Firms may need to support each other or firms may compete even more for the leadership in product innovation. As mentioned by Scott (2001, appud Bidmon, Bohnsack, Kolk & Pinkse; 2019), *"companies in the same industry tend to face similar types of institutional pressures, such as government regulation, social norms, and common beliefs"* (Aldrich & Fiol, 1994 appud Bidmon,

Bohnsack, Kolk & Pinkse; 2019) and, because of that, they may feel inspired to act in accordance. It is very common to observe a "follow-the-leader" attitude that leads companies to a *"convergence in product innovation" that "can even occur when the motives of rivals' moves are unclear to a company, as it may want to prevent competitors from gaining undue advantage"* (Chen & MacMillan, 1992 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). This actuation is frequently adopted in technology adaptation circumstances, when *"a critical mass builds up at a certain point where uncertainty is sufficiently reduced and/or the disadvantages of non-adoption become too large, thus creating pressures to invest and 'jump on the bandwagon'"* (Aldrich & Fiol, 1994; Deephouse, 1996 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019).

Facing the same situation, there may be different perspectives and ambitions. Not all the firms want to have the same role and even knowing that cooperation may be a more secure way to survive in a constantly changing industry, "*company-specific differences, particularly in perceptions of market potential, customer demand, and the future of the industry do matter"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019) and may be traduced in alternative behaviors that will lead to divergent kind of actuations.*"Generally, however, systemic innovation should not allow companies to reap strong first-mover advantages because uncertainties with regard to the market and technology are high, shifts in technology and consumer demand likely, and followers may be able to free-ride on costly infrastructure investments"* (Montgomery & Lieberman, 1988 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). Nonetheless, *"incentives such as learning-based advantages and gaining technological leadership may still drive individual companies to act more proactively than others and not simply 'wait-and-see'"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019).

First movers in the automotive industry were General Motors, Mitsubishi and Nissan with their, respectively, Chevy Volt, iMiev and Leaf. The three companies were living through a financial crisis that needed to be solved with a new positioning of the brand, related to new kinds of customers attracted by new kinds of solutions. Conscious about environmental needs and believing in EV's potential, acting progressively on the change, saw hybrid vehicles as a way to arrive at total electrification.

General Motors had a background on electrification, having found support from the United States Government that pressured the company to obtain *"sustainable technologies in exchange for loans to solve its financial distress in the 2009 crisis"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019). Furthermore, it *"was also needed to be able to comply with U.S. corporate average fuel economy (CAFE) standards for its fleet and avoid having to pay penalties"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019). Mitsubishi, also leading with CAFE standards, *"suffered consecutive losses in the early 2000s"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019). *"The company's commitment to a full EV helped it to leapfrog technology-wise, address fuel-economy concerns, and reorient itself as the iMiev represented one of the "new pillars for penetrating new markets"* (Greimel, 2010 appud (Bidmon, Bohnsack, Kolk & Pinkse; 2019). Nissan, also with financial problems, having entered into an alliance with Renault in 1999, declared in 2007: *"Our most urgent R&D challenge today*

is to meet society's environmental expectations. That's why 40% of our budget for advanced engineering is devoted to the Nissan Green clean diesels" (Bidmon, Bohnsack, Kolk & Pinkse; 2019), arguing that *"Nissan was a 'me too' company. But in electric, we're pioneers"*.

1.2. BMW, a distinct follower

Generally, first movers *"put greater emphasis on the higher cause of sustainable development as driving their efforts, and followers on competitive dynamics"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019), BMW distinguishes itself for being considered a follower and even so a player for the sustainable development. *"BMW strongly emphasized sustainability as a 'higher cause' to motivate its actions and clearly pushed the development of EVs in the period under study. Specifically, it announced that its 'long-term aim is to produce emissions-free mobility'"* (BMW, 2010, p. 35 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). It is not the first time that electrification appears in BMW history, which makes BMW a special follower. The oil crisis mentioned before, caused the launch of BMW 1602e in 1972. In its website, BMW remembers the Summer Olympic Games of 1972, when a *"BMW 1602e totally electric went ahead of the athletes in endurance events, to film and provide water as needed"*, *"mission-free and silent, it was the ideal partner at the time and did not prevent competitors from achieving their best performance"* (BMW, 2021).

Different because it is a follower that led in the past, BMW has a special statute when compared with the actual first movers, that do not present premium brands like it presents, even sharing the same values. Electrification may be hard to associate with luxury since luxury is naturally associated with tradition and electrification may mean the whole change and the practicality. Even so, BMW had the courage to affirm that *"premium has to become sustainable in the long-run"* (FAZ, 2009, p. 14 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). *"Products labeled 'sustainable' will have other instrumental and symbolic features that address users' individual concerns such as safety, comfort, luxury, or status"* (Ali et al., 2019; Noppers et al., 2014 appud Bohnsack & Pinkse; 2021).

Between the launched models since 2010, we can observe the three first movers on the top positions of the table and BMW in 8th. Seeming to be a big distance between them, we must consider that, apart from the first movers, BMW presented the only purpose built vehicle behind the other three.

TABLE 3 Incumbents' EV engagement in the U.S. market

Company	First model	Year	Location of first launch	Purpose-built vs. converted	Other models
GM	Chevy Volt	2010	US	Purpose-built	
Nissan-Renault	Leaf	2010	Japan & United States	Purpose-built	ZOE, Twizy
Mitsubishi	i-MIEV	2010	Japan	Purpose-built	
Daimler	Smart EV	2011	Germany	Converted	
Ford	Focus EV	2011	US	Converted	
Toyota	Prius-Plug-in	2012	Japan & US	Converted/Purpose-built	
Honda	Honda Fit EV	2012	Japan (2010)	Converted	
BMW	i3	2013	Germany	Purpose-built	i8
Fiat	e500	2013	US	Converted	
Geely	Volvo V60-PlugIn	2013	Sweden (2012)	Converted	XC90 Plug-In
VW	e-Up	2013	Germany	Converted	e-Golf

Note. Adapted from Bidmon, Bohnsack, Kolk & Pinkse (2019)

Comparing BMW to an equally luxury brand of the same industry and country such as Mercedes-Benz, we can see how Daimler seems to be more cautious, investing with Smart in an already existing model. Daimler presented an antagonic position to BMW that used BMW itself, and not only an already existent Mini but both, showing this way much more commitment but, also, the leadership of converting luxurity into sustainability. BMW, committed to "*significantly reduce the environmental impact of the car all the way along the value-added chain*" (BMW 2009 p.35 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019) and ambitioning to *"produce emissions-free mobility with vehicles powered by electricity and hydrogen"* (BMW, 2010, p. 34 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019), reinvented itself via BMW-i *"visionary electric vehicles, revolutionary lightweight construction, inspiring design and innovative mobility services"* (BMW, 2012, p. 38 appud Bidmon, Bohnsack, Kolk & Pinkse; 2019). Later in time, Daimler also presented a new generation of electric vehicles - EQ.

1.3. Electric sales and affordance theory

Despite the investment made by some companies, the big doubt about *"which technology would be most suitable for a move towards sustainable mobility"* (Bidmon, Bohnsack, Kolk & Pinkse; 2019) persisted. Until now, electrification has been the final goal and other solutions have been promoted in order to get there. Electrified car sales were low as predicted. Higher prices associated with the higher costs of production were an explanation, as well as the absence of governmental incentives to buy reinforced by the initial lower level of information about electric vehicles that may lead to untrust or unrealistic assumptions. Commonly, "*sustainable products are sometimes perceived to have lower functional performance"* (Luchs et al., 2012; Olson, 2013 appud Bohnsack & Pinkse; 2021).

TABLE 4 Worldwide sales of the Top 20 (PH) EV models in 2015

Rank in 2015	Model	Volume in 2015	Purpose-built*	Type
1	Tesla Model S	50.366	Yes	EV
2	Nissan Leaf	43.870	Yes	EV
3	Mitsubishi Outlander PHEV	43.259	No	PHEV
4	BYD Qin	31.898	No	PHEV
5	BMW i3	24.083	No	EV
6	Kandi K11 Panda EV	20.390	Yes	EV
7	Renault Zoe	18.846	Yes	EV
8	BYD Tang	18.375	No	PHEV
9	Chevrolet Volt	17.508	Yes	PHEV
10	Volkswagen GTE	17.282	No	PHEV
11	BAIC E-Series EV	16.488	No	EV
12	Zotye Z100/Cloud EV	15.467	No	EV
13	Volkswagen e-Golf	15.356	No	EV
14	Audi A3 e-Tron	11.962	No	PHEV
15	Roewe 550 PHEV	10.711	No	PHEV
16	JAC J3 EV	10.420	No	EV
17	Ford Fusion Energi	9.894	No	PHEV
18	Ford C-Max Energi	9.643	No	PHEV
19	Kandi K10 EV	7.665	Yes	EV
20	Kia Soul EV	7.510	No	EV
Total		400.993		

Note. Adapted from Bidmon, Bohnsack, Kolk & Pinkse (2019)

Observing the top sales table, the majority of the models are citadins or utilitarians, limiting the target and promoting a more citadin usage where parking is hard and the kilometers made are lower, so these models satisfy because even lower autonomies may last for many time and parking will still be easy. People with different needs such as bigger cars or bigger autonomies may feel excluded, but this is something normal that evolution has to be gradual and be started by the cheaper segments to produce.

Even though smaller and converted existing cars are cheaper to produce, not presenting costs on cars' architecture, following the affordance theory, this may present disadvantages on consumer's minds. Technology as an object or in its usage will only impact persons if it is capable of creating meaning. *"Firms can design features into a technological object—a product—but when these remain invisible to consumers, they fail to get meaning*" (Norman, 1999 appud Bohnsack & Pinkse; 2021), which must explain the success of proposed-built vehicles.

Another question is the division that consumers may feel between totally electrified vehicles and the hybrid ones. Even knowing that both are environmental options, hybrids are traducing customer's preference when they were expected to be a step to total electrification. We can see the first two sales leaders presenting electric cars and in third and fourth place hybrid solutions with Mitsubishi hybrid in third place with a sales value very close to the total electric sales value of the electric Nissan Leaf, that is in second place. Still, on a general level, these environmental cars were not successful. Worldwide, only 400993 units were sold in 2015.

The reasons for consumers to not adopt sustainable cars were a little bit explored before, nonetheless, it is intriguing the division between the two efficient solutions for mobility. It is

important to consider *"whether a product's underlying technology has advanced enough for it to meet user demands regarding multiple expected environmental benefits. It also depends on the functionality the sustainable product offers, in particular compared with products currently in use"* (Luchs et al., 2012; Wever et al., 2008 appud Bohnsack & Pinkse; 2021). Hybrid technology came first and satisfied a wider range of people, being cheaper and being applied into a major kind of car's segments and traducing more independence to its users since the electric motor regenerates for itself. People for those who environment is the big concern could themselves think about EVs as a beautiful lie, when compared to hybrids that never hide the fact that were still a car moved by internal combustion, since many of them used *"electricity produced from fossil fuels"* (Ellsmoor, 2019 appud Bohnsack & Pinkse; 2021) and *"the electricity to charge its batteries must be generated in electrical generation plants that produce emissions"* (Eberhard & Tarpenning, 2006).

This new technology needed to erase *"mismatches between delivered functionalities and desired functionalities"* (Bohnsack & Pinkse, 2017 appud Bohnsack & Pinkse; 2021) in order to find the *"functionality matching"*, the concept that puts the two in equilibrium. However, *"when sustainable alternatives hit the market, they tend to underperform on desired functionality for some time"*, taking time in *"reaching performance parity with existing products"* (Bohnsack & Pinkse; 2021).

"Whereas certain consumers will not have a willingness to compromise on functionality, others might perceive the sustainability affordances as a starting point of discovering new functionality. So instead of seeing a sustainable product's natural affordances as a problem limiting desired functionality, they can be an incentive to develop workarounds and discover new types of functionality" (Bohnsack & Pinkse; 2021). For that, many times it is applied the tactic of imposing the changes on customer's minds gradually. Hybrids were thought of as a way to lead to electric mobility and its preference may show us the point of change in which the consumer is, not necessarily a permanent position in the market that translates competition.

1.4. Competition inside the industry and goal framing theory applied to customer thought

Companies will compete using the technologies and applying the features that lead them to a bigger volume of sales. BMW, committed with the idea of bringing luxury to the sustentable car market, gained a new competitor with Tesla, and its *"highlighted fast acceleration and a luxurious design to win over customers"* (Bohnsack & Pinkse, 2017 appud Bohnsack & Pinkse; 2021). Tesla seemed successful not because it was selling a total electric car but because it gave to it a sportive appearance, a very developed technology that translates quality and a good acceleration, contradicting the idea of the borring electric car.

Following affordances theory, there are ways to almost force consumers to change their behaviors. *"Scripting"*, mentioned by Jelsma & Knot (2002, appud Bohnsack & Pinkse; 2021), *"refers to design choices that invite sustainable behavior and discourage*

unsustainable behavior", many times by producing *"products that can only be used sustainably"* (Wever et al., 2008 appud Bohnsack & Pinkse; 2021). With Tesla, customers had no choice.

Evoking the goal framing theory, *"goals govern or 'frame' what people attend to, what knowledge and attitudes become cognitively most accessible, how people evaluate various aspects of the situation, and what alternatives are being considered"* (Lindenberg & Steg, 2007, p. 119 appud Bohnsack & Pinkse; 2021) and, also, it establishes that *"in any given situation, people tend to satisfy multiple goals, but one goal—the goal frame—will be dominant, whereas other goals—the background goals—will be pushed to the back (but still be of influence). The theory suggests that three types of goals jointly motivate behavior: hedonic goals (how people feel), gain goals (what people gain in terms of resources), and normative goals (what people consider appropriate)"* (Bohnsack & Pinkse; 2021). It is very probable that people have a notion of how political correct it is to buy an electric car, since they know how it can be environmentally friendly and, however, feel less willing to pay for it because of it's prices (conflict with gain goals) or because it gives them no satisfaction to drive (conflict with hedonic goals).

1.5. From customer apprehension to fact based information

According to Eberhard & Tarpenning (2006), hybrid vehicles, at the beginning, were *"nothing more than somewhat more efficient gasoline cars*". Hybrid cars pollute almost as much as a gasoline engine car, not being that far from diesel CO2 emissions. Hybrid, the second least emissions provider, polluted nearly three times more than electric, in 2006, when hybrid technology was not that evoluted.

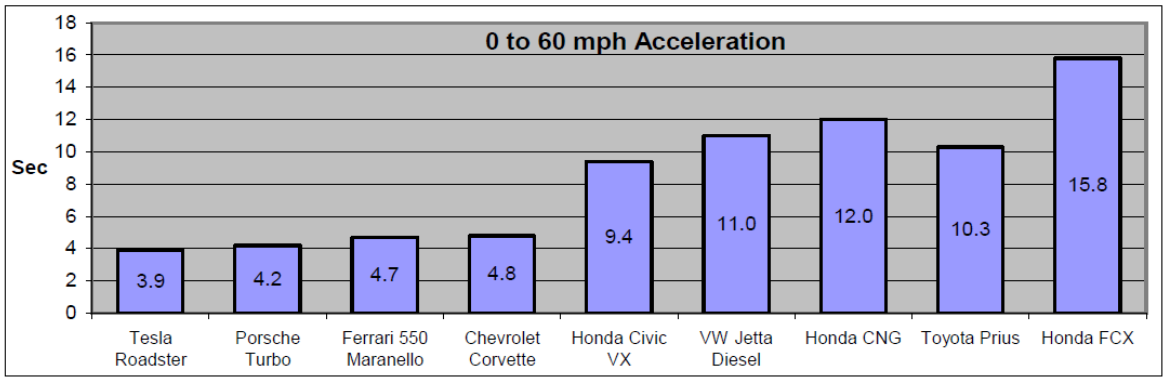
Technology	Example Car	Source Fuel		Well-to-Wheel	
			CO_2 Content	Efficiency	CO_2 Emissions
Natural Gas Engine	Honda CNG	Natural Gas	52.8 g/MJ	0.32 km/MJ	166.0 g/km
Hydrogen Fuel Cell	Honda FCX	Natural Gas	52.8 g/MJ	0.35 km/MJ	151.7 g/km
Diesel Engine	VW Jetta Diesel	Crude Oil	73.0 g/MJ	0.48 km/MJ	152.7 g/km
Gasoline Engine	Honda Civic VX	Crude Oil	73.0 g/MJ	0.52 km/MJ	141.7 g/km
Hybrid (Gas/Electric)	Toyota Prius	Crude Oil	73.0 g/MJ	0.56 km/MJ	130.4 g/km
Electric	Tesla Roadster	Natural Gas	52.8 g/MJ	1.15 km/MJ	46.1 g/km

Note. Adapted from Eberhard & Tarpenning (2006).

Values must have changed with plug-in technology. Analysing BMW's official site, we see plug-in hybrids have an autonomy of 70 kms in electric mode. Being electric for a larger number of kms, people may never use the combustion engine in their routines from home to work. Hybrids always had a larger variety of available automobile segments. However, electric cars are also changing their targets and possibilities. Toyota developed an electric vehicle that is expected to have a battery that will last ten years, the major promise of autonomy until now in the market. Nissan has now totally electrified commercial vehicles. BMW, beyond the utilitarian i3, presents a vast list of electric cars with iX, iX3, i3s and i4,

presenting more segments. Hybrids are more electric than ever and still more cheap and convenient.

Pleasuring normative goals, electric cars when compared to gasoline cars have more torque. *"A gasoline engine has very little torque at low rpm's and only delivers reasonable horsepower in a narrow rpm range. On the other hand, an electric motor has high torque at zero rpm, and delivers almost constant torque up to about 6,000 rpm, and continues to deliver high power beyond 13,000 rpm"* (Eberhard & Tarpenning; 2006). Electric cars are *"very quick without the need to use a clutch pedal"* adding that *"the electric car accelerates at least as well as the best sports cars, but is six times as efficient and produces one-tenth the pollution"*.



Note. Adapted from Eberhard & Tarpenning (2006)

Even considering safety, this acceleration may be useful in a circumstance of avoiding obstacles, translating in trust for drivers. Gains goals are good considering the saved money in gasoline or diesel. Even so, this customer may be less happier than others,since electric cars *"will certainly not be cheaper until their sales volume approaches that of a typical gasoline car – many thousands per year at least"* (Eberhard & Tarpenning; 2006).

1.6. New business models and Industry 4.0 in value network analysis

Related to the issues observed before, we saw how it all was based on technology. *"Recent digital innovations like self-driving cars, connectivity, big data, and social networks are fundamentally revolutionizing the automotive industry"* (Wijnen, 2013; Simonji-Elias et al., 2014; Hanelt et al., 2015; Gao et al., 2016 appud Böhm, Galic & Riasanow; 2017).

Cars are changing their meaning with reality 4.0 that consists in it as *"integrated systems in a connected world of things"* (Veledar, 2019), illustrating an industrial revolution based on digitalization. *"This industrial revolution dictates the usage of automation, which enables the compartmentalisation of production"* (Veledar,2019), since *"the distributed manufacturing is driven by Internet of Things and Cyber-Physical Systems which is acclimatising"* (Kagermann & Wahlster, 2013; Wang, Törngren, & Onori, 2015; appud Veledar, 2019) while impacting manufacturing situation. *"The interconnectedness and transparency are critical for the automotive industry, as they enable effective lifecycle management"* (Veledar, 2019), in a

time in which *"the testing processes (...) are continuously fed with data"* (Macher, Diwold, Veledar, Armengaud, & Römer, In-print appud Veledar, 2019).

	Industrial revolution (~1800)	Second industrial revolution (~1900)	Third industrial revolution (~1950...)	Industry 4.0 (now...)
Progress	Mechanisation (textile industry)	Electricity, gas, oil, assembly line (cars), phone, radio	Nuclear energy, semiconductors (transistors, microprocessors)	IoT, CPS, AI, AD, Smart anything, edge computing, cloud services...
Main character	Move from manual labour to machines	Mass production, industrialisation	Automation	Merging technologies, distributed manufacturing
Mobility	Steam engine - train	Internal combustion engine / cars	--	AD, Smart mobility, MaaS
Social impact	Move to the cities	Birth of consumer culture	Continual urbanisation	Smart cities

Note. Adapted from Veledar (2019).

The first industrial revolution introduced mechanization and human labor was accompanied by the machines. The train was new and allowed people dislocation that then moved to urbanized regions where the industry was a fount of work. After that, many things changed in technology and society. In the second revolution, electricity, gas and oil gained importance and internal combustion cars started to circulate and continued until now.

The growing urbanization of the past two centuries has had consequences. Since that, technological evolution must continue in an environmental way. Electrification of cars was seen as a solution to avoid pollution, however, with lots of technology being applied to vehicles, connection to the internet and artificial intelligence usage is possible. This change in the car by itself, spreads us to new kinds of mobility such as smart mobility and mobility as a service and lets us see how services of mobility and technology entered the automobile industry, changing the business models.

Well established organizations must adapt themselves to the new tendencies to which people are joining, since *"digital technologies have enabled rapid pace of product and service innovations, shorter product life cycles, and crossboundary industry disruptions, which requires new forms of business strategies"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini;2015). According to Hanelt at al. (2015 appud Böhm, Galic & Riasanow; 2017), there are "*four business model change types: business model extension, revision, termination, and creation, in the automotive industry".* According to Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini (2015), *"a business model creation refers to the initial business model design based on a business idea. Business model extension is described as adding further activities to an existing business model without fundamentally altering the existing core logic. Business model revision refers to a profound redesign of the existing business model and thus can be related to radical or disruptive change"* and *"business model termination is described as the*

elimination of business activities". It turns out that there are not only four forms of change, there are also four pillars in a business model, according to Osterwalder et al (appud Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini;2015): value proposition/product, customer interface, infrastructure management and finance.

The same authors add that in cases such as the automobile industry, *"business models are being reshaped by the implementation of digital initiatives and solutions".* Since a business model must be seen as *"a template of how a firm conducts business, how it delivers value to stakeholders (e.g., the focal firms, customers, partners, etc.), and how it links factor and product markets"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini;2015), it is normal to observe changes. These changes are due to the fact that *"the emergence of digital technologies enables interconnected digital eco-systems that comprise new actors, structures and rules, eventually resulting in digital business models that entail such attributes as 'time compression, turbulence, and new architectures'"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini;2015).

Using a value chain and a value network approach, we must consider how *"the value chain concept",* highly contributed by Porter, presented a very common usage for the visualization of the *"chained linkage of physical activities"* (Porter, 1985 appud Böhm, Galic & Riasanow; 2017), and *"applied to analyze competitors and new market entrants"* (Peppard and Rylander, 2006; Böhm et al., 2010 appud Böhm, Galic & Riasanow; 2017). Not enough, Porter created *"an extended value chain, namely a value system, which includes the value chains of the firm, of the suppliers, the customers and the end customer, which create interdependencies between the actors of the value system"* (Böhm, Galic & Riasanow; 2017). Nonetheless, in a world more globalized and dynamic than before, *"a more complex method is required, which led to value networks"* (Biem and Caswell, 2008 appud Böhm, Galic & Riasanow; 2017). A value network is a *"set of relatively autonomous units that can be managed independently, but operate together in a framework of common principles and service level agreements"* (Peppard, Rylander;2006 appud Böhm, Galic & Riasanow; 2017), being each part only concentrated on its specific capabilities. A value network is *"an adequate method to visualize inter-organizational exchanges and relationships"* (Biem and Caswell, 2008 appud Böhm, Galic & Riasanow; 2017).

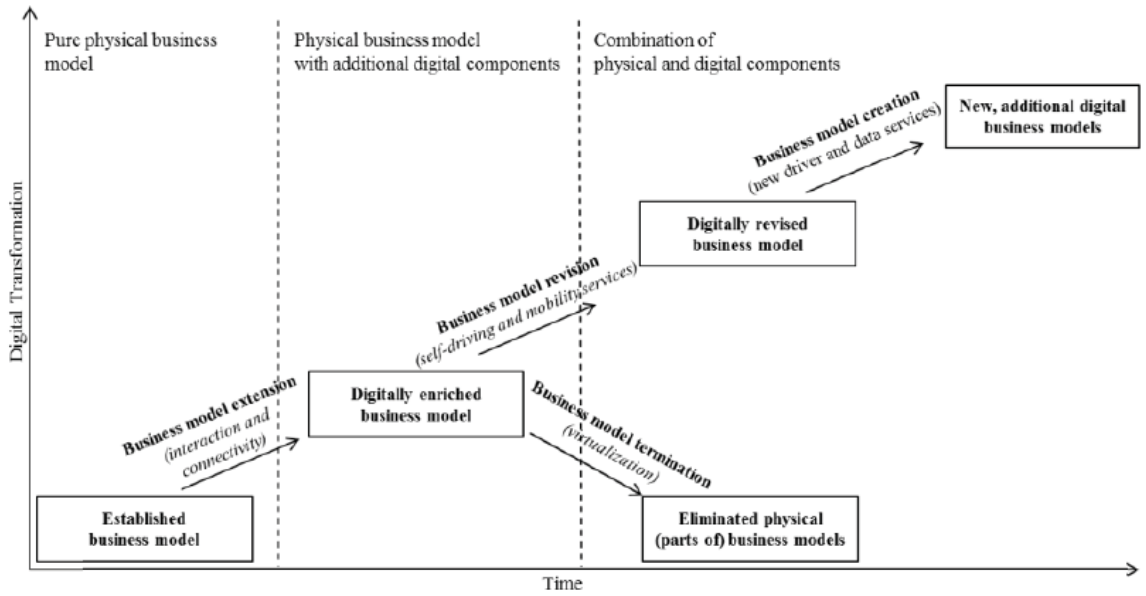
"The rising complexity of firm relationships, evoked by digitalization" caused that *"industries can no longer be classified as suppliers, customers and competitors"* (Peppard and Rylander, 2006; Pil and Holweg, 2006; Biem and Caswell, 2008; Böhm et al., 2010 appud Böhm, Galic & Riasanow; 2017). Since that, value networks are different, being *"now used for service oriented and non-physical industries"* (Peppard and Rylander, 2006 appud Böhm, Galic & Riasanow; 2017), affecting physical products. Picking up the four different business model change types mentioned before, we can verify the existence of each of them with real examples that include that change.

A case of business model extension is the involvement of the automobile with social media since this one *"allows automobile manufacturers to respond to the general societal trends of*

customers wanting to be more informed, participating and thus becoming more empowered" (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015), especially in a time in which target can be resumed to *"young and tech-savvy people"*(Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015).

In a business model revision situation, we can find it on the self-driving car innovation. *"The self-driving car is related to digital automation and concerns the processing of a large amount of data, having the road as a data set to be mined. Enabled by on-board Internet, sensor and GPS-technology, self-driving cars represent a changed driving experience, being especially attractive for digital native customers"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). Also because it is expected that accidents will not happen, this product pleases the new customers since it gives *"more freedom to use his smartphone, check his emails or use the vehicle infotainment*" (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). Another situation is the fact that *"automobile manufacturers have started to offer 'car independent mobility solutions'*" (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015), *"such as integrated service-based mobility offerings involving several means of transportation"*. Manufacturers became a service delivery in an industry once based on product. This new situation illustrates a new kind of relationship with customers, since *"owning a vehicle in cities is becoming increasingly associated with inconvenience and limited personal freedom, and less associated with a status symbol"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). Daimler and BMW bet on this service saying that "*the move was prompted by changing attitudes about car ownership, especially among young buyers, and increased urban congestion. ... Vehicles can be reserved on the Internet or by using an iPhone with an application that shows where available cars are parked*". (Automotive News, 2010, appud Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015).

Once we look for creation we can observe "New Driver-Services". These services *"continue offering hands-free technologies that promote safe driving, such as real-time navigation services that take into account traffic patterns"* (Automotive News, 2010 appud Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015), based on alerts created by the subscribers of it. Other services may consist on the *"preconditioning of the vehicle, vehicle diagnostics or automatic emergency calls"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). To access these services, customers must make a subscription to use it later on their mobile devices, which means a new kind of revenue to car makers that invested in programming competences before. These apps may be of general interest and well-being since "*data about mobility behaviors could be offered to local governments interested in optimizing traffic planning"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). Finishing, termination is already understood in processes such as of design inherent to vehicle production. *"Both prototypes of new car models and production lines can be built virtually by drawing on the increased computing possibilities, thus decreasing planning times and costs"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015). Even in other contexts, such as in the sales one, virtualization may be very useful because, by that, *"manufacturers provide virtual showrooms or even allow potential buyers to test the vehicles virtually in video games"* (Gregory, Hanelt, Hildebrandt, Kolbe & Piccinini; 2015).



Note. Adapted from Gregory, Hanelt, Hildebrandt, Kolbe, Piccinini (2015).

Relations with technology-related companies will be necessary to survive while dealing with so much innovation, as well as with mobility services companies or other well-established companies of the market dealing with the same constraints. The goal is to *"increase business performance and result in better user experience"* (Keller and Hüsig, 2009 appud Böhm, Galic & Riasanow; 2017) while *"competing with an expanding range of new rivals and non-industry rivals and entrants"* (Piccinini et al., 2015 appud Böhm, Galic & Riasanow; 2017).

Role	Description	Example(s)
OEM	The original equipment manufacturer (OEM) produces cars. We assume an OEM manufactures traditional combustion engines as well as electro vehicles (EV). The value proposition of OEMs can include direct sales, R&D, manufacturing, after sales, and services (Kang et al., 2009).	Ferrari, Tesla, Cadillac, BMW, Daimler, Bolt Motorbikes
Consumer	Consumers request mobility, which can be fulfilled in many forms like driving an own car, lending or sharing a car as well as using public transportation or a specific mobility service like Uber. Customers may use products or services before, during or after transportation. In some contexts, a consumer is a *Prosumer*, by simultaneously using and creating a service. An example is sharing personal data via smartphone with Google Maps while using the aggregated real-time traffic information of other users for navigation. Consumers can pay for services with money, data or a combination of both.	
Tier 1-3 Supplier	The traditional automotive industry is characterized by a one-sided supplier-buyer relation (Turnbull et al., 1992). Vehicle manufacturers rely heavily on *first tier* suppliers, which approximately supply 85 percent of the parts. First tier supplier may offer product development, design and technology and many depend on subcontractors, namely *second tier* suppliers. These in turn can depend on *third tier* contractors, which e.g., supply press, cutting, welding, forging or casting work.	Bosch, Continental, Faurecia, China Automotive Systems, Hyundai Mobis, ABC Group
Public Transportation Provider	This role represents the traditional public transportation, including underground station, busses, city bikes and trains (Hoffmann et al., 2016).	New York MTA, citibike
Car Rental Provider	A car rental provider offers different models for renting a car (Moeller and Wittkowski, 2010).	Sixt, Hertz
Car (parts) Dealer	Apart from directly purchasing from OEMs, consumers can purchase from car (or car parts) dealers. Cars and spare parts can be also sold via online platforms of the respective dealers (Applegate, 2001).	LUEG, Amazon (Fiat), carparts.com
Disruptive Technology Provider	Disruptive technology providers offer disruptive innovations to OEMs in form of software and hardware, such as sensors for assisted driving. Following Christensen (1997), disruptive technologies may be inferior to established technologies in the beginning. However, disruptive technologies move up market relentlessly, leading to the elimination or replacement of established technologies (Christensen, 1997).	Savari, Intel, Mobileye,
Mobility Service Platform	We distinguish between different mobility service platforms, such as private or commercial car sharing, P2P-Lending, or service platforms from	Uber, VRide, DriveNow, Tesloop, Taxify, Car2Go

	OEMs (Lee et al., 2016). Mobility services can be accessed and distributed via these platforms, e.g. Uber provides the platform that allows drivers to provide their mobility service to registered users.	
Mobility Service Aggregator	This role aggregates different mobility services, including public transport services and car sharing platforms, which may also imply intermodal mobility services (Plummer and Kenney, 2009).	Moovel, Flare
Intelligent Infrastructure Provider	This role represents the connection of physical and digital infrastructure. Due to connectivity and new technologies, e.g., sensors and electric vehicles (EV), the infrastructure, e.g., including traffic signs or parking lots can be connected to cars and consumers. Electric vehicle charging stations (EVCS) is such an intelligent infrastructure. Providers allow to access if they are currently used or free, for example.	ChargeNow, CarCharging, Chargerlink
Cloud Infrastructure Provider	A cloud infrastructure provider (IaaS), consists of a shared pool of Internet-based configurable computing resources (e.g. servers, storage, applications and services), which can be rapidly provisioned and released with minimal management effort (Youseff et al., 2008).	Amazon Elastic Compute Cloud (Amazon EC2)
Cloud Platform Provider	The cloud platform provider (PaaS) offers a digital marketplace of various cloud infrastructure services. The key objective is to connect customers and service providers. The former can search for suitable value added services, telematics services and in-car apps while the value added provider can advertise its services. The platform is built on underlying cloud infrastructure (Youseff et al., 2008).	Google Cloud Platform, Microsoft Azure
Value Added Service Provider	Value added services can be accessed before, during, or after transportation. Two types of value added service providers (SaaS) exist. First are telematics services, or technical information about the vehicle, safety features or intelligent driver assistance software. Second are services, which offer complex digital services to the customer, e.g., entertainment, security, location based information services or concierge services. These services can be access via cloud platforms (Youseff et al., 2008).	Spotify, Data Crossover, Autolinked, ParkNow, OnStar, BMW Connected Drive
Car Service Provider	Car services include all traditional services, such as maintenance, insurance, or stationary services like car wash (Remane et al., 2016).	Washtec
E-Payment Provider	Provision of payments, which also work for mobile devices or cars.	MercedesPay

Note. Adapted from Böhm, Galic & Riasanow (2017).

The original equipment manufacturer (OEM), being the car producer, are connected to the various areas that act in name of their value proposition in the market. No news unless the fact that value proposition is changing due to the new consumer, with his new vision of the car and searches for mobility in new ways apart from owning a car, with *"lending or sharing a car as well as using public transportation or a specific mobility service like Uber"* (Böhm, Galic & Riasanow; 2017), being prosumers,*"by simultaneously using and creating a service"*, sharing *"personal data via smartphone with Google Maps while using the aggregated real-time traffic information of other users for navigation"*.

In what concerns supplier relations, it was expected an *"one-sided supplier- buyer relation"* (Turnbull et al., 1992 appud Böhm, Galic & Riasanow; 2017), however, manufacturers are highly dependent on them since their work depends on the parts received, as well as of *"product development, design and technology and many depend on subcontractors, namely second tier suppliers"* (Böhm, Galic & Riasanow; 2017), that depend on their third contractors that provide *"supply press, cutting, welding, forging or casting work"* (Böhm, Galic & Riasanow; 2017).

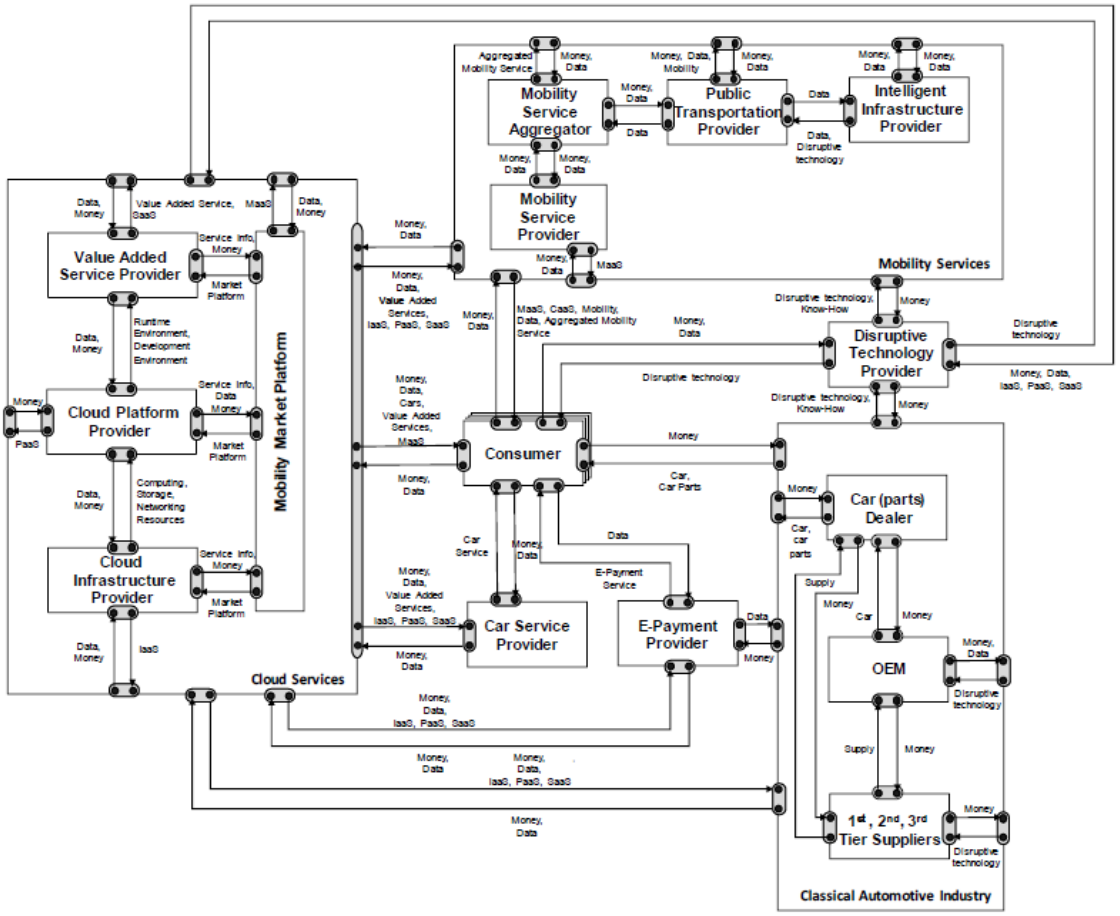
Public transportation providers may be subject to changes or be replaced for new models like car sharing. Car rental providers may have a more diversified range of models in their businesses and dealers, having them too, will be more receptive to do their sales by online platforms, even being sales lower when there are new car's usages in which mobility service platform offers "*private or commercial car sharing"* (Böhm, Galic & Riasanow; 2017). A mobility service aggregator may be useful since it *"aggregates different mobility services,*

including public transport services and car sharing platforms, which may also imply intermodal mobility services" (Plummer and Kenney, 2009 appud Böhm, Galic & Riasanow; 2017).

The disruptive technology providers will supply manufacturers with *"software and hardware, such as sensors for assisted driving"* (Böhm, Galic & Riasanow; 2017), important for *"the connection of physical and digital infrastructure"* offered by the intelligent infrastructure provider that allows the supply of technologies such as *"sensors and electric vehicles (EV), the infrastructure, (...) including traffic signs or parking lots" that "can be connected to cars and consumers"* (Böhm, Galic & Riasanow; 2017).

A cloud infrastructure provider, *"consists of a shared pool of Internet- based configurable computing resources (e.g. servers, storage, applications and services), which can be rapidly provisioned and released with minimal management effort"* (Youseff et al., 2008 appud Böhm, Galic & Riasanow; 2017). Complementary, the cloud platform provider *"offers a digital marketplace of various cloud infrastructure services"* (Böhm, Galic & Riasanow; 2017), connecting consumers to service providers. Also by cloud platforms, value added services can be accessed in all process of transportation, using it for *"telematics services, or technical information about the vehicle, safety features or intelligent driver assistance software"* or, in other hand, because it *"offer complex digital services to the customer, e.g., entertainment, security, location based information services or concierge services"* (Böhm, Galic & Riasanow; 2017).

"Maintenance, insurance, or stationary services like car wash" (Remane et al., 2016 appud Böhm, Galic & Riasanow; 2017) still useful, supplied by car services providers. However, a new is the e-payment modality that consists in *"provision of payments, which also work for mobile devices or cars"* (Böhm, Galic & Riasanow; 2017).



Note. Adapted from Böhm, Galic, Riasanow (2017).

"Products and services are exchanged in favor of money or data" (Böhm, Galic & Riasanow; 2017) in a customer centered value network. The automotive industry is now *"a multi-sided value network"* (Böhm, Galic & Riasanow; 2017) in which new roles are emerging, such as *"mobility service platforms, or intelligent infrastructure providers"* (Remane et al; 2016 appud Böhm, Galic & Riasanow; 2017). Continuing this reasoning, *"emerging roles threaten the value creation of OEMs from two sides. On one hand, the generic value network shows the automotive industry is being intervened through mobility service platforms, like Uber, which directly offer mobility services to the customers. Therefore, OEMs may gradually lose the customer touchpoint. On the other hand, trends like self-driving cars force OEMs to cooperate emerging players. This is represented by the central role of disruptive technology providers between OEMs and mobility services"* (Böhm, Galic & Riasanow; 2017). Digital innovations also were the reason of new data-driven roles such as *"intelligent infrastructure providers share real-time traffic information with self-driving cars"* (Böhm, Galic & Riasanow; 2017)

Another question to address is the fact that original equipment manufacturers need "*to be open to new market entrants and need to gain external knowledge to foster innovation"* (Hildebrandt et al., 2015 appud Böhm, Galic & Riasanow; 2017) many times based on partnerships.

2. CASE STUDY

Introduction

Urban regions, increasingly occupied globally, demand measures to control problems such as accidents, traffic and parking difficulties that contribute to less environmentally friendly questions. Thinking about quality of life and relying on the power of technology in Industry 4.0, governments in the world imposed higher standards regarding the number of emissions per vehicle. Some companies, that never collaborated with the automotive industry, emerged there with mobility or technological solutions that promote environmental well-being to a much wider target. In favor of the environment, car brands adjusted themselves. Mobility and technology solutions are pushing car brands to collaborate, expanding their market footprint. BMW and Daimler's union represents this after a turbulent period in the German's history that destroyed the reputation of these brands.

New forms of manufacturing and new forms of business combined with new ways of using the automobile are behind all this necessary change. Such challenges are accompanied by technological evolution and new material choices related to that and, also, to different consumer's needs. Pressured by legislation defined *"at the UN Climate Change Conference in Paris in 2015"* manufacturers saw *"global warming"* limited *"to two degrees centigrade, and preferably to 1.5 degrees"* (Krzywdzinski, 2019) and so, decided that "*in addition to the traditional internal combustion engine (ICE) models, there will be a plug-in hybrid electric (PHEV) and an electric vehicle (BEV) Version"* (Haider, 2020).

2.1. The German context and new market requirements

In 2015, Volkswagen *"installed special devices in its cars to manipulate fuel emissions tests"* (Popławski, 2020), the same year that these were required to be lower. All the German automotive industry was affected, since even Daimler and BMW, apart from all the brands included in Volkswagen Group, were catched up with this circumstance. The opportunity "*of implementing the so-called 'clean diesel' strategy on the American market*" (Poplawski, 2020) was lost, as well as the reputation on that domain. What was being tried to prove was that it could be possible to produce diesel cars that by itselves *"consume less fuel and thus emit less CO2"* (Poplawski, 2020), making nitrogen oxides produced in the combustion being much lower than before.

Being reputation already shaken, it was announced in *"Der Spiegel*", a german newspaper, in 2017, "*the key German vehicle manufacturers – Audi, BMW, Daimler, Porsche and VW – had set up a cartel with the intention of not introducing more costly ecological technologies in diesel engines starting from 2006*" (Poplawski, 2020). If these accusations are proven as true, *"the carmakers might lose as much as 10% of their annual income"* (Poplawski, 2020). In addition to damaged reputation of the brands, diesel also began to be frowned upon and not an option when purchasing a vehicle. Environmental organisations came up with lawsuits, local *"authorities were accused of failing to react in the face of air quality standards being*

exceeded in many cities" (Poplawski, 2020) and public opinion was very adverse to the brand's insistence in not producing vehicles environmentally friendly.

The government supported its automobile industry, once this industry was the one that contributed the most to the country's GDP, but ended up being sanctioned in 2016 because, jointly with France and the United Kingdom, in 2015, tried to remain unchanged the existing form of European fuel emissions, in order for its carmakers to continue to produce without new restrictions. Once this happened, thanks to the exalted public opinion, courts decided to ban the entry to older diesel vehicles into some more populated cities.

"*Many manufacturers active on the European market have announced the discontinuation of the production of diesel vehicles, considering the sudden drop in popularity of this technology in the EU"* (Poplawski, 2020). Being Porsche an exception, since it decided to stop producing diesel cars, German carmakers still bet on diesel. *"BMW intends to continue manufacturing diesel vehicles for the next two decades, believing that the time of the development of electric cars is overhyped. It also seems that diesel vehicles will continue to have a major share in the production of Daimler and Volkswagen in the longer run. The position of many German companies depends too much on the sale of diesel vehicles even though this technology is becoming less and less popular*"(Poplawski, 2020). These companies were used to address their customer's needs and proof of that is that, in their segment of luxury cars, *"of the roughly 6.5 million premium vehicles sold worldwide in 2012, eighty percent came from German brands"* (Krzywdzinski, 2019). All the profits they registered on car sales made them realize that diesel would still be the major preference.

All the weak participation in electric sales vehicles, given the priority that was given to diesel-powered cars and all the delay in its production translates to us how unprepared the German automotive industry was for a new reality. So, while all their concerns were about improving the combustion engines, electric engines gained ground. This lack of preparation may surprise anyone who knows that "*in the 1970s, international debates about the limits of growth and sustainable development raised awareness for a much-needed transformation towards more socially, ecologically, and economically sustainable practices"* (Haas,Richter; 2020) and that, according with the same authors, *"car manufacturers, suppliers, the electricity industry, politicians, and also environmental associations engaged in research and development of new technologies in the early 1990s"*.

2.1.1. National Platform for Electric Mobility

Several times this was a matter brought up as a priority, even by German politicians, but it was always forgotten even by themselves. Because of that, when the German Government created the National Platform for Electric Mobility (NPE), in 2010, it was not taken as seriously as it could have been. "*The NPE's task was to combine all forces from business and industry, politics, and science, and to deliberately develop strategies for the run-up to the e-mobility market. Four federal ministries, namely Economics (BMWI), Transport (BMVI),*

Environment (BMU), and Education and Science (BMBF), had already addressed the topic prior to the founding of the NPE" (Haas & Richter;2020).

NPE was constituted by 150 entities from the several areas enumerated before, not forgetting the unions and the environmental associations that were present in minority. In the reverse situation *"the automotive and supplier industry formed by far the largest group (22 percent) in the NPE, and the electrical industry and IT sector accounted for a further 15 percent of representatives"* accompanied by *"universities and science (14%), the chemical and battery industry (14%), and politics, administration, and authorities (9%)"* (Haas & Richter;2020).

Industry dominated the committee and this discrepancy of participation led minorities to an accusation of NPE's possible lack of transparency. Also, *"some scholars argue that stakeholders such as the automotive and supplier industries have been particularly successful in pushing their interests through"* (Haas & Richter;2020), a credible accusation since the German government has tried to avoid that the limits of polluting gas emissions in Europe were modified, agreeing with the absence of changes for the automobile industry.

German carmakers *"attitude towards electromobility is ambivalent because they are strongly anchored in the traditional fossil-fueled automobile system and, at the same time, have to open up for alternative technologies"* (Haas & Richter;2020). German universities, that had an important role in research, didn't have the desired knowledge about electrochemistry and electrophysics and German research centres had insufficient budgets and too much bureaucratisation, not attracting experts to study this kind of field - something that may confirms NPE's minorities accusation once again, since it was expected that these groups were financed to do this kind of work without constraints. According to Haas & Richter (2020), The German Federation of Trade Unions (DGB) have the opinion that *"the larger manufacturers are trying to avoid responsibility. There are various research projects, but the companies obviously only want to get involved once the product is marketable".*

2.1.2. Exportations and Suppliers

All the passiveness analysed in this process makes German carmakers highly dependent on importation of batteries but, also, makes them fragile when compared with the emerging competitors and the older ones, better adjusted. Following Haas & Richter (2020) reasoning, although Germany has batteries producers, it was understood in a NPE Steering Committee, *"that an investment of approximately 1.3 billion euros and financial stamina would be required"* and *"that the production costs would be redeemed over a period of up to 10 years"*, evidencing the need of *"state support especially as the production involves great uncertainty as to whether such an investment would pay off for industry"*. German car production has highly depended on exports and this trend has increased in recent years. According to Verband der Automobilindustrie (2018, appud Haider; 2020), with a 77.5 percent export rate in 2017, a new record was achieved. An explanation may be that supplier's *"production becomes globalised and is relocated from Germany to foreign locations"* (Krzywdzinski,2019). A survey conducted by Krzywdzinski (2019) translates that

"over 47 per cent of German works councils stated that there had been relocations of production or other functions to CEE from their site in the past five years". Suppliers are adopting a global presence in order to be strategically positioned, however, "*suppliers has largely been based on long, historically emerging network relationships, cooperation and knowledge exchange between R&D sites in Germany, regional universities and research institutes, nearby production equipment manufacturers and suppliers' own production facilities"* and there is a question that is imposed: *"whether these cooperative relationships are breaking down and, if so, whether the ability of automotive suppliers to innovate is thus being weakened"* (Krzywdzinski,2019). It will be possible to attract new customers on the new foreign locations in which they cooperate, however, smaller suppliers may not be able to remain in the market while the stronger ones will survive with less profit.

2.1.3. Direct Competition and production's incentives

In 2020, associated with Panasonic, "*Tesla's market capitalisation exceeded US$132 billion for the first time, achieving a higher value than the market value of BMW"* (Poplawski, 2020), however, Tesla sold, in 2019, 367000 vehicles, much less units than those sold by BMW - 2.5 million. Tesla's emergence may lead consumers to think of traditional brands as outdated, especially when Tesla presented a mobility solution never seen before with its autonomous Tesla Roadster. Customers associate new brands with new diversified products and the fact that "*the stocks of BMW and Daimler over the past two years have been among the worst-priced amid Germany's 30 major companies listed on the DAX*" (Poplawski, 2020) may be a sign of that.

Even though the delay in innovation may be a justification, the truth is that BMW didn't waste much time to produce its first electric car of the actual times - the BMW i3, in 2013, not forgetting the launch of 500 electric Minis in 2008. With VW adopting a sceptical position and Daimler having promised a total electric car (Necar5) in 2004 that never came to the market, BMW seems to have been the pioneer, even being averse to risks and nothing supported by the German government in all the changes it has made, producing in low quantities and never having left diesel motorizations. Electric car production is costly and batteries' prices tell that. It becomes hard to sell an electric car for a symbolic price. Because it may be an obstacle to evolution, *"the Environmental Ministry and in particular the then Secretary of State Machnig (who later moved to the Ministry of Economics), already campaigned for such a scheme in 2009 in attempts to subsidize the purchase of electric cars registered between 2012 and 2014, by between 3000 and 5000 euros. However, this proposal was not accepted at the time."* (Haas & Richter;2020). BMW, analyzing how its i3 was not being a font of profit, aligned with the partie CSU (Christian Democratic Union), made as it was possible in 2016 that electric cars, which prices were up to 60000 euros, were subsidized by 4000 euros.

2.1.4. Autonomous drive

In an interview written by Bloomberg (2021) to the website *InfoMoney*, BMW's CEO, Oliver Zipse, seems to be confident about BMW's future thanks to the launch of new electric models. Still in this interview that occured in the technological conference DLD All Stars, Zipse told that *"Tesla's growth in vehicle deliveries in Europe has already slowed last year and was almost in line with the general expansion of the electric vehicle market*", devaluing the rival. Once again, Germans devalue this evolution since it looked impensable to them, as impensable as the electric vehicles were. Even when thinking about this possibility that will have to be faced someway, there is a new possible problem emerging. "*If vehicles are reduced to autonomously moving devices in the future, and software becomes the criterion for choosing the optimal model instead of such parameters as driving comfort, a large share of the value-added generated by the automotive industry will be taken over by IT tycoons. It is they who have huge funds available, a massive amount of data, the capability to analyse and process them, and the skills of developing effective and user-friendly software*" (Poplawski, 2020).

Following this trend, Germans will have the possibility to expand their market once the same cities in which their diesel cars were prohibited to circulate, will be the same with the highest interest in autonomous mobility, specially the companies that offer transportation services in there, that *"will be able to pay more for such cars, hoping that the autonomous fleet will help them significantly cut the costs generated by driver's wages, improve driving smoothness and reduce the risk of accident"* (Poplawski, 2020). In 2020, *"according to a survey conducted by Navigant Research, (...). The German companies Volkswagen, Daimler (in cooperation with Bosch) and BMW, and the entire group of eleven other manufacturers, have been recognised as lagging behind the technological leaders*" (Poplawski, 2020).

All of the german brands face similar problems related to the conditions level to work autonomous drive. Not having the possibility to be on top, germans must trust in the american knowledge and means of testing since Germany has a poor *"availability of the 4G network, the country's administrative structure (it is too complex and impedes the development of standards on the national level) and consumers' acceptance of autonomous cars"* (Poplawski, 2020). Even so, *"the technologies used are already well-known (radar systems, sensors, cameras) and are produced not only by the major suppliers (Bosch, Valeo, Delphi, TRW, Magna and others) but also by companies outside the automotive sector"* causing that *"demand for these components can be expected to increase further and to create growth opportunities for electronics suppliers or software-oriented companies"* (Roland Berger and Lazard 2016: 34 appud Krzywdzinski, 2019) that will compete with the traditional suppliers that are adjusting themselves to the new reality and, also, be a new alternative to carmakers.

Concerns about the car's symbologie and how it is changing turns out to be a big point. Something that before was an indicator of the social level of its owners seems to be turning on something that is used by its utility and thought even more for the common use, as we can see in the plans for the big cities in which it constitutes a service and not a personal good. All the electrification changes introduced an ecological vision of the use that a car must have and, since that, new kinds of car utilizations are being brought by emerging companies and being

accepted by customers all around the world. So much so that it is expected that in the future what will bring profits to these brands are these solutions, being sales a minority.

2.1.5. Ride-hailing

Ride-Hailing companies entered the market with a *"platform where individuals could hail and pay for a ride from a professional or part-time driver through an app"* (Scherer,2020). These companies became a new kind of competition and a new kind of market evaluators, although it may seem to be very indirect, since these professionals choose the cars they use and the chosen ones have to be technologically well developed with all the support they search on amenities such as the *"GPS, digital road maps and smartphone*" (Scherer, 2020) association.

People that don't like to drive and have a car only for the utility will give up on buying a new one. Probably will sell the present one, once they have a service that provides them dislocation. One car may solve lots of people's necessities and lots of people that are served by only one car will not buy lots of cars. Even people that don't have drivers license, that before had to accommodate their dislocation needs to public transport or other's preferences, others such as familiars or friends, are now deciding by themselves which cars they want to be transported in. These persons will also be included in a target position.

According to Scherer (2020), in 2020, the Ride-Hailing market had 1.14 billion users and was the fastest-growing one in the Mobility as a Service sector. According to her, the entry barriers were also low and the competition was fierce.

2.1.6. Digital Parking

The big cities, seen as the biggest problem for environmental questions, are enjoying new smart city solutions, that accompanied by the emergence of the electric cars, are improving the quality of life and reinforcing the technological expectations from the common user with digital parking. The intention is to optimize the available space for cars, since the numerous population can't provide a reduction in car's ownership. Human error can't, sometimes, provide a good utilization of the parking space and it may cause traffic until some possible other space. In this new kind of service it is tried to avoid driving time in ignorance of the parking possibilities, as well as traffic and pollution. The effective service consists of an app-based system whose utilization is based in *"real-time data and applications, and low-cost sensors that enable users to observe […] parking locations"* (Scherer, 2020).

This parking service was also well accepted, having its usage increased exponentially, and it is expected to continue this way until 2025 following Scherer (2020) prevision. This is a very successful idea in the USA and Europe, however,*"the market in Europe was fragmented and reached from simple parking reservation apps for cities, to fully autonomous parking apps regulated by on-site sensors"* (Scherer, 2020). This kind of service is a new one to include in

the list of new actualizations for the automobile industry, jointly with telecommunications industry and some startups.

2.1.7. Electric Charging Infrastructure

Electric and hybrid vehicles' sales was a goal imposed mainly on German cars thanks to the diesel emissions scandal, however, the fact that the charging network is not that developed increases the need of actuation in order to give conditions that may attract consumers. This lack of solutions may represent the creation of a new industry that would complement the automobile's one and, in years, represent the substitution of the actual industry of the petrol stations, the same way electrification represents a substitution to diesel or gasoline.

Manage these stations based on the petrol station's example would be a reasonable idea, especially because of the importance of having *"rapid-charging stations in public areas that are important for long-distance trac*" (Haas & Richter;2020). The old reality is a legitim starting point to improve, not only by the service differentiation, but also by a more digital service composed of a *"transparent pricing and smooth payment"* (Scherer, 2020). It is expected that principal petrol station's owners grab this new business since they already have the infraestructures, they just need to adjust them to the new market demands via a brownfield strategy, such as BMW is applying in its plants. However, in Germany, E.ON and Siemens were the first ones dedicated to developing the electric charging infrastructure.

Nonetheless, in addition to the old petrol station's owners, that could have interest in reformulating their businesses,as well as in addition to the companies from the energy sector, that could take advantage of this need to create one more field of activity, there are the automotive companies that, feeling that this need has been triggered from a change of its production, it is an actuation that must be carried out by them. This is a shared area of domain. Petrol stations have adjustable infraestructures, already well distributed across the territory, but energy companies have the necessary energy to supply them, and the automotive industry has a word to say in an evolution that they oriented to happen and in which they have customers to please.

The German Government took energie suppliers position for liability motives and, in 2016, it was adopted a program that served as a market incentive for e-mobility. Haas & Richter (2020) reported that *"a total of 300 million euros were allocated to partly fund the installation of at least 15,000 publicly accessible charging stations from the start of 2017 until 2020; 100 million euros were allocated for charging up to 22 kW and 200 million euros for rapid-charging stations with capacities of 22 kW and upwards"*. These stations are, normally, associated with an IT-backend for e-roaming that results that *"drivers of electric cars can charge their vehicles using a single access medium, regardless of who operates the charging station"* (Haas & Richter;2020). Examples of this kind of platforms are 'Plugsurfing', e-cleaning.net, owned by Smartlab and 'Intercharge', which belongs to Hubject, *"a joint venture between the large companies in the automotive and electricity markets: BMW, Daimler, Volkswagen, Bosch, Siemens, and EnBW"*.

The focus on rapid-charging stations in public spaces turns e-mobility into a contested business field. Start-ups, as well as the quasi-monopolists of the German energy and automotive industries, are competing for market share, whereas with large ventures (such as Hubject) the established power relations tend to prevail.

2.2. BMW's strategic situation

All the prevention *"to limit the losses in case electric cars turned out to be merely a rich clients' fad"* (Poplawski, 2020) caused a delay in response to new market necessities and competition. Many things must change while producing new cars: new construction processes, new needs of parts and work tools, new work modalities that require training, new needs in terms of construction materials that will generate new professional alliances, new workshop layout to embrace new production processes, new investments in R&D, among others.

BMW was a successful brand while manufacturing and putting high quality fossil-fuel cars into the market. Now, like many other brands, BMW is living the German drama - recovering from the reputation damage and getting into a new exigent era. It is not new how this brand could reinvent itself through the ages, having started to be something antagonistic to what it is today. Founded in 1916, it started to be an aircraft factory that produced engines destined to planes serving the German Navy in the 1st World War. After all, its creation came *"with the merger of Flugmaschinenfabrik Gustav Otto, an aircraft manufacturer, into Bayerische Flugzeug-Werke AG (BFW AG)"* (Santos & Anselmo, 2020).

BMW suffers its first crisis when this war has an end and the Treaty of Versailles is signed. Prohibited from continuing in its industry, it started producing motos and this way, in 1922, was born BMW - Bayerische Motoren Werke. BMW innovated to survive, changed its path but never forgot its origins and continues to honor its past in it's symbol. Mascarenhas (2015) adverts us to the two possible theories about it: first that the *"panels in there represent the blue sky and white fields, in analogy to a rotating airplane propeller – referring to the brand's origins as an airplane builder; and another that says the blue and white comes from the Bavarian flag*". The same author, contrary to what BMW affirmed for many years, assumes that the second theory is the correct one, although it couldn't be accepted since *"at that time it was illegal to use national symbols in a denomination or graphism of commercial brands"*.

In 1933, in the 2nd World War, BMW started to produce cars, but returned to the old habits of production of military armament and aircraft engines. When this war ends, in the same way it happened with the 1st World War, BMW is harmed and produces electrodomestics only. This brand was almost sold to Mercedes-Benz, once its sales on motorcycles and automobiles that started to be produced in, respectively, 1948 and 1952, were too low. Saved by Herbert Quandt's son, one of the biggest BMW's shareholders, BMW survived and preserved until today it's motos and car's productions, owning Rolls Royce and Mini.

2.2.1. Production's locations choices

Nowadays, having to change its production, changes in factories locations and production are applied. *"The central production system of the BMW Group comprises five sub-networks. Whereas Regensburg (Germany) and Oxford (UK) form a sub-network for small vehicles, Munich (headquarters, Germany) and San Luis Potosi (Mexico) constitute a network for the compact models. Dingolfing (Germany) and Goodwood (UK) manufacture luxury class vehicles. Spartanburg (USA) supports Rosslyn (South Africa) in the production of SUVs. The only plant which is currently not part of a sub-network is Leipzig (Germany), because the factory has a diverse product portfolio and is currently still the only factory, albeit with a different production logic, for e-vehicle production"*(Haider, 2020).

These location choices have reasons to be and the major one comes from the fact that global trade tariffs are being charged on vehicles, being a variable one depending on the car's motorization, as well as also for car's components thanks to regulations that implement this procedure. In order to reduce these costs, BMW started to produce its models in the countries in which the specifical model is more successful, having the majority of sales. Since then, "*the US has been the largest sport utility vehicle (SUV) market, thus, these models are produced locally, mainly in Spartanburg*" (Haider, 2020). China, one of the biggest rising markets, and being a allowed partnership even in a state-protected economy context, produces the smaller models, in Dadong and Tiexi, corresponding to Chinese market necessities.

This existence in the Chinese market is a demonstration of another strategy: the investment in small-scale manufacturing in countries belonging to BRICS even if it presents a financial burden. *"In order to ensure market flexibility despite capital bound in new locations, upgrades and electric vehicles, BMW, like its competitors, organizes its production in smaller sub-networks within its established production system"* (Haider, 2020). BMW's production has been increasing with the exception of Oxford and Rosslyn where the production level seems unchanged. Munich registered the unique decrease immediately recovered by the new series-3 launch and seems to be the key location for an electrified car in 2021.

Actually, Leipzig is the only plant location in Germany where totally electrified vehicles are produced. "*Munich, Dingolfing and Regensburg will join Leipzig in producing all-electric cars"* (Kane, 2020). The strategic reason is due to the fact that those four locations "*are concentrated within a radius of 100 kilometres and can exchange information concerning the core tasks of the subnetworks in no time*" (Haider, 2020).

2.2.2. The Munich plant

"*Munich plays a special role in this network. This site houses the corporate headquarters and the Vehicle, Technology and Component Development Research and Innovation Centre. The campus for autonomous driving is located in close proximity on the outskirts of Munich. With*

the BMW World, the BMW Museum and the BMW Classic, Munich is also the centre of the lived brand history and perception" (Haider, 2020). BMW doesn't forget its history and even being the Munich plant's the smallest and the less productive one, this still be the oldest and the most important for the brand's identity. A change in this factory represents an effective change in identity - a big demonstration of preparation for the future in a place that marks identity but also the past traffic habits accompanied by pollution. Munich and BMW are connected by the same goals. Traffic Concept 2030+, a plan that consists in making improvements in traffic situations in the North of Munich, makes every plant cooperate in what concerns their activities, especially in the necessary displacement. Not only can the final product be greener, but the manufacturing processes too and BMW shows it. "*Since 2015 the Munich plant has undergone a process of continuous restructuring characterized by the vehicle life cycle, technological change, and sustainability and efficiency upgrades*" (Haider, 2020). It was there, in Munich's factory that emerged "*a more efficient and sustainable paint shop among others*" (Schulenburg, C. and Hemmerle, A. 2015 appud Haider, 2020).

"*The construction or reorganization of a production site is always a long-term decision that binds large sums of capital. In addition, a site must meet the requirements of many different functions*" (Haider, 2020). Logistics, human resources, assembly and production, legal affairs and IT are examples of areas that compose a plant and concerned parties while making decisions. Each of them with different perspectives, all together may bring the better options for the factory and with that we conclude how a long-term decision must also be an "*optimal across-departmental solution*" (Haider, 2020). The production of a totally electric vehicle in the factory will be expensive, however, applying changes in Munich have advantages such as *"the plant's proximity to the research and development departments, the availability of many university graduates and high-skilled workers as well as the perception as a regional player have a positive effect on the Munich location"* (Haider, 2020).

2.2.3. Plants' restructuring investments

When concerned about the future, BMW analysed how the improvement of what they had was always less costly than starting again from the beginning and because of that chose a brownfield strategy and so *"the investments that had been made a few years earlier to launch the successor model of the 3 series continued to be used beneficially"* (Schulenburg, C. and Hemmerle, A. 2015 appud Haider, 2020). It was possible an optimized utilization of the existing structures, a technological transformations installation in the leading plant and an optimal distribution of the produced volumes to sales markets. Costs of compensation needed to be analysed since modifications would affect technologies or change them in a more cost-effective way. Also, many of the available machines for production have to be used differently or simply be replaced, meaning this a new investment that brings more running costs, such as the acquisition and the monthly or annual expenditure associated (electricity payments, for example).

As we can see by BMW specific case,*"the risk appetite of the actors is changing from an aggressive investment culture to the passive optimization of proven structures and*

partnerships" (Klier, T.H. and Rubenstein, J.M. 2012; Häntsch, M. and Huchzermeier, A. 2016 appud Haider, 2020), after all, *"the large research needs of automotive technology, such as battery technology and autonomous driving, are preferably developed in cross competition cooperation in order to spread the risk and the immense costs"* (Eriksson,R.H. 2011; Hägler, M. 2019 appud Haider, 2020).

2.2.4. Future decisions based on cooperation

The same way that a production network may be an open door *"to enter new markets, to serve existing markets in a customer-centred manner, to avoid trade barriers as best as possible and to reduce dependencies on individual sites"* (Haider, 2020) globally, and these may be strictly financial strategies, sustainability is a new key word in every decision. Since e-mobility has been the central point of this change, it is not only the product that counts as innovative, the values behind the product must be incorporated along the process in every choice and every public demonstration starts to be the carmaker's new mentality every hour. The expensive investments are necessary to translate appearance into reality. The technologies behind batteries need to be explored and well known in order to make the better product, autonomous driving needs its first steps and competencies must go along with the evolution. For that, new partnerships will be necessary and new ways of actuation also. New products may present new solutions that, being a recent reality, such as technology and mobility in cars, will need a different kind of support.

2.2.4.1. Luxury associations to technology

As we had the opportunity to absorb before, many were the associations between companies in the automobile industry, some of them with technological companies that came to substitute the old subcontractors, such as Bosch, Continental or ZF, that *"do not have lithium-ion battery production technology"* (Poplawski, 2020). Even so, subcontractors, also leading with this automobile industry crisis, are reinventing themselves by making new kinds of products, such as *"electronics, software and drive train components for electric cars, thus entering a field which has so far been reserved for brand owners"* (Poplawski, 2020).

Having its subcontractors working differently, adjusted to the most recent needs, premium car brands, thinking that environmentally friendly all the industry will be, tend to differentiate themselves by the inclusion of the latest possible technology on their cars. According to Poplawski (2020), "*it seems that the only way in which quality and innovation can be offered in the segment of premium cars is to create another generation of software for autonomous cars*". BMW, following the logic, collaborates with APTIV, a company that supports the new and futuristic mobility providing services such as advanced safety, autonomous mobility, connected services, connected systems, electrical distribution systems, e-mobility, hellermanntyton, smart vehicle architecture, user experience and winchester interconnect.

2.2.4.2. BMW and Daimler

The mobility sector, referred before as a new competitor, has been a sector in which investment was made in different ways such as buying or partnering with emerging companies, informs Scherer (2020). BMW and Daimler, they are part of those who join into the emerging markets. The goal is to control businesses that may damage theirs while extending its own business to other profitable areas instead of just waiting for it to start bringing disadvantages. The nowadays best strategy seems to be partnership instead of rivalry and BMW, as well as Daimler, seem to have noticed that. After all, it is a good advantage to have, for example, ride-hailing services associated with its cars. It's a new kind of consumption but also a service that the companies themselves are providing to a new target, extending its number of consumers and being indirectly advertised and irreverent. These associations are very helpful for the startups, after all it is easier to trust in a new company involved with a well-established one.

Daimler invested, in a global context, in a range of companies dedicated to services of that kind. Examples are MyTaxi, RideSoutlvi, Hailolvii and Blacklane, expanding its market once again with this last one that corresponds to mobility via limousine but, also, with investments *"with Clevershuttle, a ride-pooling servicelix, and had a stake in Flixbus, the half a billion Euro rated intercity bus service. Besides on-road services, Daimler had been funding the flying taxi startup Velocopter with $30m"* (Scherer, 2020). According to the same author, *"BMW started its mobility investment in 2014 with a stake in RideCell, a leading software provider for Mobility as a Service. Further funding included the carpooling service Scoop, the local journey planner Moovit, as well as the new-generation car rental company Skurt"*. While Daimler made itself complete in a sense of providing ride-hailing from different kinds of vehicles, BMW conquered the same completeness feeling on the other side, by encompassing the whole process of a trip: since the technological software needs, the essential planning of it and the scoop or the vehicle to go on it.

BMW and Daimler were in an equal position, being both luxury German brands. All the services in which they acquired a percentage of ownership or all the new suppliers with which they recently collaborated present a complementary relationship. Being both needed, jointly, BMW and Daimler, as well as Audi, *"announced their acquisition of Nokia's mapping and location service in August 2015"* (Scherer, 2020). From this we captured a normal business situation, however, this investment was considered "*as a competitive move against Google, which relied heavily on accurate mapping systems for its self-driving cars"*(Scherer, 2020). A danger that was mentioned before is how other industries are invading the automotive one thanks to the multitude of elements that a car needs nowadays. Could it be considered a preventing action?

2.2.4.3. Joint Venture

Apart from external context, with all that examples of mobility services or products supplied, reality is that even in an internal context there is investment in order to get a multitude of services beyond the products and in an attempt to agilize product fluxes. Example of that is Daimler Mobility that integrated *"financial services (leasing, insurance), fleet management*

as well as digital mobility solutions" (Scherer, 2020). More than that, according to the same author, *"Daimler was pioneering the car-sharing market with car2go since its launch in 2008 and was heavily expanding in European and North American markets"*. BMW followed the trend and, in 2011, engaged in the same process with DriveNow jointly with Sixt, a German rental vehicle.

It was in 2017 that the theory about the possibility of a Joint Venture existence started. The suspicions also increased with the joint action related with Nokia's product acquisition since it was seen as the establishment *"of barriers for competitors like Google and Uber"* (Scherer, 2020). Based on that, it turned out to be easier to imagine a merger of the two brands' mobility services and, also, see it happen since *"BMW paid €209m for the 50% DriveNow shares of Sixt and Daimler purchased 25% of car2go shares from Europcar"* (Scherer, 2020), adding that *"Daimler was generating €167 billions and BMW €99 billions with their respective mobility solutions"*.

There are many utilities in making partnerships and, since that, all the involvement with the technological companies are valued in this new era, however, it would be enough if it were only the car sales the only font of profit. In the future, sales will only present 40% of the car brand's gains. Competitors are no longer only other car brands, they are also the emerging service providers - as we conclude by analysing Ride-Hailing, or with the electric charging infrastructures' case. With this enlargement of concerns and new concurrents from other activities sectors (Technological and Mobility Services), the Automobile Industry needed support inside itself and then BMW cooperated with Daimler. Dieter Zetsche, Daimler CEO, according to Scherer (2020), admitted the challenges that were being faced by the two brands and, indirectly perceived by the author, how *"it took some time to get used to seeing those two companies together, having been direct rivals for decades", adding that "the collaboration was no spontaneous idea but a longstanding development from both sides"*.

In 2019, negotiations gave rise to the approved partnership, as it had to be, by US and European competition authorities. From this cooperation resulted a brand designed by *YourNow,* which *"combined a total of 14 brands with 60 millions users"* (Scherer, 2020). Initially, the brand was a mix of 5 mobility solutions:

1. "FreeNow: Ride-hailing – contained companies such as MyTaxi, Kapten or Beat;
2. ShareNow: Car-sharing – included the two companies car2go and DriveNow;
3. ReachNow: Multimodal mobility platform for the North American market – offered a Mobility as a Service platform that combined all mobility services in one app;
4. ParkNow: Digital parking platform – included companies such as ParkNow, ParkMobile;
5. ChargeNow: Electronic charging network (e-mobility service provider)".

(Scherer, 2020)

Both carmakers invested an amount of €1.13 billion in JointVenture, leaving the opportunity to others to join them, being investors or companies from the same industry. At the end of the

first year partnership, BMW and Daimler decided to convert the five specificities of their businesses into three, remaining FreeNow & ReachNow, ShareNow and ParkNow & ChargeNow. The profitest specification was FreeNow, contributing €2 billions in the same year. Although *"user numbers had increased by 44% since the launch of the JV, to 90m users worldwide"* (Scherer, 2020), contrary, ShareNow imposed a problem, in 2020, felt majority in the USA and UK: lack of demand combined with high costs. Location was a relevant factor in order to have gains from this service and ShareNow continued only in certain European Locations. In order to improve customers' experience, BMW and Daimler launched an app, including car2go and DriveNow, to make the accession to the service more practical.

The expectations are that the effective profits come from 2025 on, suggests Scherer (2020) based on expert opinion. Seeming to be very far, the distance pushes away investors, protecting themselves from huge risks associated with lower gains. Comparing the Mobility Services Industry and Technology Industry with the automobile one, the two first ones seem to be more attractive to investors since they *"had extremely high cash reserves and market valuations, which provided them with enormous cash resources and, hence, financial flexibility"* (Scherer, 2020). However, it is possible that this JointVenture may signify a turn around in innovation and in financial status, since the own automobile market started to include the other two industries and seem to have conditions to have a healthy survival supported by them.

Conclusion

BMW, dealing with transformations, chose to produce e-mobility only in German, in Leipzig, with the intention of extending the production to Munich, Dingolfing and Regensburg for the proximity of the plants and the facility of exchange of information. Investment was needed in order to adjust e-vehicles production to the conditions already existent and so BMW adopted a brownfield strategy, taking advantage of older investments in order to take less risk.

Even so, with risks associated and in a market suffering changes, BMW started cooperating with Daimler, that such as BMW, got involved with the technological and mobility sectors by mergers and acquisitions necessary to the adaptations needed to the success with the new customer, the prosumer one. The Joint Venture presented 5 mobility solutions that ended up to be 3, included 14 brands and had 90 millions users worldwide. Being technological and mobility sectors so lucrative, it is possible that this Joint Venture will be a distinct surviving strategy, supporting itself on its biggest concerns to get financial stability.

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