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Closing Time? Incumbent Strategies during Ecosystem Emergence

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ABSTRACT

By changing how firms compete, the trend towards ecosystems and platforms has the potential to disrupt entire industries and challenge established firms. The literature shows that incumbents can respond to this trend by using either an open strategy (which focuses on collaboration, and the firm integrating its product with existing ecosystems) or a closed strategy (which entails a firm building its own, self-orchestrated ecosystem). However, we lack systematic evidence on how firms choose between these strategies and what challenges they face as they seek to implement them. To address this question, we use a qualitative, comparative case study on the three leading automotive producers in Germany—Mercedes-Benz, BMW, and Volkswagen—as they respond to the trend towards software-based vehicles. We find that an open strategy can lead to profit and power inertia in the ecosystem, which may induce firms to become less open. In contrast, a closed strategy is connected to organization-internal structural and skill inertia, which puts pressure on firms to open up. Moreover, we show that a closed strategy can be implemented more easily if the firm is early in responding to the ecosystem trend, since this provides more time to overcome structural and skill inertia. By providing detailed insights into how incumbents balance open vs. closed strategies in response to ecosystem emergence, our study makes important contributions to the literature on ecosystems and platforms. Moreover, we contribute to the literature on incumbent adaptation by providing detailed insights into the inertia firms face in the context of ecosystem disruptions.

INTRODUCTION

In recent years, the diffusion of digital technologies has challenged firms in a large number of industries (Hanelt et al., 2021; McIntyre et al., 2021). A specific characteristic of these technologies is that they are closely tied to the emergence of so-called platform ecosystems (Ansari et al., 2016). Ecosystems are defined as sets of companies that interact to generate joint value for their customers through complementary products or services (Jacobides et al., 2018). In platform ecosystems, customer value is no longer defined by a single firm, but generated through the interplay of many firms that develop

complementary services and goods for a focal platform (Adner, 2006; Kapoor, 2018). For example, the value of Apple's iPhone is highly dependent on cooperation with firms and individuals that develop complementary apps (Agarwal & Kapoor, 2018; Dattée et al., 2018). The importance of complements leads to a fundamental shift in the logics of strategizing and competition (Adner, 2006; Jacobides et al., 2018). Rather than competition taking place between individual firms, entire networks of firms compete with each other both within and across ecosystems (Adner, 2017). In order to remain competitive, incumbent firms therefore must adjust their strategies and organizational structures as their industry shifts toward an ecosystem approach (Ansari et al., 2016; Ozcan & Hannah, 2020).

As ecosystems gain importance in practice, they have also aroused the interest of management scholars. In this context, ecosystems research has investigated what actors exist in an ecosystem, how value is created, and how different actors in the ecosystem interact (Jacobides et al., 2018; Kapoor, 2018). For example, the literature has investigated how firms can manage the tradeoff between cooperation and competition that arises in an ecosystem as different actors strive to create customer value through their joint offer (Daymond et al., 2023). From this strategic stance, various studies have analyzed who stands the best chance of becoming the ecosystem orchestrator and how firms can occupy strategic bottlenecks in the ecosystem to capture most of the value (Jacobides, 2019). For example, recent studies show how firms can use the potential of complementarities and coopetition to take advantage of the dynamics of ecosystems and adopt a more powerful role (Adner & Lieberman, 2021; Borner et al., 2023).

While our understanding of ecosystems has deepened greatly in recent years, most of the literature has focused on start-ups or digitally proficient firms that have grown up with the ecosystem approach (Adner, 2012; Kapoor & Agarwal, 2017). Recently, however, scholars have become more interested in how incumbent firms can respond as their industry shifts from a supply chain-oriented, hierarchical order to an approach that is more strongly based on cooperation and joint development targets, as is the case for ecosystem approaches (Falcke et al., 2024; Stonig et al., 2022; van Dyck et al., 2024). In this context, scholars have started to investigate how incumbent firms can build a platform business around their focal product or core competency (Gawer & Cusumano, 2008; Hagiu & Altman,

Elizabeth, J., 2017; Stonig et al., 2022; van Dyck et al., 2024; Zhu & Furr, 2016), suggesting that incumbents can choose between two generic strategies, open or closed, that form the two extremes of a continuum (Ozcan & Hannah, 2020). In an open strategy, firms collaborate with complementors and integrate their product with existing ecosystems (Baldwin, 2019), which offers greater potential for growth but entails increased uncertainty (Adner, 2006) and giving up a greater share of value creation and related profits (Agarwal & Kapoor, 2023; Gueler & Schneider, 2021). In a closed strategy, firms build and orchestrate the ecosystem themselves, which potentially allows them to capture a greater share of the value (Eisenmann et al., 2009) but also entails the risk of limited ecosystem growth (Parker & van Alstyne, 2017).

Despite increasing research on incumbents' strategies in the context of ecosystems, we lack systematic evidence on the challenges incumbent firms face as they respond to emerging ecosystems. Specifically, from the literature of incumbent adaptation, we know that established firms often encounter different types of organizational inertia when they try to address radical change in their environment. For instance, prior research has shown that incumbents may encounter cognitive inertia (Kaplan, 2008) or inertia arising from routines and entrenched rules (Edmondson et al., 2001), resource inflexibility (Gilbert, 2005), and existing organizational structures (Argyres & Silverman, 2004). Yet, the literature on incumbent adaptation and organizational inertia focuses on firms' responses to technological change (Eggers & Park, 2018) rather than investigating how incumbents react to the emergence of ecosystems as a new industry structure and competitive logic (Adner & Lieberman, 2021). Against this background, we investigate how incumbent firms choose between open and closed strategies in response to ecosystem emergence and which challenges firms face as they seek to implement them. Investigating this question is important, as it holds the potential to generate important insights into how firms can survive in the face of ecosystem emergence and to strengthen the connection between the two major research streams on platform ecosystems and incumbent adaptation.

To address our research question, we conducted a comparative case study of the three largest German automotive manufacturers with a longstanding history in the industry: Mercedes-Benz, BMW,

and Volkswagen. Our setting is ideal, since (1) the automotive industry is facing a radical change toward software-defined vehicles, which is connected with the need to reconfigure the industry architecture toward platform ecosystems (Adner & Lieberman, 2021; Jacobides & MacDuffie, 2013) and (2) the selected firms differ in the extent to which they relied on open vs. closed strategies and their resulting inertia. Investigating the reasons driving these differences allowed us to untangle the inertia firms faced as they embarked on the journey toward ecosystems.

Our study makes two main contributions to the literatures on ecosystems and platforms (e.g., Jacobides et al., 2018) and incumbent adaptation (e.g., Eggers & Park, 2018). First, we add to the literature on ecosystems by generating insights into how firms choose between open and closed approaches when responding to ecosystem emergence. We find that, in line with the literature (Eisenmann et al., 2009), firms pursue closed approaches if they aspire to the role of ecosystem orchestrator and possess the necessary resources to develop their own ecosystem. At the same time, we find that while a closed ecosystem approach generally appears more attractive to firms, it is feasible primarily for proactive companies that shift towards an ecosystem approach early on, when ample time remains to overcome inertia without lagging behind competitors. This is because an early start allows firms to build skills and structure gradually over time. If the industry has already matured and ecosystem approaches have been implemented by competitors (both incumbents and new entrants), firms are better off pursuing a more open approach that leverages external skills, even though this might oblige them to give up some power and profits.

Second, our study contributes to the literature on incumbent adaptation by providing detailed insights into the inertia firms face in the context of ecosystem disruptions (Cozzolino et al., 2018; Eggers & Park, 2018). Specifically, we find that open and closed ecosystem strategies are linked with different types of inertia. Firms pursuing an open strategy experience profit and power inertia in the ecosystem, which prevents them from swiftly partnering with component providers and complementors. Firms pursuing a closed strategy, in contrast, will experience internal structural and skill inertia that may significantly delay the implementation of a proprietary ecosystem. We observe that inertia may require

firms to shift their approach from closed toward open and vice versa, such that successfully navigating ecosystem emergence requires balancing the two poles. This finding is important, as it suggests a tradeoff between long-term prospects and short-term performance in ecosystem development. In the long run, a more closed strategy promises greater control and returns. Yet, in the short run, this more ambitious strategy is connected with severe inertia, which impairs short-term performance and may even threaten organizational survival.

THEORETICAL BACKGROUND

In the literature, ecosystems are defined as sets of interacting companies that depend on each other to create value (e.g., Kapoor, 2018; McIntyre et al., 2021). Three types of ecosystems are conceptualized in the literature: business, innovation, and platform ecosystems. We focus on the last of these, in which firms align around a technological architecture known as a platform (Jacobides et al., 2018). The provider of the platform and complementors divide up value creation among themselves and can thereby create an ecosystem around the focal platform and its offer (Kapoor, 2018). In contrast to traditional buyer–supplier relationships, companies in platform ecosystems engage in a dynamic, more committed, and less hierarchical mode of value creation (Cuypers et al., 2021; Geyskens et al., 2006). At the same time, ecosystems focus on the central value proposition; involve decentralization, interdependence, and complementarities; and potentially have no fixed time horizon (Adner, 2017), all of which set them apart from strategic alliances (Parmigiani & Rivera-Santos, 2011). Complementors can connect to the platform via technical standards or shared or open-source technologies (e.g., programming interfaces, software development kits for IT-related ecosystems). As a result, complementors can not only gain access to potential customers but can also join in with complementary innovation on the platform and are essential to the value created by the ecosystem as a whole (Jacobides et al., 2018). The extent to which complementors gain access to the platform and customers and can participate in innovation depends on the governance of the platform sponsor or ecosystem orchestrator (which, in most cases, are one and the same) (Eisenmann et al., 2009; West, 2003).

Much research has explored how ecosystem orchestrators interact with complementors and how complementors interact among themselves (e.g., Falcke et al., 2024; Granstrand & Holgersson, 2020; Hannah & Eisenhardt, 2018). The literature shows that designing firm strategies in the context of ecosystems involves a delicate tradeoff between cooperation and competition (Ansari et al., 2016; Daymond et al., 2023; Khanagha et al., 2022). On the one hand, firms need to cooperate with other firms in their ecosystem to ensure their ecosystem creates value for customers and is able to compete with other ecosystems (Kapoor, 2013). On the other hand, firms have been found to seek a dominant position in the ecosystem in order to capture as much of the generated value as possible and define the rules of cooperation on the central platform (Gawer, 2022; Gawer & Cusumano, 2008).

Incumbents' Ecosystem Strategies

While recent research provides rich insights into the strategies firms use within and across ecosystems (Adner, 2017; Hannah, 2018), most extant research has focused on start-ups and digitally proficient firms that have grown up with an ecosystem approach. However, given that ecosystems increasingly disrupt established industries, more recently, scholars have also started to explore how firms pursuing a traditional business logic (i.e., one that is not geared toward mobilizing complements or competing at ecosystem level) can adapt to emerging ecosystems (Falcke et al., 2024; Khanagha et al., 2022; Stonig et al., 2022). Prior ecosystems literature describes two strategies for companies seeking to build an ecosystem, which form the two extremes of a continuum: (1) opening up to partners and orchestrating an open ecosystem approach (open strategy) or (2) setting firm ecosystem boundaries and controlling a large share of the ecosystem internally (closed strategy) (Jacobides, 2019; van Dyck et al., 2024). Ecosystem research also explains that there are several other strategies between these two extremes and that firms' strategies may shift over time (Ansari et al., 2016; Jacobides et al., 2018; O'Mahony & Karp, 2022). Gawer and Cusumano (2008) even describe the need to strike the right balance between open and closed as "perhaps the greatest challenge to platform leadership" (p. 30). The following paragraphs describe the advantages and disadvantages of a closed vs. an open strategy, respectively.

Open strategy. Adopting an open approach requires firms to share value creation and value capture in their ecosystem but also allows their platform to become more valuable through the participation of a wider array of complementors (Adner & Kapoor, 2010; O'Mahony & Karp, 2022). By attracting more complementors, an ecosystem's platform can increase its adoption and relevance (West, 2003), benefit from network effects (Gawer, 2014), reduce the cost of innovation (Hippel & Krogh, 2003), and thereby enhance the value of the platform (Rietveld et al., 2019). In ecosystems, value-creating relationships emerge as a consequence of co-specialization governed by standards set by the orchestrator and need not necessarily be announced like formal alliances between organizations (Shipilov & Gawer, 2020). For example, Google's Android software platform is very valuable since many complementors develop applications for it (Kapoor & Agarwal, 2017). The firm provides the basic platform architecture upon which further complementors can provide their products and services, e.g., by means of standardized interfaces or a standardized coding language (Adner, 2017; McIntyre et al., 2021). This allows open systems to reach a wider community of potential complementors and has the advantage of enhancing customer value through a wider-ranging offer (West, 2003). In addition, as Toh and Agarwal (2023) show, complementors may enable platform owners (i.e., ecosystem orchestrators) to learn about the opportunities in their product market and allow them to enter the market with their own offering later on.

To decide on the form of cooperation in their ecosystem, orchestrators have to formulate rules for complementor participation (i.e., who can join and who is excluded) (O'Mahony & Karp, 2022; Parker & van Alstyne, 2017). In an open system, this may mean that anyone can participate, but also that firms open up to partners to generate joint value (Kapoor, 2018). Cooperation in this context can take different forms. One form is to jointly develop a value proposition in a strategic partnership and hence share the profits of co-innovation (Hannah, 2018; Lanzolla & Markides, 2022). Another form is to use standards and allow complementors to access the orchestrator's platform to deliver services of their own that are compatible with the platform (Gawer & Cusumano, 2008; Stonig et al., 2022; Zhang et al., 2022). Openness to partners may be present as early as knowledge search, i.e., the product development process

(Cozzolino & Verona, 2022; Laursen & Salter, 2006), or it may mean designing products to be compatible with others (i.e., the use of standardized APIs) (Baldwin & Clark, 2000). Reiter et al. (2024) show that firms' choice of cooperation form is influenced by the degree of uncertainty over the future design of the ecosystem, and that this degree of uncertainty also impacts the governance model: low-uncertainty domains rely on formal agreements and coordination while high-uncertainty domains use co-investment and information coordination.

There are also several downsides to an open ecosystem approach (O'Mahony & Karp, 2022; Zhang et al., 2022). First, in an open system, the ecosystem orchestrator captures less value, implying that a larger share of the revenues and profits generated by the ecosystem is left for complementors (Gawer & Cusumano, 2008). In addition, giving up control may mean granting complementors access to critical resources (Agarwal & Kapoor, 2023) such as customer data, which may lead to a situation where complementors become the future ecosystem orchestrators and further increase their share of value captured (Adner & Lieberman, 2021; Jacobides & Tae, 2015). Second, the fact that design decisions are not made centrally in open ecosystems may lead to greater uncertainty (Adner, 2006; Greenstein, 2009). Intense competition among complementors can make it difficult to generate sufficient profits, potentially inducing complementors to leave the ecosystem (Parker & van Alstyne, 2017). For these reasons, many firms decide to pursue a more closed approach.

Closed strategy. With a closed strategy, the orchestrator takes more control over value capture and sharing, makes all decisions about platform architecture itself, and restricts third-party access. The orchestrator may even decide to deliver a large part of the ecosystem itself by providing not only the core platform but also many of the complements (Gawer & Henderson, 2007). At earlier development stages characterized by great uncertainty, the platform provider/orchestrator's in-house development may provide complementors with examples to follow and inspire them with ideas and avenues for their own development (Schilling, 2003). Complementors may infer that the platform's user numbers are likely to grow, which in turn can increase their motivation to develop products or services (Hagiu & Spulber, 2013). Ecosystem access may even be limited to selected complementors that adhere to the orchestrator's

rules and fulfil certain quality requirements (Gawer & Henderson, 2007). This allows the orchestrator to ensure a certain level of quality to customers (Zhang et al., 2022), may enable the orchestrator to capture a larger share of the value (Jacobides & Billinger, 2006), reduces coordination costs (e.g., Gulati & Singh, 1998), and gives the orchestrator more freedom to make ecosystem design decisions (e.g., what interfaces are standardized or individualized; software requirements) (Cennamo, 2018; Eisenmann et al., 2009).

While these limitations may ensure a certain level of control and quality, they also reduce the openness to complementors and thus may limit customer value, since the community of complementors with access to the platform will most likely be smaller (Zhu & Liu, 2018) and have less incentive to develop for the platform's limited range (Gawer & Henderson, 2007). The potential specificity of a more closed ecosystem may also discourage complementors from making the effort to meet the technological standards of the platform, thus obliging the orchestrator to create all the value and run the risk of failing to meet all customers' demands on its own (Cennamo, 2018). Overall, thus, the closed approach promises greater control, implying that a greater share of the value captured remains with the orchestrator and that complementors cannot easily take over its dominant position. At the same time, the closed strategy has the disadvantage that it potentially reduces the value that the ecosystem generates for customers and complementors, hence limiting prospects for growth.

Strategic Inertia during Ecosystem Emergence

The previous section introduced two generic strategies through which incumbents can address the challenge of emerging ecosystems. Yet, while we are starting to understand the advantages and disadvantages connected with each, we know relatively little about the concrete challenges that incumbents face as they try to transition from a logic based on hierarchical buyer–supplier relations toward an ecosystem logic (Hannah & Eisenhardt, 2018; Ozcan & Hannah, 2020). Research on incumbent adaptation and strategic change suggests that incumbents experience organizational inertia, which may significantly hamper their ability to adjust to changes in their environment (Barnett & Pontikes, 2008; Leonard-Barton, 1992). For example, incumbents often lack the cognitive capacity

(Kaplan, 2008), necessary routines and capabilities (e.g. Christensen & Rosenbloom, 1995; Tushman & Anderson, 1986), or complementary assets and resources (Gilbert, 2005) to respond adequately and promptly to change.

While the literature on incumbent adaptation provides a useful starting point for understanding how inertia may hamper the implementation of ecosystem strategies, it has primarily examined how incumbents respond to technological, regulatory, or societal discontinuities (Cozzolino & Rothaermel, 2018; Eggers & Park, 2018). Initial studies have shown that such disruptions may affect not only individual organizations but also entire ecosystems (Ansari et al., 2016). For example, the study by Adner and Lieberman (2021) outlined potential means through which complementors may disrupt the ecosystem of automotive incumbents and shift existing power dynamics. However, despite these insights, extant studies provide no systematic evidence on the inertia that incumbent firms face when their industry structure shifts towards an ecosystem approach and how this inertia might differ in nature depending on the alternative ecosystem strategies that incumbents adopt. We expect that the inertia firms face in the context of ecosystem emergence differs from that described for technological, regulatory, and social discontinuities, since for ecosystems a fundamental challenge lies in redesigning relationships to external stakeholders such as suppliers, competitors, and customers and the dependencies inherent to such relationships (Ozcan & Hannah, 2020). At the same time, we expect that inertia might depend on the extent to which incumbents choose an open vs. closed strategy (Daymond et al., 2023). Investigating the inertia that incumbents incur as they address the challenge of ecosystem emergence may thus also be helpful when trying to understand how firms situate their ecosystem strategy along the continuum of open vs. closed. In this sense, investigating inertia in the context of ecosystem emergence has the potential to make important contributions to the literatures on both ecosystems and incumbent adaptation. Moreover, by studying the antecedents and challenges connected to specific strategies, such research might help managers understand the strategic inertia that can arise as they seek to transition their companies from a traditional to an ecosystem-based logic.

METHOD

To address our research question, we chose a comparative case study approach, since case studies are ideal for providing in-depth descriptions of phenomena for which little theory is available (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Siggelkow, 2007).

Research Setting

In line with Eisenhardt and Graebner (2007), we followed a theoretical sampling approach and decided to situate our study in the automotive industry between 2000 and 2023. Specifically, we analyze the software strategy and related challenges of the three largest German automotive manufacturers: Mercedes-Benz, Bayerische Motoren Werke (BMW), and Volkswagen. The sector is ideal for our research since it has faced disruption from the digitalization in the past two decades, driving a trend toward software-based vehicles that is closely tied to the emergence of platform ecosystems (Jacobides & MacDuffie, 2013).

Over the past hundred years, automotive manufacturers have perfected their skills in building well-designed cars, hence focusing on the hardware aspect of development. Software development for car components has traditionally been delegated to automotive suppliers (Adner & Lieberman, 2021). Therefore, automotive manufacturers have yet to develop the skills required to develop infotainment, operating systems, and the like internally and entirely on their own. However, in recent years, customer demands and resulting product requirements have shifted from those centered on hardware (e.g., a vehicle's driving experience, safety features, or fuel economy) toward software-centric concerns (e.g., a vehicle's Internet connectivity and the digital services it provides) (Perkins & Murmann, 2018).

In addition to requiring new skills and processes, the trend toward software-based vehicles is accompanied by a shift in the competitive landscape and the emergence of platform ecosystems. These new, software-based domains function differently than the traditional automotive business, as they represent a fundamental shift in how value is created. They bear more resemblance to the setup of the smartphone industry and require more cooperation between firms within an ecosystem as opposed to the

individual strategic alliances or hierarchical buyer–supplier relationships that have traditionally been common in the automotive industry. For instance, to provide a valuable infotainment system for customers, automotive manufacturers need to provide the software platform so that application developers can design compatible in-car applications (e.g., music or movie streaming applications). Providing a platform upon which many different complementors can develop their offer holds the promise of jointly creating a more valuable ecosystem for the customer and enhancing profits for both ecosystem orchestrators and complementors. Similarly, in the case of autonomous driving, many new components (e.g., microprocessors, artificial intelligence software, sensors) and corresponding suppliers are involved in the joint creation of value. To develop a functioning and valuable autonomous driving experience, firms must cooperate closely, even to the point where the profits are shared among them. This stands in contrast to hierarchical buyer–supplier relationships, where cooperation is less dynamic and not necessarily so tightly intertwined. Hence, the required mode of value creation has shifted from one where a single firm dictates the terms and conditions of contractual relationships toward cooperative participation in developing a product and related services, i.e., software development. Furthermore, the new setup presents automotive manufacturers with a difficult tradeoff: giving too much value creation away bears the risk of losing their focal position in the automotive ecosystem but producing much of the value in-house requires firms to develop new skills beyond their core competences.

To study automotive companies' strategic responses to these new trends and the challenges their strategies presented them with, we selected Mercedes-Benz, BMW, and Volkswagen, since all three firms have a long history in the automotive industry, are innovative key players in the industry, and show ambitions to implement a software-based ecosystem approach into their strategy. We decided to limit our analysis to the largest German automotive firms to avoid variance in the institutional setting. Moreover, Germany, as a national context, is particularly relevant since the automotive sector traditionally plays an important role in this country. At the same time, initial analyses revealed fascinating differences between the three companies with regard to (a) the design of their strategies and (b) the challenges they faced. Specifically, we noticed that both BMW and Volkswagen pursued rather closed approaches, while

Mercedes-Benz pursued a more open approach. At the same time, the firms differed with regard to the nature and types of inertia they faced. In our study, we use this variance to investigate what drove the differences in strategic choices and inertia across the three firms.

Data Collection

We relied on three types of data to conduct our analysis: (1) archival data and interviews with (2) industry experts and (3) company representatives. Table 1 provides an overview of our data sources. First, we drew on archival data between 2000 and 2024 from the NexisUni database and official company releases to elicit the software strategy the three firms had decided on over time. To identify relevant articles in the NexisUni database, we searched for the company names and respective abbreviations (i.e., Volkswagen, VW) combined with search terms for the software ecosystem (e.g., software and develop* or platform*). We selected the keywords based on their relevance for the firms' development of a software ecosystem and limited out search to the time between 2000 and 2024. When going through the 1,006 articles, we limited our analysis to newspaper articles, removed duplicates, and skimmed articles for relevant content. We then coded the resulting articles inductively to assess what strategies the individual firms had adopted and composed dossiers of our results. More precisely, we noted differences between the three firms' strategies, the motives behind their strategic choices or changes to those choices, and challenges the firms encountered with the strategic path they had chosen.

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Second, we conducted semi-structured interviews with 30 industry experts between 2020 and 2024 to gain an overview of the changes in the industry and verify the observations from our archival data analysis. Our interviewees were consultants and researchers who possessed in-depth knowledge of the automotive industry and had conducted projects with our case companies. We discussed the software strategy of each firm with them, asked them what differences they saw (i.e., in strategic timing and the

closedness of the strategies), what those different strategic approaches were based on, and what challenges were associated with those strategies. Based on these interviews, we developed an initial theoretical framework showing the mechanisms behind firms' strategy outcomes and what types of inertia they had experienced.

Third, to better understand the reasons underlying the firms' strategies and inertia, we conducted interviews with 20 company representatives. We chose our interview partners based on whether they had an overview of the currently changing market, strategic insights into the handling of software and the surrounding ecosystem in the automotive firms of our sample, or knowledge of the challenges the companies faced during this change. To gain further insights into the internal workings of the firms' ecosystem strategies, we asked about the partnerships and strategies we had identified in our archival data analysis and our expert interviews. We asked company representatives why their firm had opted for a closed or open approach, what challenges they encountered with the chosen approach, and, if applicable, why they had decided to change their strategy. We continued our interviews until further interviews generated only minimal new insights and improvements to our emergent theoretical framework. To ensure the validity of our results, we triangulated the data from expert and company representative interviews with archival data.

Overall, we conducted 50 interviews that lasted between 22 and 91 minutes, with an average duration of 50 minutes. For every firm in the sample, we interviewed six to eight representatives to rule out major subjective differences. All interviews were recorded, transcribed, and stored in a central interview database (Yin, 2014).

Data Analysis

When analyzing our data, we iterated between data collection and theorizing. To analyze our archival and interview data, we used the qualitative data analysis software MaxQDA. In the first step, we created a list of the sampled firms' strategic choices pertaining to different software domains and determined whether the firms had taken an open vs. closed ecosystem approach using our archival data. To assess the

proactivity of an ecosystem strategy, we scanned our archival material and created chronological tables of the key events (e.g., important strategic changes, introductions of products and features, changes in leadership). For each of the companies in our sample, we created dossiers about the different measures they had taken to implement software development in their company and noted when they had started their initiatives. We also noted changes in their strategic orientation (i.e., whether they started to cooperate more or less with external partners). Our initial analysis revealed major differences between the firms in terms of the closedness and proactivity of their strategies.

Subsequently, we complemented our archival analysis with insights from the expert and firm interviews, allowing us to better understand the reasoning behind the firms' strategic choices. We first interviewed industry experts to gain a better understanding of the dynamics and challenges of the industry before speaking to company representatives about the organizational dynamics in their adoption of software development and an ecosystem approach. Moreover, creating a strategic timeline allowed us to assess the timing and intensity of ecosystem approaches. This analysis showed that the firms differed not only with regard to their strategic approaches but also with regard to their proactivity—i.e., the extent to which they addressed ecosystem emergence early on and made strategic investments accordingly.

To assess the closedness of firms' strategies, we assessed the extent to which companies used partnerships and knowledge sharing in (1) the ecosystem development process and (2) the commercial stage, i.e., once final products (i.e., cars) enter the market. Specifically, we considered a strategic approach more open when the firm decided to open up its ecosystem and partner with one or more companies for cooperative development, allowing third parties to provide their solution against a license fee or use open-source software stacks and integrate them into their system internally. This goes hand in hand with relinquishing control and dominance in the ecosystem. Conversely, we considered a strategic approach rather closed when a firm decided to develop a large share of its software internally and have very little or no reliance on third parties or third-party content to establish its ecosystem. This implies that the firm did not grant others access to its ecosystem but developed products and services largely on its own. We scanned our transcripts for differences between the approaches the three firms had taken and

whether the firms had changed their strategy over time (e.g., switching from internal, i.e., closed, to cooperative, i.e., open, development over time) and the reasoning behind their strategy.

Once we had analyzed these strategic components of the ecosystem approach, we identified the drivers behind the ecosystem strategies. Using our archival and interview data as a basis, we found that there were three key factors that influenced the firms' strategic choices: (1) their willingness to assume an orchestrating position in the ecosystem; (2) the availability of firms' resources; and (3) ecosystem and organizational inertia. To glean additional insights into the ecosystem and organizational inertia, we coded our archival and interview data with regard to whether the firms encountered any challenges with the strategic approach they had taken and, if applicable, why these challenges emerged and what consequences emerged for the firms as a result. This led us to identify two forms of ecosystem inertia (power and profit) and two forms of organizational inertia (structural and skill) that affected strategic choice and strategy implementation. Finally, we used pattern matching to establish relationships between the mechanisms that had led to challenges with the strategic approach.

Based on our in-depth analysis of strategies and inertia, we then developed a theoretical framework that summarizes the key insights from our analysis. This framework, for which we iterated between data and literature, shows the antecedents of firms' choices between open and closed ecosystem strategies and links them to the emergence of inertia in the ecosystem and the organizations. We refined our theoretical framework by continuing to conduct further interviews, until additional data yielded only minimal improvements.

RESULTS

In the following, we present the results of our analysis to show how firms situate their ecosystem strategies on the continuum of open vs. closed, as well as the inertia they encounter depending on their strategic choice. Toward this end, we first describe the ecosystem strategies of Mercedes-Benz, BMW, and Volkswagen and outline why the firms opted for their respective approaches. In a second step, we

describe the inertia that these automotive manufacturers faced in building up their software ecosystem depending on the strategy they chose.

Our analysis showed that Mercedes-Benz, BMW, and Volkswagen differed considerably with regard to two important aspects of their ecosystem strategies, namely proactivity and closedness. In the following, we describe each of these components in more detail and explain the differences across our case companies.

Proactivity of Ecosystem Strategies

The proactivity of an ecosystem strategy describes the extent to which a company makes early and strategic investments in ecosystems based on a clear vision. This means that decisions and actions are not just reactions to current challenges, but well-thought-out strategies to guide the future path and ensure the success of the ecosystem over time. Among the three automotive firms, we find that BMW was a first mover regarding in-car software development and approached the topic very proactively, while Mercedes-Benz and Volkswagen only realized the importance of software years later (see Figure 1 for further detail).

Early on, BMW saw software skills as important know-how and future core competency of an automobile producer. For this reason, the firm created its own software units—for instance, BMW Car IT in 2001. The task of this unit was to build up know-how, structures, and processes in the domains of vehicle software and IT for the BMW Group and to gain experience with innovative forms of working at the same time. BMW continued to prioritize software over time and continuously laid the groundwork for software development in the firm:

> The establishment of BMW Car IT is a strategically important step. The trend in the automotive industry is clearly moving from hardware to software. Information technology has become an important core competence for BMW. With BMW Car IT, we can bundle and further expand this expertise for the company. (AD18)

In contrast to BMW, both Mercedes-Benz and Volkswagen represent late movers in automotive software development. Mercedes-Benz, then still called Daimler AG, founded its first IT facility in India in the 1990s. Still, the firm did not commence serious efforts in building a software platform for its vehicles until the late 2010s. For instance, our archival data showed that in terms of infotainment, "Mercedes-Benz is late to the display dashboard game" (AD13). Mercedes-Benz' software subsidiary MBition was only founded in 2017, followed by its new Electric Software Hub in 2022.

Volkswagen only started serious efforts in the software domain following the negative press coverage of Dieselgate in 2015, with the opening of its first digital labs in Berlin in 2016. In 2019, Volkswagen founded its own in-house software development unit, Cariad, which has since grown through hiring and the acquisition of smaller IT start-ups. Hence, both Mercedes-Benz and Volkswagen were late to a market that had already begun to make advances in the domain of in-car software and future-oriented trends such as autonomous driving.

INSERT FIGURE 1 ABOUT HERE

Closedness of Ecosystem Strategies

The second dimension on which Mercedes-Benz, BMW, and Volkswagen differed with regard to their ecosystem strategies was closedness, which we define as the extent to which a firm makes use of partnerships and knowledge sharing in (1) the ecosystem development process and (2) the commercial stage, i.e., once final products (i.e., cars) enter the market. Our analysis showed that Volkswagen displayed the most closed strategy, Mercedes-Benz demonstrated the most open strategy, and BMW chose a hybrid strategy. Table 2 compares the three sample firms' ecosystem strategies with regard to closed they are on different dimensions.

INSERT TABLE 2 ABOUT HERE

In a closed ecosystem development process, an organization manages all necessary resources, functions, and processes internally on its own. During our interviews we found that whether the ecosystem development process is open or closed is determined by (a) the number of partners, (b) the type of partnership, and (c) intellectual property protection. The more partners are involved in knowledge search, the more distinct perspectives and areas of knowledge can be combined, making partner diversity and quantity defining factors of an open ecosystem strategy. Partnership type reflects whether the relationship is a traditional supplier–buyer arrangement where decision-making and control lie with the buyer or a strategic partnership where two companies pool resources for joint development, or even an innovation ecosystem where multiple companies pool resources. Another key defining factor is the handling of intellectual property, with a spectrum of fully open-source at one end and tightly controlled proprietary intellectual property at the other.

The closedness of an end-user ecosystem (i.e., vehicle drivers or passengers) refers to the extent to which the interaction or integration with external systems or products is restricted and whether it provides profit opportunities for third parties during the usage phase. During the analysis, we found that closedness essentially comes down to two key factors: (a) platform access and (b) profit sharing: while an open ecosystem allows unrestricted platform access and distributes profit, in a closed ecosystem the incumbent restricts access and controls the profits. We discuss the implications for our three cases below.

Mercedes-Benz. Our analysis of the three automotive manufacturers showed that compared to BMW and Volkswagen, Mercedes-Benz' ecosystem strategy was the most open. When developing its software, Mercedes-Benz adopted the strategy of partnering with a few established technology companies such as NVIDIA and Alphabet (Google). Although Mercedes-Benz had been developing some features in-house, these selective strategic collaborations were chosen "to take a short cut to state-of-the-art technology" (AD07). Mercedes-Benz explained that, as a premium manufacturer, it sought to deliver the best customer experience. As Steffen Hoffmann, then Vice President of Investor Relations, explained, "When we team up with somebody, we want to team up with the best" (AD05). Having struck these strategic partnerships, Mercedes-Benz does not shy away from sharing intellectual property with its

partners. For example, when developing its infotainment system MBUX, the firm shared its intellectual property rights with NVIDIA. Through this cooperation, Mercedes-Benz "has achieved a quantum leap" (AD01).

Pertaining to the openness of its platform, Mercedes-Benz also adopted an open approach. This is affirmed in statements by Mercedes-Benz CEO Ola Källenius, who in 2020 stressed that the company's offerings were "perfected" by external providers (AD15). Källenius went on to explain that the firm's infotainment system was open to integrate apps from TripAdvisor, Spotify, and many more. As he observed, "You can't reinvent the wheel everywhere, especially where there are damned good wheels already." In 2023, Mercedes-Benz opened up its infotainment platform still further by announcing that it would use Google Built-in in the future, starting with the integration of Google Maps for in-car navigation services. As the prior analyses imply, Mercedes-Benz' openness also means that it had to confront a tradeoff in its model for sharing profit with its industry-leading partners. An example of this is the revenue-sharing agreement between NVIDIA and Mercedes-Benz in the two firms' autonomous driving collaboration. As Markus Schaefer (CTO at Mercedes-Benz) explains, "NVIDIA […] receives a share of revenues. In return, we receive their high-performance chip at a significant discount" (AD08). This method is quite uncommon in the automotive industry, as one of our interview partners pointed out: "There are other automobile producers that have very big problems with such a model" (CR01). Mercedes-Benz "announced a cooperation with Google, whose maps Mercedes[-Benz] will include in its cars in return for a license fee going forward" (AD04), implying a continuous flow of financial resources to a third party and allowing Google to participate in the success of Mercedes-Benz' vehicles.

BMW. While Mercedes-Benz has a rather open approach, BMW pursues a hybrid approach that is open in some dimensions but closed in others. Specifically, when weighing up the openness of its approach, BMW strategically distinguishes between differentiating and non-differentiating software, and between its own core business and complements. In terms of the development of customer-differentiating and core business software, BMW's ecosystem is rather closed. The firm considers the user interface the most customer-differentiating part of the software: "You have augmented reality coming in, which is

much more differentiating and much more important in the customer experience than an automated driving function" (CR07). The company also ascribes great importance to everything related to driving function—areas that it seeks to control completely and single-handedly. A statement by one company representative underlines this: "In such a customer ecosystem, it tends to be regarded as a closed ecosystem, in the sense that BMW controls it completely. And somehow, they don't want to let other parties into it" (CR04). Hence, BMW also maintains full intellectual property rights over the software that they consider customer-differentiating and crucial to their business.

In non-differentiating and complementary areas, BMW combines open-source code, internally developed and co-developed code, and externally acquired third-party solutions. Depending on the domain, BMW opts for a strategic partnership (e.g., for autonomous driving with the experienced firm Qualcomm) or actively initiates open-source code development (e.g., in the car operating system domain) to maintain its focus on the software it deems crucial for competition. In such partnership instances, each partner benefits from the other, and intellectual property rights are shared: "BMW is now also helping Qualcomm to find its feet a little bit, helping to build up such an ecosystem, so that there is still negotiating power in other areas" (CR07).

Regarding the end-user ecosystem, BMW's platform access is rather closed, e.g., only selected third-party apps are deeply integrated. However, there is an ongoing transition: BMW has recently changed its infotainment operating system to the most common infotainment coding language, Android Automotive OS, and integrated the Faurecia Aptoide Automotive App Stores in its cars to grant broader access to third-party applications.

While BMW is selectively open in the ecosystem development process, "BMW tries to avoid having those profit-sharing approaches as much as possible because the future profit pools are not yet clear" (CR07). For instance, similar to Mercedes-Benz's cooperation with NVIDIA, BMW pursues a strategic partnership for autonomous driving development with Qualcomm. Yet, in contrast to Mercedes-Benz, BMW's cooperation does not involve a unit-based revenue-sharing model. In summary, BMW has

adopted a hybrid approach for its ecosystem: it is selectively open in development while protecting the end-user ecosystem interface.

Volkswagen. Finally, in contrast to both Mercedes-Benz and BMW, Volkswagen has a rather closed ecosystem strategy, characterized by a limited set of partners and predominantly in-house operations. As one of our interviewees emphasized, "Volkswagen has really come to the conclusion that they have to do it all by themselves" (CR01). This mindset was manifested in the establishment of their internal software unit, Cariad, which handles the development of every aspect of software, from the operating system to autonomous driving features and infotainment. By purchasing IT-related start-ups and establishing innovation hubs, Volkswagen has expanded its knowledge base internally. Existing collaborations, such as the one with TomTom for navigation functions, tend to be buyer–supplier relationships rather than strategic partnerships between equals. Volkswagen's former CEO (Herbert Diess) envisioned pursuing a similar approach to Tesla, which largely exercises sole control over its entire software ecosystem. Consequently, Volkswagen is protective of its intellectual property and values autonomous control over quality.

In contrast to Mercedes-Benz' open approach, Volkswagen aims to control user-generated data of the end-user ecosystem and potentially optimize future revenue streams from in-car services. Thus, it adopts a rather closed approach. Our archival data underlined this: "We [Volkswagen] want to and must retain control of the vehicle and data sovereignty. If you give that away, you make yourself dependent on others. In addition, software will become the decisive differentiating factor in competition" (AD16).

Since it mainly develops software internally, e.g., through its infotainment division, Volkswagen has no profit-sharing models and retains full control over cash flows and data. It limits access to its software platform and only grants access to application providers for services that customers are already used to, e.g., Spotify. In addition, Volkswagen is considering "potentially licensing the [proprietary operating] system to other car makers" (AD10) to generate further revenue streams, rather than sharing profits with third parties. In consequence, Volkswagen pursues an ecosystem where profit pools and

platform access are tightly controlled and only rarely granted to others, in the hope of maintaining a competitive advantage.

Drivers of Ecosystem Strategies

The previous chapters show that Mercedes-Benz, BMW, and Volkswagen pursued ecosystem strategies that differed substantially with regard to their closedness. This raises the question of what drives these differences. We find that firms' ecosystem strategies are shaped by three main factors, namely (1) the willingness to assume an orchestrating position in the ecosystem; (2) firm resources; and (3) ecosystem and organizational inertia. Below, we first discuss the impact of the first two factors; the impact of inertia will be discussed in the subsequent section.

Willingness to assume an orchestrating position in the ecosystem. A core driver of firms' ecosystem strategies is their willingness to assume an orchestrating position in the ecosystem to maximize the degree of control and profits. We found that, in principle, all three sample firms showed a keen interest in becoming an ecosystem orchestrator. They feared that as a result of the shift toward software-defined vehicles, their role in the ecosystem would be reduced to that of hardware suppliers with less power than IT companies. One of our interviewees stressed that "I still have to make sure that the customer experience is a great, luxurious end customer experience […] and ideally, you don't let anyone take that out of your hands, no matter who you are" (CR11). In a similar way, another interviewee pointed out that "BMW does not want to be reduced to the role of, shall I say, a shell manufacturer" (CR08). Consequently, all three firms invested in building their own software units to maintain the desired control over parts of the ecosystem instead of opening licensing negotiations with technology firms like Google for Google Automotive Services. As one of our interview partners explained, "Our hypothesis has always been that Google Automotive Services could be an option at some point, but not with the conditions that are typically discussed at the moment, because that would mean giving up quite a bit" (CR08).

Availability of firm resources. While, overall, a closed approach was seen as more attractive by the company representatives we spoke to, they had very different views of the feasibility of such an

approach for their individual firm. Implementing a closed approach requires significant firm resources, such as financial capital, knowledge, and staff who can develop software internally. Therefore, among our three sample companies, only Volkswagen considered itself capable of implementing an approach on the closed end of the continuum. As one of the world's largest automotive manufacturers, Volkswagen possesses considerable financial resources and benefits from economies of scale that allow it to spread its R&D costs over a significant number of units, thereby reducing the costs per vehicle. Indeed, several of our interviewees pointed to differences in size as the main reason why Volkswagen had adopted a more closed approach: "If they [Volkswagen] create an operating system that can theoretically be used as a basis in all vehicles […] then it has huge scaling potential because it can be distributed to 10 million cars. If Mercedes[-Benz] or BMW do it now, they can then distribute it to 2.5 million cars […]. That means the system would be four times as expensive per vehicle for them" (IE23). As a result, Volkswagen considered itself in a good position to develop a proprietary operating system and software and invested several billion dollars in this field. For example, in 2019 Volkswagen announced that it would "make major investments to upgrade its IT" and invest "some €4.6 billion in that area over the coming years" (AD17).

BMW and Mercedes-Benz, being smaller than Volkswagen[1], have a much lower budget for research and development and, since they sell far fewer cars than Volkswagen, much less scope to benefit from economies of scale. Therefore, the two firms needed to be more strategic and selective about which projects or technologies to invest in: "At Mercedes-Benz and BMW it's simply born out of necessity due to the volumes. So, BMW, with two and a half million vehicles per year, simply has a different opportunity to scale than Volkswagen with 10 million" (CR07). Therefore, both, BMW and Mercedes-Benz opted for a more open approach in which they relied more heavily on partnerships that allowed them to share the financial burden of software development.

[1] VW sold 8.26 million motor vehicles worldwide in 2022, compared to just 2.4 million for BMW.

Compared to BMW, however, Mercedes-Benz had to be even more open to compensate for the fact that the company had started its software development much later than BMW, leading to a lack of knowledge, staff, and skills in this domain. As a result of this lack of proactivity, Mercedes-Benz had to rely more heavily on strategic partnerships with very strong partners, such as "NVIDIA, a global leader that specializes in accelerated computing and computer graphics, to develop the next generation of supercomputers for automated cars" (AD06). Only through such partnerships could the firm ensure that the software in its premium cars was state-of-the-art. BMW, in contrast, possessing more in-house expertise, purposefully decided to avoid the strongest players in the market and instead only made use of strategic partnerships in non-competitive domains to reduce its own development efforts and costs. For example, "BMW does not want to work with such a strong partner like NVIDIA, but rather wants to have a little more influence itself somehow" (CR07). This is the main reason why BMW chose Qualcomm as a partner for autonomous driving: it allows the firm to maintain control and cooperate on its own terms. While both Qualcomm and NVIDIA develop and produce microprocessors and the associated software, NVIDIA is a much more influential and established player in the market. One of our interview partners stressed this by saying, "It has become apparent in recent years that it is not the large automobile producers that tend to specify such technological architectures, but rather Tier 2 [suppliers][2] such as NVIDIA, Mobileye, [and] Qualcomm" (CR07). Having selected Qualcomm, however, BMW could avoid signing a pay-per-unit contract (as Mercedes-Benz did with NVIDIA) and subsequently wielded greater influence over Qualcomm's developments and feature roadmap.

Ecosystem and Organizational Inertia

The previous section described the factors that explain why Mercedes-Benz, BMW, and Volkswagen used different ecosystem strategies along the open vs. closed continuum. Interestingly, however, we

[2] The label "Tier" is used in the automotive industry to describe the hierarchy in the supply chain. Tier 1 suppliers provide modules or system directly to the original equipment manufacturer (e.g., BMW, VW, Mercedes-Benz), while Tier 2 suppliers deliver components to the Tier 1 supplier.

observed that the choice of strategies depended not only on the willingness to become ecosystem orchestrators and the availability of firm resources but also on different types of inertia that affected both the choice of strategies and their implementation. Conversely, the strategies themselves were also shaped by inertia, since the type of inertia depended on the type of strategy chosen. While a more open strategy was linked with power and profit inertia in the firms' ecosystems, a rather closed strategy led to organization-internal structural and skill inertia. In the following, we describe the four different types of inertia in more detail and explain how they are dynamically shaped by, and shape, firms' strategies.

Power inertia. The first type of inertia we observed was power inertia, which describes delays in strategy implementation as a result of an organization's reluctance to relinquish or share control in an emergent ecosystem. Power inertia emerged for all three firms, but was particularly relevant for Mercedes-Benz and BMW, as they pursued an open ecosystem strategy and sought to form partnerships. An open ecosystem approach requires the parties involved to relinquish some degree of autonomy to allow a more cooperative development approach. Yet, as several of our interviewees emphasized, giving up power "would go against the group's DNA, to let go of the reins" (CR08). For example, when BMW tried to develop its software for autonomous driving, it first chose to work with Intel using a classical buyer–supplier relationship. However, this mode of cooperation provided no incentives for Intel to go the extra mile and make a lasting commitment to the partnership. In consequence, BMW ended the partnership and found a new strategic partner in Qualcomm, explaining that "while a supplier like Intel always delivered as agreed, Qualcomm as a business partner should also have its own interest in further development for the BMW Group." BMW agreed with Qualcomm that the platform developed under this new partnership would not be exclusive to the cooperation, but could also be licensed to third parties. This gave Qualcomm an additional motivation to stay committed and continuously optimize the product. This was also illustrated by our archival data: "It is important to us to have not just a supplier, but a partner. Because they are motivated to keep improving things so that we can constantly become more competitive" (AD19).

The underlying reasons for power inertia were that all three companies had been accustomed to a hierarchical mode of cooperation, in which the car manufacturers exert strong control over their supply chain and suppliers must abide by their rules. For instance, Volkswagen, as one of the world's biggest car manufacturers, is used to dictating the market and dominating partnerships or supplier relations, as our interview partner pointed out: "I think that the history with the suppliers plays a big role. Volkswagen is known as one of the 'pushers' who always demanded the screw €0.01 cheaper. The economies of scale make this noticeable" (CR02). Thus, they are not used to sharing power and therefore did not opt for a more open approach. Since Volkswagen lacked experience in sharing power, which is essential in software development, cultural issues arose once the firm targeted a shift towards automotive software.

In addition to being used to a culture of unilateral control, delivering upon a premium promise was another reason why all three firms encountered power inertia. For instance, BMW argued that as a premium manufacturer it is important to control the end-user experience, which has to differ from that of other manufacturers: "For BMW, that means thinking from the customer's perspective, which is of course always crucial: how can we generate the best possible experience for the customer?" (CR08). BMW believed that it could only deliver on this promise by taking full control over user data, which is essential to understanding the customer's needs. The only way for the firm to preserve its access to this data is by remaining in charge of the emergent software ecosystem and pursuing an in-house development approach. Mercedes-Benz followed a similar line of reasoning and also decided to develop some software in-house to fulfil its premium promise to customers: "And the answer is indeed that you will have to develop certain software elements yourself in future" (CR11).

Profit inertia. The second type of inertia we identified was profit inertia, which describes delays in firms' strategy implementation as a result of their reluctance to share profits with other ecosystem firms. Similar to power inertia, we found profit inertia at all three companies, but particularly for open ecosystem strategies since such strategies involve purposefully giving up parts of value-adding activities and related profits. While sharing profits is a critical element of open ecosystem strategies, all three

sample companies we studied were reluctant to do so, leading to lengthy negotiations with potential partners.

When automotive companies strike agreements with a partner, they usually pay a price per component or a predetermined sum for the service. In software development, however, this practice is rare, since the partners continue to work and optimize the product together. These two contrasting mindsets clash in the context of automotive firms, as one of our interview partners from BMW explained: "The purchasing department are still stuck in their old bargaining mentality" (CR07). Indeed, one of our interview partners explained that the companies view sharing their profits and margins as "selling the family heirlooms" (CR01). For example, BMW has done all it can to avoid a profit-sharing approach to retain sovereignty over not only current, but also potential future profit pools. As one of our interviewees stressed, "It was extremely important for BMW to avoid having to assign too many future cash flows to the potential cooperation partner […] because they don't yet know exactly how these cash flows will work in the future" (CR07). In a similar way, Volkswagen did not opt for a profit-sharing model when developing its autonomous driving technology. Instead, the firm formed a partnership with Bosch for software development and continued to purchase the necessary chips from Qualcomm, paying the latter per item like a traditional supplier.

Structural inertia. The third type of inertia we encountered in our analysis was structural inertia, which we define as delays in strategy implementation that result from the tendency to resist changes to the internal organizational structure. While all three firms exhibited structural inertia, it was most relevant for those that pursued a more closed approach, since in this approach many ecosystem development activities are done in-house, requiring new units to be set up. Consequently, Volkswagen suffered most from structural inertia, while Mercedes-Benz only had to change its structures to a limited extent, since critical software development activities were conducted by its partners.

Traditionally, in the automotive industry, car development processes follow a so-called "waterfall" process in which development teams move from one phase to the next once certain milestones have been reached and the preceding phase has been successfully completed. For example, in the first

phase, all requirements are collected; once this is done, the process moves to the design phase. The entire vehicle development process until the start of production used to take around seven years. In software development, agile methods with fluid teams and iterative development processes are more common and expedient. Thus, a major challenge for automotive manufacturers in moving towards an ecosystem approach is to introduce more agility into their in-house software development processes as well. As one of our interview partners explained, the automotive manufacturers have struggled to integrate more agile development into their processes to grant their developers more freedom: “The work of the last five years, which has not yet been completed, at all automobile producers, consists of bringing together this highly synchronized process and this more self-determined, iterative process, because of course it doesn’t play well at first” (CR03).

One way to swiftly introduce more agile work structures was to establish new organizational units. For example, to compensate for its late start in software, Volkswagen set up its Cariad software unit in 2019 in the hope that it would deliver quick results. Unfortunately, Cariad faced an uphill struggle, as one of our interview partners explained: “For the first two years, they were really only busy with themselves, to be able to work at all, to set up the locations, to find and onboard the right experts” (CR14). Since the unit was new, many processes were still unclear. Some employees struggled to get their work equipment and it took some time for the unit to get into a functional working mode. Therefore, it is not surprising that the “there has been a lot of delay” (CR14) and the unit could not meet all its development targets.

BMW, in those domains where it pursued a closed approach, faced similar problems, but benefitted from the fact that it had started its journey to make software a core competence around 15 years earlier than Volkswagen. As a result, BMW had far longer to set up adequate organizational structures. Yet, while the company has adopted a more agile working method on its autonomous driving campus in Unterschleißheim, it still struggled to implement agility in other departments such as connectivity or digital IT. This was echoed by one of our interview partners: “The entire work structures and organizational structures were changed very significantly towards very agile, rapid development. The

connectivity or digital services division is still a long way off" (CR08). As another interviewee confirmed, even BMW as a first mover has not yet fully embraced agile methods and continues to "think in vehicle generations" (CR08).

Those carmakers that pursued a rather closed approach caused friction in their new IT units by imposing old organization structures rather than granting the freedom to establish new ones. Volkswagen was particularly prone to this problem; as one of our interviewees explained, when the company set up its new Cariad unit, it simply replicated the of its other divisions such as procurement, strategy, and HR, expecting the nascent unit to stand on its own two feet. At the same time, Cariad lacked the autonomy to make the necessary decisions in software development and instead had to wait months for the boards of Volkswagen to rubber-stamp its decisions, as one of our interviewees explained: "You can't go through different committees for nine months every time [you want] to make a decision as we did in the past […]. Decisions simply have to be made differently than for a vehicle series" (CR14). Similar prolonged processes emerged in the procurement department, where purchasing for IT followed the same rigid processes as those used for hardware:

> The procurement manager still goes and looks at, "What is the unit price for a thing?" […] then pushes the price down accordingly. And of course, that is fatal for this platform idea, because if they only look at unit prices […], how do they translate the price of a platform to a module when you calculate the value of the platform? (CR01)

While these hierarchical processes may be normal in the step-by-step development of vehicles, they caused severe friction for Volkswagen's software development processes and unit. Thus, a tradeoff emerged for the car companies. As one Mercedes-Benz representative put it, "Carmakers may either place their software unit too close to the company, resulting in slower processes, or face a lack of connection to their products if they place the unit too far away from the core organization" (CR12).

Skill inertia. The final type of inertia we observed was skill inertia, which we define as delays in the implementation of ecosystem strategies due to a lack of skills. Similar to structural inertia, this type of inertia is particularly prevalent among firms pursuing a closed approach since these firms require skilled

human resources to develop solutions and orchestrate the ecosystem. Indeed, Volkswagen in particular struggled to hire and train sufficient software developers to implement its ambitious, closed ecosystem strategy. At the same time, the influx of new recruits into Cariad made coordination across individuals and teams very difficult. In addition, since qualified software developers are hard to find on the job market, Volkswagen ended up shifting employees from other departments to Cariad, resulting in a situation where "there are so many philosophical differences within it that the teams cannot function together" (CR03). Moreover, to achieve its ambitious goal of setting up its own software ecosystem, Volkswagen targeted the expansion of Cariad to at least 10,000 employees, leading to a focus on quantity over quality in human resources. In fact, one of the consultants we talked to pointed out that "actually, you don't need that many employees" (CR03).

In contrast to Volkswagen, the rather open strategy pursued by Mercedes-Benz did not require the firm to build a large software unit. The firm's decision to work with partners such as NVIDIA allowed it to avoid some of the inertia caused by the realignment of internal processes: "If we really did everything from scratch ourselves, we probably wouldn't get enough people quickly enough who can do it all" (CR01). BMW's proactive strategy proved very helpful, since it allowed the firm to build the necessary skills step by step. As one of our interviewees stressed, "Software is a field where people grow continuously" (CR03).

Overall, the organization-internal structural and skill inertia that resulted from Volkswagen's rather closed ecosystem strategy became so severe that it had a major impact on the quality of the firm's products as well as its short-term performance. Cariad, absorbed with internal matters, could not deliver upon the ambitious software development targets. As a result of the delays, Volkswagen produced several models, such as their volume model Golf 8 and the new electric vehicle ID3, without implementing a software platform, and put launch and delivery on hold until the vehicles could be finished and delivered to customers. In addition, "[vehicle] owners […] all over the world reported problems with infotainment screens, range calculations, buggy smartphone connections, charging, and other features" (AD11). The problems resulted from software that had been developed in-house and even led to problems with the rest

of the vehicle, such as breakdowns. In response to these issues, several of Volkswagen's brands, e.g., Porsche and Audi, decided to continue using old software solutions or develop their own, which undermined the possibility of benefiting from economies of scale and led to considerable friction between the various brands. As a result of these internal power conflicts, Volkswagen replaced first the head of Cariad and later its CEO, Herbert Diess, who was considered the architect of Volkswagen's software strategy. Under new CEO Oliver Blume, who assumed his post in September 2023, Volkswagen had to cancel the so-called Trinity and Audi Artemis projects, which had aimed to develop a revolutionary new product architecture with the goal of catching up with Tesla. Moreover, Volkswagen pushed the launch of its operating system variants back further and revised its ecosystem strategy. The firm decided to build its system on existing open-source solutions, such as Google Android, implying that as a result of the significant inertia, its formerly closed strategy would now be opening up.

DISCUSSION

In the following, we discuss the theoretical implications of our findings. Toward this end, we first describe the theoretical framework we developed before outlining the contributions of our study to the literature on ecosystems and incumbent adaptation and presenting avenues for future research.

Theoretical Framework

Figure 2 shows the theoretical framework we developed, which shows how incumbents place their strategies along the continuum between open and closed in times of ecosystem emergence and the challenges they face as they seek to implement them.

INSERT FIGURE 2 ABOUT HERE

We find that, in general, incumbents are very willing to become ecosystem orchestrators, which drives them to prefer rather closed over open strategies whenever possible. At the same time, however, a

closed ecosystem strategy requires considerable firm resources, such that the availability of resources determines whether firms actually make use of a closed strategy.

Importantly, we also notice that an incumbent will experience different types of inertia depending on the strategy it chooses. If the firm pursues an open ecosystem strategy, this will incur only limited organizational inertia (since many value-adding activities take place in other firms in the ecosystem) but will lead to considerable ecosystem inertia. Specifically, we observe that firms that pursue an open ecosystem strategy will have to deal more intensively with power and profit inertia during strategy implementation. While power inertia reflects delays resulting from the organization's reluctance to relinquish or share control in an emergent ecosystem, profit inertia describes delays as a result of the reluctance to share profits with other ecosystem firms. We find that power and profit inertia may induce firms to reduce the openness of their approach, e.g., by excluding powerful partners with significant capabilities and cancelling existing partnerships.

Firms that pursue a closed ecosystem strategy, in contrast, experience limited ecosystem inertia during strategy implementation, since they develop many of their solutions in-house. However, they face considerable organizational inertia. Specifically, we identify structural and skill inertia as two important types of organizational inertia. While structural inertia consists in delays in strategy implementation resulting from problems in adjusting organizational structures, skill inertia results from the fact that firms have to hire and train a considerable number of employees to make a more closed strategy work. We observe that organizational inertia may significantly affect strategy implementation—even more than ecosystem inertia—leading firms to opt for a more open approach.

Finally, we also observe that both ecosystem and organizational inertia can be reduced if the firm is highly proactive in its ecosystem strategy. High proactivity in ecosystem strategy buys companies the time they require to work through implementation processes, invest in development paths, and learn from their mistakes. By addressing ecosystem emergence in a timely manner, firms can thus build valuable knowledge and skills early on, which reduces the need to share power and profits in the ecosystem and also helps overcome inertia in structure and skills.

Contributions to the Literature

Our study makes two important contributions to the literatures on ecosystems and incumbent adaptation.

First, we contribute to the literature on ecosystems and platforms by providing detailed insights into the strategies incumbents use when responding to platform ecosystem emergence. Scholars have explored the optimal level of closedness for platforms (Boudreau, 2010; Eisenmann et al., 2009; Parker & van Alstyne, 2017; West, 2003), while the tradeoff inherent in the degree of closedness in ecosystem strategy has so far received less attention (e.g., Daymond et al., 2023; Hannah & Eisenhardt, 2018). Ozcan and Hannah (2020) identified a focal firm's tradeoffs between a proprietary or closed strategy and an open ecosystem strategy. We complement their findings by providing insights into what type of challenges, in terms of the form of inertia, firms face as they try to implement the different strategies. We show what factors determine whether a strategy can be deemed more open or closed and that whether a chosen strategy causes more or less inertia depends on the proactivity of the firm. A more closed approach requires more in-house skills and knowledge and a more fundamental redesign of structures and processes, which requires more time. These findings imply that a combination of a closed strategy with late timing is less likely to work. Instead, being late may require a firm to open up its partnership strategy and platform design to avoid costly delays and poor-quality solutions, both of which hurt the company's competitiveness. Our findings about proactivity also complement research by Hannah and Eisenhardt (2018), who explored the different ecosystem strategies that lie between cooperation and competition. While they argue that companies with a strong focus on competition (i.e., a system strategy) can be successful over time and when the pace of innovation is moderate, our results provide concise evidence on the challenges that incumbent firms, in particular, may encounter if they adopt such a closed approach at a later juncture. We show that such firms will most likely struggle not only ecosystem-wide but especially internally, since setting up the necessary skills, knowledge, and structure causes too much friction.

Furthermore, we add to the literature on ecosystems by providing further evidence that incumbent firms face major challenges in transitioning their thinking from a singular organizational mindset towards an ecosystem approach (Ozcan & Hannah, 2020). As previous research has shown, companies must pay attention to what maximizes overall ecosystem value rather than solely corporate profits (Gawer & Phillips, 2013; Nambisan & Sawhney, 2011; Parker & van Alstyne, 2017; Wareham et al., 2014). We find that if a company focuses solely on its own profit and chooses a closed approach with its established suppliers, it may miss out on the opportunities and value afforded by a more open approach and encounter severe structural and skill inertia instead. Similarly, companies that opt for an open approach have to anticipate potential drawbacks resulting from their history as incumbents. This may come in the form of profit inertia, which can prevent the firm from sharing knowledge and revenue at the expense of creating an ecosystem that could grow and create much greater value through cooperation. With our research, we provide more detailed insights on the potential struggles faced by companies that adopt a more cooperative strategy, (i.e., a bottleneck or component strategy as Hannah and Eisenhardt (2018) suggest). We show that companies choosing such a strategy can face inertia because they are simply unprepared for the demands of the orchestrator role.

Second, we contribute to the literature on incumbent adaptation and strategic change (e.g., Eggers & Park, 2018) by providing detailed insights into the inertia firms face in the context of ecosystem disruptions. The literature on strategic change has pointed out that firms face different types of inertia as they seek to respond to changes in their external environment. Firms may be hampered by cognitive frames (Kaplan, 2008; Tripsas & Gavetti, 2000), existing incentive structures (Kaplan & Henderson, 2005), resource rigidity and routines (Edmondson et al., 2001; Gilbert, 2005), or organizational structures (Argyres & Silverman, 2004). Thus far, however, the literature has focused on studying firm responses and inertia in the context of technological, social, or regulatory change (Cozzolino et al., 2018; Eggers & Park, 2018) and has not investigated the challenges firms face as they respond to the emergence of novel ecosystems. Addressing this shortcoming, we identify two types of ecosystem inertia (power and profit) and two types of organizational inertia (structural and skill). Moreover, we show that ecosystem inertia

emerges as firms pursue open ecosystem strategies, while organizational inertia emerges as a result of closed ecosystem strategies. In addition, we show that inertia may induce firms pursuing more open strategies to become less open, while it may enhance openness for firms pursuing rather closed strategies. Thus, firms find a balance between openness and closedness along the continuum of ecosystem strategies available to them.

Moreover, we find that inertia is more pronounced if firms choose a more closed approach to ecosystem development—i.e., seek to have a large share of proprietary elements and become ecosystem orchestrators—at a later juncture. This finding is important as it suggests a tradeoff between long-term prospects and short-term performance in ecosystem development. Although a closed strategy may appear most promising in the long run as it allows firms to occupy an orchestrator position, this strategy is connected with the greatest inertia in the short run if the player adopts this strategy when the market has already progressed. Given that incumbents usually possess a culture and capabilities that are not directly geared toward digital technologies (Cozzolino et al., 2018; Tripsas & Gavetti, 2000), pursuing a closed ecosystem strategy runs the risk of significant problems in technology development, product failures, reputational losses, and, as a consequence, a limited ability to mobilize complementors for the ecosystem. For managers, these insights are important, as they help them understand the challenges firms face as they seek to navigate in times of ecosystem emergence.

Limitations and Future Research

Our study has some limitations, which may provide avenues for future studies. First, we investigated the strategies adopted by incumbent automotive firms to adapt to their industry's shift towards ecosystems and the associated inertia they have encountered if they chose the wrong approach. Although our setting was well suited to investigate the research question of this paper, our results may not be generalizable to other organizational approaches towards ecosystems since our sample was comprised of either high-volume manufacturers with multiple brands or premium manufacturers for whom control over their ecosystem is crucial. Hence, future research could investigate whether incumbents with a different

position in the automotive industry or other industries respond differently to the growing importance of ecosystems in their industry and how their strategic choice affects their fortunes and corporate development in the aftermath (e.g., handing off the former orchestrator role to a technology company). Future research could also investigate how this links to value creation for customers, i.e., whether such a cooperation can generate superior value than an ecosystem dominated by an incumbent.

Second, our study has focused on the incumbent firms' perspective on ecosystem adaptation and setup. However, it may also be insightful to investigate the extent to which former suppliers (e.g., tier 1 or tier 2 suppliers) can become ecosystem orchestrators since, in the past, they have been the ones with both (1) the skills required for traditional hardware manufacturing and (2) the skills that are now required to develop software for an automotive ecosystem to emerge. Hence, future research could investigate whether former tier 1 or tier 2 suppliers (e.g., Bosch, Continental) can now seize the opportunity to establish their own ecosystem and occupy a central position to capture a larger share of the value for themselves.

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TABLE 1: Data sources

Data source	Type	No. of interviews/ documents
Interviews	Industry experts	30
	BMW representative	6
	Mercedes-Benz representative	6
	Volkswagen representative	8
	Sum	**50**
Archival data	BMW	177
	Mercedes-Benz	159
	Volkswagen	670
	Sum	**1.006**

TABLE 2: Closedness of ecosystem strategy

	Ecosystem strategy core components	**Mercedes-Benz**	**BMW**	**Volks-wagen**
Ecosystem development process	Number of development partners (many vs. few)	–	++	–
	Type of development partners (strategic partners vs. suppliers)	++	+	–
	Intellectual property protection (open vs. proprietary)	+	+	–
End-user ecosystem	Platform access (open vs. closed)	+	–	–
	Profit sharing (large vs. limited)	++	–	–
		most open approach		most closed approach

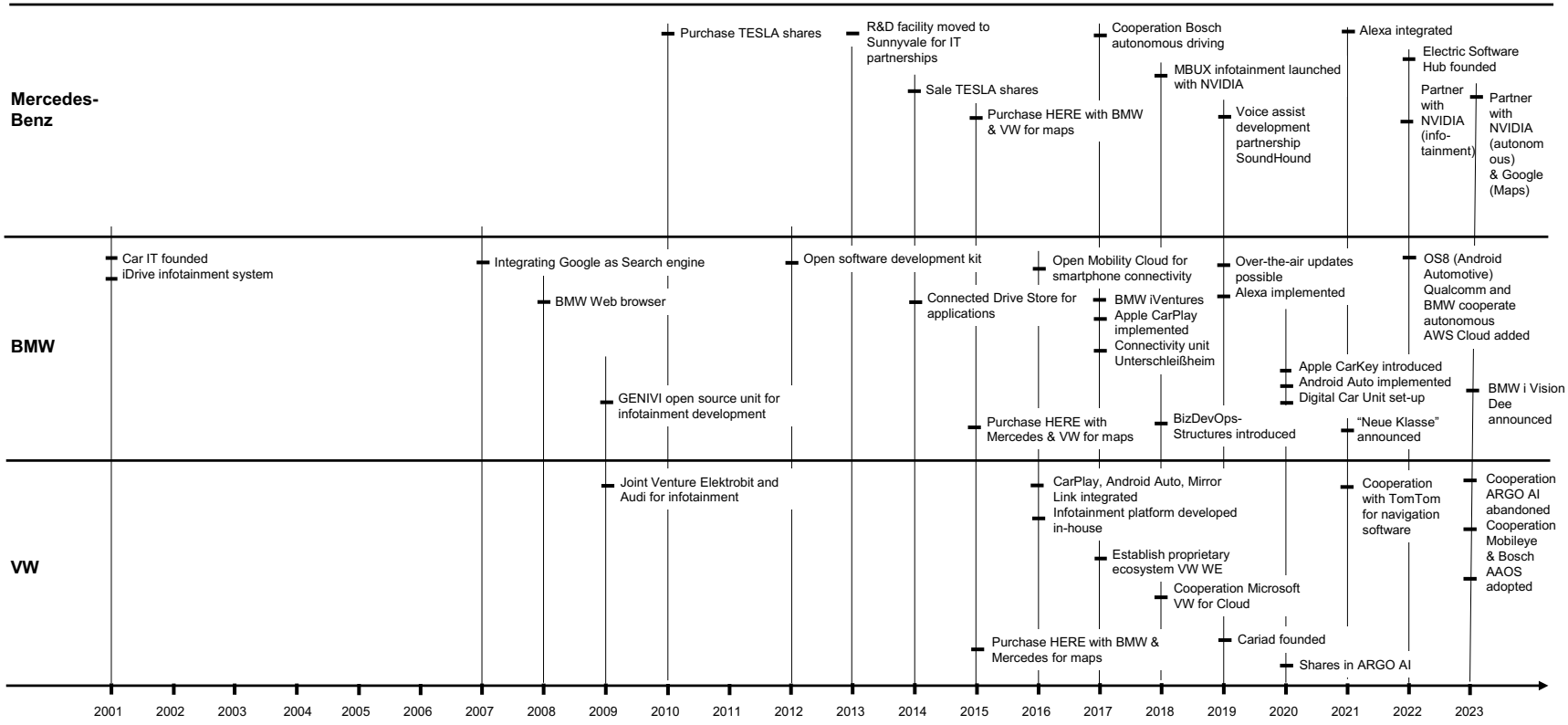

FIGURE 1: Proactivity of different automobile producers in ecosystem strategy

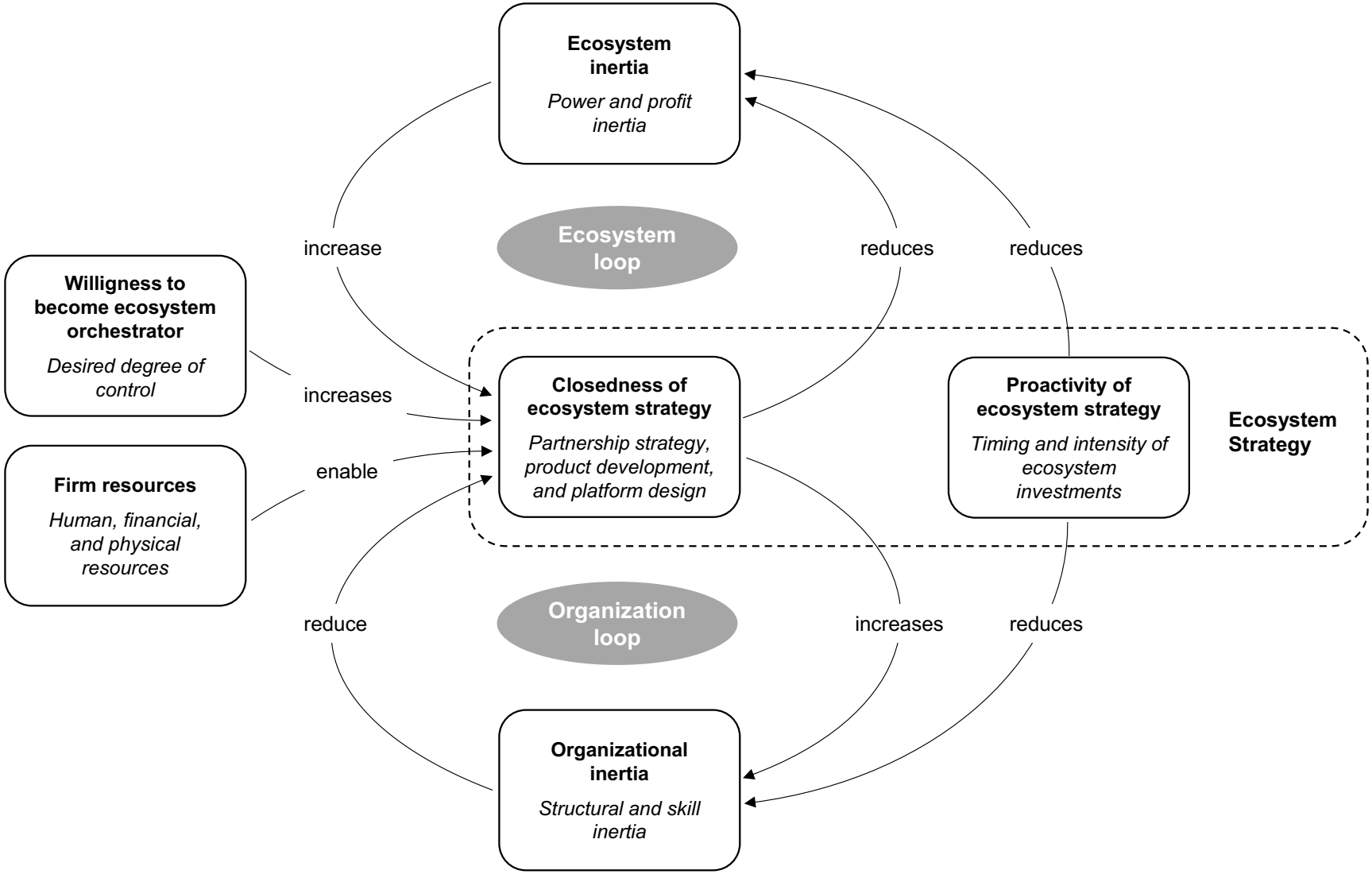

FIGURE 2: Ecosystem and organizational inertia as a result of ecosystem strategy