Incumbents’ Capability Acquisition Strategies in Sustainability Transtitions

An Analysis of the Battery Electric Vehicle Industry

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PREFACE

 This research was conducted in cooperation with FreedomLab B.V., a creative future studies thinktank that facilitates organizations to anticipate the future.

ABSTRACT

The purpose of this paper is to investigate how internal capabilities and external market conditions influence an incumbent's choice to employ internal development or external sourcing as its preferred strategy to acquire new capabilities in a sustainability transition. Using a data sample of 8 incumbent automotive firms playing in the battery electric vehicle (BEV) market, this paper uses an in-depth, longitudinal, multiple case study research design to explore the conditions that influence incumbents' strategic behavior in response to BEVs as a radical sustainable innovation in a sustainability transition. The findings demonstrate that incumbents try to bridge the capability gap that emerges as a result of the radical sustainable innovation by externally sourcing the newly required core and complementary capabilities when their current portfolio is still underdeveloped. However, as an incumbent's capability gap diminishes and its portfolio becomes more developed, the capability acquisition strategy will shift from external sourcing to internal development. This study theoretically and empirically contributes to the literature by advancing understanding of how firm-level differences may influence an incumbent's propensity to engage in a particular capability acquisition strategy and by providing evidence that it is important to examine the role of micro-level actors in the context of sustainability transitions to prevent overgeneralization.

EXECUTIVE SUMMARY

The advent of sustainability is unravelling sustainability transitions in numerous industries, thereby disrupting traditional industries that are dominated by incumbents. While incumbents have a prominent influence on the progression of a sustainability transitions, they face significant challenges because the radical sustainable innovations that shape the sustainability transition are capability destroying. For instance, the sustainability transition towards cleaner mobility pressures incumbents to develop more environmentally-friendly vehicles. Doing so required substantial investments in acquitting new capabilities. Managers have to determine their capability gaps and pursue the most suitable strategy for acquiring new capabilities. Considering that little is understood about the distinctions in strategic behavior of incumbents, this study investigates under which conditions incumbents choose different capability acquisition strategies (i.e. internal development or external acquisition) to cope with a radical sustainable innovation in a sustainability transition. By drawing on theoretical building blocks of traditional management literature (i.e. resource based view theory) and by means of a qualitative, longitudinal, multiple case study design, this study has attempted to answer this research questions. The findings of this study reveal that incumbents try to bridge their capability gap by externally sourcing new capabilities when their current portfolio is still largely underdeveloped. However, incumbents prefer internal development strategies when this gap diminishes and their internal capability portfolio is more developed. On a practical note, firms have to determine their internal capability portfolio carefully by analyzing the strength of different types of capabilities they possess in order to identify the precise capability gap. Subsequently, managers have to determine which type of capabilities to specialize in, preferably the kind of capabilities that are not only indispensable to the emerging market, but also that provide incumbents with adequate power to occupy a worthwhile position in the value chain, which they have ruled thus far.

Furthermore, the findings in this paper advance FreedomLab’s insights into the automotive industry (a sector of interest) by demonstrating the changing relations and dynamic powershifts in the industry. Whereas incumbent car manufacturers have typically directed developments in the mobility sector, the sustainability transition is challenging their position, making room or alternative sustainable technologies and trends. Besides that, FreedomLab has developed a recent interest in research on deep transitions, of which sustainability transitions are part of. Therefore, this study also contributes to FreedomLab’s understanding on deep transitions and the role of incumbents therein, which are often underestimated on the stock market.

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1. INTRODUCTION

The recent "*Global Warming of 1.5 ℃*" report by the IPCC provides strict evidence that human activities are the most prominent cause of climate change and a failure to address these environmental challenges will likely result in even more dangerous impacts (IPCC, 2018). The advent of sustainability across all societal levels is unravelling a sustainability transition, which is accompanied by notable technological changes like renewable energy and electric mobility technologies (Geels, 2011; Smink, 2015; Farla et al., 2012). Many of these sustainable technologies impose radical change, are competence destroying and have the power to disrupt traditional industries that are dominated by incumbent firms (Tushman & Anderson, 1986; Geels, 2011; Ansari & Krop, 2012). For instance, the transition towards cleaner mobility adds pressure on incumbent car manufacturers who are forced to put greener and more fuel-efficient vehicles on the road (Attias, 2017). Doing so requires substantial investments in acquiring new capabilities (Accenture, 2014). This raises the question which strategies incumbents should adopt in sustainability transitions to enhance the likelihood of success or even survival (Farla et al., 2012; Geels, 2014a; Smink, 2015; Mossel et al., 2018; Köhler et al., 2019).

While extant research has aimed to clarify the underlying models of incumbent behavior in light of technological change (e.g. Hill & Rothaermel, 2003), there is still a dearth of research on the conceptualization of actors' strategies during sustainability transitions (Farla et al., 2012; Wesseling, 2015; Mossel et al., 2018). Yet, firms, and incumbents in particular, play a critical role in sustainability transitions (Smink, 2015; Köhler et al., 2019). To illustrate, the commercial success of electric vehicles may be codependent on the strategies of incumbents because only a small number of large incumbent car manufacturers dominate the automotive industry (Wesseling, 2015). Extant literature has generally considered incumbents as a homogeneous group, while it was also found that incumbents employ diverging behavior in sustainability transitions (Geels, 2014a; Smink, 2015). This implies that the variations in incumbents' strategic behavior can be attributed to firm-level distinctions. Indeed, several scholars called for more research on actors and their strategies and resources (Farla et al., 2012; Bansal & Song, 2017; Köhler et al., 2019). Notwithstanding this knowledge gap in the context of sustainability, previous scholars have turned to traditional management literature to grasp the intricacies of firm behavior in sustainability transitions (e.g. Mossel et al., 2018).

In times of technological change, firms ought to update their capabilities continuously to strengthen their competitive advantage because most capabilities are technology-specific and technological change renders certain capabilities redundant, while simultaneously requiring new capabilities (Eisenhardt & Martin, 2000; Helfat et al., 2007). Yet, incumbents are oftentimes constrained in developing novel capabilities due to organizational inertia (Christensen, 1997). This means that although incumbents might have the resources to invest in capabilities, they lack the dynamic capability to do so in a radical manner. Dynamic capabilities are defined as the firm's ability to integrate, build, and reconfigure capabilities in view of path dependencies and existing resource endowments (Teece et al., 1997). Hence, the possession of dynamic capabilities explains whether firms *can* renew capabilities, whereas this research aims to define *how* firms can do so (ibid.). Therefore, this study follows Capron and Mitchell (2009) to analyse the capability acquisition strategies, which builds on the resource-based view theory. More specifically, capability acquisition strategies are categorized as internal development or external sourcing strategies in this study (Capron & Mitchell, 2009). However, incumbents' strategic behavior is not only influenced by these firm specific, internal factors, but also by the external context it operates in (Helfat et al., 2007, Geels & Schot, 2007).

The context of a sustainability transitions brings about three unique challenges for incumbents in contrast to traditional transitions. First, whereas the traditional transition literature generally assumes innovations are market driven, innovations in sustainability transitions are shaped by additional social (e.g. customer demand) and political (e.g. environmental regulations) pressures because they address the challenges of environmental problems such as climate change (Geels, 2014b). Second, sustainability transitions are characterized by more uncertainty because they carry multiple sustainable innovations at once (e.g. electric vs. fuel cell vehicles) with unclear market prospects for each innovation, making it hard for incumbents to prioritize among sustainable alternatives (Hansen & Große-Dunker, 2013). Third, sustainability transitions require system-innovation instead of modular-innovation; they are multi-dimensional and impose change on multiple fronts: technologies, markets, user practices, infrastructure, policies and so on (Geels 2004; Köhler et al., 2019).

As a result, sustainability transitions go hand in hand with a shift in mind-set and require a complete redefinition of an organization's capabilities (Geels, 2011; Adams et al., 2016). In this context, the capability gap between an incumbent's existing capabilities and the new capabilities required to compete in the changing competitive landscape is generally larger than in traditional market changes, thereby making capability acquisition a more daunting task for incumbents (Capron & Mitchell, 2009). Consequently, the phenomenon in which incumbents' internal capability portfolio may influence its strategic behavior to acquire new capabilities should be analyzed in the specific context of a sustainability transition.

To address these gaps in the literature, this study will analyze the case of incumbent car manufacturers in the automotive industry in response to the electrification revolution. In 2010, the transport sector accounted for 23% of the world's total energy-related CO2 emissions (IPCC, 2014) and is therefore regarded as one of the most immediate industries ripe for a sustainability transition (Geels, 2011). Concerns about environmental challenges has led towards the electrification of the powertrain, resulting in new types of vehicles, of which the Battery Electric Vehicle (BEV) stands to have the most profound environmental impact (Fournier, 2017). The introduction of BEVs is changing the power dynamics within the industry, creating turbulent times for incumbent car manufacturers who need to act fast to acquire relevant capabilities and resources to remain competitive (Mayyas et al., 2012; Attias, 2017). On the one hand, incumbents are losing power to battery manufacturers – who possess valuable core capabilities – while, on the other hand, incumbents are exploiting their complementary assets (e.g. sales network) to remain relevant and to gain an edge over new market entrants. Given the increasing technological complexity and faster development speed of BEVs, it is doubtful that incumbents possess all the appropriate capabilities to remain relevant – especially considering the array of sustainable solutions in one industry and the dynamic nature of sustainability transitions (Gnyawali & Park, 2011; Adams et al., 2016).

The fact that no industry is impervious to the increasing pressure of sustainability underlines the importance of this inquiry and indicates practical and academic relevance beyond the automotive industry. Through a longitudinal, qualitative research approach of the automotive industry's investment in BEVs as a sustainable solution, this study intends to analyze under which conditions incumbents operating in such an uncertain and highly transitional environment choose internal development or external sourcing strategies. In particular, this study will aim to answer the following research question:

Under which conditions do incumbent car manufacturers choose internal development or external sourcing strategies to cope with BEVs as a radical sustainable innovation in a sustainability transition?

In answering this question, this research makes several contributions. This study fills the dearth of micro-level, actor behavior research in sustainability transitions literature by analyzing incumbents' strategic behavior and decisions in varying conditions to provide a deeper understanding of how incumbents approach capability acquisition in the context of sustainability transitions (Farla et al., 2012). While the critical role of incumbents in sustainability transitions has been acknowledged, sustainability transition scholars mostly take a holistic, system perspective (e.g. how incumbents influence transitions) ((Markard & Truffer, 2008; Köhler et al., 2019). Therefore, scholars are now calling for more research on the organizational dynamics (e.g. strategies and resources) of firms in sustainability transitions (Bansal & Song, 2017; Köhler et al., 2019). In line with the call for more sustainability transition research on the micro-level, academics have underlined the necessity to bridge micro- and macro-levels to shed light on the underlying dynamics of micro-processes (i.e. firm behavior) as played out in arena of sustainability transitions (e.g. Köhler et al., 2019). The distinct nature of sustainability transitions compared to traditional transitions (Geels, 2011) subsequently substantiates the importance of analyzing incumbent behavior by taking the contextual factors of the sustainability transition into account. On a practical level, this study informs managers how to approach capability acquisition based on their internal portfolio of capabilities and the dynamic environment they operate in. Nevertheless, it is important to note that this research is a case study of BEV manufacturers and its findings will largely be specific to the automotive industry.

This thesis is conducted in cooperation with FreedomLab B.V., a creative future studies thinktank that facilitates organizations to anticipate the future. FreedomLab B.V. is a subsidiary of Dasym, an independent and research-driven investment firm. The proposed research will contribute to FreedomLab's market knowledge of the automotive industry – a sector of interest – and the dynamic powershifts therein. Moreover, FreedomLab has developed a recent interest in research on deep transitions – that includes sustainability transitions – and in particular the influence of incumbents and radical innovations on transitions.

The following section of this paper reviews the literature on the resource-based view and capability acquisition strategies to inform and develop the propositions. Next, the research method is discussed before the empirical findings, using data on eight incumbent car manufacturers and expert interviews, are presented. This paper concludes by discussing the results, theoretical and managerial implications, limitations and future areas of research.

2. THEORY

This research builds on two fundamental streams of literature, namely the resource-based view and the capability-acquisition literature. First, this study reviews the role of incumbents in the context of a sustainability transition. Next, the resource-based view is reviewed in order to understand the role of capabilities within a firm, how they can be defines and how they might change. Finally, alternative strategies for incumbents to acquire new capabilities are discussed. By building on traditional management literature, this study aims to understand the phenomenon in the context of sustainability transitions specifically (Bansal & Song, 2017).

2.1. Literature Review

2.1.1. Incumbents in Sustainability Transitions

The context in which radical sustainable innovations substitute existing innovations, and thereby trigger an entire socio-technical change within an industry, is commonly referred to as a sustainability transition (Schot & Geels, 2008). In this study, radical sustainable innovations are defined as "innovations that are high in novelty and also aim to significantly improve the sustainability performance of systems" (Kennedy et al., 2017, p.713). Generally, incumbents hold a leading role in the existing regime, while new entrants introduce radical sustainable innovations at the niche level (Geels, 2002). Such innovations then slowly challenge the traditional technology and, consequently, also the dominant position of incumbents. In the present system, incumbents have a strong asset position, while most incumbents stand to lose a fair share of their profits if the sustainable paradigm emerges (Smink, 2015). Given their dominant position and strong asset base, incumbents can exercise significant power on the system, which provides them with enough control either to block the emerging system or to accelerate it (Geels, 2014a; Smink, 2015).

Typically, incumbent behavior in response to the new entrants is depicted as very defensive as they use their rich resource base as a competitive advantage to hinder the new technology (Chandy & Tellis, 2000; Geels & Schot, 2007; Wesseling, 2015). In doing, incumbents impede their ability to adjust to the changing environment, which often leads them to suffer or fail following radical innovations (Bettis & Prahalad, 1986; Chandy & Tellis, 2000). Nevertheless, more recent research found "the extent of the incumbent's curse in the face of radical innovations may be overstated" (Ansari & Krop, 2012, p. 1358). Indeed, there are cases in which incumbents remain inert (Mossel et al., 2018) or even introduce radical sustainable innovations themselves (Hill & Rothaemel, 2003; Geels, 2014a). To illustrate, some incumbent oil manufacturers are supporting biofuel initiatives (Negro, 2007). Although, this implies that incumbents cannot be regarded as a homogenous group that pursues similar behavior, transition scholars often take a holistic and systemic perspective at the expense of a more actor-oriented analysis (Farla et al., 2012). Therefore, Bansal and Song (2017) argue that in order to understand the intricacies of businesses behavior in sustainability transitions, researchers should work with concepts and frameworks used in management studies and apply them to transitions related research.

Hence, while there is a dearth of research on incumbent behavior during sustainability transitions specifically, traditional firm-level management literature has provided several explanations for different modes of incumbent behavior in the face of radical innovations that will serve as a foundation for this study. Mossel, Rijnsoever and Hekkert (2018) performed a review of organizational theories that can be used to explain incumbents' behavior during transitions by comparing different theories of the firm that each highlight different dimensions of complex organizational processes. These theories conceptualize firms differently: as a set of production plans (behavioral theory of the firm), as collective identities (institutional theory), or as bundles of assets (resource-based view). This research will use the resource-based view theory (RBV) as the preferred theory to answer the previously stated research question because "seen through the lens of the RBV, persistent inter-firm resource heterogeneity causes a transition's impact to vary between incumbents" (Mossel et al., 2018, p. 52). Specifically, RBV posits that a firm's specific capabilities determine the range of available strategic options it can use to build new capabilities by assessing whether the firm's capabilities are adequate enough to support the development of those new capabilities (Capron & Mitchell, 2009)

2.1.2. The Resource Based View

The RBV builds on the notion that a firm's resources should be rare, valuable, non-substitutable, and inimitable in order to have a competitive advantage (Barney, 1991; Amit & Schoemaker, 1993; Corbett & Claridge, 2002). In case of technological change, new capabilities come into play, which urges incumbents to update their existing capabilities by tapping into their dynamic capabilities (Sirmon et al., 2007). Dynamic capabilities are defined as the firm's ability to integrate, build, and reconfigure capabilities in view of path dependencies and existing resource endowments (Teece et al., 1997). However, not all firms have equally strong dynamic capabilities (Eisenhardt & Martin, 2000; Teece, 2007). Given that a firm's resources and capabilities are unique and oftentimes technology-specific, the specific aggregation of these resources results in a company-specific resource portfolio consisting of different types of capabilities. Indeed, numerous scholars build on the resource-based view, or capability portfolios specifically, to explain the underlying dynamics in firms' strategic behavior (e.g. Capron & Mitchell, 2009; Anand et al., 2010; Wesseling et al. 2015), which substantiates the relevance of discriminating between different types of capabilities. Furthermore, Farla, Markard, Raven and Coenen (2012) found that the variety of strategies different incumbents pursued in the context of sustainability transitions could be explained by their distinct resource configurations and called for further research on a possible conditional role different resources and capabilities may portray.

Previously, capabilities have been categorized in several ways, such as physical, human and organizational (Barney, 1991), technological, infrastructural, complementary and reputational (Wesseling et al. 2015), or core and complementary (Teece, 1986). Drawing on the common strands of thinking in technology-related research and capabilities specifically, this study follows Teece's categorization of distinguishing between core and complementary capabilities (1986). For instance, Thompson (1967) distinguished between core and peripheral activities, Richardson (1972) differentiated between similar and complementary activities, Henderson and Clark (1990) separated core product technologies and complementary technologies, and, finally, Cleland and Bursic (1992) distinguished between core and complementary technologies.

According to Teece (1986), core capabilities relate to a firm's technological know-how necessary to develop innovations, whereas complementary capabilities relate to a firm's capacity to commercialize the innovation through specific channels and services. At the organizational level, core capabilities are the set of routines that are intrinsic to the development and manufacturing[1] of the technology, while complementary capabilities are the set of routines

[1] This paper acknowledges that Teece (1986) categorizes 'competitive manufacturing' as a complementary capability in his article. However, many other scholars categorize manufacturing as a core capability and especially in the automotive industry, manufacturing is defined as a core capability for car manufacturers. Hence, this study will categorize manufacturing as a core capability.

that concern the distribution and sales of the innovation (Teece, 1986; Mitchell, 1992; Anand et al., 2010).

Given that this study's analysis of the firm focuses on their behavior in response to a sustainability transition, it is important to complement the resource-based perspective with a consideration of the environment in which the firm operates (Geels, 2014b). In fact, sustainability transition scholars have not only called attention to the gap in micro-level research recently, but also identified the significant challenge regarding the connection between the micro- and macro-levels of analysis (Köhler et al., 2019). In sustainability transitions specifically, multiple different sustainable technologies compete with one another to become the dominant design (Geels & Schot, 2007; Hansen & Große-Dunker, 2013). For incumbent companies to pull off a successful transition, they must navigate not only the intricacies of adapting their own internal capability portfolio, but also the external changes in the market place (Geels & Schot, 2007; Köhler et al., 2019). In order to account for changes in the environment, this study examines the market conditions of two separate time periods.

To that end, the first period is defined as the 'early stage' of the BEV market, which started in the late 2000s (Sierzchula et al. 2012) and remained relatively unchanged until 2013. During the early period, the market was clearly dominated by three major players: Tesla, Nissan and Renault (see Figure 1). However, from 2013 onwards, an increasing number of new players entered the electric vehicle market, as indicated by the emergence of additional colors and their subsequent sales growth (see Figure 1). Given that the BEV market is far from reaching maturity, this period (2013 onwards) will be defined as the middle stage (Geels & Johnson, 2018). The middle stage is characterized by a substantially more proportional distribution of EV sales across brands, which denotes a fundamental change in market forces and therefore qualifies it as a separate time period.

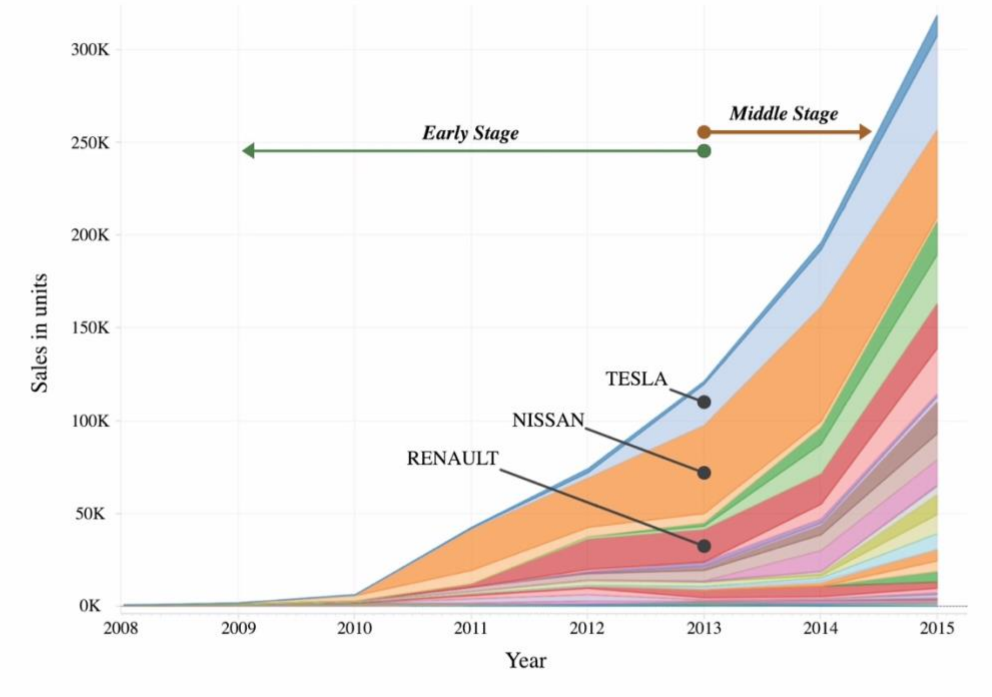


Figure 1: Global EV Sales by Brand (source: EV-volumes.com)

2.1.3. Capability Acquisition Strategies

Following Capron and Mitchell (2009), firms need to understand the conditions under which *internal development* or *external sourcing* strategies will be most fruitful for obtaining new capabilities. Fundamentally, organizations either leverage their dynamic capabilities to develop the desired new capabilities internally or they acquire them externally (Helfat et al., 2007; Capron & Mitchell, 2009; Anand et al. 2010). When employing internal development, firms create new capabilities within the boundaries of the firm either by recombining existing capabilities or creating entirely new ones (e.g. internal training or opening new R&D labs) (Capron & Mitchell, 2009). Firms choosing external sourcing trade strategic capabilities through purchase contracts, alliances or mergers and acquisitions (ibid.). With purchase contracts, incumbents buy distinct capabilities (e.g. off the shelf technologies) from third parties. Alliances are defined as “external relationships such as joint ventures, direct investments, technology licensing/exchange, and research contracts” (Anand et al. 2010, p1216). Through M&As, firms either obtain a majority control of other entities or share control with another entity (e.g. buying entire corporations or purchasing individual businesses) (Capron & Mitchell, 2009).

For the automotive industry specifically, Attias (2017) found that the range of sustainability-oriented transformations are redefining carmakers partnerships strategies as exemplified by an increasing diversification of collaborations in the areas of software. Indeed, several scholars argue that the increasing complexity of the sustainability problems is expected to result in a high degree of coordination between actors (e.g. Farla et al., 2012). However, there is a gap in the academic understanding of the conditions that influence the strategy dimensions in which actors either pursue their goals alone or join forces with others (Köhler et al., 2019).

Numerous management scholars have proposed how different constructs (in relation to capabilities and the contextual environment) influence a firm's strategic behavior in times of technological change. First, Capron & Mitchell (2009) argue that small capability gaps between a firm's traditional[2] capabilities and the emerging ones often lead to internal development strategies, whereas large capabilities gaps result in external sourcing strategies. Second, Anand, Oriani and Vassolo (2010) argue that resources stemming from strong traditional capabilities can oftentimes serve as a security buffer against the increasing popularity of new technologies. However, capabilities are often technology-specific, meaning some capabilities might drop in value or become redundant, while others maintain their value and can serve as a buffer. Third, incumbents are less likely to pursue permanent partnerships due to uncertain market prospects of various emerging sustainable innovations (Hansen & Große-Dunker, 2013). Finally, general advantages and disadvantages of the different strategies that are likely to influence the incumbents' decision making are summarized in **Table 1**.

Table 1: Advantages and disadvantages of each strategy

	INTERNAL DEVELOPMENT	**EXTERNAL SOURCING**
Advantages	• Protect intellectual property • Combine unique, tacit capabilities to develop unique new ones	• Explore new external resources and combine in novel ways • Less permanent (unless M&A)
Disadvantages	• Constrains development • Lack of resources makes it difficult	• Exposed capabilities can threaten IP when it gets leaked • Cultural and structural barriers between firms in case of M&A • Permanency in case of M&A

Sources: Capron & Mitchell (2009); Anand et al. (2010)

[2] In times of technological change capabilities can be split into traditional capabilities (i.e. current technology like conventional car) and emerging capabilities (i.e. new technology like BEV) (Anand et al., 2010).

In sum, incumbents face significant challenges in adapting to radical innovations in transitions and often even fail (Chandy & Tellis, 2000). The uncertain and dynamic environment of sustainability transitions further complicates these challenges due to three reasons: increasing social and political pressure, uncertainty due to the rise of multiple sustainable innovations and trends and, the system-level change. Incumbents will have to acquire new capabilities in this situation, but the question remains how they are going to acquire these capabilities, specifically, how are they going to choose between internal development or external sourcing strategies.

2.2. Propositions

Sustainability transitions impose a fundamental shift in mindset and a complete redefinition of a firm's capabilities across all organizational levels (Adams et al., 2016). Hence, if incumbents truly want to integrate the new paradigm, they will have to rethink all relevant capabilities and the most suitable strategy to acquire those capabilities. As aforementioned, this study distinguishes between core and complementary capabilities, yet these capabilities are highly connected within the firm, underlining the importance of analyzing them in conjunction (Teece, 1986). In order to understand nuanced changes in a firm's capability portfolio over time, this study differentiates between different strengths of capabilities to facilitate more richness in the data and avoid high-level either/or results that would introduce too much ambiguity. Therefore, by distinguishing between core and complementary capabilities (Teece, 1986) in the emerging technology and subsequently assessing an incumbent's relative strength along those two axes, four possible configurations emerge, as presented in **Figure 2.**

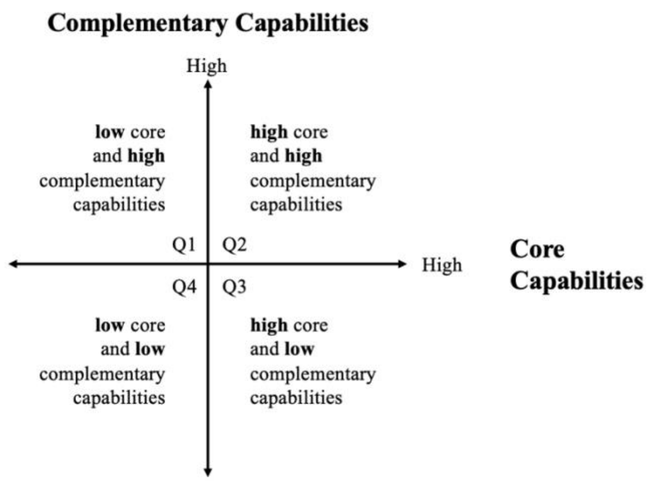


Figure 2: Capability Configurations of Incumbents

The propositions are structured according to the different quadrants in order to understand the variations in capability acquisition strategies based on different capability compositions. There are three important assumptions that underline the rationale of the propositions. First, based on the literature, this study implicitly assumes that incumbents ultimately want to acquire high core and high complementary capabilities that are specific to the emerging technology (Helfat et al. 2007). Second, this study builds on the notion that firms focus on acquiring core capabilities first because core capabilities refer to the knowledge that fundamentally underlies and is required to create the new technology (Teece, 1986; Mitchell, 1992). Third, it is understood that once the firm holds a sufficient level of core capabilities to attract customers, it will focus to acquiring complementary capabilities as well to maximize capitalization through economies of scale. Therefore, incumbents will invest in complementary capabilities next to increase the demand of their products to exploit economies of scale to save costs and facilitate further core capability acquisition. A summary of all the relevant considerations for incumbents is listed at the end of this section in **Figure 3** in the form of a decision flow chart, which can be used as visual guidance in understanding the rationales behind the propositions.

When an incumbent portrays low core and low complementary capabilities in the emerging technology (quadrant 4 in Figure 2), its behavior will primarily be guided by external factors such as the maturity of the market. In early stage of a market, the emerging technology is still at its infancy, gradually leaving the niche level, and is picked up by a small, yet slowly growing, number of companies competing in the new market. Some traditional management literature scholars argue that firms who enter[3] the market at this stage will each independently pursue their own strategy to establish a successful position, implying that each firm develops its own best version of the technology internally (Peng et al. 2012). In contrast, traditional technology transitions are accentuated by external sourcing strategies in their early stages (Nesta & Magnematin, 2002). However, sustainability transitions carry multiple innovations at once (e.g. hybrid, fully electric, fuel cell), making it a daunting task for incumbents to allocate appropriate resources to the different, competing innovations while also mitigating the effects of cannibalization. Additionally, the early stage is characterized by the presence of a wide array of technological approaches to one specific sustainable innovation with firms attempting to find the most successful approach (Tushman & Anderson, 1986). In the case of BEVs, this is exemplified by firms searching for the most efficient and sustainable battery technology, which

[3] This study looks at firm entry to the BEV market, not the sole presence in an industry.

has resulted in the emergence of multiple technologies (i.e. lithium-ion battery, solid-state drive battery and nickel-metal battery). Due to the high degree of uncertainty in this early stage of the market, incumbents who enter the market in this stage will typically prefer more flexible and less permanent methods of acquiring the relevant capabilities and therefore decide to develop the capabilities internally (Paech, 2007).

Once the market begins to evolve, an increasing number of companies enter the market. At this middle stage, newly interested incumbents find themselves in a less favorable position because they lack the relevant capabilities for the emerging technology (Smink, 2015). As opposed to the early stage, the future potential and importance of the emerging technology is increasingly recognized during the middle stage. In turn, new incumbents are prompted to pursue external sourcing strategies to acquire the necessary capabilities as a way to catch up with the existing players as fast as possible (D'Aveni, 1994). Specifically, Smink, Hekkert and Negro (2015) found that while incumbents often aim to keep the sustainable innovation on a leash in the early stages, incumbents speed up the implementation of the innovation significantly through partnerships once they abandon their defensive behavior. Given the novel and complex nature of the new technology, catching up through internal development is deemed difficult and too time-consuming (Anand et al., 2010). External sourcing strategies, on the other hand, offer the possibility to leapfrog some of the early, burdensome research and development headaches (Capron & Mitchel, 2009). Moreover, at the middle stage the newly interested incumbents will have the opportunity to imitate best practices from early adopters and assess which capabilities to explore further for external sourcing based on verified success in the early stage (Teece, 1986). Hence, the decision for incumbents in the lower left-quadrant of Figure 2 to develop core capabilities internally or source core capabilities externally is dependent on the maturity of the market. Accordingly:

Proposition 1A: *Incumbents with low core and low complementary capabilities are more likely to acquire core capabilities through* ***internal development*** *in the early stages of the market during a sustainability transition.*

Proposition 1B: *Incumbents with low core and low complementary capabilities are more likely to acquire core capabilities through* ***external sourcing*** *in the middle stages of the market during a sustainability transition.*

When an incumbent holds low core and high[4] complementary capabilities (quadrant 1 in Figure 2), this may provide them with a competitive advantage. According to Teece (1986), firms lacking complementary capabilities are likely to fail in the face of radical technological transitions, while firms that have these complementary capabilities but lack the core capabilities can sometimes still succeed. This is exemplified by the survival of incumbents in the typesetter industry, who buffered complementary capabilities to survive the radical technological change in that industry by pursuing extensive collaborations with the new entrants that were driving the development of the emerging technology (Tripsas, 1997; Rothaermel, 2001). Nevertheless, complementary capabilities (i.e. distribution and sales) for the traditional technology might not hold the same value for the emerging technology because many capabilities are technology specific (Teece et al., 1997).

Radical technological change can spawn entirely new complementary capabilities that were previously non-existent (or not pertinent) yet have become key differentiators in the context of the sustainability transition (Teece et al., 1997). For instance, in the case of BEVs, traditional sales differentiators such as excellent dealerships can be superseded by sales differentiators like charging infrastructure or e-mobility services (Attias, 2017; PwC, 2018). That is not to say traditional complementary capabilities always become obsolete, but rather their significance and the role they play in the new paradigm are subject to reassessment (PwC, 2018). In fact, some traditional complementary capabilities may be directly transferable to the new context (Rothaermel, 2001). For instance, if incumbents invest in carsharing capabilities for conventional internal combustion engine vehicles (ICEV), they can extrapolate these capabilities to carsharing with electric vehicles (Attias, 2017). Indeed, carsharing with electric vehicles has proven to increase public awareness, acceptance, production and sales of BEVs as well as promote economies of scale of BEV production (Fournier et al. 2015). In the automotive industry, this can partially be explained by the interconnectedness of multiple diverging sustainability trends such as electromobility, autonomous driving, connectivity and mobility services (Fournier et al. 2012). Together, these trends underline the transition towards a new paradigm and all pillars are connected to one another (ibid.). Nevertheless, given the lack of research on the role of complementary capabilities in the context of sustainability transitions, this research will follow the traditional management literature by arguing that most traditional

[4] The cut-off criteria for 'high' capabilities are adjusted over time depending on the evolution of the market. The BEV market is still in the middle of its evolution, hence in order to determine the nuances in capabilities across incumbents, their capabilities are cross-referenced at each point in time.

complementary capabilities are unlikely to provide incumbents with relevant resources to develop the newly required capabilities internally. Accordingly:

Proposition 2A: *incumbents with low core and high complementary capabilities are more likely to acquire core capabilities through* ***external sourcing****, regardless of the market stage during sustainability transitions.*

Proposition 2B: *incumbents with low core and high complementary capabilities are more likely to acquire (further) complementary capabilities through* ***external sourcing****, regardless of the market stage during sustainability transitions.*

When an incumbent holds high core and low complementary capabilities (quadrant 3 in Figure 2), they hold fundamental expertise in the emerging technology. According to the management literature, firms ultimately want to bring core capabilities in-house to mitigate the risk of opportunistic behavior and to build on tacit knowledge (Rosenkopf & Tushman, 1998). Therefore, this study argues that once an incumbent possesses 'high' core capabilities, they tend to strengthen these core capabilities internally – regardless of the stage of the market – rather than employ external sourcing to bolster their core capabilities.

Nevertheless, the fully integrated incumbent is best positioned to benefit from the emerging innovation through exploitation of complementary assets (Teece, 1986). While these incumbents could develop such complementary capabilities internally, external sourcing methods allow the incumbent to solidify their focus on their core competencies whilst gaining access to complementary capabilities by partnering with other firms along the value chain. Building on management literature, external sourcing in this manner bears two advantages. First, it can improve organizational learning and adaptation to market and technology shifts by having access to new resources which can be combined in novel ways with the firm's existing resources to create resources that are valuable, rare, difficult to imitate and non-substitutable, as determined by RBV (Gulati, 1998). Second, it creates an opportunity for firms to generate relational rents because effective governance of an alliance results in lower transactional costs and higher willingness of the alliance partner to engage in specific, value-creating activities (Dyer and Singh, 1998). Therefore, this study proposes that once the incumbent has the required core capabilities to manufacture the emerging technology, they will look to capitalize on their investments and know-how by acquiring powerful complementary capabilities through external sourcing (Mitchell, 1992). Doing so enables the manufacturer to optimally commercialize the emerging technology (Teece, 1986).

Proposition 3A: *Incumbents with high core and low complementary capabilities are more likely to develop (further) core capabilities through* ***internal development****, regardless of the market stage during a sustainability transition.*

Proposition 3B: *Incumbents with high core and low complementary capabilities are more likely to develop complementary capabilities through* ***external sourcing****, regardless of the market stage during a sustainability transition.*

When incumbents excel in both core and complementary capabilities of an emerging technology (quadrant 2 in Figure 2), it can be inferred that this technology holds substantial strategic importance to the firm. While these incumbents have acquired a promising internal capability portfolio, they should continuously maintain and advance their capabilities to remain relevant (Helfat et al., 2007). On the one hand, academics argue that once the market matures, resource similarity across competitors increases as well, which invites competitors to cooperate to increase economies of scale and share risk across a larger pool of assets (Peng et al., 2012). On the other hand, Teece (1986) argues that fully integrated incumbents are in the best position to exploit their strong, tacit resource base to create new ones, thereby diminishing the risk of intellectual property exposure through partnerships. Indeed, Karim and Mitchell (2000) found that internally developed capabilities provide a more stable platform for future capability development because they are highly integrated into the firm's knowledge base and context. As discussed, the BEV market is a long way from reaching maturity, implying that incumbents are still far removed from attaining sufficient levels of resource similarity that justify further cooperation with competitors (Peng et al., 2012). Therefore, in order to protect their competitive position and capability base, incumbents with a high capability portfolio are unlikely to pursue external sourcing strategies at this stage of market other than in areas of other emerging technologies (Smink, 2015). Accordingly:

Proposition 4A: *Incumbents with high core capabilities and high complementary capabilities are more likely to acquire (further) core capabilities through* ***internal development*** *strategies, regardless of the market stage, during sustainability transitions.*

Proposition 4B: *Incumbents with high core capabilities and high complementary capabilities are more likely to acquire (further) complementary capabilities through* ***internal development*** *strategies, regardless of the market stage, during sustainability transitions.*

Figure 3 summarizes some of the relevant considerations for incumbents and depicts the position of each proposition to give a holistic overview of the step-wise logic applicable to incumbents with varying degrees of core and complementary capabilities. The numbers in red show which decision flow incumbents have followed to arrive at the subsequent decision and align with the propositions.

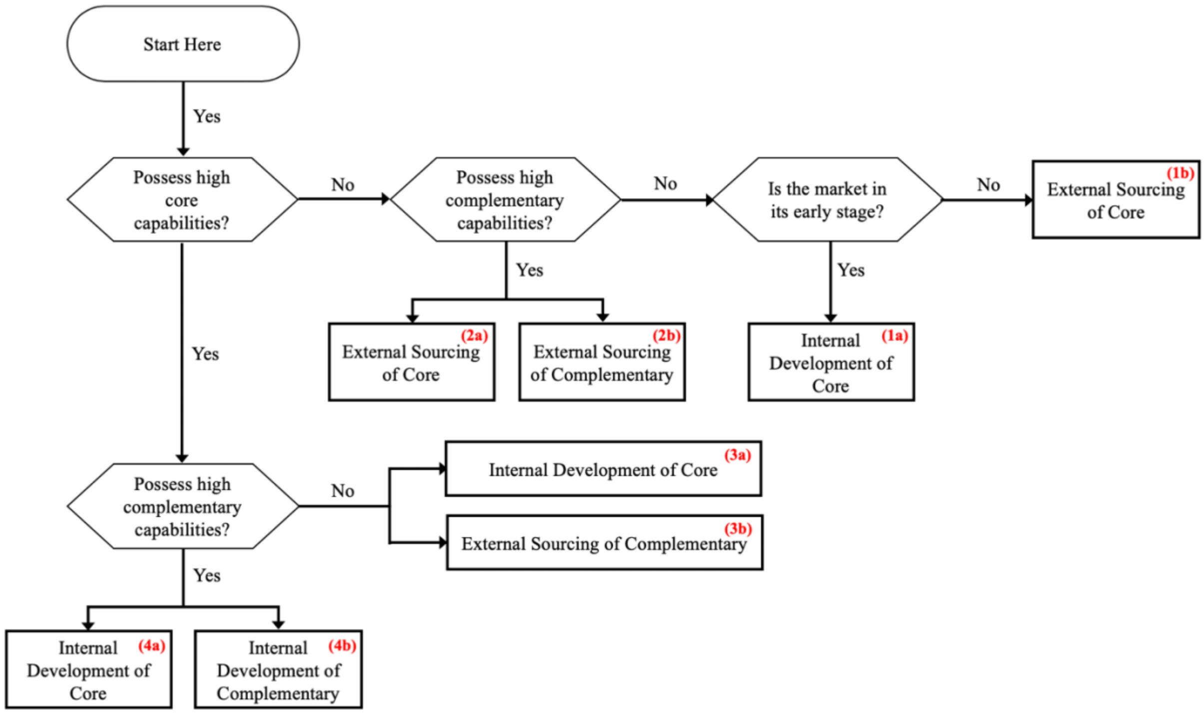


Figure 3: Decision flow chart for internal development versus external sourcing strategies

3. METHODOLOGY

The goal of this study is to examine under which conditions incumbent car manufacturers choose internal development or external sourcing strategies in light of BEVs as a radical sustainable innovation. Understanding incumbent behavior in sustainability transitions provides an entirely new context, which may result in new repercussions for theoretical constructs, for instance, if they relate differently to one another. As a result, this study is explorative in nature, despite the deductive approach that propositions otherwise suggest. This explorative method subsequently substantiated the suitability of qualitative research (Denzin & Lincoln, 1994). Seeing as most incumbents operate under different conditions (capability portfolios), a *multiple case study* research design is appropriate.

Within each case study, the incumbent car manufacturer represents the unit of analysis. Car manufacturers are defined as incumbents if they meet the following three criteria: 1) they sold automobiles before 1991, 2) they are one of the 30 largest vehicle manufacturers globally based on the 2017 International Organization of Motor Vehicle Manufacturers production figures, and 3) they sold at least 1 million vehicles in 2017 (Sierzchula et al., 2012; OICA, 2017). Each case was observed in a longitudinal manner, ranging from 10 years back in time to 5 years into the future. This study looked 10 years back in time because incumbents only introduced BEVs, or prototypes thereof, from 2009 onwards[5] (Sierzchula et al., 2012).

Specifically, each case will be comprised of an incumbent car manufacturer that is active in the BEV market. The study sample was drawn from a list of 22 incumbents based on the three previously described selection criteria. Subsequently, of these 22 incumbents five were eliminated because they had not released a BEV yet. Of the remaining 17, a fair distribution was made between Asia, Europe and North-America to allow for an even geographical coverage: 3 in Asia, 3 in Europe and 2 (all) in U.S. (cf. Appendix 1). This means that 8 firms[6] were selected of the remaining 17 in descending order of the 2017 production figures as listed in Appendix 1 (OICA, 2017). There cases are: Toyota, Volkswagen, Hyundai, General Motors, Ford, Nissan, Renault, Daimler AG.

[5] With the exception of some incumbents in the 90's (e.g. General Motors EV1 in 1996)
[6] The typical criteria regarding sample size are irrelevant for case study research (Yin, 2013). Hence, 8 cases was the maximum given time and resource constraints of this study and the attempt to represent all four capability portfolios.

3.1. Data Collection

This study relied on numerous data sources such as expert interviews, company reports, industry reports, news articles and external databases. Secondary data served as the primary data source because information on capabilities and partnerships is often publicized in media outlets and published data is generally more objective and can be cross-referenced by using triangulation (Yin, 2013).

Data collection involved three approaches. First, company and industry reports were analyzed to provide information on the companies, technologies and industry trends. Second, complementary data was collected through other sources (i.e. annual reports, internal news rooms, industry reports and Google search) by building on specific constructs for each of the relevant concepts as shown in **Table 2**. Third, data was supplemented by semi-structured interviews. Informants for this study were selected based on 'purposeful sampling' by choosing experts of the automotive industry who are knowledgeable enough about the BEV market to provide rich insights both on micro-level capabilities as well as on macro-level trends within the industry (Corley & Gioia, 2004). A total of four interviews were conducted (cf. Appendix 2) following the interview questions listed in **Appendix 3**, resulting in 5.5 hours' worth of interviews. Summaries or transcripts of each interview can be found in **Appendix 5**.

3.1.1. Operationalization

Table 2: Operationalization of Constructs

CONCEPTS	INDICATORS	CUT-OFF CRITERIA	DATA SOURCES
Core capability: development	Prototypes	On average[7] > 1 per year	Company, news & industry reports
	New product development	On average > 1 every 3 years	Company, news & industry reports
Core capability: manufacturing	Main element of product (battery cell, battery package)	YES/NO	Company, news & industry reports, product specifications

[7] Average always between 2009 – 2018

	Supporting element of product (electric motor, e-architecture)	YES/NO	Company, news & industry reports, product specifications
Complementary capability: distribution	Distribution system fit	HIGH / MEDIUM / LOW	Company, news & industry reports
Complementary capability: sales	Customer satisfaction (charging infrastructure, carsharing and e-mobility services)	HIGH / MEDIUM / LOW	Company, news & industry reports
Internal development	• Investment in R&D • Business unit collaboration	n.a.	Company, news & industry reports
External sourcing	• Purchasing contract • Joint venture • Research contracts • Technology licensing/exchange • Working agreements • Acquisition • Merger	n.a.	Company, news & industry reports

Sources: Anand et al. (2010); Ansari & Krop (2012); Bakker (2010); Bakker et al. (2012); Corbett & Claridge (2002); Deloitte (2013); Dutta et al. (1999); Nath et al. (2010); Rothaermel (2001); Teece (1986); Tripsas (1997); Wesseling et al. (2015).

Some of the measures listed in **Table 2** require further elaboration. First, 'prototypes'[8] per se are not a suitable proxy for development capability due to the oftentimes limited provision of technical information (Wesseling et al., 2015). Therefore, only prototypes with technical specifications were included. Second, since 'manufacturing' capability is dependent on the production skill set of the firm, it is necessary to divide between main and supporting elements of the product (Tripsas, 1997). Third, comparing the degree of internal development and external sourcing of one firm to another was done on a sample-relative basis by summing the number of activities supporting each strategy per case. Fourth, the concept of 'distribution' refers to the movement of goods from the plant to the final customer and is determined by both the distribution network and distribution modes. A firm's distribution network is defined by the geographical distribution of production locations, central warehouses, regional distribution

[8] Patents are most commonly used as indicator for a firms' development capability, however a comprehensive patent analysis is not operable given the time constraints of this thesis (Bakker et al. 2012).

centers and dealers. A firm's distribution mode is strongly related to its sales capability and refers to the channels through which it distributes its goods to end-consumers such as through franchise dealers, online direct retail, carsharing, leasing companies, and so on. Hence, while distribution modes and networks are fundamental indicators, they are difficult to benchmark, warranting the inclusion of 'fit' as the indicator. While distribution logistics of incumbents will undergo a significant transformation due to the rise of mobility as a service, the precise impact of electromobility on distribution is less severe (Attias, 2017). Yet, is was found that the high weight of the battery causes increasing logistical complexity because the costs of transporting these heavy batteries (and BEVs) around the world are much higher than for conventional cars. Therefore, incumbents should aim to minimize the distance between battery suppliers and their plant and between the plant and their warehouses or distribution centers.

Data for each specific concept listed in **Table 2** was collected in the following manner: concerning core capabilities, data on *development* was obtained by using the power search function on the company-specific sources (i.e. annual reports and internal newsrooms) as well as through external websites found through Google search. In particular, the search queries applied to company-specific sources were 'prototype' and 'concept'. In addition, the following websites were scanned for both prototypes and newly developed products: autogids.be, wikipedia.org and wattev2buy.com. Next, data on *manufacturing* was obtained by using the power search function on company-specific sources and Google search using the following search queries: 'batter[9]', 'platform', 'plant' and 'electric'. For Google search hits, a selection was made either by analyzing the first ten hits only or by looking for a specific year of publication.

Regarding complementary capabilities, data on *distribution* was collected by using the power search function on company-specific sources and Google search using the following search queries: 'dealer' 'distribut', 'channel', 'network' and 'online'. Next, data for *sales* was also obtained by using the power search function on company-specific sources and Google search, this time using the following search queries (or synonyms thereof): 'connect', 'charging', 'sharing', 'retail', 'digital' and 'sales'.

[9] Oftentimes a search query was used that could cover variations of the word. For example, 'batter' covers the words battery and batteries.

To gather data on the firms' choice of capability acquisition strategies, a similar data collection process was employed. For *internal development*, data was collected through the search query 'invest' and by scanning the R&D sections of each annual report. For *external sourcing*, data was collected through the search queries: 'partner', 'collaborat', 'venture', 'agreement', 'acquisition' or 'merger'.

The discrepancy in applicability of particular search queries is worth noting because some search queries were highly effective for some firms, but not for others. For instance, the search query 'sales' was often too broad resulting in +150 hits per document and was subsequently disregarded for some cases. In contrast, sometimes alternative search queries or synonyms worked better such as searching for the word 'warehouse' instead of 'distribution center'.

3.2. Data Analysis

To test the propositions, this study followed five interrelated steps (Rowley, 2012).

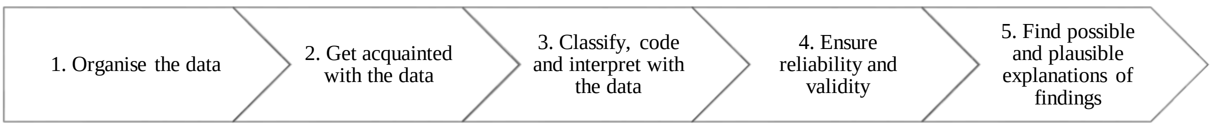


Figure 4: Data Analysis Process

Step 1: Secondary data was examined and interviews were conducted and summarized. Considering the fact that material collected by means of semi-structured interviews is relatively unstructured and unwieldy, it was necessary to write down the verbal conversations not only to make it possible for the researcher to accurately analyze the data, but also to obtain further verification of the data by providing interviewees with a summary or transcript and asking whether they had been correctly cited (Ritchie & Spencer, 2002). Next, all qualitative data points were entered in NVivo, a qualitative analysis software, following the operationalization of Table 2, whereas quantitative data points were entered in Excel. Other key themes and pivotal observations that emerged during Step 1 were also considered and sometimes even added as constructs as suggested by Rowley (2012). Specifically, information on the background and future of BEV for each case specifically was added. In total, 310 documents were analyzed resulting in 2418 codes in NVivo across the different constructs. Given the large and diverse amounts of sources, each source was given a code. The first character refers to the first letter of the company name and the second character refers to the type of source with 'A' referring to annual reports, 'I' referring to internal news room and 'E' referring to external news. To illustrate, Ford's 2009 annual report is coded as 'FA1'. These codes are used in the results section. An overview of all sourcing codes is listed in **Appendix 4**. A list of all sources and their accompanying codes can be found in **Appendix 5**.

Step 2: The process of getting acquainted with the data revolved around finding and organizing ideas and concepts. Hence, data was structured according to the operationalization presented in Table 2. In particular, the codes for each construct per case were summarized in tables[10] to highlight the significant findings per construct on a yearly basis. This provided a more practical overview for further analysis and allowed patterns to be established and identified more easily over time. These tables are included in **Appendix 5.**

Step 3: This stage served as a final revision for the ultimate configuration of constructs with which to test the propositions (Ritchie & Spencer, 2002). Seeing as the cut-off criteria mentioned in Table 2 are specific to each indicator, a more elaborate step-by-step plan was required to arrive at low or high values for core and complementary capabilities. First, values (low-med-high) for each of the four capabilities specifically were determined. For the development capability, incumbents were considered to have a low capability if they did not meet the criteria for the prototypes indicator and the New Product Development (NPD) indicator, medium capability if they only met the criteria for either prototypes or NPD, and high capability if they met both criteria. The same methodology was applied to determine the values for incumbents' manufacturing capability. Given that both complementary capabilities were assessed on a single cut-off criterion (see Table 2), values for sales and distribution capabilities were determined without further specification.

Second, the overall values for core and complementary capabilities were calculated. This means that the values for development and manufacturing capabilities were combined into a single rating of core capabilities while the values for distribution and sales capabilities were combined into a representative rating of complementary capabilities. Low, medium and high capabilities were assigned a 0, 1 and 2 respectively. To illustrate, if an incumbent displayed medium distribution capabilities (1) and high sales capabilities (2), its complementary

[10] The tables in Appendix 5 represent a rough summary and was developed to aid the researcher in the data analysis process. They were added in the appendix to bridge the gap between the significantly reduced data included in the thesis itself and the 2418 codes that represent the rough data. With that, the tables can serve as an intermediate step for readers who are interested in richer data, but do not want to scan through all codes.

capabilities would be valued at 3. The justification for a scale from 0 to 4 is to capture the nuances within each quadrant. In order for incumbents to 'acquire' a capability, this capability has to increase at least by (+1) compared to the previous time mark (e.g. from 2013 to 2018).

Third, to test the propositions, a final alteration was applied to determine whether an incumbent possessed low or high core and complementary capabilities (i.e. the medium option was eliminated). To arrive at these overall final values, low-med values were reduced to 'low' and high-med values were increased to 'high'. Furthermore, given the lack of a sound academic or objective guideline to assess low-high or med-med values, these values remained 'medium'.

Step 4: To evaluate the quality of this study's research methodology, validity and reliability were assessed. Specifically, this study established construct validity by pursuing triangulation of data in terms of diverging data sources and geographical reach. Additionally, internal and external validity were assured by employing pattern matching and using replication logic across cases, respectively. Similarly, this research established reliability by using publicly available data, following a strict case study protocol and developing a comprehensive case study database (Appendix 5), which consists of all NVivo codes, summary tables of Step 2 and the quantitative data in Microsoft Excel. In addition, all interviewees were asked to confirm the accurateness of the interview summary or transcript.

Step 5: By comparing the theorized capability acquisition paths to the empirically observable patterns, this study employed pattern matching as a data analysis technique to test the propositions (Yin, 2013). By analyzing four capability portfolios, theoretical replication was achieved. While pattern matching does not involve precise quantitative comparison, Yin (2013) argues precision can be increased by developing more precise measures, as was done in **Table 2.** The propositions were confirmed if empirical patterns (i.e. capability acquisition paths) matched those prescribed in the propositions under the corresponding conditions. If rejected, alternative explanations for the findings were further explored based on the empirical evidence (Almutairi et al. 2014). To elaborate, the process worked as follows:

First, incumbents' capability acquisition paths were documented by assessing the capability portfolio configuration at three points in time: 2009, 2013 and 2018. Additionally, in doing so, a concise overview of each capability per incumbent was created.

Second, only cases with a unique portfolio at a certain point in time that match a particular proposition could be used as evidence for that proposition. Once the relevant cases were identified, three factors were analyzed (if required by the proposition): 1) at which stage did the incumbent display the unique capability portfolio, 2) which capabilities did the incumbent acquire in the subsequent stage, and 3) how did the incumbent acquire those capabilities in the next stage. Findings for the stage (factor 1) and the type of capabilities (factor 2) were unambiguous because firms either acquired in capabilities in the early or the middle stage. However, determining whether an incumbent had pursued internal development or external sourcing to acquire those capabilities (factor 3) was less visible. For instance, determining which strategy an incumbent pursued to acquire complementary capabilities was dependent on the aggregation of strategies for: distribution system fit, charging infrastructure, carsharing and e-mobility services. Moreover, since it is not unusual for incumbents to pursue both internal development and external sourcing strategies at any point in time, determining which strategy dominated their capability acquisition path was done through majority voting.

Third, the primary pattern among all relevant cases was ruled as the empirical pattern to be compared with the theoretical pattern. For instance, if four cases were found relevant to compose an empirical pattern and three out of four cases followed a similar pattern on all three aforementioned elements, then this pattern was used as the empirical pattern.

Fourth, if the empirical pattern matched the theoretical pattern (i.e. proposition) then the proposition was confirmed and if the pattern deviated from the proposition, it was rejected.

4. RESULTS

The following chapter presents the findings from all case studies that were analyzed to test this paper's propositions. This study's final data sample of eight incumbent car manufacturers was documented in precise detail over the course of a 10-year period in the context of the electrification of the automotive industry by means of battery electric vehicles. These eight companies are Toyota, Volkswagen, Hyundai, General Motors, Ford, Nissan, Renault and Daimler. In particular, a summary of the findings per case are outlined with the accompanying capability acquisition path over time as visually displayed in the graphs. Subsequently, the interview data is summarized and structured into a section on changes in capabilities and one on interesting contextual factors. Finally, the propositions are analyzed by comparing the empirically based pattern to the propositions.

4.1. Case by case analysis

4.1.1. Toyota

Toyota is a Japanese car manufacturer and was founded in 1937. Toyota is the world's number one car manufacturer in terms of vehicle production and they are global market leader in sales of hybrid electric vehicles (HEV) and hydrogen fuel-cell vehicles (OICA, 2017). Between 2012 and 2014, Toyota introduced three BEVs (yet only selling one commercially) selling a total of 3.951 vehicles. However, in 2012, Toyota's chairman announced they are "backing away from pure electric vehicles due to cost, range and charging challenges" (TI6, TE13). Sustainability is an integral part to Toyota's strategy, but the firm believes the automotive industries' sustainable transition will direct to hydrogen fuel-cell vehicles in the long term, noting that hybrid electric vehicles serve as a good bridge to that future (TE6). Nevertheless, Toyota aims to mass-market 10 BEV models by the first half of the decade as part of their '2030 strategy' stating 50% of all vehicles sold should be electric (TA9). Furthermore, Toyota envisions a 'mobility as a service' future for the automotive industry and subsequently invested significantly in mobility service business units such as their Toyota Mobility Service Platform and Toyota Big Data Center (TI4). **Table 3** shows a summary of findings from secondary data sources (33 files and 259 references). The final value (low, medium or high) for each capability is listed in red in the variable column.

Table 3: Summary of Toyota-specific variables

VARIABLE	INDICATOR	SUMMARY
core cap.: development → LOW	Prototypes & NPD	12 BEV prototypes and 3 BEVs produced between 2009 – 2018. 2 developed for pilots (170 units total) and 1 developed in collaboration with Tesla.
Core cap.: manufacturing → MEDIUM	Main element	While Toyota makes HEV batteries in-house (Primearth EV energy subsidiary), they partnered[11] for the production of the main element of their BEV (the batteries) with Tesla (TE12). Primearth mainly produces nickel-metal hybrid batteries, but also some lithium-ion which gives Toyota limited capability in BEV battery production (TE9). In 2017, Toyota announced ambition to start producing solid-state batteries for BEVs by 2020 in a joint venture with Panasonic Corporation (TE7).
	Supporting element	Toyota sourced the electric motor and platform from Tesla for their BEV (TE12) and while they have been investing in standardization of platforms and manufacturing since 2012 (TA4), they have not invested in capability development of electric motors or platforms thus far.
Compl. cap.: distribution → MED	Distribution system fit	Toyota sells cars via two channels: Toyota and Lexus. They partnered with eBay to sell accessories and parts as e-commerce and tested with an online sales channel (TI1). Over the past 10 years they have expanded their distribution network (from 89 to 169) aiming for at least one distribution center in each country it sells vehicles (TA7).
Compl. cap.: sales → HIGH	Customer satisfaction	Toyota teamed up with several parties for ‘charging’ projects: WiTricity wireless charging – 2011, Nippon Charge Service – 2014 and countries like China, France and the US to evaluate their charging infrastructure – 2011 (TA3/6). Toyota also teamed up for electric mobility services: Panasonic ‘Smart City Society’ - 2014 and Toyota Connect – 2014 (TA6). They invested in Toyota Mobility Services Platform and Toyota Big Data Center internally (TI4). They invested in carsharing projects in 2018: Grab (invested $1B), JV with Servco Pacific to launch Hui (Hawaii market) and they invested in Japan Taxi (TA9) – all with HEVs.

[11] When referring to external sourcing strategies, the terms ‘partner’, ‘partnerships’ and ‘collaborate’ are used interchangeably

Figure 5 reveals the capability acquisition path of Toyota between 2009 and 2018. At the starting point of this study, in 2009, Toyota's BEV capability portfolio was still largely underdeveloped, like the majority of incumbents in this study. By 2013, Toyota had acquired medium complementary capabilities in development and sales, predominantly by engaging in external sourcing. As shown in Table 3, the only BEV they actually brought to market was developed in collaboration with Tesla and for sales they formed several partnerships (e.g. WiTricity). Next, by 2018 Toyota had dropped their BEV interest, lowering their development capabilities to low in the process. Nevertheless, their core HEV capabilities (e.g. battery technology) may be transferrable to BEVs in the future. Thus, they enhanced their manufacturing capability to medium. In addition, Toyota engaged in a range of partnerships (i.e. external sourcing) to successfully acquire sales capabilities in the last years.

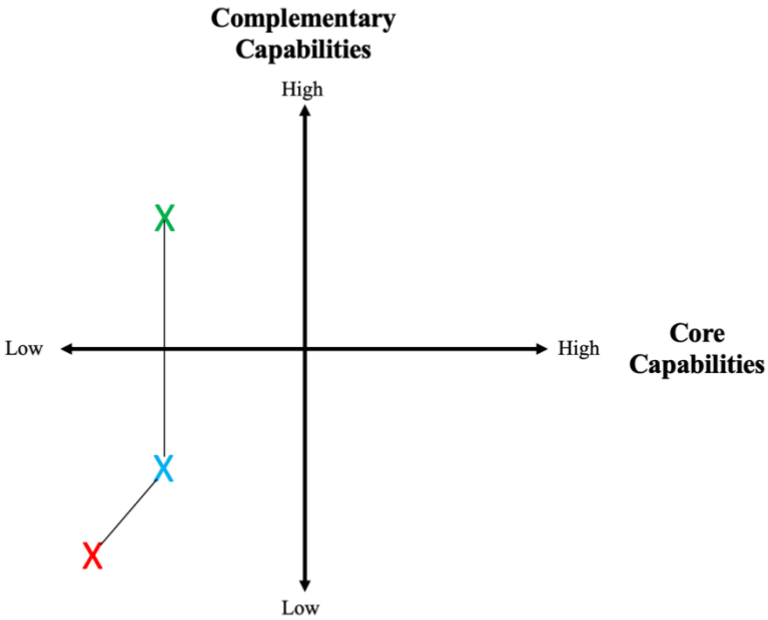


Figure 5: Capability acquisition path of Toyota between 2009 – 2018[12]

4.1.2. Volkswagen

Volkswagen AG is a German car manufacturer and was founded in 1937. Volkswagen is the world's second largest car manufacturer in terms of vehicle production (OICA, 2017). Volkswagen owns eight brands: Volkswagen, Audi, Porsche, Seat, Skoda, Bentley, Bugatti and Lamborghini. It introduced its first BEV in 2013, the Volkswagen e-UP!. In 2010,

[12] The red cross = 2009, blue cross = 2013 and green cross = 2018

Volkswagen expressed its ‘road to e-mobility’ ambitions to usher in the age of electrification. While they have been investing in e-mobility for over a decade, the 2015 diesel gate scandal clearly accelerated their e-mobility agenda and investments. In 2016, Volkswagen introduced the all-electric I.D. family with four BEV concepts expected to launch in the next 3 years. With that, they will invest $30 billion in electric mobility aiming to become the number one e-mobility provider worldwide by 2025. **Table 4** shows a summary of findings from secondary data sources (35 files and 652 references).

Table 4: Summary of Volkswagen-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → MEDIUM	Prototypes & NPD	25 BEV prototypes and 3 BEVs produced between 2009 – 2018. Volkswagen developed all BEVs in-house.
Core cap.: manufacturing → HIGH	Main element	Volkswagen never produced their own battery cells (suppliers: SKI, Samsung, LG Chem & CATL), although they have been researching battery cells since 2010 in a joint venture with Varta Microbattery (VE3, VA2). Since 2013, they develop the battery systems and electric motors at their own plants in Germany (VA5). In 2016, they announced ambitions for in-house battery cell production to reduce supplier dependency (VA8). In 2017, they invested in strong battery cell supplier relationships through tenders of €50 billion until 2025 to secure battery supply (VA9).
	Supporting element	In 2015, VW made investments in a BEV-platform (MEB by 2020) and in 2018 they were transforming plants into pure-electric plants (VA7/10). While VW performs many BEV-manufacturing activities in-house, they also collaborate with Chinese partners for the Chinese market (i.e. SAIC & JAC – VA7/8).
Compl. cap.: distribution → HIGH	Distribution system fit	VW increased its production locations from 60 to 123 between 2009 and 2018 and employs a flexible production network through regional hubs (evenly distributed among markets to reduce risk – VA3). In 2017, the firm announced plans for online sales in collaboration with its dealerships and in 2018 they invested in a 24h global after-sales network (VA9/10). They work with different battery suppliers for different

		regions to spread risk and reduce cost of expensive because battery cell transport (VE3).
Compl. cap.: sales **→ HIGH**	Customer satisfaction	VW has invested heavily in charging, carsharing and electric mobility services. Charging: standardized plugs – 2013 and formed partnerships with V-Charge – 2015, Charge & Fuel – 2015, IONITY – 2017, Hubject – 2017, Electrify America – 2017 and several countries – 2013. Investments in charging infrastructure is VW's 2019 priority as part of their e-roadmap strategy 2025 (VI6). Carsharing: test pilot Quicar – 2011, launched VRent – 2014, launched MOIA – 2016. Finally, Audi is at the forefront of (electric) mobility services and other VW brands can tap into Audi's expertise for mobility services (Audi Connect). In 2019, Volkswagen introduced Car.Software to develop its own software systems (vw.os) with 5.000 in-house software experts by 2025 to develop 60 percent of software in-house (VI7).

Figure 6 on the next page reveals the capability acquisition path of Volkswagen between 2009 and 2018. At the starting point of this study, in 2009, Volkswagen's BEV capability portfolio was still largely underdeveloped. By 2013, Volkswagen had acquired both medium core and medium complementary capabilities. They developed capabilities for BEV development, manufacturing and distribution internally, but partnered for most sales initiatives. In terms of development capability, they developed BEV variants of existing models. For the production of the BEVs, they invested in their own battery plants, battery labs and a modular production toolkit to make BEV assembly possible in existing plants. Furthermore, they adjusted their distribution system to create a flexible global production network. Finally, as listed in Table 4, Volkswagen implemented external sourcing strategies in charging and carsharing.

Subsequently, by 2018, they had continued to strengthen their capabilities in manufacturing, distribution and sales. Some advances in manufacturing were due to internal investments (e.g. center of excellence for battery systems), while others were attributable to external sourcing (e.g. in-principle agreement with Chinese carmaker JAC). To enhance distribution efficiency (and thereby their capability), they made investments to move battery production closer to the customer, offering 24-hours service globally at the same time. Finally, they engaged in many more sales partnerships (i.e. external sourcing) in areas of charging, carsharing and e-mobility services. However, recently, Volkswagen started investing in its own operating system to raise the portion of in-house software development from 10 to 60 percent by 2025.

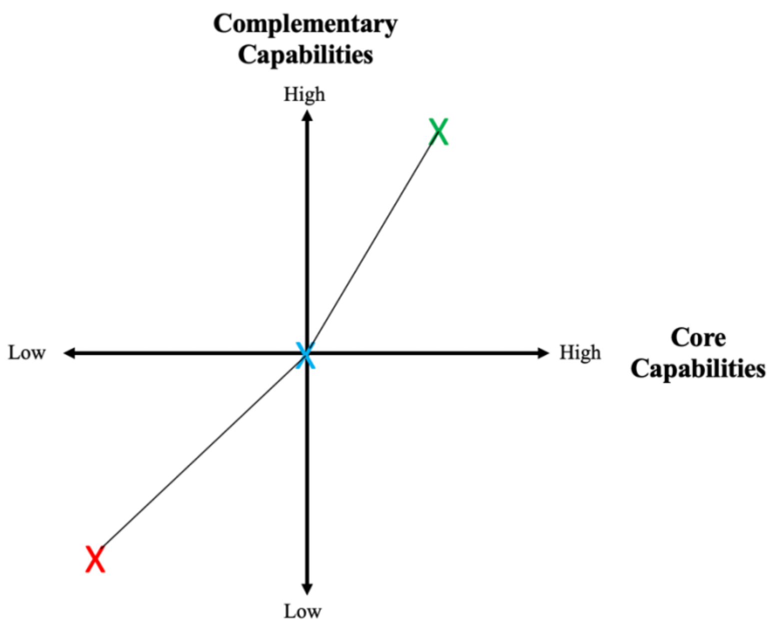


Figure 6: Capability acquisition path of Volkswagen between 2009 – 2018

4.1.3. Hyundai

Hyundai is a South-Korean car manufacturer and was founded in 1967. Hyundai is the third largest car manufacturer in the world and owns 32.8% in subsidiary Kia Motors and 100% in Genesis Motors. Hyundai introduced its first BEV in 2017, but its subsidiary Kia already introduced two BEVs in 2011 and 2014 respectively, which significantly benefitted Hyundai in terms of development costs and other capability developments. Before Hyundai introduced BEVs, their electrification strategy was focused on hybrids and fuel-cell electric vehicles. While they entered the BEV landscape relatively late, both of their BEVs (Ioniq and Kona) have been taking home awards across the globe (HI15/21/22, HE1).

In 2018, as part of their electric mobility agenda, Hyundai announced they would introduce two BEVs by 2020 in addition to Kia's plan to introduce five BEVs by 2025 (HI9). **Table 5** shows a summary of findings from secondary data sources (70 files and 251 references).

Table 5: Summary of Hyundai-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → MEDIUM	Prototypes & NPD	10 BEV prototypes and 4 BEVs produced between 2009 – 2018. Hyundai developed all BEVs in-house.
Core cap.: manufacturing → MEDIUM	Main element	Hyundai has never produced their own battery cells (suppliers LG Chem and SKI), but makes the battery systems in-house with Kia (Hyundai Kona and Kia Niro have same battery system – HE3). In 2018, Hyundai invested in Solid Power, a solid-state drive battery developer (HE7). Hyundai has been facing serious bottleneck issues for both BEVs due to battery supply shortages (HE2/11/13/14).
	Supporting element	Hyundai offered the Ioniq in three electric versions (BEV, HEV, PHEV) and invested in a versatile platform accordingly (HA7). They announced an upcoming BEV-platform in 2019 (HI25). Hyundai and Kia collaborate closely by sharing manufacturing plant and using the same electric motors or even producing the same cars under different brands (HE3/18).
Compl. cap.: distribution → MEDIUM	Distribution system fit	Between 2009 and 2018, Hyundai has focused mostly on expansion of its production and sales network. They employ a relatively traditional distribution network. They sell cars through three channels: Hyundai, Kia, Genesis and launched an online sales channel in 2016 (HI6). They have also invested a lot in their brand through partnerships with e.g. UEFA and digital retail experiences (Hyundai Motor Show, Rockar, Museums – HA6, HI1).
Compl. cap.: sales → MEDIUM	Customer satisfaction	Seeing as Hyundai entered the BEV landscape relatively late, they have not invested much in charging yet. In 2016, they invested in after-sales by developing a home-diagnostics system for their EVs and by educating dealers how to sell EVs (HA8, HI10). In 2017, they started investing in carsharing with their BEVs in Vienna and Amsterdam and Kia launched their carsharing service WiBle (HI7, KA9). In 2018, Hyundai invested in several electric mobility services through partnerships: Migo (MaaS), Grab, Revv, Baidu Fortify (HI12/16/17/19).

Figure 7 reveals the capability acquisition path of Hyundai between 2009 and 2018. At the starting point of this study, in 2009, Hyundai's BEV capability portfolio was still largely underdeveloped. By 2013, Hyundai still had not expressed any interest in developing BEVs. However, considering their close partnership with Kia, Hyundai at some point in time might have concluded that it would have easier access to BEV capabilities through Kia in the future if desired. Indeed, by 2018, Hyundai had introduced two relatively successful BEVs, but relied on partner Kia to access most of the required core and complementary capabilities. Some of Hyundai's and Kia's BEVs share the same platforms, batteries or electric motors and are produced at shared manufacturing plants. Hence, Hyundai relied on external sourcing for a large part to acquire medium BEV capabilities in development and manufacturing. The incumbent's achievement of sales capabilities is not only attributable to external sourcing (e.g. e-mobility service partnerships with Grab or Revv), but also to its own internal investments (e.g. carsharing pilots in Amsterdam or its home-diagnostics system).

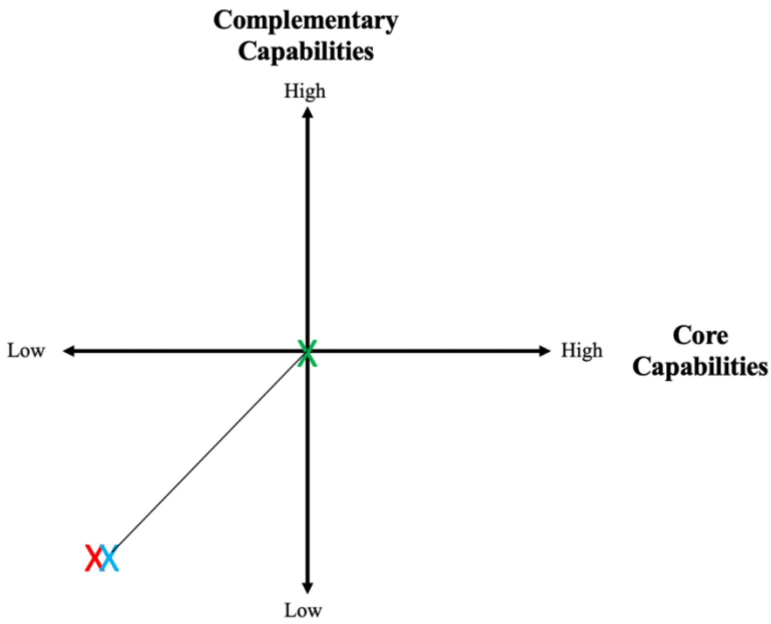


Figure 7: Capability acquisition path of Hyundai between 2009 – 2018

4.1.4. General Motors

General Motors is an American car manufacturer and was founded in 1908. GM is the fourth largest car manufacturer in the world and its core brands include Chevrolet, Buick, GMC and Cadillac (OICA, 2017). In 2009, GM was on the verge of bankruptcy, which resulted in extreme consolidation of manufacturing plants and dealerships in the years following. While GM continuously stressed the influence of climate change on automotive regulations, they remained relatively vague about their specific electrification efforts by repeating the same statement every year in their annual reports: "we plan to invest heavily to support the expansion of our electric vehicle offerings and in-house development and manufacturing capabilities of advanced batteries, electric motors and power control systems" (GA1, GA2, …, GA9). In 2018, GM called itself a pioneer in electrification, although experts argue that GM is actually behind its competitors in terms of electrification (GI5, GE4). That same year, GM announced their five-year strategic plan to end its relationship with gasoline and diesel, instead insisting on an all-electric age with the introduction of 20 EVs by 2023. These will all contain battery cells and packages produced by GM with a commercial focus on the Chinese market (GE4/8/13/14/17, GI6). **Table 6** shows a summary of findings from secondary data sources (37 files and 225 references).

Table 6: Summary of General Motors-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → MEDIUM	Prototypes & NPD	8 BEV prototypes and 5 BEVs produced between 2009 – 2018. Three BEVs were developed in collaboration with SAIC through a joint venture (GA2, GI8).
Core cap.: manufacturing → MEDIUM	Main element	General Motors has never produced their own battery cells (suppliers A123 and LC Chem – GE4/20). They operate several battery labs (US, Germany, China) and two battery assembly plants with SAIC (GI1, GE16/17). In 2018, they formed a partnership with Honda for R&D of next generation battery cells (GI6, GE4).
	Supporting element	General Motors is generally recognized for its excellent manufacturing capabilities (GE10). Over the past ten years they have been investing heavily in efficiency and cost reductions (GE6/12). For BEVs, thus far, the electric motor and components were supplied by LG Chem (GE20) and they formed partnerships with SAIC

		and LG Chem in 2010 and 2011 respectively for EV architecture, platforms and components (GA2/3). GM assembles its own BEV's at its Orion Plant, which is their only plant capable of producing EVs (GE16).
Compl. cap.: distribution → MEDIUM	Distribution system fit	In 2009 and 2010 GM had to cut many production locations and dealerships (GA1/2/3, GE2). They operate a traditional distribution network, but introduced an online sales channel in 2015 (GE6). While GM pursues a successful localization strategy (GA6) and exploits their global production network, their EV production is restricted to the US and China (GA2/5, GE8).
Compl. cap.: sales → LOW	Customer satisfaction	GM has made small investments in carsharing and mobility service since 2016, but has not invested in charging. In 2015, GM started investing in carsharing: launch of Maven, partnerships with Lyft, Uber and GrubHub (GA7/9, GI7). In 2017, GM updated their OnStar mobility service to include basic info in charging levels (GA8).

Figure 8 on the next page reveals the capability acquisition path of General Motors between 2009 and 2018. At the starting point of this study, in 2009, GM's BEV capability portfolio was still largely underdeveloped. By 2013, GM had acquired medium BEV development capabilities by introducing two BEVs to the market (one developed internally and one with JV partner SAIC). While General Motor sourced the battery, electric motor and electric components for its BEVs externally from LG Chem, it aimed to create strong relationships with the LG Group to remain in control. Specifically, they formed a strategic partnership with LG Chem: "GM and LG engineers will work together on development of electric vehicle platforms and components" (GE5). In similar vein, they formed a joint venture (i.e. external sourcing) with Chinese carmaker SAIC to develop and manufacture BEVs for the Chinese market under their collaborative brand called Baojun.

By 2018, GM had expressed several BEV ambitions such as internalizing battery development, developing a next generation agile EV platform, and the launch of a carsharing service. However, thus far, it has not realized any of those ambitions. Interestingly, over the course of ten years, GM did not adequately invest in BEV specific complementary capabilities, not with internal development nor through external sourcing.

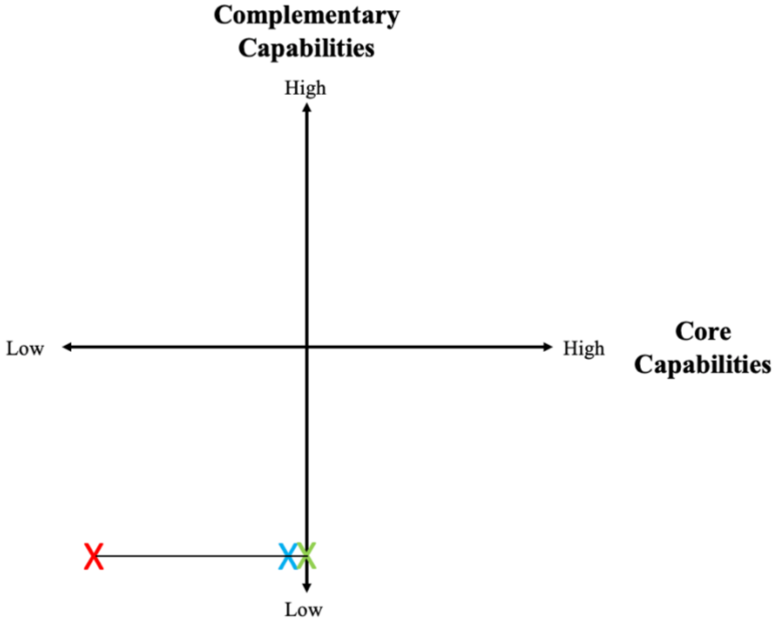


Figure 8: Capability acquisition path of General Motors between 2009 – 2018

4.1.5. Ford

Ford is an American car manufacturer, founded in 1903 and is the fifth largest car manufacturer in the world (OICA, 2017). Its brands include Ford and Lincoln. Ford introduced its first BEV in 2010, the Ford Transit Connect, followed by the Ford Focus EV in 2011. For both BEVs Ford depended on partners to deliver all BEV essential components (FE14/15). In 2012, as evidence to their external sourcing strategy preference, Ford stated that "our electrification strategy absolutely depends on forging alliances with key suppliers whose expertise complements [their] extensive experience and global production capabilities. Developing these new technologies requires major investments, so it is especially important to have strong supplier alliances" (FE16). Currently, Ford is behind in the electric vehicle market because they adopted more of a wait-and-see strategy (FE11). Recently they have intensified BEV investments to catch up with competitors. In 2017, Ford announced it would develop 16 BEVs by 2022 with its Chinese partner Zotye through an $11 billion investment (FA9, FI4). However, this EV lineup is focused on hybrid models mostly (FE20/21). They envision a future that is autonomous, connected and electric and invest accordingly (FA9). **Table 7** shows a summary of findings from secondary data sources (43 files and 233 references).

Table 7: Summary of Ford-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → MEDIUM	Prototypes & NPD	2 BEV prototypes and 2 BEVs produced between 2009 – 2018. Ford developed one BEV with Azure Connect and developed the Ford Focus EV itself.
Core cap.: manufacturing → LOW	Main element	Ford never produced their own battery cells or packs (suppliers Johnson Controls and Compact Power – FE14/15). Until 2019, Ford did not expressed interest in developing battery development capabilities, preferring alliances. However, in April 2019, Ford invested largely in Solid Power for solid-state batteries (FE18).
	Supporting element	In term of BEV specific components such as the electric motor and powertrain components, Ford supplies everything (suppliers Magna International and Azure Dynamics – FE1/14/15). However, they have been investing in modular architecture (FA6) and standardized platforms (FA1) that are also relevant to cut EV production costs (GA2).
Compl. cap.: distribution → MEDIUM	Distribution system fit	Since 2011, Ford has been transforming its distribution system to align with its more flexible production structure (modular and standardized) by investing in a global supply base and hub and satellite model. In the early years of this study Ford eliminated many brands (e.g. Jaguar) and dealerships (in US) to refocus after the turbulent financial crisis. In 2018, they opened an online sales channel and digital dealerships (FE3/6).
Compl. cap.: sales → MEDIUM	Customer satisfaction	Ford has invested significantly in (electric) mobility services in 2015: FordPass and Ford Smart Mobility LCC (FA7). In 2015, Ford also launched a carsharing pilot in London with 50 BEVs (program cancelled now – FE17) and their own carsharing program in Germany (FI9) alongside several partnerships over time, like Zipcar (FI12). In terms of charging, Ford is part of the IONITY (charging infrastructure) joint venture with VW, Daimler and BMW, and they started testing with wireless charging pads in 2016 (FI5, FE2/4).

Figure 9 on the next page reveals the capability acquisition path of Ford between 2009 and 2018. At the starting point of this study, in 2009, Ford's BEV capability portfolio was still largely underdeveloped. By 2013, Ford had acquired medium development capabilities by bringing two BEVs to market. However, Ford was still largely dependent on purchasing contracts for the development of those BEVs by supplying all relevant electric components (e.g. battery or electric motor parts) externally through suppliers.

By 2018, Ford had discontinued its Ford Focus EV sales in Europe due to a lack of volume (sold 141 in two years time) focusing on hybrids instead (FE19). In addition, Ford did not introduce new BEV models after 2011. As a result, their development and manufacturing capabilities remained medium and low respectively in 2018. In terms of complementary capabilities, Ford invested in its distribution system over the last couple of years by introducing its hub and spoke model as well as an online sales channel. Next, they engaged in a few partnerships for charging infrastructure (e.g. IONITY) and invested significantly in e-mobility services with Ford Pass. As a result, both their distribution and sales capabilities improved to medium by 2018.

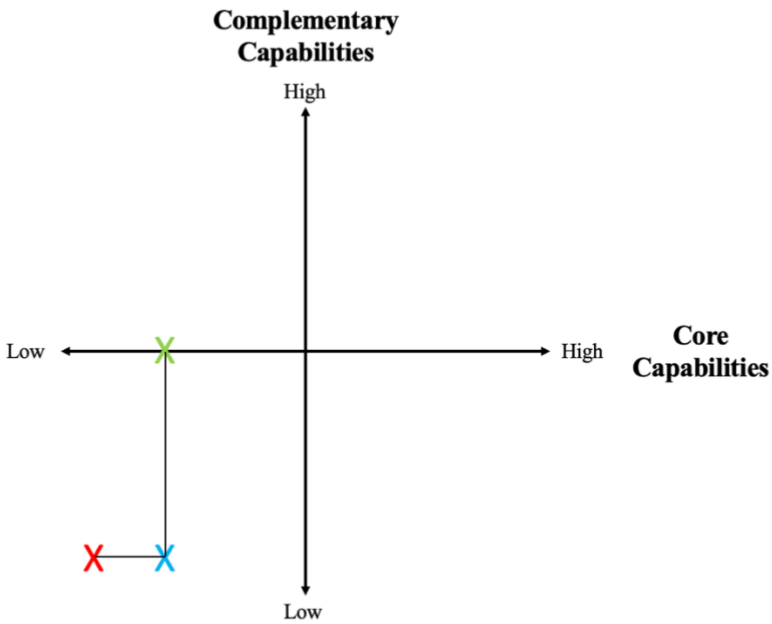


Figure 9: Capability acquisition path of Ford between 2009 – 2018

4.1.6. Nissan

Nissan is a Japanese car manufacturer, founded in 1933 and is the sixth larger car manufacturer in the world (OICA, 2017). Its brands include Nissan, Infinity and Datsun. Nissan is a pioneer in electric mobility and its BEV, the Nissan Leaf, is the world's most sold BEV at 400.000 units since 2010 (NE4). In the early years of the BEV market, Nissan pursued vertical integration, to offer a complete EV ecosystem with everything from the development of batteries, chargers and charging infrastructure to battery recycling, energy storage and BEV mobility services (NI8). As a result, Nissan was the first incumbent car manufacturer to internalize production of battery cells through a joint venture with NEC, called AESC (NA1). In 2014, AESC was the second largest EV battery manufacturer in the world (after Panasonic). However, Nissan's AESC soon struggled with price competitiveness from growing rivals such as LG Chem.

In 2018, Nissan sold 75% of its stake in AESC and refocused on its core business of developing and manufacturing electric vehicles, while getting batteries at affordable prices from external suppliers (NI14, NE1/5). As part of the Alliance 2022 strategy, Nissan, Renault and Mitsubishi aim to introduce 12 EVs by 2022 of which 70 percent will be based on a common EV platform and 100 percent of e-components will be shared across the alliance to promote synergies and cost reductions. Nissan's individual strategy for 2022 is called M.O.V.E (mobility, operational excellence, value to customer and electrification). **Table 8** shows a summary of findings from secondary data sources (35 files and 217 references).

Table 8: Summary of Nissan-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → MEDIUM	Prototypes & NPD	17 BEV prototypes and 2 BEVs produced between 2009 – 2018. Nissan developed both BEVs in-house.
Core cap.: manufacturing → HIGH	Main element	Already in 2009, Nissan was developing their own battery cells and packs through their AESC joint venture (NA1, NI13). The batteries were produced at the Zama Plant (NA1). In 2010, Nissan also invested in battery recycling with partner Sumitomo (NA2). In 2018, Nissan sold 75% of their stake in AESC to Envision (NA10, NE1/5). Now, they supply batteries from AESC and CATL through strong deals (NE5/6).

	Supporting element	Between 2009 and 2018, Nissan successfully exploited the alliance with Renault (and Mitsubishi) both for scale and expertise. Already in 2009, they developed an EV platform and operated a BEV plant in Japan (NA2). In 2013, Nissan and Renault opened 4 more BEV plants in Portugal, France, UK and US (NA5). Nissan was the first car manufacturer to mass produce and sell a BEV (Nissan Leaf).
Compl. cap.: distribution → HIGH	Distribution system fit	Nissan distribution system is traditional, selling products either through the Nissan, Infiniti or Datsun brands via dealerships. Between 2011 and 2018, Nissan expanded their dealerships from 6,000 to 10,000 (NE7) in congruence with the expansion of their production network. Since 2011, Nissan is providing dealers and employees with 'EV-trainings' (NA3).
Compl. cap.: sales → HIGH	Customer satisfaction	Already before 2009 Nissan was investing in charging infrastructure and charging plugs (NA1). In 2010, Nissan invested in quick-charging stations at dealers and houses and developed 3 energy programs: energy supply, share and storage (NA2, NI7). In 2013, partnered with Rio city for BEV taxis (NI11). In 2014, Nissan invested in carsharing with BEVs in Yokohama city and invested in 4 charging goals (NA6). In 2017, Nissan formed partnership with EVgo, a fast charging network (NI3). In 2018, they formed an alliance with DiDi for carsharing with BEVs (NA10), launched e-ride, a carsharing service with the Nissan Leaf in Japan and Easy Ride a range of mobility services for electric and autonomous vehicles with DeNa (NI15).

Figure 10 on the next page reveals the capability acquisition path of Nissan between 2009 and 2018. At the starting point of this study, in 2009, Nissan's had already formed a joint venture with NEC (AESC) for battery production for its upcoming Nissan Leaf, resulting in medium manufacturing capabilities. This makes Nissan the only incumbent in this study to have developed BEV capabilities in 2009. By 2013, Nissan continued BEV capability investments. In terms of development capabilities, Nissan introduced the highly successful Nissan Leaf and the e-NV200 in 2010 and 2014 respectively, alongside 9 prototypes. Additionally, they strengthened their manufacturing capabilities by investing in battery production (cell and pack), an EV platform and the internal development of all other electric components. For distribution capabilities, they focused on proportional global expansion and EV trainings for

dealers. Finally, they made significant investments, both internally and through external sourcing, in charging and some mobility services by 2013. By 2018, Nissan continued steady improvements in manufacturing. Furthermore, they invested in high quality distribution capabilities by adding e-commerce stores to complement dealers and by investing in high-quality after-sales services. Finally, Nissan significantly upscaled sales partnerships in the areas of charging, carsharing and e-mobility services.

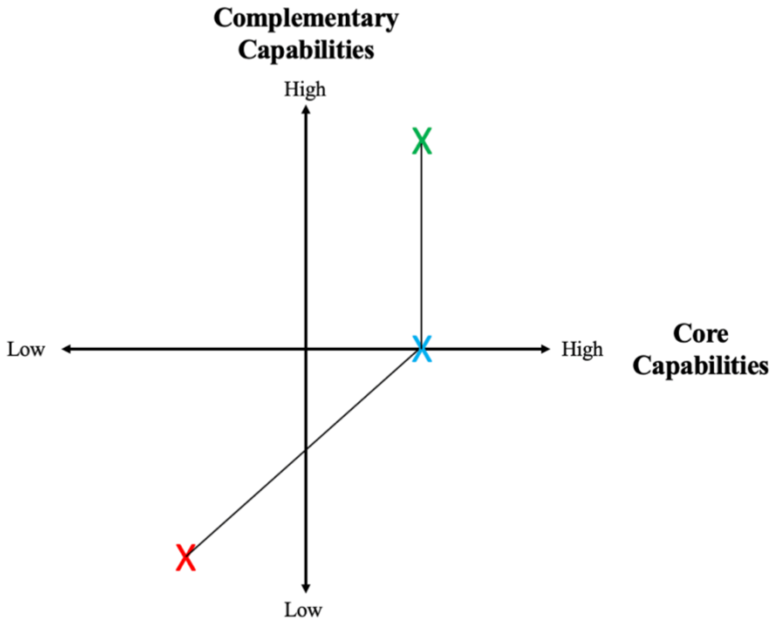


Figure 10: Capability acquisition path of Nissan between 2009 – 2018

4.1.7. Renault

Renault is a French car manufacturer, founded in 1899 and is the ninth largest car manufacturer in the world (OICA, 2017). Together with alliance partner Nissan, Renault pursued an aggressive electrification strategy in the early years of the BEV market. Renault introduced 4 BEVs between 2011 and 2012. The alliance partners had high expectations for the future in terms of an electric automotive industry, expecting to sell 1,5 million BEVs by 2016 (RA2). In order to meet that expected demand, the firms invested significantly in battery and BEV plants to reach an annual capacity of 500,00 units (RA1). However, in reality, the alliance only sold 600,000 BEVs by 2018 attributing this demand setback to a lack of charging infrastructure (RA5). Still, the alliance remains the world leader in electrification in terms of cumulative sales

(Tesla's cumulative sales in 2018 were 500,000 units – NE4). Renault's main market is Europe, contributing to about 30-40% of its sales on average. Renault's vision of the future of mobility was set out in their 'Drive the Future 2017-2022' plan, founded on four pillars: electric mobility, connected mobility, autonomous mobility and shared mobility (RI2). By 2022, the alliance aims to inaugurate 12 electric vehicles. **Table 9** shows a summary of findings from secondary data sources (24 files and 276 references).

Table 9: Summary of Renault-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → HIGH	Prototypes & NPD	14 BEV prototypes and 4 BEVs produced between 2009 – 2018. Renault developed all BEVs in-house.
Core cap.: manufacturing → MEDIUM	Main element	Renault has been able to benefit from Nissan's battery expertise, but also sourced battery cells from other suppliers (i.e. LG Chem – RE1). Renault built 5 battery plants with Nissan across the globe, a capacity of 500,000 units. Other partnerships: HELIOS to study batteries and with Daimler for electric-LCVs (Daimler supplied battery – RA1/2). In 2018, the alliance announced plans to develop solid-state batteries by 2025 with partners like Ionic Materials (RE6).
	Supporting element	While Renault has developed strong BEV manufacturing capabilities, they collaborated with Nissan on many fronts. Their synergies were mostly focused on cost reductions through scale, but also involved sharing best practices (RA1). In 2009, Renault was investing in common platforms, standardization and modular design with partners (e.g. Nissan and Daimler). In 2018, Renault announced development of an EV platform with the alliance (RE5).
Compl. cap.: distribution → HIGH	Distribution system fit	Renault operates a traditional distribution system with dealers. In 2010, Renault launched the Z.E. academy to train employees and dealers in electrification after which dealers become Z.E. expert dealers (RA2). In 2011, Renault invested in after-sales services for their EV fleet: 24/7 breakdown service (RA3). In 2018, Renault invested in less traditional sales channels such as online to attract younger customers (RE2).

Compl. cap.: sales **→ HIGH**	Customer satisfaction	From 2010 onwards, Renault invested in several charging projects: stations at malls – 2010, 100 smaller partnerships – 2011, 4 ways to change – 2011, solar energy – 2011 and Caméléon charging system – 2014, smart charging app and Z.E. Pass - 2018 (RA2/3/6, RI4, RE7). From 2013 onwards, Renault invested in several carsharing projects: Rio BEV fleets – 2013, Bolloré carsharing pilots – 2013, BlueAlliance joint venture– 2014 and Renault carsharing program through subsidiary RCI mobility – 2015, Paris with ADA – 2018, carsharing with Vulog - 2019 (RA5/6/7, RE3/4). In 2010, Renault developed mobility services to provide customers with info on battery range, capacity, journey plans and optimal driving instructions to save battery (RA2). In 2011, they launched the open innovation lab in Silicon Valley (RI3). From 2014 onwards, Renault started investing in autonomous driving and connectivity, also for BEVs specifically (e.g. R-link – RA6). In 2018, the alliance created 'Alliance Ventures' with $1 billion for mobility services (RI1). In 2019, created the 'Alliance Intelligent Cloud' with Microsoft Azure for AI in area of mobility services (RE5/6).

Figure 11 on the next page reveals the capability acquisition path of Renault between 2009 and 2018. At the starting point of this study, in 2009, Renault's BEV capability portfolio was still largely underdeveloped. By 2013, Renault had strengthened all capabilities. With the launch of four new BEVs in two years Renault revealed its high development capabilities. While relying to some extent on Nissan and other battery cell suppliers, Renault developed medium manufacturing capabilities by investing in battery and BEV plants with Nissan. In terms of distribution capabilities, Renault followed a similar path to Nissan, investing in global expansion, 24/7 aftersales and EV-trainings for dealers. In addition, they pursued partnerships for a range of sales initiatives (i.e. charging, sharing, e-mobility services).

By 2018, Renault had continued steady investment in development by improving their existing BEV fleet (e.g. better range). Additionally, they started investing in alternative sales channels and invested in strong battery supplier relationships to avoid future battery shortages. In terms of sales capabilities, they either strengthened existing partnerships or forged new ones (e.g. EEM for charging or Microsoft for e-mobility services).

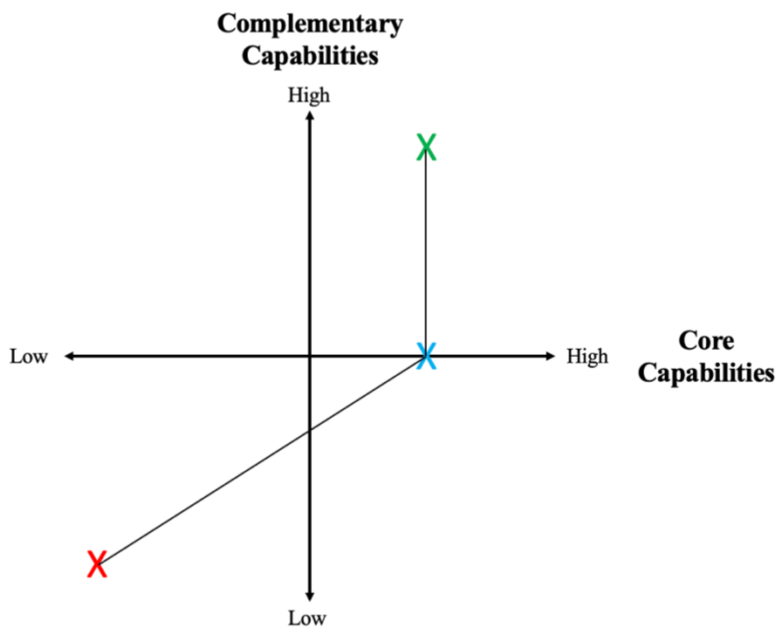


Figure 11: Capability acquisition path of Renault between 2009 – 2018

4.1.8. Daimler

Daimler is a German car manufacturer, founded in 1926 and is the thirteenth largest car manufacturer in the world (OICA, 2017). Its brands include Mercedes and Smart. Daimler introduced its first BEV in 2009, the Smart Fortwo electric drive, followed by the launch of four more BEV-models by 2018. They were already active in electrification at the early stage of the BEV market in 2009. Between 2009 and 2018, Daimler has internalized some key BEV capabilities (e.g. battery development – DA4) and started its transition from a traditional car manufacturer to a mobility provider (DI7). In 2016, Daimler formulated their future mobility strategy as CASE: connected, autonomous, shared and electric (DA8).

In 2018, Daimler expressed their goal to have unlimited access to key components for electrification (DI7). With that, they invested over €9 billion in their global battery production network (eight more factories) and purchased battery cells worth €20 billion to secure future supply by 2022 (DA9, DI1). By 2025, Daimler wants to produce an electric variant of each model and create a holistic ecosystem (i.e. energy storage, smart charging) around its EQ brand (DA9, DI4). In addition, 25% of its total vehicles sales by 2025 should stem from EVs with

China as their number one market (DA9). **Table 10** shows a summary of findings from secondary data sources (33 files and 305 references).

Table 10: Summary of Daimler-specific variables

VARIABLE	INDICATOR	SUMMARY
Core cap.: development → HIGH	Prototypes & NPD	14 BEV prototypes and 5 BEVs produced between 2009 – 2018. Daimler developed all BEVs in-house.
Core cap.: manufacturing → HIGH	Main element	In the early years of this study, Daimler relied on partners for battery development and production (i.e. Tesla, Evonik, Li-Tec – DA1). They founded a joint venture (Accumotive) with Evonik to produce the battery packs and partnered with Li-Tec (Evonik Subsidiary) to produce the cells in Kamenz (DA1). In 2012, Daimler acquired all shares (both Accumotive and Li-Tec), thereby internalizing battery development (DA4). However, in 2015, Daimler shut down battery cell production in Kamenz because of the high costs (DE2). In 2017, Daimler announced it would expand its global production network from 1 plant in Germany to 9 plants across three continents (producing the pack with LG Chem cells – DA9).
	Supporting element	Daimler operates 15 production locations on four continents. They currently produce EVs in Hambach, but will expand this production to five more locations (DA9). Their production lines can produce different powertrains on the same line (DA9) and Daimler has been investing in a BEV architecture with modularity to meet its goal of producing an EV variation of each model (DI8). Daimler has formed several partnerships in the area of electrification: Bosch for e-components (DA3), Renault-Nissan for Smart's electric motors (DA6) and with BYD to develop and produce EVs for the Chinese market (DA2).
Compl. cap.: distribution → HIGH	Distribution system fit	Daimler has a traditional distribution system selling vehicles through Mercedes and Smart brand channels. Between 2009 and 2018 they focused on global expansion by adding dealerships and distribution centers and through partnerships: Chinese partners to access Chinese market (i.e. BYD, BAIC – DA2).

Compl. cap.: sales **→ HIGH**	Customer satisfaction	Daimler invested in several carsharing projects since 2012: Car2go, MyTaxi and Flinkster (DA4). With that they also invested in (electric) mobility services such as Moovel, Mercedes ME and HERE mapping (DA4/610). Finally, they Daimler pursued several charging partnerships (IONITY, ChargePoint, The Mobility House – DA6/8/9). In 2018, Daimler separated its Financial Services business unit, renamed it to Daimler Mobility with the aim to allow for higher development speed and easier partnership formations in the area of mobility services (DE5). In 2018, Daimler and BMW announced to merge their mobility services (charging, carsharing, ride hailing, …) for scale purposes (DE7).

Figure 12 on the next page reveals the capability acquisition path of Daimler between 2009 and 2018. At the starting point of this study, in 2009, Daimler's BEV capability portfolio was still largely underdeveloped. By 2013, Daimler had strengthened all capabilities. They developed three BEVs, invested in battery (cell and pack through a joint venture), invested in electric motor (through a joint venture) and BEV plants, expanded its distribution network and invested in several carsharing and e-mobility services. Daimler invested in carsharing and e-mobility services (i.e. sales capability) internally in the early stages of the market.

By 2018, Daimler invested in the launch of two more BEVs and 9 prototypes. The German incumbent introduced its ambitious electric strategy (the EQ generation) in 2016 and following that announcement, they pursued several charging partnerships (e.g. IONITY). Furthermore, Daimler continued to strengthen their distribution capability, recognizing the importance of timely and high-quality after-sales for EVs. While Daimler sold its battery cell production capability in 2015 for similar reasons as Nissan, they continued strong collaboration with battery cell partners, which means they will be able to contain much of their high manufacturing capabilities in the future. In 2018, they announced to merge of most mobility services with BMW in 2018 and to transform Daimler Financial Services into three separate entities of which Daimler Mobility is one, which will focus on collaborating (i.e. external sourcing) with other partners in the area of mobility services.

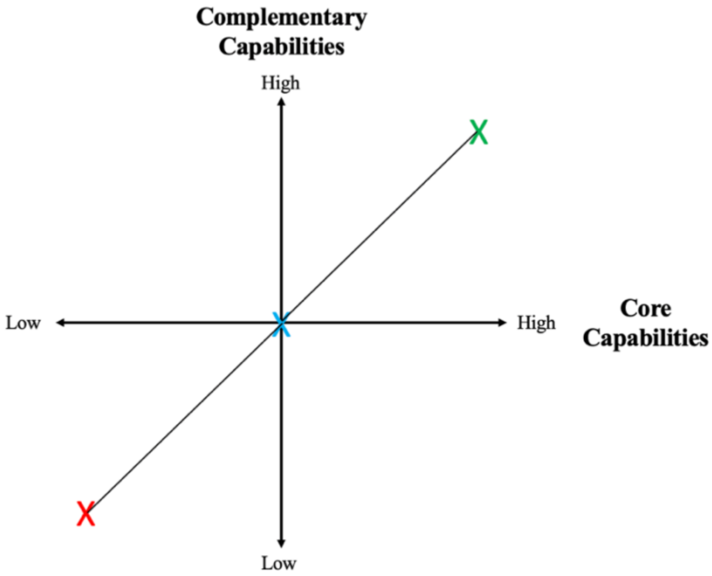


Figure 12: Capability acquisition path of Daimler between 2009 – 2018

A summary of these findings is listed in **Table 11** on the next page.

4.2. Interview Data

The following section will first discuss some important background on the BEV market and its development. Next, the changing relevance of each capability will be examined (i.e. development, manufacturing, distribution and sales) not only to understand how these capabilities are transforming in this sustainability transition, but also to understand the underlying dynamics of such change. Next, four overarching contextual factors will be discussed that appear to have an impact on specific capabilities, the capability acquisition strategies or the sustainability transition in general: geographic differences, temporal differences, incumbents' mindset and diversification.

Overall, interviewees listed four key factors within the sustainable transition of the mobility sector that are subsequently guiding corporate decision making: Tesla proved there is a market potential for BEVs, environmental scandals like dieselgate increased societal pressure on incumbent car manufacturers, stricter environmental regulations pushed both incremental and radical innovations and finally, consumer demand is changing tremendously. In particular, consumers' perception of mobility is transitioning from car ownership that facilitates a certain status or image to mobility as a service in which cars itself become a commodity and consumers

Table 11: Summary of variables across cases

VARIABLE	TOYOTA	VW	HYUNDAI	GM	FORD	NISSAN	RENAULT	DAIMLER
Development	Introduced 2 BEVs since 2012, but cancelled in 2015	Introduced 3 BEVs since 2013 and 4 BEVs coming in next 3 years	Introduced 4 BEVs since 2011 and 10 more coming by 2025	Introduced 5 BEVs since 2012 (3 with partner), 18 EVs by 2023	Introduced 2 BEVs since 2010 (2 with partner), 16 EVs by 2022	Introduced 2 BEVs since 2010 (alliance EV leader), 12 EVs by 2022 with alliance	Introduced 4 BEVs since 2011 (alliance EV leader), 12 EVs by 2022 with alliance	Introduced 5 BEVs since 2009, electric variant of each model by 2025
Manufacturing	Sourced all BEV parts, but some expertise from hybrids	Sourced cells, but produced battery pack, electric motor and BEV in-house. Battery R&D, EV-platform	Sourced cells, but produced battery pack, electric motor and BEV in-house with Kia	Sourced cells and electric motor (both JV), but produced pack and BEV in-house (with SAIC)	Sourced entire battery and electric motor, but assembled BEV in-house. Focus on flexibility and modularity	Controlled production of all BEV parts until 2018 (sold cell production). EV platform	Sourced cells (JV), produced battery pack, electric motor and BEV in-house with Nissan. EV platform	Controlled production of all BEV parts until 2015 (sold cell production).
Distribution	Sells parts via eBay, one DC in each active country	From local to regional-hub network with strong dealer relationships	Traditional network, but added digital showrooms and online sales	Traditional network, cut many dealers and added online sales	From local to hub-spoke network and added online sales	Traditional network, but global expansion of network and train dealers	Traditional network, but added online sales and e-training for dealers	Traditional network, but global expansion of network
Sales	Partnerships for charging, carsharing and mobility services	Partnerships for charging, carsharing and mobility services	Invested in all elements (partners), but only since 2016 = still limited	Only invested in some car-sharing since 2015 through partnerships	Invested a lot internally in mobility services and partnered for charging	Nissan's goal was EV ecosystem. Invested in all elements via partnerships	Partnerships for charging and carsharing, invested a bit in mobility services	Invested itself in carsharing and e-mobility services, but partnered for charging

prefer the most convenient service to get from point A to point B, suitable for a specific moment or use. These factors are influencing incumbents' decision making because they make certain capabilities redundant and other capabilities distinctive for incumbents to participate in the new market. Electromobility is a pivotal trend in the automotive sustainability transition because electric vehicles cannot be devised, designed and manufactured in the same way as conventional vehicles. However, at the same time, incumbent car manufacturers are challenged by additional sustainability trends (e.g. autonomous driving or mobility as a service). As a result, this section will present the interview findings which included rich discussions and insights about electromobility primarily, but also about related sustainability trends that are intertwined with electromobility to some extent.

4.2.1. Capabilities

With the sustainability transition well on its way, experts and (in some cases) incumbents are dawning on the realization that the relevance and importance of specific capabilities is shifting. *Manufacturing* capabilities are becoming less distinctive due to the commodification of cars in general and the simplification of electric vehicles (i.e. electric motor consists of far less parts than conventional car engine). To illustrate: "there was a time when car manufacturers could differentiate themselves from competitors with technical elements such as the performance of the motor. What is happening with electrification is that all key technologies are exchangeable. The majority of car manufacturers will be dependent upon the same three to four battery manufacturers, resulting in extreme uniformity" (I1[13]). While dependency upon relatively few battery manufacturers bears obvious risks such as supply shortage, interviewees agreed that the internal development of battery technology (cells) is not as attractive for incumbents due to the low margins and need for high scale.

Development capabilities are expected to remain highly relevant for incumbents in the upcoming ten years. Despite the fact that consumers increasingly consider cars as a commodity, all informants mentioned that elements such as quality, comfort, performance and price will continue to influence customer preference, but to a lesser extent. Especially older generations still believe that driving a certain car or brand gives them some level of prestige or identity. In the long-term, this implies that design will continue to play a high-level differentiating role, though to a lesser degree than it does today. "Comparing the Jaguar i-Pace and the Smart

[13] Following appendix 3, the four interviewees will be references as I1, I2, I3 and I4.

Fortwo we can argue that they both have the same powertrain, but obviously there is a big difference in terms of performance and comfort. People who currently drive an Audi A8 based on status, will now prefer a Tesla or i-Pace, while the middle class chooses a Nissan Leaf…I believe roughly five or six large car manufacturers will remain in the future after some serious consolidation, but even between these few there will be differences in terms of luxury versus middle-class cars" (I4).

Distribution capabilities require no considerable adjustments in response to electromobility for incumbents directly, but they have to be cautious about the relationship with their dealership network. There was consensus that the role of dealerships will change in the long term not only because electric vehicles require less maintenance and repair due to the simplification of the BEV (maintenance is currently important element of dealers' business model and income), but also because alternative sales channels, like leasing, carsharing or online/direct sales, are becoming more attractive to consumers. However, "incumbent car manufacturers do not dare to play too much with alternative sales channels because currently, they are still largely dependent upon their dealers and for that reason, they do not dare to make such a considerable change" (I4). Nevertheless, "dealers are starting to get very frustrated by these problems (i.e. less maintenance and alternative sales channels) and as a reaction they introduce all kinds of improvident mobility concepts into the market, simply to fill that void in their business model" (I4). At the moment, most incumbents operate a relatively traditional distribution system by transporting vehicles from plants to distribution centers to dealerships and, finally to the customer. With the changing role of dealerships as the primary sales channel, incumbents have to think strategically about the global positioning of their plants and distribution centers to avoid high transportation costs.

Sales capabilities will undergo the most significant change of all four capabilities because people view cars increasingly as a commodity, changing incumbents' traditional sales differentiators such as brand value or performance. "Right now, people buy a car because it aligns with their identity. This perception is going to change towards buying a car for a specific moment because you actually prefer a different type of car to go to work relative to going to the beach in the weekend with your family" (I3). It is therefore believed that the entities who are able to offer customers mobility as a service[14] will also be able to exert significant power in the industry. Alternatively, this is framed as a transition from pull strategies (i.e. incumbents pull customers towards them with their brand) to a push strategy (i.e. putting customer demands for mobility in general at the center of sales) – I4.

While all four capabilities are subject to certain adjustments from traditional capabilities, changes in sales capabilities are considered more radical in nature because they do not require adjustments to existing capabilities, but demand completely new capabilities and the specifics of these new sales capabilities will be discussed next.

First, carsharing is considered a valuable capability to stimulate BEV sales, especially in urban environments. Carsharing programs with electric vehicles are especially promising in big cities, where most conventional cars will be banned in the next ten to fifteen years and inhabitants are experiencing significant trouble due to traffic jams and a lack of parking facilities – I4. Moreover, "there is great opportunity for incumbents to guide consumers in behavioral change, by allowing consumers to experience an electric car in carsharing programs, which can subsequently stimulate the consumer to buy their BEV in the future" (I4).

Second, in line with the propositions, it was argued that charging infrastructure can significantly push BEV sales by tackling challenges such as range anxiety for consumers. Furthermore, the findings suggest that collaboration between competitors and third parties is not a choice, but a necessity because a valuable charging infrastructure should be both convenient (i.e. large network of charging stations) and compatible (i.e. uniformity in charging plugs across models and brands) for the consumer.

Third, it was confirmed that mobility services are becoming an important sales differentiator, but these services provide significant challenges for incumbents in terms of data analysis and speed of development, although interviewees' opinions regarding the specifics of data and speed are sometimes contradicting. Whereas some informants argued that the collection of rich and large amounts of data is crucial for the development and management of mobility services

[14] This study acknowledges that electromobility is not the sole trend to explain these changes in sales capabilities. Rather, the connections between multiple trends such as connectivity, autonomous driving and MaaS can fully explain why and how capabilities are changing. Therefore, other trends will be mentioned as well in several occasions.

(I1, I2, I4), other believed data is regarded as a pot of gold by incumbents while in reality, incumbents do not possess the right skills to draw value from data in the first place (I3). "Car manufacturers operate as separate entities and cannot collect enough data on their own to detect global trends in customer mobility preferences. Big tech companies like Google not only have access to large amounts of data (e.g. through Google Maps), but also have the technological skills to draw value from this data (e.g. through machine learning). This may transfer immense power to tech companies in the future era of mobility" (I2). Moreover, the automotive industry develops at a much slower clock speed, taking about three to five years between developing a concept vehicle and introducing that vehicle onto the market. In contrast, mobility services require mostly software development, which generally develops at a much faster clock speed. Together, this implies that incumbents face three constraints: they lack the scale to collect large amounts of data, they lack the technological capabilities to analyze this data and, they are not used to develop products at such high speeds.

Fourth, alternative sales channels in the nature of subscription-based models are experiencing considerable growth due to the commoditization of passenger vehicles and the trend towards mobility as a service. "I think the 'lease' kind of companies are going to have most power in the industry because people will not care whether they drive a Mercedes or an Opel, as long as it fits with whichever use they need it for" (I3). While the car-leasing market is growing steadily in recent years, there may still be an opportunity for incumbents to overtake this responsibility by offering subscription-based business models themselves – I2. However, "I do not think I will ever sign a leasing contrast with a specific car manufacturer, because the value of a brand and the image accompanied with a certain type of car is slowly disappearing. Therefore, I believe current lease companies will continue to fulfill the demand of this trend" (I3).

4.2.2. Contextual Factors

Four additional broad themes in relation to the sustainability transition emerged from the interview data that provide additional explanation for differences in incumbent behavior.

First, several geographical distinctions between the US, the EU and Asia in terms of behavior were highlighted by looking at region specific differences such as regulations and mobility customs. Particularly, case data revealed that US-based incumbents (i.e. GM and Ford) invested less in capability acquisition compared to their European and Asian counterparts due to two reasons: they experienced less pressure to invest in electromobility because US environment regulations are not as strict compared to the EU and Asia (I1, I3, I4) and they took a significant hit during the last financial crisis, implying they may have lacked sufficient resources to make investments in a technology that was not a direct priority for them (I3, I4). Contrary to the US, Asian incumbents acquired significant BEV-related capabilities in this study, which can not only be explained by favorable regulatory regime (I2, I3, I4), but also by the fact that Asian incumbents have less history and brand identity in the global arena compared to their American and European competitors (I3).

Second, based on the secondary data findings, it seems like incumbents who entered the market in the early stage do not have an advantage over incumbents who entered in the middle stage. Indeed, the majority of the interviewees believe there is not really an early adopter advantage for parties like Nissan and Daimler – who developed battery cell technology very early on the market, but sold these business units again later on – because battery and other related technologies develop at such a fast pace. To illustrate, Daimler and Nissan both invested in lithium-ion batteries, while currently most car manufacturers are investing in solid-stage drive batteries, which has a completely different technical structure. However, the fact that these companies invested in developing their own battery technology or other BEV-related capabilities does positively influence a favorable mindset. “I believe the true challenge for car manufacturers does not reside in manufacturing BEVs, but in the accompanying mindset and culture. So, the way in which they sell cars, offer services and that requires a big change in mindset for everyone within the firm, which can take a very long time to adjust” (I2). Contrary to the lack of an early adopter advantage, incumbents should also be wary of investing too late. Experts believe the BEV market is going to tilt in about three to five years and incumbents who still need to develop their first BEV now may face an incredible challenge – I4.

Third, in relation to the aforementioned concept of mindset, it also believed that the wrong mindset can significant hinder incumbents from acquiring the right type of capabilities. Based on the case data it become evident that some incumbents pursued a dominant electrification strategy (e.g. Renault), while others were still more focused on conventional vehicles with some electric models on the side (e.g. Ford). According to the majority of the interviewees, this reason why incumbents are locked into incremental improvements of conventional vehicles is because they are too short-term oriented and performance focused, as exemplified by the following statement: “i talked to Harald Krüger (CEO) from BMW recently about their i3 because I was wondering why they did not continue with BEV investments after the i3, but decided to focus on plug-in hybrid models instead. His argumentation was that most people only drive 30KM a day on average, which can be met by a smaller battery, which is more efficient according to them. In my opinion, they will never be able to meet the CO2 limits for 2025/2030 with plug-in hybrid, but that is their short-term blindness" (I3).

Fourth, there were some noteworthy opinions on the diversification versus specialization debate, which is directly linked to which capabilities incumbents should acquire. Overall, the majority of the informants highlighted the importance of diversification across different sustainability technologies (e.g. electric, hybrid, fuel cell). Experts believe the industry might ultimately substitute electric driving by hydrogen, implying that incumbents should diversify across powertrains because betting on one technology may be too risky (I2). This also explains why some incumbents invest in electromobility, while others show a preference for alternative technologies like Toyota for fuel cells. Moreover, within one specific technology (e.g. incumbent decides to invest in BEVs), incumbents should prefer specialization, meaning they should not aim to internalize all four types of capabilities, but select specific capabilities they can excel in (I1, I2, I3, I4).

4.3. Analysis of Propositions

This section will analyze each proposition separately by establishing an empirically-based pattern for each of the internal capability portfolios using both the case and interview data. Next, this empirical pattern is compared to the theoretical pattern reflected in the propositions to determine whether the findings support these propositions or not.

4.3.1. Propositions 1A & 1B

Concerning incumbents with low core and low complementary capabilities, all cases were representative at some point, but incumbents' strategic behavior varied in response. Incumbents either gave priority to the development of core capabilities or developed core and complementary capability simultaneously (e.g. both core and complementary capabilities improved from low to medium). In a similar vein, interview data revealed that incumbents generally update their technical skills first, followed by design and only invest in sales and software related skills last. This order can be explained by incumbent's mindset to focus on the development of technical aspects (i.e. manufacturing capabilities) because, historically, these manufacturing capabilities facilitated their competitive advantage. These insights support the assumption that incumbents with low core and low complementary capabilities prioritize core capability acquisition.

Regarding **Proposition 1A**, seven incumbents (i.e. all except Hyundai) entered the BEV market in the early stage. The management literature argues that at this stage, incumbents prefer less permanent, more flexible strategies because there is still much doubt as to which sustainable alternative or technology to invest in. Data showed that the majority of these seven incumbents acquired core capabilities predominantly through external sourcing strategies. For development capabilities, a comparatively equal division between internal development and external sourcing was found. Incumbents mostly collaborate with Chinese partners to develop a BEV together as a means to access the Chinese market. However, in the area of manufacturing capabilities, most incumbents pursued external sourcing strategies. Based on the interview data this surge for partnerships can be explained by the challenge for incumbents to prioritize among sustainable alternatives, meaning they will diversify by investing in several technologies (e.g. electric and fuel cell). However, demand for these new technologies is still relatively low in the early stages of the market, implying that incumbents have insufficient scale to cover the high costs of investing in several novel technologies on their own. Only Volkswagen acquired core capabilities through internal development, which may subsequently be attributed to the fact that they are the second largest car manufacturer in the world, allowing for better economies of scale. Overall, these findings reject **Proposition 1A** because the majority of the incumbents who entered the BEV market in the early stages engaged in external sourcing strategies to acquire core capabilities instead of internal development as proposed.

In terms of **Proposition 1B**, Hyundai was the only incumbent who entered the BEV market in the middle stage. Case data showed that Hyundai also invested in core capability acquisition first and through external sourcing strategies, thereby supporting this proposition. Hyundai's relatively late entry into the market may be explained by its close relationship with Kia, who had already introduced two BEVs before Hyundai in 2011. It may be that Hyundai anticipated support from Kia once it would decide to introduce a BEV itself. This is in line with the rationale of the proposition stating that incumbents who enter in this stage of the market can copy the behavior of earlier entrants, similarly to Hyundai copying and partnering with Kia.

4.3.2. Propositions 2A & 2B

Contrary to expectations, **Propositions 2A and 2B** cannot be tested based on secondary data sources because none of the incumbents held a capability portfolio of low core and high complementary capability before 2018[15]. This observation may be explained by the fact that most incumbents invest in technical capabilities first and only invest in sales-related capabilities in the final stages. However, it was also noted that several sales capabilities such as carsharing or mobility services are also relevant in the context of conventional vehicles. This would imply that incumbent may acquire complementary capabilities relevant to the BEV market before investing in core capabilities. Evidently, this observation strongly correlated with the interconnectedness of different sustainable mobility trends that incumbents face in a sustainability transition. To illustrate, Toyota held a capability portfolio with low core and high complementary capabilities in 2018, which can subsequently be explained by the fact that Toyota prioritized on hybrid and fuel cell technologies. However, sales capabilities like carsharing, charging infrastructures and mobility services are also relevant to these technologies. These insights suggest that complementary capabilities play a different role in sustainability transitions compared to what the management literature argues because the management literature focuses on one innovation and the complementary capabilities required for that innovation specifically, whereas the sustainability transition literature considers a multitude of sustainable innovations that subsequently transform complementary capability requirements for the industry.

4.3.3. Propositions 3A & 3B

Regarding incumbents with high core capabilities and low complementary capabilities, the findings reveal that the majority of the incumbents pursued internal development strategies to acquire core capabilities and external sourcing strategies to acquire complementary capabilities. These incumbents were General Motors, Nissan and Renault at the 2013 mark.

In relation to **Proposition 3A,** case data revealed that between 2013 and 2018, none of the concerning incumbents were able to significantly improve their core capabilities, meaning their core capability values did not increase by at least 1 unit in that specific time period[16]. Therefore,

[15] Strategic behavior in response to a specific capability portfolio held in 2018 cannot be observed because it is in the future.
[16] As explained in the methodology, incumbents are only considered to have acquired capabilities if the specific capability value (range from 0 to 4) increases by at least 1 unit (+1).

there is no evidence to support or reject **Proposition 3A**. Despite the lack of evidence, a notable preference for internal development strategies was observed in the case data. Indeed, Nissan and Renault were already investing in their BEV-related core capabilities since 2009 due to the lack of relevant suppliers (i.e. BEV-battery market was still new and underdeveloped); external sourcing did not offer much promise in the way of acquiring important capabilities at that point in time. In the following years, Nissan was able to strengthen (and subsequently exploit) its internal core capabilities, exemplified by their investments in a BEV ecosystem consisting of batteries, chargers, electric grid studies, battery recycling and battery energy storage and so on. Due the Renault-Nissan alliance, Renault pursued a highly similar strategy with the exception of the battery technology for which it used third party suppliers. In addition, General Motors also aimed for more control over BEV-related core capabilities. This is illustrated by their transition from purchase contracts to forming joint ventures with SAIC and LG Chem for the production of the electric motor and batteries respectively. Such a transition suggests a desire for more control because alliances – especially joint ventures – allow firms to access new knowledge, while purchase contracts do not. Moreover, in comparison to purchase contracts, firms build much stronger relationships with alliances, which helps to mitigate the supplier dependency risk and thereby minimizes the likelihood and impact of supply shortages of critical BEV components (e.g. battery cells). These insights reveal that although Nissan, Renault and General Motors did not significantly improve their core capabilities, they underline a trend towards more control in the form of internal development strategies. Thus, although Proposition 3A can neither be rejected nor accepted due to insufficient data availability, the logic upon which it is predicated is discernible to some degree.

On the other hand, regarding **Proposition 3B**, the findings demonstrate that the incumbents which acquired complementary capabilities did so by engaging in external sourcing strategies; **Proposition 3B** is therefore supported and accepted. Specifically, the case data revealed that Renault and Nissan[17] actively engaged in external sourcing strategies to acquire further sales capabilities (i.e. complementary capabilities). It is important to note that complementary capability gaps were primarily driven by the sales capabilities dimension because there were no significant differences found between traditional and emerging distribution capabilities. As reflected by the interview data, at the organizational level, incumbents' preference for acquiring complementary capabilities through external sourcing can be explained by a lack of

[17] General Motors did not acquire any complementary capabilities and is therefore not considered for 3B.

technological skills and sufficient scale. More broadly, these deficiencies are highly related to the faster industry clock-speed (and therefore much shorter product development lead times) and greater complexity of technological developments associated with the emerging innovation. These observations do not directly align with the rationale for external sourcing in the management literature (i.e. exploit learning effects and effective governance to forge strong relationships) because the empirical explanation is more oriented to the constraints of the firm, whereas the theoretical rationale of the propositions is more directed at opportunities of external sourcing given the incumbent's constraints.

4.3.4. Propositions 4A & 4B

Concerning incumbents with high core and high complementary capabilities, the results show that incumbents pursue internal development strategies to acquire both core and complementary capabilities. These incumbents[18] were Volkswagen and Daimler in 2013. The management literature argues that firms prefer internal development once the market starts to mature because it allows firms to exploit their tacit knowledge base in which current capabilities are highly integrated, thereby not only avoiding intellectual property leakage, but also facilitating development of novel and distinct capabilities.

In relation to **Proposition 4A,** this study's findings reveal that both Volkswagen and Daimler predominantly pursued internal development strategies to acquire core capabilities; **Proposition 4A** is therefore supported. Analysis of the data reveals that the rationale for internalizing such capabilities can be attributed to incumbents' short-term mindset. Interview data disclosed that incumbents' competitive advantage has traditionally – indeed, for the better part of a century – been based on their manufacturing capabilities and that most incumbents still think in such terms to differentiate themselves. As a result, they tend turn to what they know and strive to internalize these core capabilities (i.e. technical knowledge) in the hope that new manufacturing expertise can deliver the same value as it did historically. While current consumer preferences are indeed still largely based on physical features or brand value (e.g. status, performance, price etc.), this preference is inevitably going to be based on mobility as a service (e.g. mobility convenience, variety of options etc.). Moreover, as the market evolves,

[18] Hyundai, Nissan and Renault held high core and high complementary capabilities in 2018. Hence, no strategic behavior can be analyzed in response.

the uncertainty between sustainability alternatives diminishes, allowing incumbents to not only better prioritize among innovations, but also to make more informed decisions about which specific capabilities to specialize.

Similarly, the results show that both Volkswagen and Daimler also engaged in internal development strategies to acquire key complementary capabilities; **Proposition 4B** is thus supported. Interview data revealed that incumbents are mostly unable to internalize complementary capabilities (i.e. carsharing and mobility services) due to their lack of technological skills and sufficient scale. Nevertheless, the majority of the interviewees argued that Toyota and Volkswagen might be the exception to this argument because they may be able to exploit their scale (i.e. being the world's first and second largest car manufacturers) to collect large amounts of data and reduce development costs through economies of scale. Indeed, it was found that Volkswagen is the first, and only, incumbent to announce plans to develop its own operating system (vw.os) by 2025, a single unified platform for all of its mobility service. In doing so, Volkswagen will significantly reduce the number of operating systems it works with today from 70 to 10 and will hire over 5.000 software experts to realize this tremendous project.

However, this same rationale cannot be applied to Daimler because they are, in fact, much smaller than Volkswagen and therefore lack the scale (Daimler sold 2.5 million cars in 2017, while Volkswagen sold over 10 million). Hence, Volkswagen and Daimler's preference for internal development strategies to acquire complementary capabilities cannot only be attributed to the proposed rationale of 'exploiting a highly integrated, tacit knowledge base' nor to the interviewees' theory of scale because it appears both cases employed a different rationale. To that end, more research is required to delineate the underlying explanation for the observed pattern.

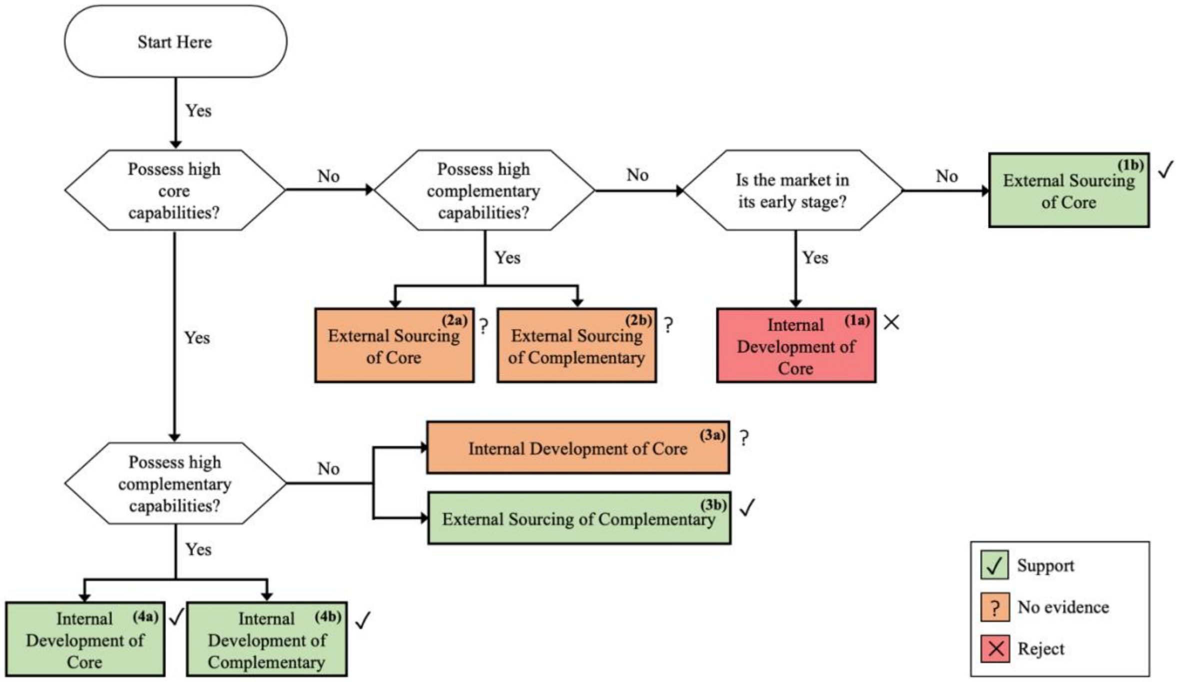


Figure 14: Summary of proposition analysis in the decision flow chart

In sum, as displayed in Figure 14, the empirical findings show that incumbents pursued internal development strategies only when they held high core and high complementary capabilities and aimed to strengthen these capabilities. Additionally, incumbent car manufacturers pursued external sourcing strategies either when they held low core and low complementary capabilities or when they wished to strengthen (and acquire) their complementary capabilities. There was no evidence to test propositions 2A, 2B and 3A.

5. DISCUSSION

This study aimed to advance current understanding of incumbents' strategic behavior in sustainability transitions by analyzing the influence of an incumbent's internal capability portfolio on strategic capability acquisition strategies (i.e. internal development and external sourcing). To this end, this study makes several contributions to both the sustainability transition literature and the traditional management literature as well as to practitioners.

5.1. Theoretical Implications

This paper makes three theoretical contributions. First, this study begins to address a widely expressed concern in the sustainability literature, namely the lack of micro-level actor research and – a weakness in the studies that do exist – its primary focus on descriptive, niche-level and policy-oriented research (Köhler et al., 2019). While scholars increasingly recognize the importance of the role incumbents play in sustainability transitions (e.g. Geels, 2014a), little remains understood of the specific incumbent behavior in response to such highly volatile transitions (Farla et al., 2012; Mossel et al., 2018). Extant literature has generally considered incumbents as a homogeneous group even though incumbents have also been found to display varying behavior in sustainability transitions (Wesseling, 2015). These gaps in the literature substantiate the importance of this study's research, namely the analysis of firm-specific factors to explain distinctions in strategic behavior. Indeed, the findings of this study reveal that incumbents' strategic behavior and response does in fact vary across different capability portfolios, thereby complementing Wesseling's (2015) notion that sustainability transition research that treats incumbents as a single homogeneous group runs the risk of over-generalizing, which, in turn, undermines the applicability and relevance of practical implications. In doing so, this study provides much needed empirical evidence to warrant further study on how firm-level differences influence strategic behavior and the development of changing market forces in the context of sustainability transitions. At the same time, the documented differences in behavior also link to the notion of path dependencies in management literature, which argues that a firm's future strategic choices are dependent upon the capability repertoire it currently holds and the strategies firms have employed to acquire these existing capabilities (Teece et al., 1997). However, this paper not only finds that incumbent behavior varies, but also reveals important relationships between a firm's specific capability portfolio and the chosen capability acquisition strategy.

In particular, this study found that only incumbents with both high core and high complementary capabilities pursued internal development strategies to further strengthen both core capabilities and complementary capabilities. In contrast, incumbents with both low core and low complementary capabilities prefer external sourcing strategies to acquire both types of capabilities. In addition, incumbents with high core and low complementary capabilities also employed external sourcing strategies to acquire complementary capabilities. Hence, the possession of a high capability portfolio (i.e. high core and high complementary capabilities) appears to be the differentiating factor when choosing which capability acquisition mode to implement.

To elaborate, the rationale for choosing *internal development strategies* – as demonstrated by the empirical findings – goes beyond the arguments discussed in theory of this study. Whereas the traditional management literature argues that firms should internalize all capabilities once the market starts to mature (Peng et al., 2012) to extract most value from their tacit and interconnected resource base (Teece, 1986; Karim & Mitchell, 2000), empirical findings suggest a similar, yet more nuanced approach. Specifically, in the context of a sustainability transition, interview data stressed the importance for incumbents to specialize in a few, specific capabilities related to the emerging innovation instead of opting for total vertical integration of all capabilities. In this regard, the case data is neatly complemented by the interview data to delineate the nuanced approached. Cases revealed that incumbents with a high core and high complementary capability portfolio pursue internal development strategies to further strengthen their capabilities. Extending these findings, the interview data highlighted that incumbents should specialize in a few, specific capabilities to strengthen their market position once they have established a good foothold in the market. Together, the findings suggest that this kind of specialization is particularly relevant in more mature stages of the market when market prospects and specifics of a radical sustainable innovation are clearer and can be assessed more accurately. Indeed, by putting internal development on hold until the high degree of uncertainty begins to fade (Köhler et al., 2019), incumbents can more safely navigate the turmoil and environmental dynamism brought on by sustainability transitions.

With the knowledge of hindsight, Nissan and Daimler become interesting examples to which these findings may have been relevant. Each incumbent invested in the internal development of battery cell production in the early stages of the market when they had not yet obtained a foothold in the market (while also having low core and low complementary capabilities) and market uncertainty was still exorbitantly high – the market prospect of BEV technologies was undetermined. Soon after, both firms decided to sell this capability because they could not compete with third party battery cell manufacturers in terms of price and quality when new, yet different iterations of the same technology were released and thereby acknowledged that battery cell production was not worth specializing in. One could argue that it would have been smarter, or at least safer, to hold off on developing this capability in-house until a more prevalent design of the technology had been established because they have not enjoyed an early adopters' advantage technologically speaking.

Moreover, the empirical findings support the theoretical proposition that incumbents with high core and low complementary capabilities pursue *external sourcing strategies* to acquire complementary capabilities because incumbents face significant resource constraints (e.g. lack of technological skills for software development). These constraints are results of the fact that radical sustainable innovations in a sustainability transition not only necessitate adjustments to existing capabilities, but also require completely new capabilities (e.g. data analytics for mobility services). To illustrate, incumbent car manufacturers have strengthened and honed their core capabilities – manufacturing was especially critical for the production of ICEVs – for over a century, but now, as (BEV) manufacturing becomes simplified, these core capabilities are becoming increasingly redundant. Simultaneously, new complementary capabilities (e.g. software development) that did not exist before are arising and quickly becoming table-stake capabilities in the new market, forcing incumbents to search beyond the confines of their own firm to source these capabilities externally. This same logic can be applied to the case of incumbents with low core and low complementary capabilities – who also prefer external sourcing strategies to acquire core capabilities – because battery technology and the electric motor are radically different from the internal combustion engine, with different challenges, different suppliers, different mechanics and so on.

Second, this study advances the sustainability transition literature by analyzing micro-level incumbent behavior against the backdrop of the macro-level of sustainability transitions, thereby answering the call of scholars to connect micro- and macro-level processes in the analysis (Köhler et al., 2019). Specifically, it was proposed that the bridge between the micro- and macro-level can be made implicit during the development of case narratives by zooming-in on micro-processes of firms as played out in arenas of development (ibid.). The findings demonstrate that numerous micro-level characteristics, such as an incumbent's lack of technological skills or scale to collect, analyze and exploit sufficient data, can directly be explained by more macro-level processes such as the greater complexity and faster clock-speed of technological and software development as well as the market uncertainty that arises due to the variety of market prospects of different sustainable innovations. To illustrate, the reason why some incumbents entered the BEV-market in the early stages is partially attributable to niche-player Tesla, who first showed there was a market for electric cars. However, whether the BEV market would actually go on to become commercially viable and sustainable for the traditional automotive incumbents remained uncertain at that point in time. As a result, what followed was a spike in experimentation through external sourcing (as opposed to internal development) to minimize the financial impact of potentially investing in the wrong technology. Thus, these micro-level characteristics are also indirectly explained by the high level of market uncertainty between sustainable alternatives.

Following the previous two contributions, this paper identifies a third contribution to the literature. By drawing on theoretical building blocks (e.g. RBV, capability-acquisition, etc.) of traditional management literature to explain firm behavior in sustainability transitions, this study reveals that firm behavior in sustainability transitions deviates from the foreseen behavior by the management literature. In combination with the widespread expectation that no industry is immune to the increasing pressure of sustainability underlines a necessary convergence of these two bodies of literature. Indeed, this research demonstrates that the boundaries that define the scholarly domains of the sustainability transition and traditional management literature are becoming increasingly blurred and that they should be seen to complement each other rather than perceived as individual research streams. To elaborate, the sustainability transition in mobility is characterized by an inherent and fundamental interconnectedness of different sustainable mobility trends such as connectivity, autonomous driving, electromobility and mobility as a service. That makes it a particularly interesting case for the sustainability literature to research and also explains why the extant management literature – which primarily tries to understand the effect of a single radical innovation – on its own falls short on explaining the underlying market interactions and micro-level variations in incumbent behavior. While electromobility was found to have a significant influence on incumbents' strategies, the underlying interconnectedness of the various sustainability trends raises the question to what extent the BEV as an innovation on its own is truly radical in nature. Indeed, based on the empirical findings of this research, it appears that the disruptive effect of the sustainability transition within the mobility sector is perhaps better attributable to the simultaneous convergence of multiple considerable trends. As such, this study's analysis of automotive incumbents begins to shed light on an important question in the sustainability transition literature, namely: "what are the consequences of industry convergence for sustainability, how can existing transition frameworks deal with the complexity of transitions that involve multiple sectors and industries, and how do firms handle these challenges?" (Köhler et al., 2019, p.12).

5.2. Managerial Implications

The findings of this research also have several managerial implications. First, practitioners should seek to understand the value of their own capability portfolio in the larger context of the sustainability transition in order to cope with the challenges of new and improved capability requirements of the radical sustainable innovation. Firms have to determine their current capability portfolio carefully by analyzing the strength of different types of capabilities. Subsequently, they should determine the precise gap between their existing capability portfolio and the emerging capability portfolio. The findings of this paper demonstrate that incumbents should determine which type of capabilities to specialize in, preferably the kind of capabilities that are not only indispensable to the emerging market, but also that provide incumbents with adequate power to occupy a worthwhile position in the value chain, which they have ruled thus far. Nevertheless, a firm's short-term mindset (i.e. inertia) and the uncertainty regarding market prospects and technical specifics of the emerging innovation constitute hurdles to the efforts to determine the capabilities gaps. Managers may decide not to acquire certain capabilities because they are too occupied adjusting existing capabilities to the new technology instead of acquiring new ones or because internal frictions are too high. In a similar vein, managers may be rationally bounded and not fully capable of assessing their capability needs because the radical sustainable innovation is accompanied by rapid change and high uncertainty about the value of future capabilities (Capron & Mitchell, 2009).

Second, managers should acknowledge the advantages of pursuing external sourcing strategies when they hold low core and low complementary capabilities as a means to acquire emerging capabilities specific to a particular innovation. When incumbents face significant capability constraints, external sourcing strategies allow for learning from competent partners and for effective governance by building strong relationships with relevant partners (Gulati, 1998; Dyer and Singh, 1998). Once the firm has reached a high level of core and complementary capabilities, practitioners should select specific capabilities they wish to specialize in by internalizing those capabilities. On the one hand, this allows firms to protect their intellectual property (Teece, 1986). On the other hand, by combining new resourcing with existing resources within the firm in novel ways, incumbents can create resources that are valuable, rare, difficult to imitate and non-substitutable, as determined by RBV (Gulati, 1998). Indeed, "firms that select appropriately between internal development and external sourcing as modes of obtaining new capabilities may renew their capabilities more effectively and gain long-term performance advantages" (Capron & Mitchell, 2009, p. 294).

5.3. Limitations and Future Research

Although this study makes several significant contributions to literature, it also has several limitations that may direct future research. This study faces two significant limitations as a result of adopting a case study design: generalizability and construct validity (Yin, 2013). Given the focus on BEV incumbent car manufacturers, the findings of this study may be less applicable to other industries because it draws on data from a single industry (i.e. the BEV market). Future research should perform comparable studies for other industries to contribute to a more general understanding of incumbents' strategic behavior in sustainability transitions. Next, it would be useful for future research to examine the relationship between different types of capabilities and capability-acquisition modes through a quantitative research approach based on large-scale quantitative data. While large amounts of insightful data were collected as part of this qualitative research, the translation of this data to numerical codes (i.e. capability values between 0 and 4) resulted in the loss of rich nuances that could have aided in identifying more rights insights and possible avenues for future research. Moreover, this translation from raw data to numerical codes oftentimes lacked objectivity due to the research procedure. Specifically, small adjustments to the cut off criteria between 0 or 1 would be able to prove or disprove some of the propositions because there were no universally-agreed criteria to guide this aspect of the research. In a similar vein, this paper did not define rigorous boundaries whether to define existing partnerships (i.e. Nissan-Renault or Hyundai-Kia) as individual or separate entities.

Furthermore, several interesting observations were discovered in the data that are worth exploring in future research, but were beyond the scope of this research. For instance, it would be interesting to test the relationship between capabilities and incumbents' strategic behavior by building on the resource dependency theory instead of the resource-based view because this theory takes the perspective of firm survival instead of firm competitive advantage (Mossel et al., 2018). Researchers could even go beyond the concepts of competitive advantage and survival by examining the link between an incumbent's capability portfolio and capability acquisition choices to its financial performance (thereby investigating success). This paper underlined the necessity for incumbents to determine in which capabilities to specialize, in order to maintain maximum control in the renewed value chain. Given the unfavorable prospects of incumbents in sustainability transitions (Smink, 2015), it would be beneficial to both scholars and practitioners to better understand best practices of incumbents in this context.

Additionally, future research may look into interfirm strategic behavior within a specific industry. This paper looked into the behavior of incumbents specifically due to their prominent influence on the progression of sustainability transitions (Smink, 2015). Yet, incumbents pursued external sourcing strategies with a range of diverse actors such as battery producers, municipalities, big tech firms, energy providers, and many more. In order to fully understand the changing (power) dynamics in an industry like the automotive industry, it may be beneficial to understand how different actors behave and interact by also considering new entrants or alternative actor typologies such as market leaders versus market contenders (Köhler et al., 2019).

Finally, it would be beneficial to analyze capability transformations and capability acquisition strategies not only in the context of a single sustainability trend (e.g. electromobility), but across the entire system with several interconnected trends (e.g. electromobility, autonomous driving, connectivity, …). The empirical findings revealed clear connections between these trends and analyzing multiple trends at once may provide greater clarity into the actor behavior in a sustainability transition overall.

6. CONCLUSION

Despite the proliferation of sustainability transition research, current understanding of actor behavior within such transitions has been widely disregarded (Köhler et al., 2019). More specifically, the strategic behavior of incumbents in sustainability transitions is a particular under-researched area of sustainability transitions, although incumbents have a prominent influence on the advancement of a sustainability transition (Farla et al. 2012; Smink, 2015). Prior research has insufficiently acknowledged the distinctive nature of sustainability transitions in contrast to traditional transitions and the subsequent adaptations in firm behavior (Geels, 2011; Mossel et al. 2018). Such insights underline the importance of studying incumbent behavior in the context of sustainability transitions specifically. Although the sustainability literature contends that external circumstances such as environmental regulations influence incumbent behavior on a macro-level, prior studies have not investigated the impact of firm-specific factors on incumbents' strategic behavior – thus on a micro-level – or the connections between these micro- and macro-level factors in relation to firm behavior (Smink, 2015; Köhler et al., 2019). As a result, questions regarding how incumbents behave in response to firm-specific capabilities in sustainability transitions remain unanswered.

In conclusion, this study contributes theoretically and empirically to the sustainability transitions literature by confirming that varying internal capability portfolios bring about different patterns of strategic behavior in choosing between internal development and external sourcing strategies to acquire capabilities in sustainability transitions. Specifically, incumbents only pursue internal development strategies when they already hold high core and high complementary capabilities and wish to strengthen these capabilities. These findings advance current understanding of how firm-specific factors like capabilities influence their strategic behavior to acquire new capabilities and provides evidence that the boundaries that define the scholarly domains of the sustainability transition and traditional management literature are becoming increasingly blurred, underlining the necessary convergence of these two streams of literature.

APPENDICES

Appendix 1 – Study sample

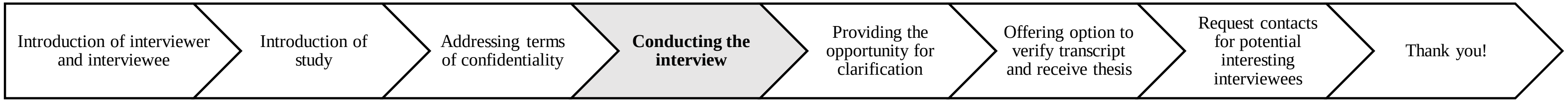
	Car Manufacturer	Vehicle production volume in 2017[19]	Founded	First BEV to market	Country	Selected
1	Toyota	10466051	1937	2012	Japan	YES
2	Volkswagen	10382334	1937	2013	Germany	YES
3	Hyundai Motor Company	7218391	1967	2017[20]	South Korea	YES
4	General Motors	6856880	1908	2012	U.S.	YES
5	Ford Motor Company	6386818	1903	2010	U.S.	YES
6	Nissan Motor	5769277	1933	2010	Japan	YES
7	Honda	5236842	1948	2014	Japan	NO
8	Fiat	4600847	1899	2013	Italy	NO[21]
9	Renault	4153589	1899	2011	France	YES
10	Groupe PSA	3649742	1976	2016	France	NO
11	Suzuki	3302336	1909	n.a.	Japan	NO
12	Daimler AG	2549142	1926	2009	Germany	YES
13	BMW	2505741	1916	2012	Germany	NO
14	Chang'an Motors	1715871	1862	2014	China	NO
15	Mazda	1586013	1920	n.a.	Japan	NO
16	BAIC Motor	1391643	1988	2013	China	NO
17	Dongfeng Motor	1315490	1969	n.a.	China	NO
18	Geely	1266456	1986	2014	China	NO
19	Great Wall Motors	1094360	1984	2018	China	NO
20	Mitsubishi Motors	1091500	1970	2009	Japan	NO
21	Tata Motors	1084678	1945	2017	India	NO
22	Fuji Electric	1024604	1923	n.a.	Japan	NO

[19] http://www.oica.net/category/production-statistics/2016-statistics/
[20] Hyundai, Honda and GM introduced a first generation EV in earlier BEV waves (90's) (Wesseling et al. 2014).
[21] Fiat is currently not producing any BEVs, therefore it will not be included

Appendix 2 – List of interviewees

	DATE	NAME	FUNCTION AND EXPERTISE	DURATION
1	24/04/2019	Erwin Wijman	Writer (e.g. Denken als Elon Musk & Wat je rijdt ben je zelf), journalist (e.g. FD, NRC, Volkskrant), columnist (e.g. nu.nl, NRC), interviewer and a brand- and marketing expert with a special interest in the automotive industry.	120 minutes
2	04/06/2019	Niels Stolte	Editor for GTsprit.com for four years and now active at IT/innovation department within Daimler Financial Services.	90 minutes
3	14/06/2019	Bard van de Weijer	Journalist and editor for the Volkskrant with a focus on the automotive industry and analyses the societal debate concerning mobility	60 minutes
4	17/06/2019	Flip Oude Weernink	Works at FIER automotive as a manager of new mobility with a focus on sharing programs and concepts and the further development of 'e-Mobility as a Service' (eMaaS). In his work he balances the interests of governments, companies, institutions and end-users to initiate, develop and introduce sustainable mobility services.	50 minutes

Appendix 3 – Interview guide [22]



Interview Questions

1. Could you tell me more about your career, current occupation and expertise?
2. What are the most important differences for incumbent car manufacturers, organizationally, between electric and conventional vehicles?
3. The battery consists of battery cells and the entire battery pack. I found that most incumbents source the battery cells externally from three of four large producers, but produce the battery packs internally. However, some have expressed ambition to develop these battery cells internally as well. What do you think about these strategies?
    a. Do you think incumbents should (have) pursued alternative strategies ten years ago or ten years from now?
4. In what ways do incumbents have to adjust their distribution system with the arrival of BEVs?
5. How can incumbents stimulate greater demand for their BEVs?
    a. What is the role of 1) carsharing, 2) charging infrastructure, and 3) mobility services therein?
6. Incumbents have typically directed developments in the automotive industry because they rule the value chain, do you think they can maintain this position in the future?
7. Do you think incumbents should aim for vertical integration or specialization of all relevant capabilities and why?
8. Do you think that incumbents who invested in BEVs early on have acquired an early adopter advantage?
9. Do you think American/Asian/European incumbents are currently well positioned for the BEV transition and why?

Probing Questions

Probe to seek clarification:

- Could you explain what you mean by X?
- So, you are saying that X, do I understand that correctly?

Probe to get more information:

- Can you tell me more about X?
- Can you give me an example of X?

Probe to understand rationale:

- Why do you think X matters?
- What was a driver/barrier of X?

Probe to test counterfactual:

- Last week I talked to someone who said X, what do you think of that?

Probe to steer interview back on track:

- How does this issue relate to X we talked about earlier?

[22] List of questions present the standard questionnaire format. Depending on the interviewee and his specific expertise some questions were adjusted or added.

Appendix 4 – Codes for sources (A = annual reports, I = internal news, E = external news)

TOYOTA	
TA1	Annual Report 2009
TA2	Annual Report 2010
TA3	Annual Report 2011
TA4	Annual Report 2012
TA5	Annual Report 2013
TA6	Annual Report 2014
TA7	Annual Report 2016
TA8	Annual Report 2017
TA9	Annual Report 2018
TI1	https://media.toyota.co.uk/2013/11/toyota-clicks-e-commerce-launch-official-ebay-stores-genuine-parts-accessories-sales/
TI2	https://newsroom.toyota.eu/2011-microsoft-and-toyota-announce-strategic-partnership-on-next-generation-telematics/
TI3	https://global.toyota/en/newsroom/corporate/22940912.html
TI4	https://newsroom.toyota.eu/toyota-connected-europe-to-bring-advanced-mobility-services-to-the-european-market/
TI5	https://media.toyota.co.uk/2018/01/toyota-launches-new-mobility-ecosystem-concept-vehicle-ces-2018/
TI6	https://newsroom.toyota.eu/2011-independent-study-confirms-toyota-as-consumers-first-choice-for-hybrid-and-electric-vehicles/
TI7	https://newsroom.toyota.eu/2012-comprehensive-environmental-technology/
TI8	https://newsroom.toyota.eu/tmc-to-conduct-phv-and-ev-charger-infrastructure-verification-tests-in-japan/
TI9	https://newsroom.toyota.eu/2013-toyota-nissan-honda-and-mitsubishi-agree-to-joint-development-of-charging-infrastructure-for-phvs-phevs-and-evs-in-japan/
TI10	https://global.toyota/en/newsroom/corporate/20353243.html
TI11	https://newsroom.toyota.eu/2011-salesforcecom-and-toyota-form-strategic-alliance-to-build-toyota-friend-social-network-for-toyota-customers-and-their-cars/
TE1	https://www.reuters.com/article/us-toyota-nikkei/toyota-to-make-lithium-batteries-for-hybrids-nikkei-
TE2	https://mpk732t12016clustera.wordpress.com/2016/05/16/distribution-keeping-it-simple-the-toyota-way/
TE3	https://www.bloomberg.com/news/articles/2018-09-06/toyota-s-hybrid-fixation-clear-from-supplier-with-no-ev-battery
TE4	http://fortune.com/2018/07/10/toyota-hui-car-sharing-honolulu-hawaii/

TE5	https://www.zdnet.com/article/ces-2018-toyota-unveils-autonomous-e-commerce-mobility-solution-e-palette/
TE6	https://www.caranddriver.com/news/a26703778/toyota-why-not-selling-electric-cars/
TE7	https://www.reuters.com/article/us-toyota-panasonic/toyota-panasonic-announce-battery-venture-to-expand-ev-push-idUSKCN1PG0MP
TE8	https://en.wikipedia.org/wiki/List_of_electric-vehicle-battery_manufacturers
TE9	https://www.peve.jp/en/
TE10	https://cleantechnica.com/2015/08/29/toyota-following-teslas-lead-trying-direct-online-sales/
TE11	https://en.wikipedia.org/wiki/Toyota_iQ#Scion_iQ
TE12	https://en.wikipedia.org/wiki/Toyota_RAV4_EV
TE13	https://www.reuters.com/article/us-toyota-electric/toyota-drops-plan-for-widespread-sales-of-electric-car-idUSBRE88N0CT20120924
VOLKSWAGEN	
VA1	Annual Report 2009
VA2	Annual Report 2010
VA3	Annual Report 2011
VA4	Annual Report 2012
VA5	Annual Report 2013
VA6	Annual Report 2014
VA7	Annual Report 2015
VA8	Annual Report 2016
VA9	Annual Report 2017
VA10	Annual Report 2018
VI1	https://annualreport2017.volkswagenag.com/group-management-report/sustainable-value-enhancement/sales-and-marketing.html
VI2	https://www.volkswagen-newsroom.com/en/press-releases/volkswagen-digitalizes-sales-new-era-of-car-buying-to-start-in-2020-4257
VI3	https://annualreport2016.volkswagenag.com/group-management-report/sustainable-value-enhancement/research-and-development/synergies-and-alliances.html
VI4	https://www.volkswagenag.com/en/news/stories/2018/10/powerful-and-scalable-the-new-id-battery-system.html
VI5	https://www.volkswagenag.com/en/news/2018/11/volkswagen-nominates-further-battery-cell-supplier.html

VI6	https://www.volkswagenag.com/presence/investorrelation/publications/presentations/2018/07_july/2018-07-02_Volkswagen_Group_Investor_Conference_Presentation_Mr_De_Bock.pdf
VI7	https://www.volkswagen.nl/nieuws/volkswagen-start-carsoftware-met-5000-in-house-ontwikkelaars/
VE1	https://www.electrive.com/2018/12/13/audi-to-assemble-battery-packs-in-germany/
VE2	https://www.electrive.com/2019/02/04/catl-plans-up-100-gwh-battery-factory-in-germany/
VE3	https://www.electrive.com/2019/02/21/volkswagen-battery-production-blocked-by-competition/
VE4	https://www.automotivelogistics.media/delivering-on-vws-targets/7907.article
VE5	https://www.autocar.co.uk/car-news/new-cars/volkswagen-aims-solid-state-battery-production-2025
VE6	http://fortune.com/2019/01/25/volkswagen-electric-vehicle-battery/
VE7	https://www.reuters.com/article/us-volkswagen-alliances-batteries/volkswagen-open-to-joining-german-battery-cell-consortium-source-idUSKCN1NH1XS
VE8	https://www.reuters.com/article/us-autoshow-shanghai-vw/volkswagen-pushes-battery-partners-to-build-gigafactories-idUSKCN1RR09A
VE9	https://www.electrive.com/2018/03/16/volkswagen-partners-up-with-korean-battery-manufacturers/
VE10	https://www.forbes.com/sites/ellenrwald/2019/05/15/volkswagens-new-battery-plant-could-be-a-game-changer-in-electric-vehicle-strategy/#14167791df7f
VE11	https://www.wired.com/story/vw-make-batteries-power-electric-future/
VE12	https://www.electrive.com/2019/01/25/vw-bundles-their-battery-business/
VE13	https://www.electrive.com/2019/01/23/vw-group-invests-10-million-usd-in-startup-forge-nano/
VE14	https://www.automotivemanufacturingsolutions.com/vw-group-to-spread-bev-production/36389.article
VE15	https://www.reuters.com/article/us-autoshow-detroit-volkswagen/volkswagen-to-invest-800-million-build-new-electric-vehicle-in-u-s-idUSKCN1P81R1
VE16	https://uk.reuters.com/article/volkswagen-electric-batteries/vw-to-create-battery-production-unit-in-push-for-e-cars-mass-production-idUKL8N1ZP1UW
VE17	https://uk.reuters.com/article/uk-volkswagen-dealers/vw-to-reduce-size-of-dealer-network-launch-online-sales-idUKKBN1CF13B
VE18	https://www.electrive.com/2019/02/04/electrify-america-to-integrate-tesla-batteries/
HYUNDAI (& KIA)	
HA1	Annual Report 2009
HA2	Annual Report 2010

HA3	Annual Report 2011
HA4	Annual Report 2012
HA5	Annual Report 2013
HA6	Annual Report 2014
HA7	Annual Report 2015
HA8	Annual Report 2016
KA1	Annual Report 2009
KA2	Annual Report 2010
KA3	Annual Report 2011
KA4	Annual Report 2012
KA5	Annual Report 2013
KA6	Annual Report 2014
KA7	Annual Report 2015
KA8	Annual Report 2016
KA9	Annual Report 2017
KE1	https://www.greenbiz.com/article/final-stop-ev-batteries-hyundai-kia-toyota-nissan-and-bmw-grid
KE2	https://electricrevs.com/2019/04/30/lg-sues-sk-alleges-stolen-trade-secrets-used-to-make-kia-niro-and-future-vw-batteries/
HI1	https://www.hyundai.news/eu/brand/an-all-new-way-to-buy-a-car-rockar-hyundai/
HI2	https://www.hyundai.news/eu/brand/hyundai-motor-opens-europes-biggest-dealership/
HI3	https://www.hyundai.news/eu/brand/hyundai-motor-reputation-once-again-acknowledged-by-interbrand/
HI4	https://www.hyundai.news/eu/brand/hyundai-motor-launches-new-global-luxury-brand-genesis/
HI5	https://www.hyundai.news/eu/stories/a-brief-history-of-environmentally-friendly-cars/
HI6	https://www.hyundai.news/eu/brand/hyundai-motor-launches-all-new-online-way-to-buy-a-hyundai-in-the-uk/
HI7	https://www.hyundai.news/eu/model-news/hyundai-motor-partners-with-greenmove-to-operate-new-car-sharing-service-in-vienna/
HI8	https://www.hyundai.news/uk/model-news/hyundai-motor-reveals-vision-for-future-mobility-at-the-2017-consumer-electronics-show/
HI9	https://www.hyundai.news/eu/model-news/road-to-2021-hyundai-motor-europes-four-strategic-cornerstones-for-growth/

HI10	https://www.hyundai.news/eu/stories/the-right-mindset-is-more-important-than-simply-having-knowledge/
HI11	https://www.hyundai.news/uk/brand/hyundai-and-kia-enter-strategic-partnership-with-vodafone/
HI12	https://www.hyundai.news/eu/brand/hyundai-cradle-expands-ecosystem-of-mobility-partners/
HI13	https://www.hyundai.news/eu/brand/hyundai-cradle-partners-with-ionic-materials-to-advance-battery-technology-development/
HI14	https://www.hyundai.news/uk/brand/hyundai-kite-the-two-in-one-electric-buggy-concept-in-cooperation-with-the-ied/
HI15	https://www.hyundai.news/uk/model-news/hyundai-kona-electric-a-game-changer-say-industry-experts/
HI16	https://www.hyundai.news/eu/brand/hyundai-motor-and-grab-sign-strategic-partnership-to-expand-mobility-services/
HI17	https://www.hyundai.news/eu/brand/hyundai-motor-expands-mobility-service-in-india-investing-into-revv/
HI18	https://www.hyundai.news/uk/brand/hyundai-motor-group-and-waertsilae-forge-new-partnership/
HI19	https://www.hyundai.news/eu/brand/hyundai-motor-group-and-baidu-fortify-partnership-to-expedite-next-generation-connected-car-era/
HI20	https://www.hyundai.news/eu/brand/hyundai-motor-group-reveals-solar-charging-system-technology/
HI21	https://www.hyundai.news/eu/model-news/ioniq-electric-ranked-first-in-2017-adac-ecotest/
HI22	https://www.hyundai.news/uk/brand/hyundai-kona-electric-wins-best-green-fleet-car/
HI23	https://www.hyundai.news/uk/brand/hyundai-motor-launches-cradle-berlin/
HI24	https://www.hyundai.news/uk/brand/hyundai-named-manufacturer-of-the-year-at-the-am-awards/
HI25	https://www.hyundai.news/eu/brand/hyundais-design-your-own-world-ces-2019-exhibition/
HI26	https://www.hyundai.news/eu/brand/hyundai-motor-group-unveils-innovative-electric-vehicle-charging-and-automated-parking-systems-concept/
HI27	https://www.hyundai.com/worldwide/en/company/corporate/message
HI28	https://www.hyundai.com/worldwide/en/innovation/technology/eco
HI29	https://www.hyundai.news/eu/brand/future-mobility-hyundais-vision-of-a-sustainable-intelligent-and-connected-mobile-world/
HI30	https://www.hyundai.com/worldwide/en/company/corporate/networks/manufacturing

HI31	https://www.hyundai.com/worldwide/en/company/csr/sustainability-management/overview
HI32	https://www.hyundai.com/worldwide/en/company/corporate/information/history/2013-2019
HI33	https://www.hyundai.com/worldwide/en/company/corporate/management/quality-and-service
HE1	https://cleantechnica.com/2017/09/26/hyundai-opens-100-employee-ev-charging-stations/
HE2	https://cleantechnica.com/2018/08/12/electric-car-growth-produces-battery-shortages-carmakers-cant-match-production-with-demand/
HE3	https://electricrevs.com/2018/12/20/exclusive-details-on-hyundais-new-battery-thermal-management-design/
HE4	https://digiday.com/retail/hyundai-using-amazon-learn-customers/
HE5	https://cleantechnica.com/2018/12/04/hyundai-building-the-latest-worlds-largest-battery-system-with-150-mw-system-in-korea/
HE6	https://www.electrive.com/2018/05/30/hyundai-to-produce-its-own-electric-car-batteries/
HE7	https://www.greentechmedia.com/articles/read/industry-giants-samsung-and-hyundai-invest-in-solid-state-batteries#gs.g0j7qy
HE8	https://www.bloomberg.com/news/articles/2018-09-10/samsung-and-hyundai-investing-in-solid-state-battery-producer
HE9	https://www.designboom.com/technology/kia-hyundai-electric-charging-automated-parking-concept-01-04-2019/
HE10	https://insideevs.com/news/341644/hyundai-kona-electric-crossover-wins-award-after-award/
HE11	https://insideevs.com/news/343420/hyundai-kona-electric-production-down-but-why/
HE12	https://www.electrive.com/2019/02/28/2020-hyundai-plans-new-electric-vehicle-platform-vehicle/
HE13	https://insideevs.com/news/342970/hyundai-cant-ship-you-that-promised-kona-electric-due-to-crazy-demand/
HE14	https://insideevs.com/news/333540/lg-chem-cant-keep-up-with-unexpectedly-high-demand-for-hyundai-ioniq-electric/
HE15	https://www.topgear.com/car-news/big-reads/genesis-essentia-concept
HE16	https://www.interbrand.com/best-brands/best-global-brands/2018/ranking/#?filter=Automotive
HE17	https://www.interbrand.com/best-brands/best-global-brands/2010/ranking/
HE18	http://www.hyundai-enercell.com/about.action
GENERAL MOTORS	
GA1	Annual Report 2009

GA2	Annual Report 2010
GA3	Annual Report 2012
GA4	Annual Report 2013
GA5	Annual Report 2014
GA6	Annual Report 2015
GA7	Annual Report 2016
GA8	Annual Report 2017
GA9	Annual Report 2018
GI1	https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2013/Sep/0916-battery-lab.html
GI2	https://www.gmfinancial.com/Docs/Investors/strategic-and-operational-overview.pdf
GI3	https://investor.gm.com/static-files/850bb45b-21d4-4aef-b572-814750d145a1
GI4	https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2018/nov/1126-gm.html
GI5	https://media.gm.com/media/cn/en/gm/news.detail.html/content/Pages/news/cn/en/2018/June/0605_GM-Path.html
GI6	https://media.gm.com/media/us/en/gm/news.detail.html/content/Pages/news/us/en/2018/jun/0607-gm-honda-battery-cell.html
GI7	https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2016/Jan/0104-lyft.html
GI8	https://media.gm.com/media/cn/en/gm/home.detail.html/content/Pages/news/cn/en/2018/June/0612_Baojun-E100.html
GE1	https://www.nytimes.com/2008/02/04/business/worldbusiness/04gm.html
GE2	https://www.nytimes.com/2009/05/16/business/16auto.html
GE3	https://www.autonews.com/article/20090427/OEM02/304279773/gm-plans-4-core-brands-with-3-sales-channels
GE4	https://electrek.co/2018/06/07/gm-honda-partner-next-gen-batteries-electric-vehicles/
GE5	https://autoweek.com/article/car-news/general-motors-partners-battery-supplier-lg-electric-vehicles
GE6	https://www.industryweek.com/process-improvement/manufacturing-strategy-plays-key-role-gms-revival
GE7	http://business.time.com/2013/10/10/buying-a-car-online-is-about-to-get-way-easier/
GE8	https://www.forbes.com/sites/panosmourdoukoutas/2013/10/11/how-general-motors-wins-the-minds-and-wallets-of-chinese-consumers/#67b77c36386f
GE9	http://fortune.com/2016/02/09/gm-online-cars-sales/

GE10	https://www.strategicmanagementinsight.com/swot-analyses/general-motors-swot-analysis.html
GE11	https://qz.com/914573/after-losing-20-billion-over-17-years-general-motors-gm-may-quit-europe-by-selling-opel-and-vauxhall-to-peugeot/
GE12	https://www.cnbc.com/2019/02/06/gm-doesnt-expect-to-make-money-off-electric-cars-until-next-decade.html
GE13	https://www.wired.com/story/general-motors-electric-cars-plan-gm/
GE14	https://cleantechnica.com/2018/11/27/gm-may-finally-be-serious-about-electric-vehicles/
GE15	https://ihsmarkit.com/research-analysis/gm-plans-300-mile-plus-range-evs-on-new-platform.html
GE16	https://eu.detroitnews.com/story/business/autos/general-motors/2018/09/05/gm-invests-battery-lab-warren-electrification-efforts/1201277002/
GE17	http://www.chinadaily.com.cn/a/201806/06/WS5b178881a31001b82571e79c.html
GE18	https://techcrunch.com/2019/01/11/gm-is-transforming-cadillac-into-an-electric-brand/
GE19	https://techcrunch.com/2019/04/30/gms-electric-future-includes-a-pickup-truck/
GE20	https://en.wikipedia.org/wiki/Chevrolet_Spark
FORD	
FA1	Annual Report 2009
FA2	Annual Report 2010
FA3	Annual Report 2011
FA4	Annual Report 2012
FA5	Annual Report 2013
FA6	Annual Report 2014
FA7	Annual Report 2015
FA8	Annual Report 2016
FA9	Annual Report 2017
FI1	https://media.ford.com/content/fordmedia/fna/us/en/news/2018/04/24/ford-launches-single-distribution-channel-in-china--names-new-le.html
FI2	https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/24/rivian-500-million-investment-ford.html
FI3	https://media.ford.com/content/fordmedia/fna/us/en/news/2019/03/20/ford-adds-2nd-north-american-site-to-build-battery-electrics.html
FI4	https://media.ford.com/content/fordmedia/fna/us/en/news/2018/11/26/ford-statement-on-business-transformation.html

FI5	https://media.ford.com/content/fordmedia/fna/us/en/news/2017/11/03/ionity---pan-european-high-power-charging-network-enables-e-mobi.html
FI6	https://media.ford.com/content/fordmedia/fna/us/en/news/2018/03/22/mahindra-and-ford-sign-mous-to-co-develop-midsize-and-compact-su.html
FI7	https://media.ford.com/content/fordmedia/fna/us/en/news/2017/11/08/ford-and-zotye-sign-definitive-jv-agreement-in-china-to-meet-gro.html
FI8	https://media.ford.com/content/fordmedia/feu/en/news/2017/10/18/ford-ceo-jim-hackett-opens-smart-mobility-innovation-office-in-l.html
FI9	https://media.ford.com/content/fordmedia/fna/us/en/news/2015/01/06/mobility-experiment-ford-charsharing-germany.html
FI10	https://media.ford.com/content/fordmedia/fna/us/en/news/2019/04/23/ford-motor-company-autonomic-amazon-web-services-collaboration.html
FI11	https://media.ford.com/content/fordmedia/fap/cn/en/news/2018/09/27/Ford_Smart_Mobility_and_Zotye_to_Offer_Chinese_Ride-Hailing_Operators_Leasing_and_Fleet_Solutions_Under_New_JV.html
FI12	https://media.ford.com/content/fordmedia/fna/us/en/news/2017/04/27/ford-motor-company-and-zipcar-to-plant-20000-more-trees.html
FE1	https://www.greencarcongress.com/2009/01/ford-rolls-out.html
FE2	https://newatlas.com/ford-home-focus-electric-charging-station/17601/
FE3	http://fortune.com/2017/01/23/ford-motor-credit-buy-car-online/
FE4	https://www.cnbc.com/2017/11/03/ford-bmw-vw-daimler-building-electric-charging-network-twice-the-power-of-teslas.html
FE5	https://techcrunch.com/2018/01/25/ford-acquires-autonomic-and-transloc-as-it-evolves-its-mobility-business/
FE6	https://www.am-online.com/news/manufacturer/2018/07/12/ford-goes-live-with-buy-online-car-sales-platform
FE7	https://www.fleeteurope.com/en/connected/united-kingdom/article/ford-opens-online-sales-channel
FE8	https://autovistagroup.com/news-and-insights/ford-plans-autonomous-car-share-scheme-launch-2021
FE9	https://www.roadandtrack.com/new-cars/future-cars/a27254162/ford-build-ev-on-rivian-platform/
FE10	http://smarthighways.net/ford-develops-algorithm-to-address-electric-vehicle-charging-concerns/
FE11	http://fordauthority.com/2019/01/ford-proclaims-different-electrification-strategy/
FE12	https://www.pocket-lint.com/cars/news/ford/147518-ford-tries-to-steal-model-y-spotlight-by-teasing-its-mustang-inspired-electric-suv
FE13	https://www.bloomberg.com/news/features/2019-02-14/the-world-still-doesn-t-have-enough-places-to-plug-in-cars

FE14	https://en.wikipedia.org/wiki/Azure_Transit_Connect_Electric
FE15	https://en.wikipedia.org/wiki/Ford_Focus_Electric
FE16	https://www.scribd.com/document/9922686/Partnership-Magna-International-and-Ford
FE17	https://www.fleetnews.co.uk/news/manufacturer-news/2016/10/03/ford-to-close-godrive-car-sharing-service-in
FE18	https://cleantechnica.com/2019/04/12/ford-to-gasmobiles-look-out-solid-state-ev-batteries-are-coming/
FE19	https://europe.autonews.com/article/20170412/ANE/170419939/ford-ends-focus-ev-production-in-europe
FE20	https://media.ford.com/content/fordmedia/feu/en/news/2019/04/02/ford-goes-big-on-electrification--showcases-eco-friendly-approac.html
FE21	https://techcrunch.com/2019/04/02/fords-electrified-vision-for-europe-includes-its-mustang-inspired-suv-and-a-lot-of-hybrids/
FE22	https://www.forbes.com/sites/greggardner/2018/04/26/fords-smart-mobility-is-still-a-long-way-from-profitable/#1ba60b9c784c
NISSAN	
NA1	Annual Report 2009
NA2	Annual Report 2010
NA3	Annual Report 2011
NA4	Annual Report 2012
NA5	Annual Report 2013
NA6	Annual Report 2014
NA7	Annual Report 2015
NA8	Annual Report 2016
NA9	Annual Report 2017
NA10	Annual Report 2018
NI1	https://www.nissan-global.com/EN/TECHNOLOGY/OVERVIEW/ev_platform.html
NI2	https://www.alliance-2022.com/electrification/
NI3	https://usa.nissannews.com/en-US/releases/nissan-and-bmw-partner-once-again-to-expand-dc-fast-charger-access-across-the-u-s-to-benefit-ev-drivers
NI4	https://www.alliance-2022.com/news/global-first-alliance-distribution-warehouse-open-for-business-in-australia/
NI5	https://www.nissan-aid.com/introduction.html
NI6	https://newsroom.nissan-global.com/releases/release-fc1499a2382c4bfa3a359291600ce1db-nissan-city-hub-makes-its-worldwide-debut-in-france

NI7	https://newsroom.nissan-global.com/releases/release-b80d5f605e170e28db6d451af716d674
NI8	https://newsroom.nissan-global.com/releases/nissan-to-create-electric-vehicle-ecosystem
NI9	https://www.business-standard.com/article/news-cd/nissan-to-have-its-own-distribution-network-114021700495_1.html
NI10	https://www.nissan-global.com/EN/COMPANY/PROFILE/HERITAGE/2000/
NI11	https://usa.nissannews.com/en-US/releases/with-a-new-electric-taxi-program-rio-de-janeiro-enters-zero-emissions-era
NI12	https://www.alliance-2022.com/mobility-services/
NI13	https://newsroom.nissan-global.com/releases/release-802293a55e09aa3ecd57e61fdfa767e6
NI14	https://newsroom.nissan-global.com/releases/release-ed7b0014763a42e1693c5c954e0607c2-180803-01-e?query=AESC
NI15	https://newsroom.nissan-global.com/releases/release-4a75570239bf1983b1e6a41b7d0456fc-nissan-creates-new-value-with-mobility-services?year=2018
NI16	https://www.shelbournemotors.com/nissan/news/what-is-nissan-intelligent-mobility/
NE1	https://www.forbes.com/sites/bertelschmitt/2016/12/16/carlos-ghosn-explains-why-making-your-own-batteries-is-dumb/#1d6b4bda2c73
NE2	https://www.electrive.com/2018/05/28/renault-nissan-mitsubishi-planning-ev-platform/
NE3	https://www.alliance-2022.com/about-us/
NE4	https://www.extremetech.com/extreme/287096-nissan-leaf-ev-400000-sales-tesla-model-3
NE5	https://en.wikipedia.org/wiki/Automotive_Energy_Supply_Corporation
NE6	https://cleantechnica.com/2018/05/12/nissan-renault-make-battery-deal-with-catl-worlds-largest-battery-manufacturer/
NE7	https://www.autonews.com/article/20180423/RETAIL07/180429936/nissan-wants-9-000-stores-renovated-worldwide-in-next-5-years
NE8	https://autovistagroup.com/news-and-insights/renault-nissan-alliance-ridesharing-service-use-fully-autonomous-cars-toyota
NE9	https://www.intelligenttransport.com/transport-news/82374/renault-nissan-waymo-driverless-services/
RENAULT	
RA1	Annual Report 2009
RA2	Annual Report 2010
RA3	Annual Report 2011

RA4	Annual Report 2012
RA5	Annual Report 2013
RA6	Annual Report 2014
RA7	Annual Report 2015
RA8	Annual Report 2016
RA9	Annual Report 2017
RI1	https://group.renault.com/en/news/blog-renault/groupe-renault-is-preparing-the-mobility-services-of-the-future-with-the-alliance-ventures-fund/
RI2	https://group.renault.com/en/news/blog-renault/developing-a-cleaner-smoother-more-efficient-form-of-mobility/
RI3	https://group.renault.com/en/innovation-2/openinnovation/
RI4	https://group.renault.com/en/innovation-2/electric-vehicle/
RI5	https://group.renault.com/en/talent/our-career-areas/engineering/
RI6	https://www.alliance-2022.com/news/renault-nissan-mitsubishi-launches-alliance-intelligent-cloud-on-microsoft-azure/
RE1	https://cleantechnica.com/2018/05/12/nissan-renault-make-battery-deal-with-catl-worlds-largest-battery-manufacturer/
RE2	https://www.autovistagroup.com/news-and-insights/renault-explore-distribution-models-company-denies-buyout-reports
RE3	https://www.intelligenttransport.com/transport-news/80896/renault-vulog-car-sharing-ready-electric-cars/
RE4	https://www.electrive.com/2018/10/01/renaults-car-sharing-programme-in-paris-to-kick-off-this-month/
RE5	https://www.electrive.com/2018/05/28/renault-nissan-mitsubishi-planning-ev-platform/
RE6	https://www.electrive.com/2018/03/12/renault-nissan-mitsubishi-wants-solid-state-batteries-by-2025/
RE7	https://www.electrive.com/2018/10/11/renault-joins-forces-with-emobility-partners-ev-sharing-kick-off-in-paris/
RE8	https://electrek.co/2017/08/29/renault-electric-car-charging-stations-used-ev-battery-packs/
RE9	https://www.thedrum.com/news/2019/06/11/audi-renault-and-honda-partner-with-alibaba-ai-and-voice-technology
DAIMLER	
DA1	Annual Report 2009
DA2	Annual Report 2010
DA3	Annual Report 2011
DA4	Annual Report 2012

DA5	Annual Report 2013
DA6	Annual Report 2014
DA7	Annual Report 2015
DA8	Annual Report 2016
DA9	Annual Report 2017
DA10	Annual Report 2018
DI1	https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-buys-battery-cells-in-a-total-volume-of-20-billion-euros.xhtml?oid=42042973
DI2	https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-takes-a-share-in-energy-expert-The-Mobility-House.xhtml?oid=30014987
DI3	https://www.daimler.com/dokumente/investoren/praesentationen/daimler-ir-corporatepresentation-fy-2018.pdf
DI4	https://www.daimler.com/innovation/case/electric/eq-brand.html
DI5	https://media.daimler.com/marsMediaSite/en/instance/ko/New-site-in-the-global-battery-production-network-Mercedes-Benz-Cars-to-build-battery-factory-in-Jawor-Poland.xhtml?oid=42365055
DI6	https://www.daimler.com/case/electric/en/
DI7	https://media.daimler.com/marsMediaSite/en/instance/ko/Plans-for-more-than-ten-different-all-electric-vehicles-by-2022-All-systems-are-go.xhtml?oid=29779739
DI8	https://www.daimler.com/innovation/case/electric/eq-brand.html
DI9	https://www.daimler.com/company/locations/tuscaloosa/
DI10	https://www.daimler.com/career/about-us/insights/logistics/
DI11	https://www.daimler.com/innovation/efficiency/kamenz2017.html
DI12	https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-buys-battery-cells-in-a-total-volume-of-20-billion-euros.xhtml?oid=42042973
DI13	https://www.mercedes-benz.com/nl/mercedes-me/connectivite/
DI14	https://media.mercedes-benz.it/strategic-partnership-between-daimler-and-baic-deepens-further-mercedes-benz-compact-car-models-to-be-localized-in-china/
DI15	https://media.daimler.com/marsMediaSite/en/instance/ko/Daimler-and-Baidu-to-Enhance-Strategic-Cooperation-in-Automated-Driving-and-Vehicle-Connectivity.xhtml?oid=40757403
DE1	https://privacy.vakmedianet.nl/logistiek/?ref=https://www.logistiek.nl/supply-chain/nieuws/2018/02/162449-101162449
DE2	https://www.theverge.com/2018/8/15/17685634/germany-car-industry-battery-cells
DE3	https://www.swotandpestle.com/daimler/
DE4	https://www.fleeteurope.com/en/smart-mobility/europe/features/daimler-financial-services-becomes-daimler-

	mobility?a=FJA05&t%5B0%5D=daimler%20financial%20services&t%5B1%5D=BMW&t%5B2%5D=moovel&t%5B3%5D=car2go&t%5B4%5D=Daimler&curl=1
DE5	https://www.autoexpress.co.uk/bmw/106082/bmw-and-daimler-invest-nearly-900m-in-pooled-mobility-services
DE6	https://www.automotiveit.com/daimler-restructures-for-project-future-prepares-for-more-partnerships/5542.article
DE7	https://www.companycartoday.co.uk/mercedes-and-bmw-to-merge-car-sharing-and-mobility-services/
DE8	https://www.extremetech.com/extreme/226685-mercedes-benz-parent-daimler-launches-us-mobility-service-called-moovel

Appendix 5 – Case study database

This database consists of: 1) summary table per case, 2) quantitative data per case, 3) interview transcripts and summaries, and 4) list of all NVivo codes per case.

Please contact the researcher to access this Appendix: emmakallen14@gmail.com

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