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Dialogue, Debate, and Discussion

A Capabilities Framework for Dynamic Competition: Assessing the Relative Chances of Incumbents, Start-Ups, and Diversifying Entrants

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ABSTRACT This essay argues that to assess the likelihood that incumbent firms will successfully make the required transformations to their strategy and operations in the face of technological transformations, it is not sufficient to investigate their dynamic capabilities. Whether an incumbent is likely to succeed in its effort to change itself via dynamic capabilities depends also on how quickly start-ups or diversifying entrants can build ordinary capabilities to offer the new technology at scale. We offer a framework to assess dynamic competition that integrates both ordinary and dynamic capabilities into the analysis by systematically comparing incumbents, start-ups, and diversifying entrants. We illustrate the framework with a case study of electric vehicles and aim to show how crucial such comparative analyses are for making well-founded predictions about the likelihood that incumbents will be able to maintain their leadership positions in the future.

KEYWORDS capabilities theory, electric vehicles (EVs), Google, incumbents versus start-ups, Tesla, VW

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INTRODUCTION

The concept of dynamic capabilities (Dosi, Nelson, & Winter, 2001; Teece, 2007; Teece, Pisano, & Shuen, 1997) is typically used to illuminate questions about whether incumbent firms are able to make significant changes in their product and service portfolios to maintain their market positions when demand for products and services shifts (Helfat & Peteraf, 2009). In the background of such questions, even though it is often not made explicit, is the idea that new start-ups or diversifying entrants could develop products and services that potentially take sales away from established companies if the established companies fail to

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produce these products and services themselves. If one wants to predict the future competitiveness of incumbent firms, this implies that a comparative evaluation of the capabilities of incumbents, potential start-ups, and diversifying entrants needs to be made. Whether or not an incumbent is likely to succeed in its effort to change itself via dynamic capabilities depends also on whether a new start-up or diversifying entrant is unable to develop required capabilities quickly enough to develop a leadership position in the new product or service. It seems that this idea has not been sufficiently highlighted and made explicit in the literature on dynamic capabilities. The purpose of this essay is to illustrate, with reference to the automobile sector, how crucial such comparative analyses are for making well-founded predictions (Mellers et al., 2015; Tetlock & Gardner, 2015) on the probability that incumbents will maintain their leadership positions in the future. We have chosen the automobile sector because of its importance to the economy. Directly and indirectly, the sector accounts for about 6% of jobs in the USA and Europe, as well as 10% in China (Acea, 2022; Alliance for Automotive Innovation, 2020; Daxueconsulting, 2020).

Both incumbents and start-ups need to develop new capabilities in the face of radical technological change. It is important to point out that from the start-up's perspective, the development of its capabilities is typically not only seen under the concept of dynamic capabilities but rather under the concept of developing ordinary capabilities (OCs). It seems that having no skills at all and scaling them up represents many similar challenges to those the incumbent face in developing new capabilities. The main difference is that the start-up is not hindered by existing routines and mindsets in building new capabilities (Hannan & Freeman, 1984; Howard-Grenville, Rerup, Langley, & Tsoukas, 2016). In other words, the start-up does not have to deal with legacy issues that make learning new things difficult, as is often the case with established companies. However, scaling up new capabilities involves a considerable change as studies of firm growth reveal. Wu, Murmann, Huang, and Guo (2020) recently documented this when describing the transformation of Huawei from 50 to 180,000 employees. The firm needed to frequently destroy old routines and develop new ones to operate at a greater scale. The change process was difficult and required from 1997 (when Huawei had 5,600 employees) to 2017 (when it had 180,000 employees), an expenditure of 1% of sales per.

In short, developing and scaling up OCs for start-ups is in many ways also a problem of change that incumbents face when trying to move from one skill set to another. Fearing that we might be misunderstood here, it is important to stress that incumbents face legacy issues when technology or markets transform in a big way, which made scholars such as Teece et al. (1997) develop the concept of dynamic capabilities in the first place. Evolutionary scholars like Murmann document that most incumbent firms are not able to change quickly enough and are selected out of an industry (Murmann, 2003, 2013; Murmann & Zhu, 2021). Start-ups have a clear advantage that they are not encumbered by entrenched routines and

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mindsets at the very beginning and can focus on developing routines tailor-made for the new opportunity. But scaling up also brings big challenges that need to be considered when analyzing the competitive positions of incumbents and start-ups. Huawei, for example, according to Tian and Wu (2015: xxv), had at least 400 competitors in its early years. The vast majority never reached any significant scale. Similarly, by 2019, 500 new firms had registered in China to develop electric vehicles (EVs) (Song, Suzuki, & Aou, 2019). Because of intense competition and economies of scale in automobile production, we can confidently predict now that most of them will never reach the significant scale.

How big such scaling challenges are and how much change in routines this requires depend strongly on the particular industry. Application software represents the low difficulty end of the spectrum. Once the software is written and put on the Apple or Android app store, the customer base can be scaled from one to hundreds of millions without much effort. But app software is a special case and should not blind us from realizing that scaling is often very difficult. Scaling up in-person medical services to millions, for instance, is much more difficult (Rao & Sutton, 2014). In the chemical industry, reactions that work on a small laboratory scale often do not work on a large production scale and companies have to invest substantial money in R&D to scale up production (Mowery, Landau, & Rosenberg, 1992). Similarly, scaling up an online store that sells physical products such as Amazon is much more difficult than scaling a software service such as Facebook. Serving hundreds of millions of customers with physical products at Amazon requires approximately 1.3 million employees, while Facebook can reach 2.8 billion monthly active users with 58,000 employees.

In this essay, we want to illustrate these arguments by analyzing some current competitive dynamics in the automotive industry. We argue that it is possible to develop a more systematic understanding of what the future of an industry (here automobiles) may look like if one not only investigates whether incumbents have dynamics capabilities but also evaluates the capabilities of possible start-ups and diversifying entrants. Our essay is inspired by Teece's (2018) analysis of capability distances that he presented in a debate about current developments in the automotive industry (Jiang & Lu, 2018; MacDuffie, 2018; Perkins & Murmann, 2018; Teece, 2018). Teece offers a capability gap matrix for incumbent automobile manufacturers. Teece argues that incumbent automobile producers face challenges because of four industry developments labeled as connectivity (C), autonomy (A), sharing of personal mobility (S), and electrification (E), also referred to as CASE. Connectivity describes that cars will be connected to the internet with many diverse applications. Autonomy embodies different levels of driver assistance divided into levels ranging from 1 to 5, where level 5 means the complete replacement of the human driver by autonomously acting operating systems. Sharing is based on the concept of multiple people sharing vehicles, with the aim of increasing vehicle utilization. Electrification is the transition to electrified powertrains that ultimately replace internal combustion engines (ICEs) and promise zero emissions

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at the point of use (Hoeft, 2021). Auto companies are presently focusing a great deal of their efforts on E, electrification to achieve the emissions targets set by governments. Electrification, therefore, is the focus of our article.

In a first step, we recapitulate the main points of an earlier debate between Jiang and Lu (2018), MacDuffie (2018), Perkins and Murmann (2018), and Teece (2018: 2019). Next, we present a capability analysis of three types of firms – incumbents (I), diversifying entrants (II), and start-ups (III) – that we considered relevant for assessing the future automotive industry. The capabilities have been derived from in-depth case studies of each firm type. We selected one representative example for each type: VW (incumbent), Google 2018–2020 (a possible diversifying entrant), and Tesla (a new venture) during its start-up phase (2003–2005) and during the time that it developed its Model S and successfully started selling it (2006–2014). This allows us to evaluate how quickly an entrant is able to build capabilities in an industry where new product auto platforms have historically taken five to ten years of development time, and in the case of Tesla's Model S have been reduced to five years.[1] Finally, we organize our observations into an integrated capabilities framework extending Teece (2018) that allows for more systematic predictions about the development in the automotive sector.

RECAP OF THE PRECEDING DEBATE

Based on a study of the history of Tesla, Perkins and Murmann (2018) argued that any company investing US$1 billion to US$2 billion could design, develop, and manufacture an EV in three to four years due to lower barriers of entry associated with EV manufacturing and the more modular architecture of EVs. For this reason, they see the market positions of established automakers at risk and a migration of the value chain to new entrants with strong technological capabilities. MacDuffie (2018) did not agree that EVs are more modular and argued that a start-up needs to master the same capabilities of incumbents to manufacture EVs, and the process would be long and slow. Teece (2018) wrote the final commentary in this debate. While he agreed with MacDuffie (2018) that incumbents had important capabilities that would be useful in making cars of the future that start-ups needed to master, he argued that incumbents themselves need to develop a host of new capabilities to compete successfully in the future.

He then set out to identify the areas where incumbent original equipment manufacturers (OEMs) would face small and large capability gaps using a matrix framework consisting of four key technological developments (CASE) and three dimensions of capability distances (Technology, Business Model, and Market) (Table 1). Consistent with many other observers, Teece (2018) sees increased connectivity of cars via the internet (C), autonomous driving (A), the sharing rather than owning of cars (S), and electrification of car powertrains (E) as the main challenges incumbents face. To offer a more fine-grained analysis of

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Table 1. Distances to new capabilities from traditional car manufacturer capabilities

	Three dimensions of capability distance		
	Technology	*Business model*	*Market*
EVs	*Medium*	*Near*	*Medium*
Autonomous vehicles	*Far*	*Zero*	*Near*
Connected cars	*Medium*	*Medium*	*Zero*
Personal mobility Services	*Medium*	*Far*	*Far*

Source: Teece (2018).

capability challenges that incumbents face, Teece (2018) investigates the degree to which the four developments entail new technology, new revenue and profit generation logic (i.e., business models), and new markets (i.e., new types of customers requiring new sales and marketing expertise). He then passes judgement for each of the 12 cells in the matrix (Table 1) on how near or far the required new capabilities are using four levels of capability distances: zero, near, medium, and far. Teece (2018) concludes that in terms of successfully developing EVs, incumbent firms face medium distance in their technological capabilities, near distance in their business model, and medium distance in terms of understanding and winning customers of EVs.

Areas of Expansion

We are building on Teece's (2018) contribution and want to extend it by focusing on EVs. As indicated in the introduction, to get a complete picture of the competitive opportunities of incumbents in adapting to the new industry dynamics, one must also assess the opportunities of other types of firms potentially relevant to the industry. These are the potential BigTech diversifying entrants such as Google, Amazon, Tencent, Alibaba, and, of course, new start-ups that presently capture the fancy of investors (e.g., Tesla, Rivian, and NIO). We extend Teece's framework by adding new ventures and diversifying firms (e.g., from the IT technology industry) to the analysis and assessing their capability gaps regarding EVs (E). By integrating both ordinary and dynamic capability assessment in one framework, one can deal with all three types of players (incumbents, new ventures, and diversifying entrants) and make more systematic predictions about future dynamics in the auto industry.

METHODS

To sharpen the analysis of technology, market, and business model-related capabilities, we created a map of OCs that an automobile manufacturer needs to possess or be able to contract for. To do this, we relied on a patent (Arboletti, Torresani,

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Palle, & Segerberg, 2014) filed for a comprehensive capability assessment of automobile companies and on public reports. Building an overview of OCs and the processes they cover, we classified OCs into Teece's (2018) three dimensions of capability distances (Technology, Business Model, and Market). We identified 26 (7 technology-focused, 9 market-focused, and 10 business model-focused) OCs that served as the basis for a case study analysis of representatives of the three types of companies in the auto sector (for detailed definitions, see Appendix I). We chose the case of VW in 2020 as our representative of incumbent firms, given that it is one of the largest firms in the world and is making a big push toward electrification of its fleet. For diversifying entrants, we used Google with its current (2020) capabilities. For the new venture, we chose Tesla in its founding period from 2003 to 2005 and its development phase from 2006 to 2014, where we could draw Perkins and Murmann (2018) and conduct additional research to inform our analysis of the level of the OCs in the start-up phase.[2] In the case of a start-up and diversifying entrant, we are not only investigating whether the firm has the capabilities itself but also whether it could buy or borrow the capability in the market. Clearly no entrant has to develop all capabilities in-house. As Stigler (1963) pointed out a long time ago, when a new industry emerges, a market for raw materials or components may not exist and firms have to make them in-house. But as demand grows for final products, suppliers emerge. Today there are more auto battery suppliers then when Tesla started in 2003. Would-be EV entrants can contract for many capabilities, particularly since the auto industry is over 100 years old and EVs share a large number of components with traditional cars. These contracting options have been incorporated into our analysis capabilities of entrants in comparison to OEMs.

To evaluate the aforementioned 26 OCs, we created qualitative profiles of the three types of firms for each of the 26 capabilities. For each type of firm, we rated the degree to which they possessed a particular capability using the following coding: +++ best-in-class capability; ++ strong capability; + moderate capability; − weak capability; − − very weak capability; − − − capability non-existent. The goal behind the qualitative profiles was to collect as many data points as possible to make a sound comparison of capabilities. The documentation of the profiles is too large to include in this article. However, to give the reader an example of how we proceeded in our evaluation, we present in Table 2 for one capability (EV assembly) the summary qualitative profile and the evaluation for each type of firm, as well as the main data sources that the evaluation is based on.

We also enlisted two experts in the auto industry to validate our results.

RESULTS

We analyzed the 26 OCs with publicly available information from the companies, newspaper databases, recent news, and data from forums. We converted this qualitative analysis into comparable scores, similar to the scoring introduced by Teece

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Table 2. Example qualitative profile and capability assessment for EV assembly capability

Capability	*VW*	*Google*	*Tesla (2003–2005)*
Manufacturing and Assembly	• Investment of US$ 33 billion until 2024 for aligning plants to EV-only assembly • Planned capacity of 28 million EV until 2028 • Scaling possibilities to the same extent as for ICEs	• No EVs produced – analysis of current contractors for manufacturing • Already developed a concept car for EVs with Waymo, which was not pursued further • First experimental experiences	• Manufacturing at this time was handled via Lotus • The focus in the start-up phase was on the drivetrain • Tesla took over the chassis from Lotus and did the marriage (powertrain in chassis) in the final assembly
Ranking	• +++ • Due to the rapid restructuring of the plants to EV production (over five locations by the end of 2021) and the high scalability	• – – • Minimal knowledge acquired through experimental trials with Waymo, which led to the second worst rating, as not entirely non-existent	• – • Due to the Lotus partnership, Tesla was able to acquire capabilities in assembly, including powertrain, but still in very small unit sizes
Main Evidence	Five articles: • Ruffo (2020) • Volkswagen (2018) • Volkswagen (2019) • Volkswagen (2020) • Rauwald (2021)	Four articles: • Rudgard (2019) • Ting-Fang (2018) • Feng and Lu (2011) • Bigelow (2019)	One book and two articles: • Vance (2015) • Eberhard (2006) • Casner (2008)

(2018). If one of the analyzed companies had best-in-class capabilities, it was marked with triple plus (+++) or with a numerical value of 3 and an equivalent gradation, which can be seen in Table 2. The rating was always compared with the current best available capability known in the market and set in relation to it. To capture the new venture's capability development potential, we also evaluated Tesla after ten years and when it sold 33,000 EVs (Model S particularly) per year (end of 2014). We want to acknowledge the EV sector has developed considerably since the early days of Tesla and that new start-ups would find it easier today to buy component technologies of EVs from suppliers compared to the early period of Tesla. For Tesla in its earliest days (2003–2005), achieving best-in-class capabilities would have been very difficult to achieve. A + (moderate capability) is already an outstanding rating for a New Venture. Applying this approach consistently led us, after several iterations, to the overall results in Table 3.

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Table 3. Capability assessment for the EV dimension of the differing firm types

			New Ventures†	
	Incumbents (VW)	*Big Techs* (Google/Waymo)*	*Tesla (2003–2005)*	*(2006–2014)*
New EV Development	++	–	+	+++
EV Engineering and Design	++	+	++	+++
Software Development	–	+++	++	+++
Lifecycle Management	++	–	– –	++
Procurement Strategy	++	–	+	++
Strategic Sourcing and Category Management	+++	+	+	+
Supplier Relationship Management	+++	+++	+	+
Inbound Logistics	+++	– –	+	+
Manufacturing and Assembly	+++	– –	–	+
Outbound Logistics	+++	+	– – –	–
Brand Management	+++	+++	++	+++
Product and Service Marketing	+++	+++	– –	+
Channel Integration and Management	+++	+++	+	++
Product and Services Sales	++	++	– –	+
Customer Relationship Management (CRM)	–	++	–	+
Production Forecasting and Planning	++	+	– –	–
Service Strategy	++	– – –	– – –	–
Technical Support	++	+	– – –	+
Warranty and Recall Campaign Management	+++	+	+	++
Customer Experience	+	+	+	++
Warehouse Management	++	–	– – –	–
Order Management	++	+	–	+
Quality Management	++	+	+	+
Remanufacturing and Recycle Management	++	++	– – –	–
Environment, Health and Safety Management	++	+++	+	++
Research & Development	+++	+++	+	++

Notes: Market Capabilities; Technology Capabilities; Business Model Capabilities.

+++ Best-in-class capability; ++ Strong capability; + Moderate capability; – Weak capability; – – Very weak capability; – – – Capability non-existent.

*Google/Waymo has been assessed by overlapping capabilities developed in its hardware unit since it does not pursue an EV strategy either with Waymo or with another project.

†With the development of the EV market, new companies now have better access to high-quality capabilities compared to Tesla, so some capabilities may seem conservatively rated.

Source: Own elaboration.

Discussion of Capability Assessment

The capability assessment shows where the respective companies have capability gaps. If the qualitative assessment in Table 3 is given corresponding weighted

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Table 4. Quantitative overview of the capability assessment for the EV dimension

			New Ventures	
	Incumbents (VW)	*Big Techs* (Google/Waymo)*	*Tesla (2003–2005)*	*(2006–2014)*
Market Capabilities	2.00	1.44	−0.33	1.33
Technological Capabilities	1.44	0.67	0.11	1.22
Business Model Capabilities	2.40	1.11	−0.67	0.78
Total	**1.95**	**1.07**	**−0.30**	**1.11**

Note: *Google/Waymo has been assessed by overlapping capabilities developed in its hardware unit since it does not pursue an EV strategy neither with Waymo nor with another project.
Source: Our analysis.

quantitative values (+++ corresponds to 3 positive points, − − − corresponds to 3 negative points; a *higher* score means *higher* capabilities), an overall result emerges: to bring into market EV vehicles at scale, incumbents have the strongest capabilities based primarily on their strong business model and market capabilities (see Table 4).

It is important to emphasize that the study explicitly assessed Tesla's founding years to examine what a new venture that managed to succeed globally brought to the table from the beginning. First and foremost, these are technological capabilities and, specifically, engineering and software capabilities. The weak market and business model capabilities result from non-existent capabilities at that time. For example, Tesla was so busy developing the Roadster in the early years that barely any technical support or service strategy was developed. The focus of Tesla in the early years was clearly on its strong engineering capabilities. To close the capability gaps, Tesla had to go through a difficult learning process, which was primarily mastered under the leadership of the main investor Elon Musk, but after the period of interest for us.

Google's low scores in terms of technology and business model are striking. One reason important reason is that the industrial architecture in the electronics market barely requires any in-house manufacturing. This is why many capabilities that are associated with assembly in the automotive industry tend to be weaker at Google. Because Google orchestrates a large number of suppliers for its hardware products (smartphones, tablets, smart speakers, etc.), it has some rudimentary system integration capabilities, which start-ups, in particular, find very difficult to build. But they would not be sufficient to easily enter the design and manufacturing of automobiles. For similar reasons, Apple reportedly is looking for a partner to manufacture cars (Higgins, Koh, & McWhirter, 2021). These weak manufacturing and system design capabilities are counterweighted by Google's strong software capabilities, which incumbent auto firms do not have to the same extent. Google is not experienced with setting up manufacturing activities, even though it has now

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gained design and engineering experience from its electronic consumer goods. Google is well positioned in the market dimension from the experience of its hardware products. With a well-known brand and good customer relations, Google has a good standing to attract, even as a new entrant, enthusiasts of the brand as potential buyers.

CONCLUSION

A pure focus on incumbents and their capabilities with respect to new technologies and business models can lead to an overestimation of their challenges and to an underestimation of the challenges faced by new companies and diversifying market players. To trial run these ideas, we made a comparative analysis of the automotive industry, incorporating this broader perspective. We found that incumbents appear to possess a much stronger position than one might first assume. Indeed, in an early article on Tesla, Perkins and Murmann (2018) pointed out that Big Tech was well positioned to challenge the incumbents. Tesla, as the first significant EV start-up in the auto industry, was able to develop a brand that puts serious pressure on incumbent firms. In our new analysis, we realized that a new EV start-up today would have a much more difficult task to build such a strong brand as Tesla, given all incumbent firms have now strongly moved into EVs. Rather than seeing Tesla's success with building a brand is representative for all new start-ups in the EV space, one should treat it as a special case that can probably not be easily replicated. NIO in China is presently imitating the Tesla branding strategy by having luxury showrooms in city centers. It differs from Tesla in that it reduced the cost of EVs by offering the battery as a service, allowing users to get the battery swapped in 5 min, thereby reducing the pain point of long EV charging times. NIO has begun selling cars in Norway in 2021, which is the leading EV market in Europe by the rate of adoption. When NIO aims to expand further in the USA (speculated for later in 2022), it will be a great test case to see whether any start-up other than Tesla can build a brand that rivals the incumbent players.

In China, the transition to EV has led to a wave of start-ups. Song et al. (2019) report that 500 new firms have registered to develop battery electric vehicles (BEVs).[3] Most of these start-ups have never managed to produce a credible prototype. But there are a number of Chinese start-ups, such as NIO, Xpeng, and Li Auto, that have produced cutting edge EVs. Realizing their capability gaps, these Chinese start-ups have contracted with incumbent auto firms to manufacture their cars. For example, NIO outsourced all its manufacturing to the incumbent firm JAC, founded in 1964 (Jiang & Lu, 2018). Similarly, Xpeng contracted the manufacture of its first model, the G3, with Haima, which had 30 years of experience in manufacturing automobiles (Xpeng Inc, 2021). Different from US market environment, Chinese tech giants such as Tencent and Alibaba have collaborated with EV start-ups instead of pursuing a more go-it-alone competitive strategy of

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Google and Apple (Jiang & Lu, 2018). Consistent with this approach, Tencent holds 11.47% stake in NIO (Fintel, 2021) and Alibaba held a 19% stake in Xpeng (Narayanan, 2020). Alibaba is currently participating in a new EV brand called IM Motors together with incumbent player SAIC Motor holding, which is producing the car (Ackroyd, 2022). SAIC reportedly holds a 54% share in the venture and Alibaba 18% (Wikipedia, 2020). What these investments highlight is that software, the cloud, and AI capabilities will play a much larger role in the future.

Altogether, in USA and Europe, incumbents are better positioned than new start-ups and diversifying players. To maintain their dominance in market share, incumbents need to address their capability deficit faster than new start-ups, and diversifying entrants can build their capabilities.

Our analysis suggests that incumbents' biggest gaps are in software capabilities or the 'brain' of EVs as Adner and Lieberman (2021) call it. The bottleneck for closing this is recruiting software talent that Silicon Valley is often paid more than high-level managers. This was never done in German car firms, and given that union contracts pose challenges to changing HR processes, the catch-up process in this area is likely to be slower. The VW group recently put its software development into a new company (Cariad) to overcome hurdles of providing competitive software for EVs in its old structures and hopes to increase its in-house software production by 60% compared to 10% in 2019 (*Reuters*, 2019).

In future work, we plan to analyze EV software requirements to investigate how to accurately measure the capabilities of different players in this domain. Presently, we suspect that if incumbent players dramatically lose market share in ten years, it will be because they have not mastered software in the way Silicon Valley and China Big Tech companies have.

While we used the automotive industry to illustrate or argue, it is important to emphasize that we are making a general argument in this essay that applies to all industries. Focusing solely on the dynamic capabilities of incumbent players is not sufficient to predict the future competitive position of incumbent firms. Whether or not an incumbent is likely to succeed in its effort to change itself via dynamic capabilities depends also on whether a new start-up or diversifying entrant is unable to develop required OCs quickly enough to develop a leadership position in the new product or service. Scholars of technological disruptions have documented many cases where start-ups have captured leadership positions in industry (Christensen, 1997; Gans, 2016; Murmann, 2003; Tushman & Anderson, 1986). To predict the future competitiveness of incumbent firms, it is necessary to make a comparative and comprehensive evaluation of the capabilities of incumbents, potential start-ups, and diversifying entrants, which compete in a product class. For example, Apple was a diversifying entrant into portable music players in 2001. It dethroned Sony from its leadership position because software capabilities became key in the new generation of mp3 music players and Apple had better software skills than Sony. A competitive analysis that solely focuses dynamic capabilities of incumbent players has a limited field of vision.

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NOTES

We would like to thank Jan Küpker, Thomas Li, Srinath Rengarajan, and Benedikt Schuler for their helpful comments and suggestions on earlier versions of this essay. Can Huang provided excellent editorial guidance and an anonymous reviewer pushed us to be more clear in our arguments. We also thank the teams of Hong Jiang and Feng Lu and John Blaire and David Teece for writing commentaries. There is genuine uncertainty how new technologies will affect established firms and a debate about how this may all play out it necessary to become more sophisticated in analyzing future developments. In his work on forecasting abilities Phil Tetlock and colleagues have taught us that we can only become better forecasters if we learn to synthesize diverse pieces of evidence and ideas. To see how well strategy management theories can help guide the actions of managers, we believe that it would be useful if more scholars adopted forward-looking research designs as we have done here and make concrete predictions based on different theories. This would allow the field of strategic management to see which frameworks lead to better predictions and which ones do not.

[1] One has to distinguish between new platforms and new models. Car companies often make cosmetic changes to cars every two to three years. The development of entirely new platforms takes much longer. See also a good debate on this on https://www.quora.com/Automobile-Design-How-long-does-it-take-to-develop-a-car-design-from-scratch

[2] We chose Tesla because it is the most successful start-up to date and has left the most detailed information of its capabilities.

[3] The number is even much larger if one considers the entire sector connected new energy vehicles. There were 321,000 businesses that registered themselves in this sector. 78,000 businesses entered alone in 2020 and 81,000 entered from January to mid-August in 2021 (Cheng, 2021).

APPENDIX I

Brief explanations of the different kinds of firm capabilities assessed in our study of the automobile sector.

Table A1. Technological capabilities for the EV paradigm shift

EV Engineering and Design	Specification of the product design including powertrain, chassis, electronics, and interior and exterior design
New EV Development	Adjustment toward new innovation/technology trends and market requirements including all processes from product planning toward product ramp-up and production launch
Software Engineering	Shift from mechanical-intensive to software-intensive vehicles. Includes operating system architecture and design, testing, and reuse of software
Lifecycle Management	Business process and technology architecture for capturing and maintaining product information across the entire lifecycle. Capability splits into two main processes: – Management of product and process structure – Management of changes
Manufacturing and Assembly	Management of material, manpower, services, and testing of vehicles in detailed production scheduling and sequencing
Remanufacturing and Recycle Management	Reverse logistics in order to collect used vehicles or parts and design processes and products for remanufacturing without cannibalizing new product sales
Research & Development	Exploring of existing limitations on EV technology, production processes, or after-sale services and delivering an improved answer

Source: Own elaboration based on Arboletti et al. (2014).

Table A2. Market capabilities for the EV paradigm shift

Brand Management	Increasing the perceived value to the customer, and increasing of brand franchise and the establishment of brand quality. Capability splits into two main processes: – Management of brand positioning – Management of brand portfolio
Product and Service Marketing	A customer-centric approach which drives all high-performance marketing activities. Knowledge about key consumers, categories, and cross-category trends.
Channel Integration and Management	Management of network strategy/sales channels and network development. Automotive OEMs approach: – Direct channels (OEM experience worlds, internet); – Indirect channels (dealers, wholesalers)
Product and Services Sales	Forecasting and planning sales including early recognition of structural or culture-related discontinuous changes including their consequences for the firm's revenue streams (corporate foresight); building a sales organization that handles customer inquiries, prospects, new orders, and manages buyback programs
Customer Relationship Management (CRM)	Establishing a customer-centric strategy that influences operational processes and business functions in order to retain customers and increase their loyalty
Service Strategy	Create, develop, tailor, and monitor an overall set of service offerings based on customer, competitor, channel, and industry analysis, in addition to EV sales
Technical Support	Providing EV maintenance services as well as internal technological management
Warranty and Recall Campaign Management	Definition of warranty coverage and procedure management when it comes to claims. Including dealing with the warranty process, the execution of warranty audits, and striving for supplier collaboration
Customer Experience	Master to increase the buyer's well-being and satisfaction with the product/service. Composed of three main fields: – Customer journey – Brand touchpoints the customer interacts with – Environment customer experiences during usage

Source: Own elaboration based on Arboletti et al. (2014).

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Table A3. Business model capabilities for the EV paradigm shift

Procurement Strategy	Development and implementation of a procurement strategy and procurement operating model, category-specific sourcing, and use of cross-company sourcing synergies. Definition of key performance indicators (KPIs) to manage performance
Strategic Sourcing and Category Management	Sourcing of component suppliers based on KPIs to develop long-term supplier relationships; categories of components in order to have general procurement strategies for the parts in question
Supplier Relationship Management	Management of supplier performance, contracts and compliance, integration and development, and joint improvement projects
Inbound Logistics	Planning of inbound transportation, management of material quality, optimization of inventory and logistics, just-in-time delivery
Warehouse Management	Management of inventory and replenishment. Includes picking, packing, and shipping, kits processing, and security of sensitive and dangerous technology components
Quality Management	Definition of quality specifications and management of quality testing (internal and external). Improvement plans for quality.
Order Management	Management of vehicle to order configuration and delivery to the customer; includes customization orders
Outbound Logistics	Planning and scheduling of vehicle deliveries including shipping and transportation
Production Forecasting and Planning	Detailed production plan for estimated demand in coordination with close supplier collaboration to plan adequate material requirements
Environment, Health, and Safety Management	Environment, health, and safety programs within the organization and corresponding KPIs to ensure their fulfilment

Source: Own elaboration based on Arboletti et al. (2014).

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