
# The VW e-Race

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# Abstract

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The world is in constant change, technology is evolving fast and, for that reason, organizations need to rapidly adapt and implement change in order to survive in this highly dynamic and competitive environment. Scholars have been investigating the reasons for strategic change and what are the capabilities that a firm needs to have in order to survive in an ever-changing world. In order to better illustrate these theories with a real-life example, I selected the case of Volkswagen and its late adoption of Electric Vehicles (EVs). The VW e-Race case intends to demonstrate how unprecedented change in the automotive industry impacted the German car maker. The company has been one of the leaders in diesel cars, but in what concerns the EVs' business they seem to be getting behind their competitors. Volkswagen had a slow and weak entry in the EVs' business with only two models being launched until 2018. Nonetheless, its diesel crisis, in late 2015, pressured them to re-organize the company's strategy around electric cars. This case clearly demonstrates how, sometimes a firm needs to pass through a crisis in order to implement change. Moreover, it shows the relevance of organizational change and dynamic capabilities, for a company to sustain a competitive advantage in a changing environment.

# Resumo

**Título da dissertação:** The VW e-Race
**Autor:** Beatriz Sales Marques Barreto
**Palavras-chave:** Mudança Estratégica, Dynamic Capabilities, Choque Exógeno, Mudança Organizacional

O mundo está em constante mudança, a tecnologia está a evoluir rapidamente e, por essa razão, as empresas precisam de se adaptar rapidamente e implementar mudanças de forma a sobreviverem num ambiente dinâmico e competitivo.
Os investigadores têm vindo a procurar as razões para a mudança estratégica e quais as capacidades que uma empresa precisa de ter de forma a sobreviver num mundo em constante mudança.
Para melhor demonstrar estas teorias com um caso real, selecionei a Volkswagen e a sua adoção tardia dos carros elétricos. O caso VW e-Race pretende mostrar como a mudança sem precedentes na indústria automóvel influenciou o fabricante alemão. A Empresa tem sido um dos líderes nos carros a diesel, mas no que diz respeito aos carros elétricos, parece estar a ficar atrás dos seus competidores. A Volkswagen teve uma entrada fraca e lenta no negócio dos carros elétricos, com apenas dois modelos a serem lançados até 2018. No entanto, a crise que enfrentou no diesel, no final de 2015, fez pressão para que a sua estratégia se reorganizasse em torno dos carros elétricos.
Este caso demonstra claramente como, por vezes, uma empresa precisa de passar por uma crise de forma a implementar uma mudança. Para além disso, mostra a relevância da mudança organizacional e das *dynamic capabilities,* para uma empresa manter uma vantagem competitiva, num ambiente em constante mudança.

# Abbreviations

**BAIC**: Beijing Automotive Industry Holding Co., Ltd.

**CA**: Competitive Advantage

**DC**: Dynamic Capabilities

**EMS**: Energy Management System

**EPA**: Environmental Protection Agency

**EV**: Electric Vehicles

**FEEP**: Future Electronic Engineer Program

**IEA**: International Energy Agency

**MEB**: Modular Electric Drive Kit

**MQB:** *Modularer Baukasten* (Modular Transversal Toolkit)

**NEDC**: New European Driving Cycle

**OPEC**: Organization of the Petroleum Exporting Countries

**SC**: Strategic Change

**VW**: Volkswagen

**WLTP**: World-Wide Harmonized Light-Duty Vehicles Test Procedure

**ZEV**: Zero-emissions vehicles

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# 1. Introduction

In these days, the world is getting more dynamic, people are better informed and in constant communication, technology is evolving fast, new opportunities are arising every day and competition is increasing. In this world, the firms that survive are the ones who rapidly adjust and implement strategic change in order to better fit the environment.

In the 1980s, an increasing importance was given to change management. In the subsequent years, empirical research has shown the importance of strategic change (SC) implementation, in order to better fit an environment in constant change (Lawrence & Lorsch, 1967). Despite this, many firms still tend to persist instead of implementing change, even when it is clear that they should do it (Tsoukas & Chia, 2002). That is why Barker III and Duhaime, 1997, argued that a firm when in a "weak strategic position", facing a decline while the industry is growing, has a higher need to implement SC (Barker III & Duhaime, 1997). Higher attention has been given to the question "How can a firm achieve competitive advantage?", but less emphasis has been given to the question: What can a firm do to sustain superior performance in changing environments? The Dynamic Capabilities (DCs) view has arisen from the need to answer this question. Teece et al., 1997, defined DCs as "the firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments"(Teece, Pisano, & Shuen, 1997). Since then, many other definitions have been suggested by different researchers. Barreto's definition (2010) was an attempt to clarify the concept (Barreto, 2010). He defined DCs as "the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base". Research has been supporting the presence of DCs, in order to explain a firm's success in coping with changing environments, but in which environment is it more relevant (with low, medium or high level of dynamism), it is still not clear.

In my thesis, I will try to answer the following questions: Does a firm need to pass through a crisis in order to implement change? Is it crucial for a firm to have DCs in order to succeed in a highly dynamic environment? I want to illustrate how unprecedented change in the automotive industry impacted the German car maker Volkswagen. The company has been one of the leaders on diesel cars, but in what concerns the EVs' business they seem to be getting behind their competitors. Volkswagen launched their first two EVs in late 2014, four years later than its competitors. One year later they were passing through their darkest time with the diesel scandal, beating records of low performances. A change was urgent and with the new CEO Matthias Müller a new era has arrived at Volkswagen, with huge investments in an electric

offensive. Overall, I would like to contribute to a better understanding of the DC's view, and its four dimensions, by applying it to a very up to date and relevant matter.

This thesis will be divided in five main chapters. The Literature Review will consist on a critical analysis of the main theoretical findings about SC and the DCs. The next chapter presents a Teaching Case about Volkswagen, followed by the Teaching Notes in a third chapter. The final sections will be a discussion and a final Conclusion.

# 2. Literature Review

This chapter will cover the main theoretical findings that sustain the following Teaching Case. Several theories will be described and critically compared in different fields, namely Strategic Change and Dynamic Capabilities.

## 2.1. Strategic Change

In a recent paper which analysis and combines various definitions of the term '*Strategy'* across time, Ronda-Pupo and Guerras-Martin, 2012, described strategy as "the dynamics of the firm's relation with its environment for which the necessary actions are taken to achieve its goals and/or to increase performance by means of the rational use of resources" (Ronda-Pupo & Guerras-Martin, 2012). It was in the 1980s, that change management became an issue. It was found that, in order to succeed, firms would need more than 'out of the box' ideas and individual competencies (Pettigrew, Ferlie, & McKee, 1992).

Some researchers found evidence that strategic management is crucial in order to adjust when a firm is facing changes (Lawrence & Lorsch, 1967). In a study conducted by Stubbart and Knight, 2006, of more than 6 million US firms, they noticed that only less than 0,1% lives to age 40 (Stubbart & Knight, 2006). This numbers are coherent with the perspective of a world in constant change and with the need to constantly adjust, in order to succeed in the long-term. Moreover, a firm should maintain its alignment with the environment. Many researchers agreed that strategies are in constant change. Nonetheless, some considered that this change occurred "gradually and incrementally" (Quinn, 1978), while others have seen it as an abrupt and radical change (Mintzberg, 1978).

An exogenous shock can be defined as an abrupt change in the environment of the firm. Li and Tallman, 2011, described these phenomena as "reorienting" disruptive changes, that occur independently from the global business environment, but that have huge effects on it (Li & Tallman, 2011). Some studies showed that this can be an important stimulus to organizations (Hoffman & Ocasio, 2001; Nigam & Ocasio, 2010). When facing huge transformations in the environment, a firm should proceed to some strategic adjustments in order to better fit the new environmental context (Audia & Locke, 2000). On this same study, the authors found evidence that strategic persistence, when facing an exogenous shock, leads to substantial performance declines. Many researches have been showing that, over time, organizational routines tend to persist, even when it is clear that the firm should implement change (Tsoukas & Chia, 2002).

For this reason, it is important to distinguish strategic change from adjustments. Many studies have shown that organizations are reluctant to implement change. Thus, when facing an external pressure, they tend to adjust rather than to implement change (Snow & Hambrick, 1980). To better distinguish these events, Snow and Hambrick, 1980, considered that SC occurs only when: "(1) modifies in a major way its alignment with the environment; (2) substantially alters technology, structure and process to fit the new alignment."(Snow & Hambrick, 1980).

Despite the huge importance that early theorists gave to SC in many successful turnarounds, subsequent large-sample studies proved the contrary. Many criticized this view arguing that lack of evidence made it questionable and that SC could actually have a positive impact in a turnaround (Barker III & Duhaime, 1997; Pearce II & Robbins, 1993; Robbins & Pearce II, 1992). Barker III and Duhaime, 1997, considered a successful turnaround to be "when a firm undergoes a survival-threatening performance decline over a period of years but is able to reverse the performance decline, end the threat to firm survival and achieve sustained profitability.". Furthermore, they considered that the success of SC implementation under these conditions will depend on the firm's need to implement the change and their capacity to do it. Some studies have shown that poor performance pressures firms to implement change if a firm has the resources to do it (Ginsberg, 1988; Huff, Huff, & Thomas, 1992). Moreover, when a firm's problem is its strategic position, a change in its strategic orientation is needed in order to succeed (Barker III & Duhaime, 1997). According to Barker III and Duhaime, 1997, if a firm is in a "weak strategic position", facing a decline in performance while the industry is growing, the need for strategic change increases.

It is important to note that more SC doesn't necessarily means an increase in firm's performance. In Haynes and Hillman, 2010, view, change is due when the firm needs to be agile in order to succeed in its environment (Haynes & Hillman, 2010). Nevertheless, they recognized that sometimes a firm needs to maintain the 'status quo'. Researchers don't agree on this matter: some studies support that SC enhances performance; others that it decreases; others have found no relation between the two; while others have found mixed relations (Zhang & Rajagopalan, 2010). Rajagoplan and Spreitzer, 1997, argued that the effect that SC has on firm performance depends on the organizational conditions where the change has begun and been implemented (Rajagopalan & Spreitzer, 1997). In a more recent paper, Zhang and Rajagoplan, 2010, noted that many firms imitate competitor's strategies when implementing change, which is not very risky since they could learn from the peer's decisions. These authors have found two different effects that SC could have: (1) Adaptive if it enhances firm's alignment with its environment; or (2) Disruptive if enhances the chance for a poor strategy implementation.

In 2002, Tsoukas and Chia questioned the way firms look to change, as an "exception rather than natural", arguing that an organization is an "emergent property of change". Moreover, they considered a firm's response to an external pressure, complex and in constant change as it depends deeply on an organization's self-understanding of its environment. Orlikowski and Hofman, 1997, when analyzing the case of the customer service department at Zeta (software company) brought a very relevant view to the discussion: "change can be both exogenously and endogenously created". Zeta decided to implement a technological change once its tracking system was antiquated and advances were being made in groupware technology, but also because managers wanted to offer better customer service (Tsoukas & Chia, 2002).

Helfat and Winter, 2011, emphasized that a firm is more likely to survive and to better perform when implement changes in order to adapt (Helfat & Winter, 2011). In Pettigrew et al., 1992, study about the National Health Service, many differences were found in the ability to manage SC, in districts facing the same external pressures (Pettigrew et al., 1992). This has shown that many more factors are influencing the success of SC implementation.

## 2.2. Dynamic Capabilities

Learned, et al., 1969, stated that a company's success was in "it's ability to find or create "a competence that is truly distinctive""(Learned, Andrews, Christensen, & Guth, 1969). Early on time, several theories were created in order to answer the question "How can a firm achieve competitive advantage?". Some of them were focused on market power, as the competitive forces of Porter (1980) that helped the firm to find an advantageous position in the industry. But these theories didn't explain how a firm can adjust and achieve a long-term competitive advantage (Teece et al., 1997). There were also some theories that were focused on efficiency as the resource-based perspective (Barney, 1991) that have been criticized by other authors for being "vague and tautological" and for not explaining how a firm can sustain a competitive advantage in changing environments (Eisenhardt & Martin, 2000; Priem & Butler, 2001).

A better explanation of how to identify, maintain and empower a specific competitive advantage was needed. The first definition by Teece et al., 1997, described DCs as "the firm's ability to integrate, build and reconfigure internal and external competences", in order to adjust in a changing environment (Teece et al., 1997). Since then, many researchers have tried to better understand and improve this definition that was criticized, among other reasons, for being redundant and confusing (Danneels, 2008; Kraatz & Zajac, 2001; Newbert, 2007; Williamson, 1999; Winter, 2003). Some as Teece et al., defined dynamic capabilities as a capacity of the firm (Winter, 2003; Zahra, Sapienza, & Davidsson, 2006), others defended that it was a specific

process (Eisenhardt & Martin, 2000) while others a routine (Zollo & Winter, 2002). The authors seemed not to agree on many more specifications about the dynamic capabilities view, mainly on the relevant context to study, outcomes and about the existence of similarities across firms (Barreto, 2010). Zollo and Winter, 2002, defended that the dynamic capabilities are used in any environment, while Zahra et al., 2006, didn't consider the level of change in the environment as part of the dynamic capabilities view. Nevertheless, both researchers recognized that they were more useful in a changing environment. Eisenhardt & Martin, 2000, believed that dynamic capabilities should be used not only in high velocity markets, but also in "moderately dynamic" environments. Some consideration should be taken to a recent research, that found some evidence of a stronger relationship between competitive advantage and dynamic capabilities in a moderately dynamic environment and a weaker relationship in environments with low or high level of dynamism (Schilke, 2014).

When it comes to the link between dynamic capabilities and firm performance there are also contrasting perspectives. It's possible to enumerate three different views:

(1) some researchers supported that there is no direct connection between the implementation of dynamic capabilities and firm performance, arguing that they can change performance when a bundle of resources suffers changes (Zott, 2003);

(2) Others supported that the "dynamic capabilities are necessary, but not sufficient conditions for competitive advantage" (Eisenhardt & Martin, 2000). They argue that in the long-term a firm is able to sustain competitive advantage due to the way they implement dynamic capabilities (e.g. using dynamic capabilities sooner) and not because of the capabilities themselves;

(3) Later in time, Teece, 2007, attempted to redefine the concept of dynamic capabilities defending that they "support superior long-run business performance"(Teece, 2007).

Moreover, some researchers posited that dynamic capabilities can even damage performance (Winter, 2003; Zahra et al., 2006).

It is important to note that there is no evidence that supports that only by implementing dynamic capabilities a firm could achieve superior performance, because there are many more factors to consider. Nevertheless, many scholars also support that "strategic fit" is needed (Teece, 2007), and that it's not by maintaining the '*status quo'* that a firm can survive in the complex and competitive environment that we have today.

With so many discrepancies between perspectives, some clarity was needed and Barreto's definition (2010) was an attempt to clarify and redefine the concept. He defined dynamic capabilities as "the firm's potential to systematically solve problems, formed by its propensity

to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base" (Barreto, 2010). As suggested in previous research, none of the dimensions should be considered alone because they are interrelated. Nonetheless, there is no obligation for them to be correlated. It is important to note that these dimensions emerged as a combination of past references in several researches on this topic (Adner & Helfat, 2003; Eisenhardt & Martin, 2000; Teece, 2007; Teece et al., 1997).

It is essential to keep in mind that Dynamic Capabilities is a relatively recent topic in the Strategy field and that there is still a lot of research to do in this area. In the future some consideration should be given to the quantitative aspects of the framework proposed by Barreto (2010), since it's too broad to classify the different dimensions in low, medium or high. It is also important to better clarify in which environment (with high, medium or low level of dynamism) it's better to use dynamic capabilities since it's still a controversial topic.

# 3. Teaching Case

## The VW e-Race

In the fall of 2018, pressure was on as the well-known leader of diesel cars Volkswagen (VW) was lagging behind on the EV's technology. There had been almost 50 years of cars production with the German company ahead of their competitors, but in the EVs' business they were showing some signs of slowing down.

The last 3 years were testing the company's capability to surpass difficulties at all levels.

In September 2015, EPA[1] had declared that VW was violating diesel emissions that affected 500,000 diesel cars. In June 2016 the board redesigned its core business and decided to focus more on zero-emissions alternatives.[2] By this time, U.S. pioneer Tesla was already more experienced on the EV's technology, delivering over 76,000 electric cars in 2016[3]. With the emissions scandal, additional pressure of the new emissions rules for Europe and with the rapid advance of batteries technology, Volkswagen was lacking a reshaping strategy. On that year, VW CEO Matthias Müller announced "the most comprehensive electrification initiative in the automotive industry with Roadmap E"[4]. The company had plans to accelerate the electric transformation of the group vehicle portfolio by bringing 80 new electric vehicles to the market by 2025 (50 purely battery-powered vehicle and 30 plug-in hybrids). Until 2030, VW Group wanted to have at least one version of each model across all brands electrified. This summed up to a total of more than 300 models across all group's brands, putting up the German company again on the race to e-mobility transformation. Müller saw Roadmap E as the new chapter and explained that "Then it is up to customers to decide how fast it will gain widespread acceptance.".

*"We have got the message and we will deliver. This is not some vague declaration of intent. It is a strong self-commitment which, from today, becomes the yardstick by which we measure our performance.* ***The transformation in our industry is unstoppable. And we will lead that transformation****"*

[1] EPA (Environmental Protection Agency)

[2] http://fortune.com/2017/09/11/volkswagen-to-electrify-all-300-of-its-cars-and-suvs-by-2030/ (accessed on 25/10/2018)

[3] https://www.theverge.com/2017/1/3/14159292/tesla-q4-2016-delivery-production-model-s-x (accessed on 5/11/2018)

[4] https://www.volkswagenag.com/en/media/volkswagen-group-media-services/2017/09/roadmap-e.html (accessed on 25/10/2018)

- *Matthias Müller, CEO Volkswagen Group 2015-2018*

Volkswagen had launched their first electric vehicle on late 2014 and it was considered below expectations by the experts as it didn't achieve the performance of its competitors. Four years had passed, and in October 2018 the company had the same full EV's launched by the company in late 2014. At this time, they were striving to become the global number one on e-mobility by 2025. But despite the efforts to secure a battery's manufacturer and the announcement of an abrupt increase in the number of factories available to produce the millions of EV's that the brand was announcing, what we had seen was just a "vague declaration of intent". So, would this change in strategy be enough? Would they be able to keep up with the pace? Or was it too late for them to compete on EVs market?

## 3.1. Overview of EV's Market

### 3.1.1. Drivers of demand

Electric Vehicles (EVs) were becoming a trend worldwide with a global sales increase in 2017 of 54% compared with the previous year, which corresponds to more than 1 million cars sold.[5] This abrupt increase on the demand could be explained by many factors. For instance, the oil prices, the environmental regulations on $CO_2$ emissions and government incentives can be pointed out as drivers of the demand.

In 2017 the average price in U.S. dollars per barrel of oil was 52.51$, one year later it was 70.28$.[6] Oil has seen significant fluctuations in price over time, mainly due to OPEC's[7] influence on supply. OPEC constantly increased and decreased oil production in an effort to influence the price to be between a given maxima and minima. But despite OPEC's huge impact on oil prices, many more factors could cause fluctuations on price, as natural disasters and politics on oil prices. For instance, political instability in the Middle East has caused fluctuations on oil prices in the past. An example of this phenomena was the rapid increase in the price of a barrel of oil to 136$ due to the wars in Afghanistan and Iraq in July 2008.[8] IEA was predicting a sudden increase on oil prices for 2018: "our position is that expensive energy

[5] IEA (International Energy Agency) Global EV Outlook 2018

[6] https://www.statista.com/statistics/262858/change-in-opec-crude-oil-prices-since-1960/ (accessed on 01/11/2018)

[7] OPEC (Organization of the Petroleum Exporting countries) composed by 14 countries with the goal of coordinate the oil policies of its members.

[8] https://www.investopedia.com/ask/answers/012715/what-causes-oil-prices-fluctuate.asp (accessed on (01/11/2018)

is back, with oil, gas and coal trading at multi-year highs, and it poses a threat to economic growth.".[9] This was happening at the same time as the arrival of a new wave of electric cars, what could make them more attractive to consumers. PetroMatrix[10] revealed their position on this matter saying that this coincidence "should result in an acceleration of the sales trend of alternative fuels vehicles".

*"**The uptake of electric cars is still largely driven by the policy environment**. The 10 leading countries in electric vehicle adoption all have a range of policies in place to promote the uptake of electric cars."*

- ***IEA Global EV Outlook 2018***

As considered by the IEA, the adoption of EVs "is still largely driven by the policy environment" as we can see by looking at the country's leading the use of EV's.[11] They all have in common a large range of policies, promoted by the government, to accelerate the EVs' adoption. The government plays an important role on making electric vehicles more attractive to consumers as they can implement regulatory measures (like fuel-economy standards and restricted circulation of vehicles based on $CO_2$emissions performance) and they can also create financial incentives for the consumers that choose an electric vehicle. These incentives could be on the acquisition of the car or on the maintenance of the car (for example offering free parking or free charging infrastructures). Both have proved to be an efficient way to stimulate the initial roll-out of EVs, with the financial incentive that reduces the initial purchase price as the winning measure with the highest share of sales.[12]

If we look up to the European Union, there have been major efforts to stimulate the reduction of $CO_2$emissions and to increase the adoption of low and zero-emission alternatives (see Exhibit 1). Across all Europe, governments have been giving tax incentives for EVs' owners and ultimately, in some countries, they are even free from paying emission's tax. As part of the Clean Mobility package that the EU stablished in November 2017, an update of the $CO_2$emissions standards was launched, to be accomplished until 2030. The goal was to have a reduction of the $CO_2$emissions per kilometer for new cars of 15% and 30%, respectively for 2025 and 2030. If a manufacturer fails to comply with the regulation, it will have to pay a penalty of 95€ per g$CO_2$/km that exceeds the goal[13]. Since September 2018 only cars that pass

[9] IEA Oil Market Report
[10] PetroMatrix provides research services for oil market analysis.
[11] IEA' Global EV Outlook 2018 Report
[12] IEA' Global EV Outlook 2018 Report
[13] IEA' Global EV Outlook 2018 Report

the WLTP test[14] can be sold in Europe. Although this can be seen as a measure to reduce the $CO_2$emissions and not as an incentive to the adoption of zero-emissions alternatives, the IEA explained in their report that "respecting these long-term commitments would require increasing shares of low and zero-emission vehicles (ZEVs), and hence an incrementally stricter $CO_2$emission standard after 2030.".

### 3.1.2. Constraints on demand

Back in 2017, electric vehicles made only 0.2 percent of passenger vehicles worldwide[15], a number that was below expectations, once seven years have passed since EVs started to surge. The adoption of electric cars was not an easy road, and, at that time, there were still some constraints that made it harder to grow, from which we can highlight: the selling price, the limited driving range and the charging time and infrastructure.

Everything seemed to support the adoption of EVs if one was looking at the cost of car maintenance. In a study conducted in 2018[16] by the University of Michigan's Transportation Research Institute, they found that EVs can cost less than half to maintain when compared to gas-powered cars (in the U.S. an EV costed 485$ to operate, while a gasoline-powered car costed 1117$ annually). Despite this, due to the complexity of EV's battery technology, the acquisition price of an electric car on those days was really high in comparison with gas-powered cars. Although you could buy one EV for around 20,000€/23,000€[17], it only had a driving range of 160km. If you were looking for more autonomy, you would need to spend at least 70,000€ on Tesla Model S to have a driving range of 370-480 km.[18] Battery costs were pointed out as one of the main reasons for EVs' high acquisition price, accounting for 25% of the total price. Nevertheless, there have been huge improvements and battery costs have been falling (see Exhibit 2). In a study conducted by Accenture about EV's attractiveness, they predicted that the batteries price could fall to 200$ per kilowatt-hour until 2020 (back in 2015 it costed 383$)[19]. Tesla Motors, in collaboration with Panasonic, developed a Gigafactory only

[14] WLTP (World Wide Harmonized Light-Duty Vehicles Test Procedure)

[15] http://mitsloan.mit.edu/newsroom/articles/the-real-barriers-to-electric-vehicle-adoption/ (accessed on 09/11/2018)

[16] Study conducted by Michael Sivak, *Relative Costs of Driving Electric and Gasoline Vehicles in the Individual U.S. States,* January 2018

[17] Mitsubishi i-MiEV

[18] Bohnsack et. Al., *Value Propositions for Disruptive Technologies: Reconfiguration Tactics in the case of Electric Vehicles*, 2017

[19] https://www.accenture.com/t20161201T205153Z__w__/sa-en/_acnmedia/PDF-37/accenture-electric-vehicle-market-attractiveness.pdf#zoom=50 (accessed on 09/11/2018)

to focus on high-performance lithium-ion batteries, what has been seen as a possible accelerator to a decrease in price and consequently an overall market growth.

Other constraint, that had been less improved, was the charging infrastructure. With global sales in 2017 of 1.1 million electric cars, there were less than 500 thousand public charging outlets available as we can see on Exhibit 3. Despite this, the global forecasts were positive, due to a worldwide 50% increase of charging outlets in 2017, in comparison with the previous year.

For many customers, the charging time could be a reason not to own an electric car. While with a gas-powered car we could fill the tank in less than 5 minutes and have fuel for 300km, with an electric car it would depend on the type of charger you use. With a fast charging system, it would take you around 30 minutes to have your car fully charged, but in a public infrastructure without the fast charge technology, it would take you at least 1 hour.[20]

### 3.1.3. Competitors

Electric cars were not an early trend. The first electric car appeared in the market in the late 1800s, but its "limitations in range, speed - and style - kept electric cars from being adopted on a mass scale, and their popularity declined in the 1980s."[21] In the subsequent 30 years, electric cars saw little advancement in its technology. In the 1990s, the environmental concerns drove EVs forward with new emissions regulations, and the cars started to achieve a performance closer to gas-powered vehicles. Electric cars were not a trend at that time, but in the backstage, scientists and engineers were exploiting this technology and trying to improve it. The revival of EVs happened in the start of the 21st century and it was ignited by two main events: the launch of the Toyota Prius, the first mass produced hybrid[22] that become a huge success; and the rising of the startup Tesla Motors, that announced the production of "a luxury electric sports car that could go more than 200 miles on a single charge."[23]

In the following years, Tesla success urged many automakers to shift to the EVs' business. In late 2010, the Chevrolet Volt, the Nissan Leaf and Citroen C-Zero were launched in the market. Over the next few years, other brands released new models of electric vehicles (see Exhibit 4) with improved batteries, at the same time the charging infrastructures' networks were growing. Battery costs, that accounted for a huge percentage in the total cost of an EV, dropped a lot due

[20] https://newmotion.com/post/how-long-does-it-take-to-charge-an-electric-car (accessed on 10/12/2018)
[21] https://www.businessinsider.com/electric-car-history-2017-5#many-more-electric-cars-debuted-in-the-1970s-but-not-many-sold-8 (accessed on 11/12/2018)
[22] An Hybrid it's a car that is powered by fuel and energy that comes from the drive system (it doesn't have the capacity to plug in)
[23] https://www.energy.gov/articles/history-electric-car (accessed on 11/12/2018)

to research and development that helped increase the batteries' performance. The first two Volkswagen's electric cars, the E-Golf and the E-up! were presented in September 2013, at the Frankfurt International Motor Show (IAA), and in March 2014 the production of the first Volkswagen's EV started.

If we look at the global sales in the 1st quarter of 2018 (see Exhibit 5), we can see who the big players in the industry were. There were three companies that were clearly ahead of its competitors: Tesla Motors, BAIC (Beijing Automotive Industry Holding Co., Ltd.) and Nissan, with more than 20,000 units sold each, in three months. Following them were the Chinese company JAC Motors, that did a joint venture with Volkswagen in 2017, and Renault with 10,482 electric vehicles sold. Volkswagen appeared in 7th place with only 6,779 EVs sold in the 1st quarter of 2018. Despite this, only Renault-Nissan-Mitsubishi alliance was being profitable selling electric cars and Tesla was aiming to achieve this by the end of 2018.

## 3.2. The Dieselgate Era

*"I am shocked by the events of the past few days. Above all, I am stunned that misconduct on such a scale was possible in the Volkswagen Group.* ***Volkswagen needs a fresh start – also in terms of personnel. I am clearing the way for this fresh start with my resignation.***
*The process of clarification and transparency must continue. This is the only way to win back trust. I am convinced that the Volkswagen Group and its team will overcome this grave crisis."*

- ***Prof. Dr. Winterkorn Statement on 23th September 2015***[24]

On the 23th September 2015, Professor Dr. Winterkorn resigned as CEO of Volkswagen Group, five days after the Environmental Protection Agency (EPA) declared that VW cars, that were being sold in America, were equipped with a "defeat device" that could detect when they were being tested, changing the performance of the car. The cars equipped with the "defeated engines" (see Exhibit 6) emitted 40 times more pollutants than what was allowed in the US. VW admitted the fraud and explained how their engineers struggled to make a diesel engine that would meet both restrict US emission standards and a good performance. EPA found out that over 482 000 cars sold in the US could be affected, including Audi A3 and VW models Jetta, Beetle, Golf and Passat.

[24] https://www.volkswagen-newsroom.com/en/press-releases/statement-by-prof-dr-winterkorn-1987 (accessed on 12/11/2018)

Two days passed, it was the 25th of September 2015, in Wolfsburg, and the Supervisory Board was having the meeting that would decide VW future. They needed to point out one person to be the new face of the company, the person that would win back customers' trust. Shortly after 5:30pm, the board announced that the person who would bring a fresh start to the Group was Matthias Müller, who was at that time Chairman of Porsche AG. Bernd Osterloh, Chairman of the Group Works Council, was convinced that Müller was the right choice: "He does not work on his own, rather he is a team player. That is what Volkswagen needs now.".

Müller knew that he had a tough job in hands, but he was committed to lead VW to a much stronger place than it was before the scandal: "My most urgent task is to win back trust for the Volkswagen Group – by leaving no stone unturned and with maximum transparency.".[25]

On November 2015, Volkswagen saw their sales plunge by 20%[26], while other automakers were seeing their sales rise with a growing market. The company would need to spend in total more than 30€ billion on fines and recalls and they would need to face more restrict audits from then on. This pressured them to make changes, not only in its management but also in realigning its future strategy around electric cars, in order to distance themselves from fossil fuels.

## 3.3. Pack to the Future – Together 2025

Back in November 2016, the Volkswagen Group[27] announced their pack for the future – Together 2025 - the Group's new strategy that would set the course for the brand over the subsequent years. Dr. Herbert Diess[28] announced that the company would face huge transformations in the upcoming years: "Over the next few years, Volkswagen will change radically. Very few things will stay as they are. In the final resort, the new strategy is a major transformation program.". This transformation was divided in four main actions and can be summed up to: establishing a clear brand positioning across the various regions and segments, continuous improvements in efficiency and productivity, huge investments on e-mobility and connectivity and reshaping corporate culture and organization in order to gain back consumers' trust (see Exhibit 7). The first phase had been happening, with a restructure of the entire core business and value stream of the firm, to take place until 2020. In the second phase, up to 2025, the company had plans to lead the e-mobility transformation by offering affordable electric

[25] https://www.volkswagen-newsroom.com/en/press-releases/matthias-mueller-appointed-ceo-of-the-volkswagen-group-2040 (accessed on 12/11/2018)

[26] According to the Society of Motor Manufacturers and Traders (SMMT)

[27] The Volkswagen Group is composed by 12 brands: Volkswagen Passenger cars, Audi, SKODA, Bentley, SEAT, Lamborghini, Bugatti, Porsche, Ducati, Volkswagen Commercial Vehicles, Scania and MAN.

[28] Chairman of the Volkswagen brand Board of Management

vehicles to the customers. This would be possible through continuous improvements in efficiency and by decreasing the costs. Furthermore, and as stated in the company's website "The objective is to achieve a leading role in the new world of mobility by 2030". [29]

*"From 2020, we will be launching our major e-mobility offensive. As a volume manufacturer, we intend to play a key role in the breakthrough of the electric car. We are not aiming for niche products but for the heart of the automobile market.* ***By 2025, we want to sell a million electric cars per year and to be the world market leader in e-mobility.*** *Our future electric cars will be the new trademark of Volkswagen."*

- ***Matthias Müller, CEO Volkswagen Group 2015-2018***[30]

The company had plans to raise 2.5€ billion by cutting on certain low-volume and low-earnings models in order to invest on the e-mobility offensive. In May 2017, Volkswagen and JAC Motors agreed on establishing a joint venture in order to share knowledge about the production of electric vehicles (see Exhibit 8).[31] During the brand's annual media conference in Berlin, Müller admitted that the urgent shift to the EVs' business was driven by the diesel scandal: "The diesel scandal told us there was a need for radical change; the crisis has acted as a catalyst.".

## 3.4. A toxic sequel

In April 2018, Matthias Müller was ousted as CEO of Volkswagen Group by the supervisory board. Müller had stepped up as CEO of the Group in the most chaotic time of the company's 8th decade history.

*"Matthias Müller has done outstanding work for the Volkswagen Group. He assumed the chairmanship of the Board of Management in the fall of 2015 when the Company faced the greatest challenge in its history. Not only did he safely navigate Volkswagen through that time; together with his team, he also fundamentally realigned the Group's strategy, initiated cultural change and, with great personal commitment,*

[29] https://www.volkswagenag.com/en/news/2016/11/transform-2025.html (accessed on 13/11/2018)
[30] https://www.volkswagenag.com/en/news/2016/11/transform-2025.html (accessed on 13/11/2018)
[31] https://www.volkswagenag.com/en/news/2017/11/Joint_Venture_for_Multi_Functional_Vehicles.html (accessed pn 02/12/2018)

*made sure that the Volkswagen Group not just stayed on track but is now more robust than ever before. For that, he is due the thanks of the entire Company."*

- ***Volkswagen Supervisory Group, April 2018*** [32]

-

The supervisory board recognized that the company and the industry were facing "a phase of highly dynamic change" and that meant that Volkswagen would need to systematically continue to transform its business and establish even more efficient Group management practices. The board justified the step down of Müller as CEO, as a necessary change in order to adapt and to keep up the pace in this "highly dynamic" environment.
Dr. Herbert Diess, VW brand chief, would be replacing Müller, as Chairman of the Group's Board of Management.

## 3.5. ELECTRIC FOR ALL: The turning point

In January 2018, Volkswagen announced that they were creating a separate Board of Management division, focused just on e-mobility, as they were striving to become the leader in the mass-market of electric cars. The responsible for this division would be Thomas Ulbrich, previous responsible for production and logistics of the brand, and he would start to lead the e-mobility offensive from February 1. Ulbrich's responsibilities would be to guarantee a successful and smooth transition to the production of electric cars.[33]
In September 2018, and as part of the second phase of the strategy "Together 2025", Volkswagen launched their new promotional campaign "Electric for All" that aimed to increase EV's target by delivering top level electric cars at affordable prices. Thomas Ulbrich said himself "We build cars for millions, not millionaires", enhancing the ambitious mission of this campaign. This campaign marked the beginning of the ID family, a new generation of full battery-electric vehicles.

*"The ID. will be a milestone in technological development. It will be the first fully connected electric car with full everyday utility that millions of people will be able to afford. The car holds the road really well thanks to the flat battery in the floorpan and the space inside is much more generous – we are making substantial headway with the sense of spaciousness."*

[32] https://www.volkswagen-newsroom.com/en/press-releases/extensive-revision-of-volkswagen-group-management-structure-decided-443 (accessed on 04/12/2018)
[33] https://www.volkswagenag.com/en/news/2018/01/VW_Brand_changes_board_of_management.html (accessed on)

- *Christian Senger, Head of the Volkswagen E-mobility product line*[34]

The electrification plan of Volkswagen was based on the modular electric drive matrix (MEB), a technology platform developed for purely electric cars (see Exhibit 9).

Volkswagen already had experience on developing platforms, with the MQB platform[35] made for diesel cars, and they were trying to bring this knowledge to the electric world. Thomas Ulbrich believed that this technology was what differentiated them from the competitors: "Our MQB has already proved we are auto industry professionals when it comes to platforms. Now, we're transferring this know-how and this strategy to the electric age.".[36] The MEB (Modular Electric Drive Kit) was very advantageous for the company once it was very flexible, as it was designed for manufacturing, and therefore could be used both in compact cars and in SUVs and vans. For this reason, it would be possible to achieve huge economies of scale, which would make the cars less expensive and the "Electric for all" mission possible. The MEB technology would be used in four other Group's brands: Audi, SEAT, SKODA and Volkswagen Commercial Vehicles.

Another advantage of the design of the MEB platform was that it gave the car more space. For example, the ID. car, from the outside was the size of a Golf, but from the inside it had the space of a Passat. More space meant bigger batteries and hence longer ranges. The consumer would be the one choosing the range of the car: if it is important for the owner of the vehicle to have a higher range it will be a little more expensive; but if he doesn't need high autonomy a smaller energy content would be sufficient, and this would make the car less expensive.

*"Basically, there are two types of EVs at the moment: the first has long ranges and digital connectivity but is very expensive. The second is more or less affordable, but often not particularly attractive. People want both, though: a great electric car at an affordable price. That will bring about the breakthrough for EVs. And that is precisely what we will be putting on the road with the I.D."*

- ***Thomas Ulbrich, Head of the Volkswagen E-mobility division***[37]

The ID. family marked the beginning of a new era for Volkswagen with the brand launching 100% electric vehicles for the first time. In 2018, the company had shown already four models

[34] https://www.volkswagen-newsroom.com/en/id-workshop-electric-for-all-4193/electric-for-all-volkswagen-is-accelerating-the-breakthrough-of-e-mobility-4195 (accessed on 15/11/2018)
[35] MQB, meaning "Modular Transversal Toolkit", is VW's platform for shared modular design of its diesel cars.
[36] https://www.volkswagenag.com/en/news/stories/2018/09/electric-for-all.html# (accessed on 16/11/2018)
[37] https://www.volkswagenag.com/en/news/stories/2018/09/electric-for-all.html# (accessed on 15/11/2018)

of the ID. family: the ID. (similar to a Golf), the ID. VIZZION sedan, the crossover all electric ID. CROZZ and the ID. BUZZ, an electric microbus (see Exhibits 10 to 13). The production of these four concepts was to begin in late 2019 and the first member of the family would hit the market in 2020. In order to better perform their electric offensive, Volkswagen launched the program "Future Electronic Engineer Program" (FEEP), where 100 engineers and workers would be trained to excel in the production of MEB platform.[38] The basis of the ID. family would be the MEB platform that would allow Volkswagen "to offer electric vehicles with operating ranges from 400 to 600 kilometers, rapid charging capabilities and major package benefits at the price of a comparable diesel car.".[39] The ID. family production were to be made in Germany and mostly in the Zwickau plant, that would be transformed into a pure e-mobility facility. Volkswagen was planning to invest €22.8 billion with this electric offensive, from 2018 to 2022, and to break the 1 million electric cars sold per year by 2025.[40] In order to meet this goal VW announced in March 2018, that they would be launching one new virtual EV model per month by 2022, once the electric vehicles offensive was at full speed.

## 3.6. Volkswagen– Batteries technology

The battery was the most important component in the MEB platform, and it would be the basis of the ID. family. Christian Senger, responsible for MEB development said that "The use of a new generation of high-performance batteries begins with the ID. models. Thanks to their modular design and the multi-cell format, these batteries can be installed in smaller or larger ID. models.".

The ID. models would have scalable batteries that could be arranged with different capacities for ranges between 400 and 600 kilometers. VW' engineers compared the cell modules of the battery to individual chocolate bars - a design that was very flexible. Thus, when buying their ID. model, every customer could choose what range fits their needs better. Weight optimization and integrated cooling were some of the other features of the new battery system that conferred an advantage to the ID. models. All members of the ID. family had an increased charging performance – receiving power up to 125 kW, using the fast charging system, the battery would be charged to 80 percent in about 30 minutes. To put in place this electric offensive,

[38] https://www.volkswagen-newsroom.com/en/press-releases/electric-offensive-volkswagen-trains-top-experts-for-the-production-of-the-id-family-108 (accessed on 01/12/2018)

[39] https://www.volkswagenag.com/en/news/2017/11/VW_Brand_investment_transform2025.html (accessed on 02/12/2018)

[40] https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-to-invest-22-euros-8-cents-billion-in-the-future-viability-of-its-plants-throughout-the-world-712 (accessed on 18/11/2018)

Volkswagen would need more than 150 gigawatt hours of battery capacity per year by 2025. As the electric era arrived, a huge demand for battery's technology had begun. Volkswagen seemed to have "mixed feelings" about making its own battery cells has they had spent the year of 2018 deciding about what to do on this matter. In March of that year, Matthias Müller had announced that they had no intentions to manufacturer the batteries by themselves:

*"Building up expertise and mastering the technology does not necessarily imply that we want to start large-scale assembly of batteries ourselves. This is not one of our core competencies, and others can do it better than we can."*

- ***Matthias Müller, CEO Volkswagen Group 2015-1018*** [41]

Instead, Volkswagen decided to work with existing battery suppliers issuing contracts worth $48 billion, that would be in place, at least, until 2025.[42] Furthermore, Volkswagen announced their intention to decrease the amount of cobalt needed in the production of battery cells as it is a rare metal and constituted an EV battery sourcing issue. Nonetheless, the company seemed to be working on other alternatives, once they didn't want to become dependent on those suppliers:

*"We must not make ourselves dependent on a few Asian manufacturers in the long term. That is one of the reasons why Volkswagen increased its stake in QuantumScape and set up a new joint venture."*

- ***Herbert Diess, CEO Volkswagen Group 2018*** [43]

At that time, Volkswagen was still outsourcing the production of its EV's batteries, but they were already investing in future alternatives. In September 2018, the company announced that they were investing $100 million in QuantumScape and creating a new joint venture with this company. QuantumScape was a Californian leading pioneer in the development of solid-state battery cells technology. Volkswagen and QuantumScape decided to work together in order to develop an industrial production of these batteries. Volkswagen would contribute with "its

[41] https://www.reuters.com/article/us-volkswagen-results/volkswagen-assigns-25-billion-in-battery-orders-in-electric-car-drive-idUSKCN1GP12B (accessed on 02/12/2018)
[42] https://electrek.co/2018/08/02/vw-battery-cell-production-electric-vehicles-solid-state/ (accessed on 07/12/2018)
[43] https://www.volkswagenag.com/presence/investorrelation/publications/presentations/2018/08_august/2018-08-01_HPK_GESAMT_EN.pdf (accessed on 08/12/2018)

production expertise and know-how in scaling projects, while QuantumScape brought its technology leadership in the field of solid-state batteries to the joint venture.".[44]

## 3.7. Volkswagen – Charging Systems

*"Perhaps the greatest obstacle facing widespread adoption of EVs and e-Mobility is a lack of reliable, ubiquitous, easy-to-use, ultra-fast charging infrastructure outside of cities and metropolitan regions. This is exactly the problem IONITY is already on the road to solving."*

- ***IONITY website***[45]

With the demand for EVs growing every day, without a huge high-power-charging network, electric vehicles would struggle to be a success. That is why Daimler AG, BMW Group, Ford Motor Company and Volkswagen Group joined in 2017 to create IONITY, a joint venture with the purpose to make long-distance travel with an EV attractive. IONITY was planning to create a 400 network of 350kW EV charges in strategical points in Europe by establishing strategic partnerships.[46] The first IONITY station opened in April 2018. By October 2018, they already had 25 stations and 43 more marked as "now building".[47] One session to charge your EV in one IONITY station would cost you 8€, no matter in what country you were and what type of EV you owned.

Nonetheless, IONITY was not the only Volkswagen endeavor to try to develop on e-mobility. In August 2017, Volkswagen received six startups in its Transparent Factory in Dresden, that was transformed into an incubator. The company would provide €15,000, free office infrastructure and free accommodation to each one of the six startups that would have 200 days to make progress towards becoming a competitive company in their business: CarlundCarla, for corporate car sharing; Geospin, a geographical startup for big data analysis; Smart City System, for parking space navigation; LoyalGo, for charging columns with local advertising; Ekoio, smarter Co-Pilot telematics; and Tretbox, for the delivery of tricycles with electro-drive. Additionally, some experts from Volkswagen would provide support to the startups and they would have access to IT infrastructures. With this project, Volkswagen aimed to contribute to generate knowledge for the future of mobility.

[44] https://www.volkswagenag.com/en/news/2018/09/QuantumScape.html (08/12/2018)
[45] https://ionity.eu/en/about.html (accessed on 08/12/2018)
[46] https://www.press.bmwgroup.com/global/article/detail/T0281349EN/designworks-named-design-partner-for-ionity-joint-venture?language=en (accessed on 08/12/2018)
[47] https://ionity.eu/en/where-and-how.html (accessed on 08/11/2018)

It had become clear that the demand for electric vehicles would increase, but Bärwaldt, Volkswagen Group development coordinator for charging, believed that increasing the number of charging outlets available, wouldn't be enough to keep up with the EVs' demand. In his point of view, an intelligent charging system was needed:

*"We need intelligent charging management to optimize the usage of the grid and to minimize the need to expand. Such solutions will already be necessary with an electric car share of 25 percent."*

- ***Gunnar Bärwaldt, Volkswagen Group development coordinator for charging*** [48]

Bärwaldt and his team had been working on an "energy management system" (EMS) for customers to use at home (see Exhibit 14). Volkswagen was predicting a problem: in a world where everyone owns an electric car, when arriving at home in the evening, everyone would want to put their vehicle to charge at the same time. EMS aimed to prevent an energy overload: the user just needed to tell the system at what hour would he need the car again and for which range, in order for the system to calculate the best hour to charge the car. Bärwaldt admitted knowing that there was still a long way ahead until the EMS become a reality. It was with this goal in mind that the Volkswagen Group started to work and be involved with the non-profit organization EEBUS, that wanted to create "a uniform language for all devices so that they can communicate with each other about energy.".[49] Bärwaldt added "We have to start developing solutions now. When the boom is already here, then it's too late!".[50]

## 3.8. What's next for Volkswagen

The forecasts for the electric business were very positive: "Sales of EVs in 2020 would be about 4 million and expanding to 21.5 million by 2030. This corresponds to a 24% average year-on-year sales growth over the projection period."[51] The IEA was predicting a huge increase in the demand and production of EVs in the following years. Governments were increasing their incentives to the adoption of electric vehicles and everything pointed out to a

[48] https://www.volkswagenag.com/en/news/stories/2018/04/i-want-to-generate-happy-customers.html (accessed on 08/12/2018)
[49] https://www.volkswagenag.com/en/news/stories/2018/04/i-want-to-generate-happy-customers.html (08/12/2018)
[50] https://www.volkswagenag.com/en/news/stories/2018/04/i-want-to-generate-happy-customers.html (accessed on 08/12/2018)
[51] IEA' Global EV Outlook 2018 Report

phase of higher oil prices. Even the battery costs were expected to decrease a lot in the next years and, therefore, the acquisition price of an EV would drop too. It seemed that a successful uptake of the EVs for Volkswagen would only depend on themselves.
The company was finally getting apart from the emissions scandal and a new Era had arrived for Volkswagen, with the e-mobility dominating Wolfsburg.[52]

*"We're right on schedule. The hardware is ready, the contracts with battery suppliers have been signed and preparations for SOP[53] in Zwickau are underway. Preliminary planning work there is already finished. Now it's time for the earthworks. We are looking to start pre-series in the new body shop in early 2019."*

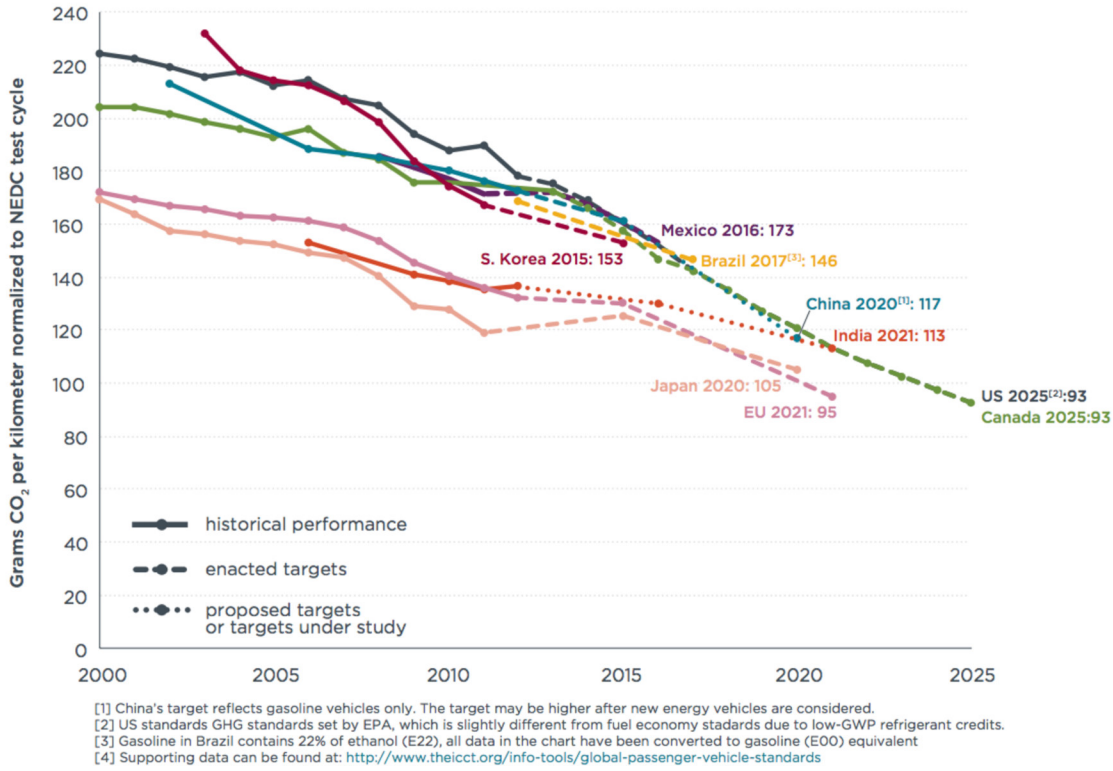
- ***Thomas Ulbrich, Head of the Volkswagen E-mobility division*** [54]

In a year, the first member of the ID. family would be hitting the market. Everything seemed to be ready to start the production of the company's first full electric vehicles: Volkswagen just secured batteries and managed to create a cooperation in order to enable fast charging outlets to all their customers; thus, the design of the MEB platform and of the first members of the ID. family were already presented. Furthermore, VW was investing every day in the knowledge creation in the area of e-mobility, which was expected to return profits in the near future. Despite all these efforts, until then, this electric offensive was just a vision and a commitment made by the company. The future of VW's EV business was still depending on many things and many more "stones would need to be turned", in order to answer all the questions that were arising about VW's EVs' future.

[52] City where it is located VW's headquarters
[53] Standard Operating Procedure
[54] https://www.volkswagenag.com/en/news/stories/2018/09/electric-for-all.html# (accessed on 15/11/2018)

## Exhibits

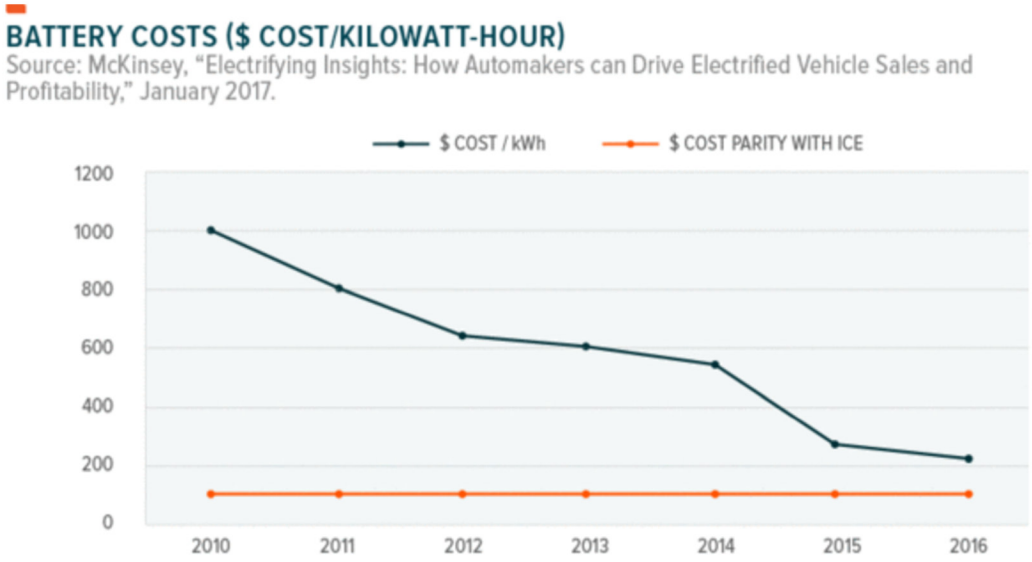
**Exhibit 1 –** Global $CO_2$ regulations for passenger cars comparison, in terms of the New European Driving Cycle (NEDC) g$CO_2$/km




Source:

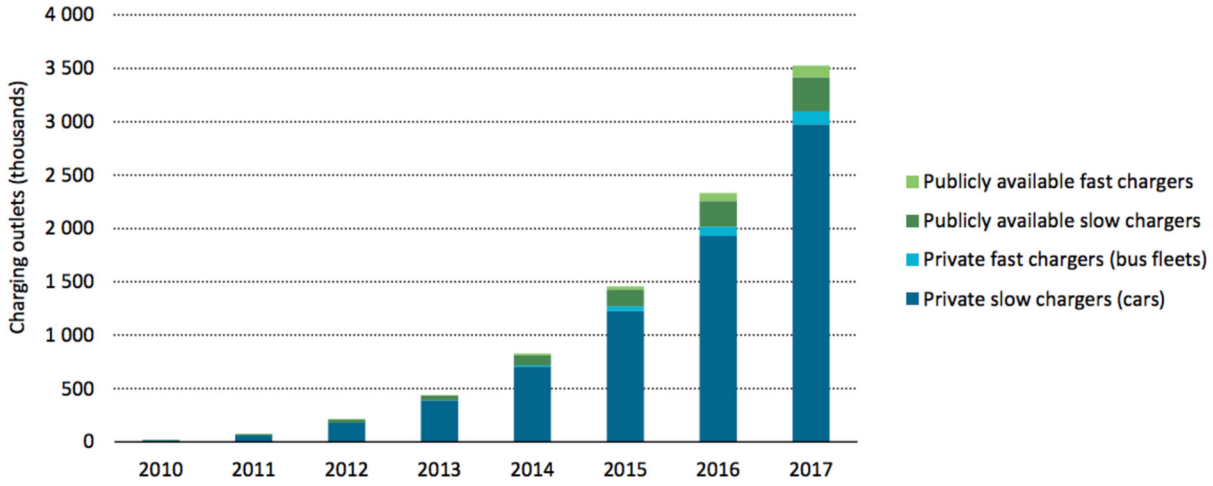
https://www.theicct.org/sites/default/files/publications/ICCTupdate_EU-95gram_jan2014.pdf (accessed on 05/12/2018)

**Exhibit 2 –** Battery Costs 2010-2016




Source: https://seekingalpha.com/article/4163546-future-transportation-autonomous-electric?page=2 (accessed on 08/12/2018)

**Exhibit 3 –** Global EV charging outlets 2010-2017



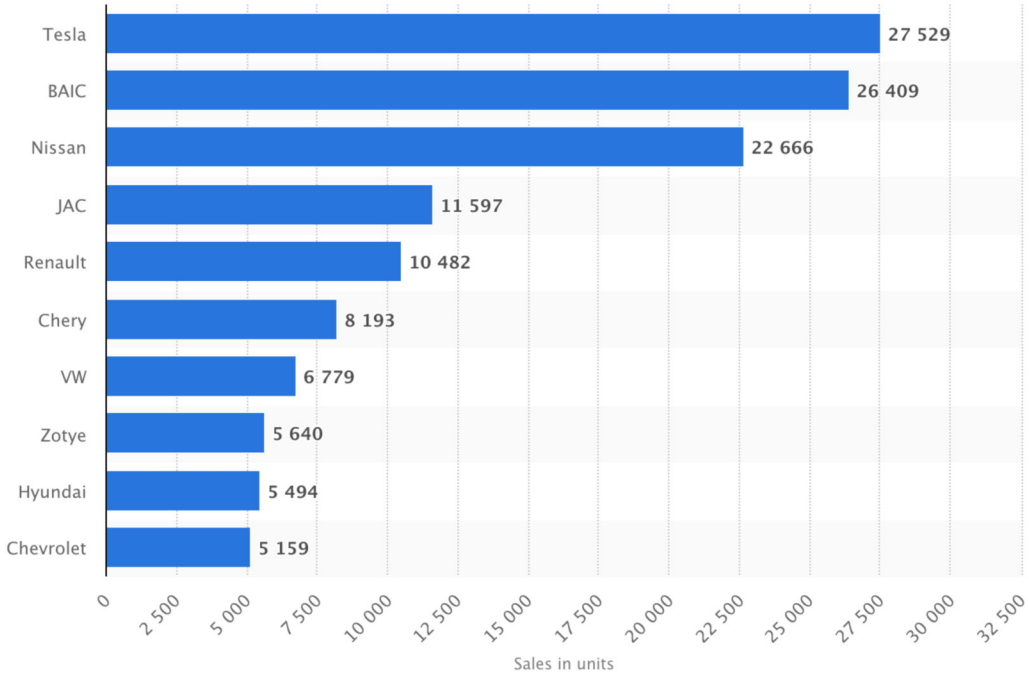

Source: IEA' Global EV Outlook 2018 Report

**Exhibit 4 –** Electric Vehicles model comparison

| Model | Year of introduction | Price starting from | Electric driving range (km) |
|---|---|---|---|
| Nissan Leaf | 2010 | €30,010/ $28,980 | 200km |
| Chevrolet Volt (E-REV) | 2010 | $34,995 | 40-80km (with range extender 670km) |
| Citroen C-Zero | 2010 | €28.990 | 150km |
| Mitsubishi i-MiEV | 2011 | €19,990/$22,995 | 160km |
| Opel Ampera (E-REV) | 2011 | €39,990 | 40-80km (with range extender 500km) |
| Ford Focus Electric | 2013 (2012 in the U.S.) | €39,990/$35,995 | 120km |
| Renault Zoe | 2013 | €20,990 (without monthly battery rental) | 210km |
| Fiat 500e | 2013 | $31,800 | 140-160km |
| Chevrolet Spark EV | 2013 | $26,685 | 130km |
| Smart Electric Drive | 2013 (2011 in the U.S.) | €19,900 (with battery)/$25,500 | 145km |
| Tesla model S | 2013 (2012 in the U.S.) | €69,000/$69,900 | 370-480km |
| BMW i3 | 2013 (2014 in the U.S.) | €35,500/$41,350 | 130-160km (with additional range extender 120-150km extra) |
| Mercedes Benz B-class Electric Drive | 2014 | $42,375 | 140km |
| Kia Soul EV | 2014 | €32,995/$33,700 | 210km |
| **Volkswagen E-golf** | **2014** | **€35,490/$35,445** | **190km** |
| **Volkswagen E-up** | 2014 | €25,520 | 160km |

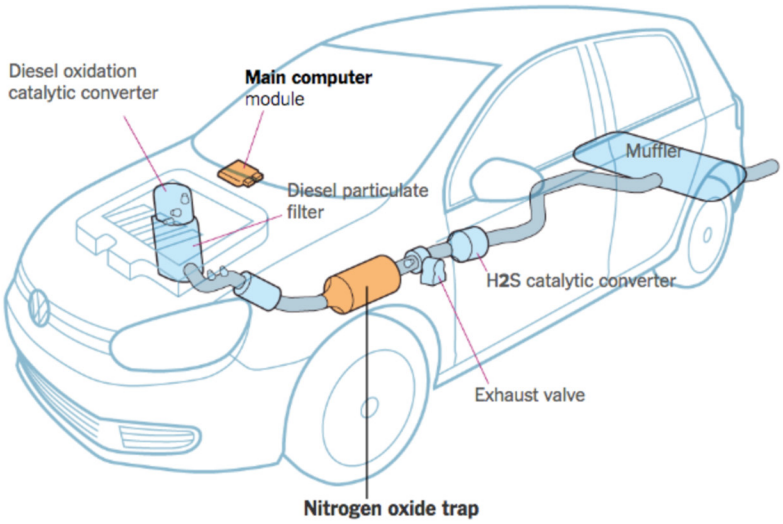
Source: Bohnsack, R., & Pinkse, J. (2017). Value Propositions for Disruptive Technologies: Reconfiguration Tactics in the Case of Electric Vehicles. *California Management Review*, 59(4), 79-96

**Exhibit 5 –** Battery-electric vehicles' global sales in the 1st quarter 2018 by brand




Source: https://www.statista.com/statistics/666130/global-sales-of-electric-vehicles-ytd-by-brand/ (accessed on 12/12/2018)

**Exhibit 6 –** "Defeat device" named Nitrogen oxide trap Illustration




Source: https://www.nytimes.com/interactive/2015/business/international/vw-diesel-emissions-scandal-explained.html (accessed on 19/11/2018)

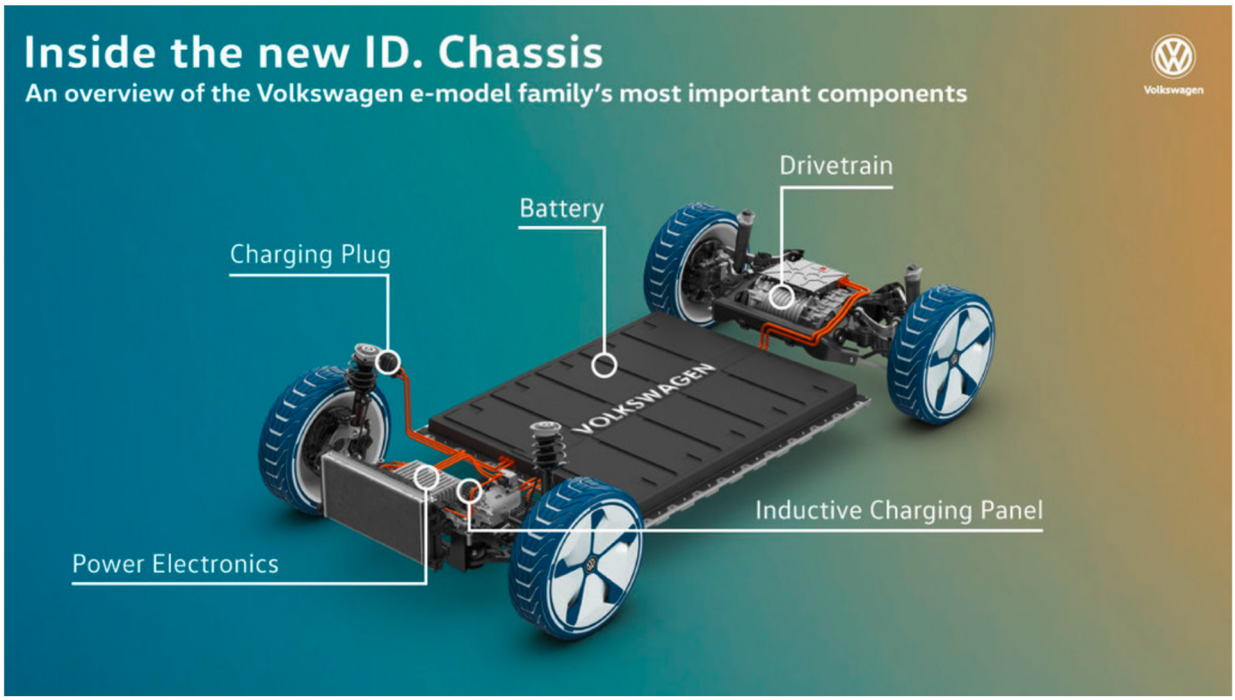
**Exhibit 7 –** Volkswagen Strategy 2025


Source:https://www.volkswagenag.com/presence/konzern/pdf/Group_Initiatives_Strategy_2025.pdf (accessed on 04/11/2018)

**Exhibit 8 –** 2017 Overview - Volkswagen Strategy 2025


Source: https://www.volkswagenag.com/presence/konzern/pdf/JPK_2018_Mueller_en.pdf (accessed on 04/12/2018)

**Exhibit 9 –** New Modular Electric Drive Kit (MEB)




Source: https://www.volkswagen-newsroom.com/en/stories/all-about-the-meb-4206 (accessed on 20/11/2018)

**Exhibit 10 –** ID. Concept

Source: https://www.volkswagen-newsroom.com/en/id-family-3965 (accessed on 20/11/2018)

**Exhibit 11 –** ID. VIZZION Concept

Source: https://www.volkswagen-newsroom.com/en/id-family-3965 (accessed on 20/11/2018)

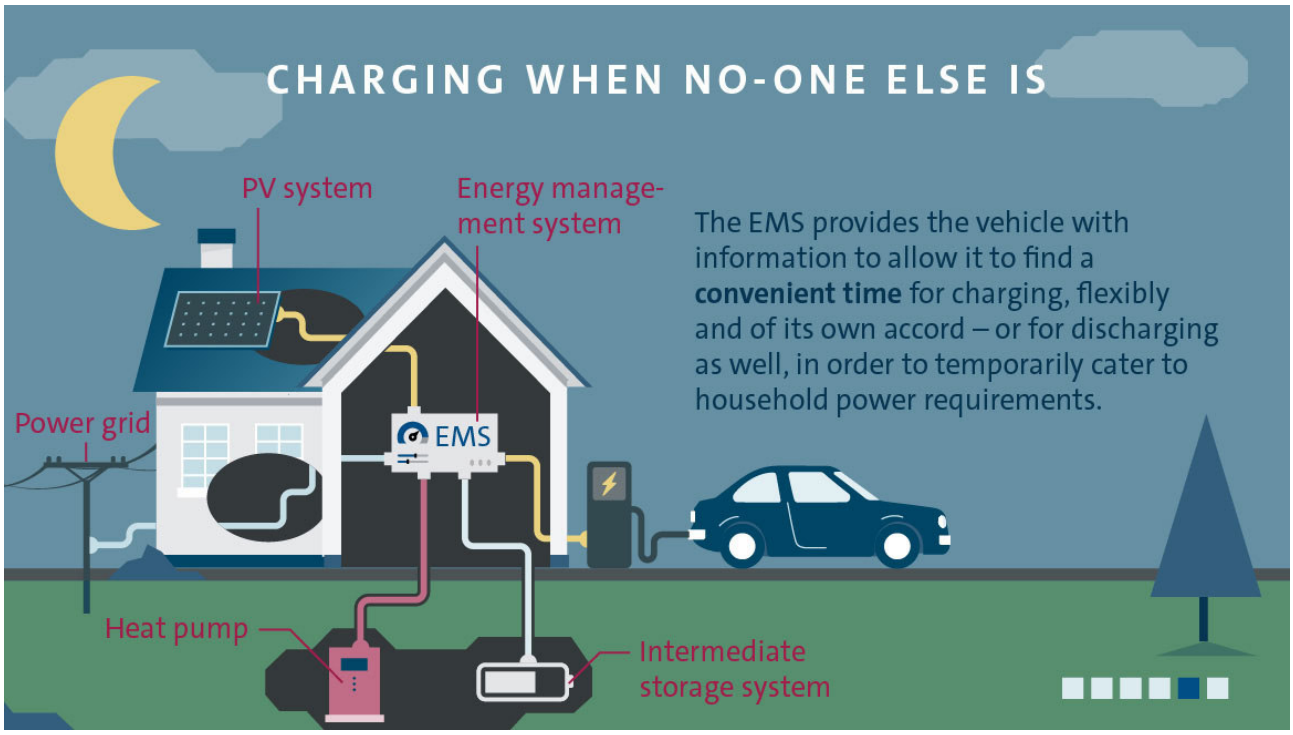
**Exhibit 12 –** ID. CROZZ Concept

Source: https://www.volkswagen-newsroom.com/en/id-family-3965 (accessed on 20/11/2018)

**Exhibit 13 –** ID. BUZZ Concept

Source: https://www.volkswagen-newsroom.com/en/id-family-3965 (accessed on 20/11/2018)

**Exhibit 14 –** Energy Management System (EMS)




Source: https://www.volkswagenag.com/en/news/stories/2018/04/i-want-to-generate-happy-customers.html (accessed on 08/12/2018)

# 4. Teaching Notes

## 4.1. Synopsis

This case illustrates, with the real-life example of Volkswagen, one of the worlds' biggest manufacturers of diesel cars, the impact of a technological and environmental exogenous shock and how the company has been struggling with the shift to the production of electric vehicles. The giant automaker had recently faced a huge scandal about the emissions of its diesel cars, that pressured them to change their strategy and enter into the EVs' market. This teaching case allows the students to clearly identify the company's business problem, and to analyze its internal and external environment. Furthermore, the case also allows a consideration of the rationale behind Volkswagen's strategy and an assessment of its prospects in a market where many volume auto makers are competing.

The first part of the case serves as an introduction to the topic and describes the situation the company is in at the end of 2018. The second section of the case is an overview of the electric vehicles' market and allows the students to better understand the drivers and the constraints on demand. Both are carefully analyzed to allow for a complete view of the factors affecting the adoption of EVs. This section also gives a view of the main competitors in the market and their position, in terms of sales of EVs, at the end of 2018. The third section of the case focuses more on Volkswagen and the crisis that lead them to invest on electric vehicles. It also covers the need for a CEO change and how an era of transformation has started when Matthias Müller was pointed out as the new CEO. The following part describes VW's pack to the future - TOGETHER 2025 – the Group's new strategy that would put them back in the leading positions. It also covers how the company strategy would begin with a reshape of the corporate culture, followed by continuous improvements in efficiency, investments on e-mobility and connectivity. In the subsequent section, the company's supervisory board's decision to oust Matthias Müller as CEO and replace him by Herbert Diess is presented. In the chapter "ELECTRIC FOR ALL: The turning point" the reader can better understand VW's commitment in the matter of e-mobility. This part explains Volkswagen's organizational changes to address the EVs' business and, the basis of its strategy: the MEB platform. In the following part, the case focuses on the most complex and important part of an electric vehicle: the battery, offering insights about the company's decision to outsource, for now, this part of the car. Moreover, it describes how the company invested and created a joint venture with QuantumScape, a pioneer company in the development of solid-state battery cells, in order to

make this battery cells at an industrial level in the future. Without charging infrastructures, the EVs' business would never be able to succeed. That is why, in this next chapter, VW's strategy to create a huge network of charging systems is explained. To conclude, the last section describes the forecasts for the industry and what it is expected to happen in the near future with Volkswagen and its uptake of the electric vehicles. The case ends with an open question to the final result of this strategy saying that "many more "stones would need to be turned", in order to answer all the questions that were arising about VW's EVs' future.".

## 4.2. Teaching Objectives

The VW case was written to be taught to both undergraduate and graduate students, in Management or Strategy courses. Ultimately, it could also fit on Innovation courses.
This case demonstrates how a global leading company in the automotive industry is pressured to respond to an environmental and technological shift in the industry – electric cars - in order to overcome a crisis. Furthermore, the case illustrates the dynamic capabilities view applied to a real company.

It is important to highlight the following teaching objectives:

- Alert students to the importance and the impact that an exogenous shock can have on an industry and the challenges that can arise to companies;
- Introduce students to the challenges of implementing a new technology and how can a firm succeed on it;
- Analyze a firm's ability to successfully adapt to an environmental and technological shift in the industry;
- Alert students for the need to constantly adapt and be aware of competitors 'actions.

## 4.3. Intended contribution

The VW case intends to illustrate the importance of strategic change for companies and how a global leading firm like Volkswagen struggled in the adoption of EV's technology. Furthermore, this case illustrates how a crisis can act as a catalyst for big changes.
The company was definitely late in the adoption of EVs, with only two 100% electric cars launched in 2014, four years later than the first EV that hit the market. More four years had

passed without the launch of new electric vehicles. Despite all efforts and commitments with e-mobility, it was taking some time for the company to make it a reality.
The VW e-Race case illustrates, with a real-life example, the topic of Dynamic Capabilities and how important it is for a firm to access them in order to respond to a highly dynamic environment.

## 4.4. Pedagogical overview

This case was constructed to fit in management, strategy or innovation classes mainly for graduated students, although it can be used with undergraduates, if they have basic knowledge about the Dynamic Capabilities' view. Nevertheless, it is recommended for both, graduate and undergraduate students to read the article "Dynamic Capabilities: A Review of Past Research and an Agenda for the Future", (Barreto, 2010), to better understand the theory and framework relevant to answer the assignment questions. Students must also have basic knowledge about strategic change and be able to perform an external environment analysis using the PESTEL framework.
In order to have a deeper understanding of the company's strategy and performance, it should be interesting, both for the instructor and the students, to visit Volkswagen's corporate website. If the instructor wants to have a deeper knowledge on the EVs market it could be interesting to take a look into the IEA' Global EV Outlook 2018 Report.

## 4.5. Assignment questions

*Question 1: After carefully reading the case, please analyze Volkswagen's external environment (macro and industry). What was the exogenous shock that the firm was submitted to?*

In this question, it is expected that students analyze each dimension of the PESTEL framework by identifying the external factors that are shaping Volkswagen's current state.

Political Factors

- Electric vehicles are exempt from emissions' tax in some European countries;
- Governments give incentives for people to buy EVs instead of diesel cars;
- $CO_2$ emissions' standards are imposed by governments;

- Political instability can affect the oil prices;

Economic Factors

- Instability of oil instable prices due to OPEC;
- High costs to produce batteries for EVs;
- Demand for EV's is growing fast (54% increase in sales in 2017);

Social Factors

- Consumers are more informed and can easily compare solutions and prices;
- Status related to owning an electric car;
- Consumers want more environmentally friendly options;

Technological Factors

- Lack of charging stations and with low progression in the last years;
- Driving range is still very low in comparison with diesel cars;
- Batteries take time to re-charge (30 minutes on average to refill the battery to 80%);
- Many startups creating knowledge in the area of e-mobility;

Environmental Factors

- Environmental policies regarding $CO_2$ emissions
- Environmental catastrophes that can influence oil prices;

Legal Factors

- Only cars that pass the World-Wide Harmonized Light-Duty Vehicles Test Procedure (WLTP) can be sold in the European Union.

Students must easily identify that Volkswagen was submitted to a technological and environmental exogenous shock caused by the shift in the industry to electric vehicles. As stated in the case: "As part of the Clean Mobility package that the EU stablished in November 2017, an update of the CO2 emissions standards was launched, to be accomplished until 2030".

*Question 2: What were the main organizational changes implemented by VW to react to the changes in the external environment?*

Students should be able to identify the main organizational changes conducted by Volkswagen:

In September 2015, Professor Dr. Winterkorn resigned as CEO of Volkswagen Group, after the Dieselgate process, and the Supervisory Board chose Matthias Müller to replace him. As stated in the case, Müller said at the time "my most urgent task is to win back trust for the Volkswagen Group – by leaving no stone unturned and with maximum transparency".

In November 2016, the Volkswagen Group announced their pack for the future –Together 2025 - the Group's new strategy that would set the course for the brand over the subsequent years, one of the pillars being reshaping corporate culture and organization in order to gain back consumers' trust.

In January 2018, in order to respond to its external environment, Volkswagen created a separated division for e-mobility in the board of management. The responsible for this division would be Thomas Ulbrich, previous responsible for production and logistics of the brand.

In April 2018, Matthias Müller was ousted as CEO of Volkswagen Group by the supervisory board. The board thanked Müller for his work during VW's dark days but recognized that the company needed a change in order to succeed in this "phase of highly dynamic change" in its environment. Dr. Herbert Diess, VW brand chief, would be replacing Müller as VW's CEO.

*Question 3: Analyze Volkswagen using Barreto's four dimensions of dynamic capabilities at the time the case study is set. Justify your answer with examples from the case study.*

Regarding this question, students must analyze each dimension of Barreto's dynamic capabilities individually based on what was described in the case and regarding the shift to EV's business.

<u>Propensity to sense opportunities and threats</u> –High

Regarding the first dimension of Barreto's dynamic capabilities, students must see that Volkswagen was able to identify the EVs business as an opportunity, not only to distance themselves from the diesel problem, but to also satisfy the market as it can be seen in the case: "But also in realigning its future strategy around electric cars, in order to distance themselves

from fossil fuels." and "We have got the message and we will deliver. The transformation in our industry is unstoppable. And we will lead that transformation".
Furthermore, Volkswagen was also able to identify an energy overload as a potential threat to the EVs business and it started to work on an Energy Management System (EMS) in order to prevent this problem. Students should be able to identify that the company's overall propensity to sense opportunities and threats was high.

Propensity to make timely decisions –Low

When analyzing the second dimension of Barreto's framework, students must identify three main situations. First of all, Volkswagen failed to be a pioneer in the electric vehicles business as it took four years for them to respond and launch their first EVs (see Exhibit 4). Then, the company tried to respond to the change in the industry by introducing the first two electric vehicles of the brand in the market, in 2014. Despite this effort, the company was not completely successful as Volkswagen was only the 7th company selling more EVs in the 1st quarter of 2018 (see Exhibit 5). Finally, students must understand that despite Thomas Ulbrich assurance that Volkswagen was "right on schedule", from 2014 to 2018, the company didn't launch any new electric vehicle to the market. Volkswagen has made many commitments in this period that could make them leaders on EVs' business, but students should be able to understand that, until the end of 2018, "what we had seen was just a "vague declaration of intent"" in the sense that the company didn't launch any new EV. For these reasons, students should be able to identify that the company's overall propensity to make timely decisions was low.

Propensity to make market-oriented decisions – Medium

Regarding the third dimension of the framework, students should be able to conclude that Volkswagen was able to identify what the market wanted by offering good electric vehicles at an affordable price, and hence increasing their possible target: "Basically, there are two types of EVs at the moment: the first has long ranges and digital connectivity but is very expensive. The second is more or less affordable, but often not particularly attractive. People want both, though: a great electric car at an affordable price." Thomas Ulbrich empathized this idea saying that "We build cars for millions, not millionaires." Nonetheless, students must be able to see that, by looking to Volkswagen EVs sales in the first three months of 2018 the company

appeared in 7th place with 6,779 cars sold, which is a strong indicator that other brands were making more market-oriented decisions. For these reasons, the overall propensity to make market-oriented decisions of Volkswagen was Medium.

Propensity to change the resource base - High

Having in consideration the three possible ways to change the resource base – gain, release or reconfigure resources – students must be able to identify that Volkswagen did changes in their resources of the three different forms.
Volkswagen has gained resources in the three joint ventures that the company established:

- with JAC for the production of EVs;
- with IONITY for the charging systems;
- with QuantumScape for the mass production of solid-state battery cells.

Moreover, students should identify that Volkswagen was also gaining resources from the incubator that it created to support startups on e-mobility: "In August 2017, Volkswagen received six startups in its Transparent Factory in Dresden that it was transformed in an incubator." Furthermore, Volkswagen started to contribute with EEBUS in an effort to make its energy management system (EMS) a reality, which could also be seen as a way to gain resources. Finally, the company gained resources when it decided to establish contracts with suppliers to manufacture its batteries. As the company's CEO said at the time: "This is not one of our core competencies, and others can do it better than we can".

The company decided to release resources to invest on e-mobility by cutting on some models that didn't have as much earnings as the most: "The company had plans to raise 2.5€ billion by cutting on certain low-volume and low-earnings models in order to invest on the e-mobility offensive.".

Volkswagen reconfigured its resources when it decided to create a new division focused on e-mobility:" On January 2018, Volkswagen had announced that they were creating a separate Board of Management division, focused just on e-mobility as they were striving to become the leader in the mass-market of electric cars. The responsible for this division would be Thomas Ulbrich, previous responsible for production and logistics of the brand.". Employees that in the past had worked in other areas were reallocated to work just on EVs' business. Moreover, it is expected that students identify that VW reconfigured its resource based when: (1) transformed the Zwickau plant into a pure e-mobility facility; (2) launched the program "Future Electronic

Engineer Program" (FEEP) to train its engineers; (3) transformed its Transparent Factory in Dresden into a start-up incubator. Students should be able to identify that the company's overall propensity to change the resource base was high.

*Question 4 (Optional): It is undeniable that the automotive industry was under a huge transformation at that time and the CEO of Volkswagen Group believed that they would "lead that transformation". Do you agree with this statement? In your opinion, was Volkswagen at that time equipped with the necessary abilities to not only successfully implement EVs technology, but to be the leader in this business?*

In this question, it is expected that the instructor promotes an open discussion in class about the future of EVs' industry and where will Volkswagen be placed. In order to add more interesting points to the discussion, the instructor could make some questions during the conversation:

- What was the overall presence of dynamic capabilities at Volkswagen at that time?
- What was VW missing in order to be the leader in this business?
- After the emissions scandal, was the company able to clean their reputation? Would the customers trust them in such an advanced technology when they know they have struggled before?
- Could they be leaders in the EVs business by outsourcing the most important part of the car, the battery?

These questions have the goal to guide the discussion and to make the students think about the challenges that managers could have when facing an abrupt change in the industry and a new technology. Therefore, there are no right or wrong answers.
Furthermore, the instructor could use the key takeaways of the discussion as a way to conclude the topic.

## 4.6. Board plan

This case was designed for a 90-minute lecture.

| Activity | Time (min) |
|---|---|
| Volkswagen Case Review | 15 |
| Question 1 | 15 |

| | |
|---|---|
| Question 2 | 10 |
| Question 3 | 25 |
| Question 4 (optional) | 15 |
| Conclusions | 10 |

# 5. Discussion

It has become clear that the world is getting more and more dynamic and that firms need to adjust and implement strategic change in order to succeed. The objective of this thesis is to show the relevance of the assessment of each dimension of Barreto's dynamic capabilities view (Barreto, 2010) with a real-life company. The case was written in a time when the result of Volkswagen's electric offensive was still unknown, making it clear the relevance of the assessment of each DC's dimension, in order to identify what changes are necessary to implement in order to succeed.

First of all, the VW case strongly supports the findings in the Literature (Lawrence & Lorsch, 1967) that strategic management is crucial when facing changes. According with Li and Tallman's (2011) definition, Volkswagen suffered an exogenous shock that actually reoriented the firm (Li & Tallman, 2011). VW's strategic persistence in investing on diesel rather than on EVs in an early stage, was in accordance with Tsoukas and Chia's theory (Tsoukas & Chia, 2002). According with Barker III and Duhaime, 1997, Volkswagen didn't pass through a turnaround since it didn't have a long period of performance decline (Barker III & Duhaime, 1997). Nevertheless, the company has passed through a crisis that ultimately resulted in a performance decline. Following this reasoning, Volkswagen case definitely supports that SC can have a positive impact in a turnaround situation. Moreover, VW had an urgent need to implement change and the resources to do it (Barker III & Duhaime, 1997). Poor performance has put them in a "weak strategic position", as defined by Barker III and Duhaime, 1997, which has pressured them to implement change (Ginsberg, 1988; Huff et al., 1992). According with Zhang and Rajagopalan's (2009) view, Volkswagen's strategic change implementation was not very risky, once they first learned from their competitors and only then decided to follow. Moreover, SC on Volkswagen had an adaptive effect. Similar to Zeta's case in Orlikowski and Hofman's (1997) study, Volkswagen's changes were both exogenously and endogenously created. They were getting behind in the industry of EVs as the technology was evolving and they were pressured by the diesel crisis. Furthermore, it was also the CEO's willingness to invest in the EV's business that triggered change. Moreover, in coherence with Snow and Hambrick, 1980, VW did implement SC that have been happening "gradually and incrementally" (Quinn, 1978).

Learned, et al., 1969, stated that a company's success was in "it's ability to find or create "a competence that is truly distinctive"". Although Volkswagen's first found it difficult to have a competence that could detach them from the competitors in the EVs' business, at the time the

case was written, they were starting to develop one, the MEB platform. According to Teece et al.'s (1997)' definition of DCs, VW was able to integrate and reconfigure its internal and external competencies, but failed to build new competencies, as it preferred to either outsource them or get them from other startup companies. The case confirms that Volkswagen was in a highly dynamic environment and that DCs are relevant in these environments (Eisenhardt & Martin, 2000; Zollo & Winter, 2002; Zahra et al., 2006), in contrast with the perspective of Schilke, 2014. The "VW e-Race" case is also in accordance with the view of Eisenhardt & Martin (2000) that supports that in the long-term, a firm is able to sustain CA due to the way they implement DCs. Moreover, my findings support the relevance of the use of DCs to better understand which changes are needed in order to sustain competitive advantage (CA), in contrast with the perspective that DCs can damage firm's performance (Winter, 2003; Zahra et al., 2006). Furthermore, VW's case findings strongly support the importance of "strategic fit" and change, in order to survive in a complex and competitive environment (Teece, 2007). Overall, we can classify VW's level of DCs as medium, once it has shown a high propensity to sense opportunities and threats, a low propensity to make timely decisions, a medium propensity to make market-oriented decisions and a high propensity to change its resource base. It is probably too soon to evaluate the effect of the organizational changes that Volkswagen has put in place, in order to respond to its changing environment. The results of some changes will only be visible in the long-term, mainly as the new CEO has been leading the company for only 6 months, at the time the case was written. Although Volkswagen's commitments to its electric offensive look very promising, it is still too early to fully know the outcome of their strategy. The automobile industry is facing huge changes and a new exogenous shock could promote a turnaround in the industry again, changing the perspective of VW's electric offensive outcome. It is important to take in consideration the available resources that Volkswagen has. As one of the leading companies in the automobile industry, it was easier for them to implement change as they had more resources available than other small companies in the business. Moreover, it is important to note that VW's case is just one example of the relevance and applicability of the DCs view and strategic change implementation. More research is needed, and these theories should be tested in a large-sample, in order to be fully understood.

Future Research is necessary in order to have a more specific and quantitative measure to access each dimension of Barreto's DCs view. Furthermore, more research is needed in order to clarify how can a firm better rearrange its strategy when facing an exogenous shock. Despite DCs' view relevance in explaining how firms can sustain a superior performance, there is no evidence that a firm can achieve this only through DCs, many more factors should be taken into consideration. Thus, more research is needed in order to fill this gap.

The case of Volkswagen and its electric offensive can serve as an example of how a firm needed to pass through a crisis in order to implement change. Thus, it can be a showcase for other companies that faced a huge crisis in its core business that made them lose customer's trust. Moreover, it has managerial relevance in showing how Barreto's dynamic capabilities framework should be used to do an internal analysis of the firm, when in a highly dynamic environment and that change should be seen as natural rather than as an exception.

# 6. Conclusion

The Dynamic Capabilities view has shown to be very relevant when analyzing a company's decisions in a highly dynamic environment. Barreto's definition (2010) has brought coherence to the concept and lifted relevant perspectives that merits further research. Strategic change, which is one of the theoretical groundworks of this thesis, also merits much attention, as many researchers have been demonstrating how strategic change is crucial in order to better fit the environment. Nevertheless, empirical research has shown that firms tend to persist and maintain the same organizational routine even when it is clear that a company should change.

To illustrate the theoretical backgrounds with a real-life case, I selected the Volkswagen company and its shift to the EVs' business. The automobile industry is suffering huge transformations with the uptake of electric vehicles. Volkswagen is one of the market leaders on the diesel cars market but has been struggling with the uptake of their electric offensive. These conditions made this case very relevant to study strategic change and the dynamic capabilities view.

By reading this thesis it should become clear that managers should see change as natural rather than as an exception. Furthermore, the case is an example of how strategic is crucial in a turnaround situation in order to succeed. Moreover, this thesis illustrates how important a crisis can be on triggering change. It has become clear that the assessment of each dimension of Barreto's dynamic capabilities' view is very relevant in order to better analyze what needs to change in a company so as to sustain a superior performance.

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