Adding a platform ecosystem to a pipeline:

A multiple case study of the automotive industry

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Before you lies my master's thesis on integrating a platform ecosystem within traditional pipeline business models within the automotive industry. The cases studied are BMW and Mercedes-Benz. Writing this thesis marks the finalisation of my Master in Business Administration, specializing in Entrepreneurship & International Strategy, at the University of Twente.

During the preparation of this work, I used the following tools/services:

- Grammarly to correct spelling/grammar errors, and to improve my writing in general;
- Scribbr source generator to manage references used in my Thesis;
- Google search engine for data collection;
- the BMW and Mercedes-Benz press data bases for data collection;
- Various Academic databases to find papers for the theoretical framework;
- Microsoft Word and Google Docs for the writing and formatting of my Thesis.

After using these tools/services, I thoroughly reviewed and edited the content as needed, taking full responsibility for the final outcome.

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ABSTRACT

The automotive industry is undergoing significant transformations driven by megatrends such as urbanization, sustainability, individualization, and digitization. Of these, digitization is having the most profound impact, compelling established manufacturers to rethink their traditional pipeline business models. Therefore, this research explored how incumbent automotive firms, specifically BMW and Mercedes-Benz, are incorporating platform ecosystems into their business models.

As the starting point, a review of the existing literature was conducted in order to gain an initial understanding of the topic and to substantiate the research gap and resulting research questions. It was followed by a qualitative multiple case study approach where data was gathered through document analysis. Using the Eisenhardt method, both within-case and cross-case analyses were performed to explore how these companies integrate platform ecosystems into traditional business models, providing insights into the challenges and opportunities of this transformation.

The findings show that the incorporation of the platform ecosystem takes place both "around" and "in" the car. Around the car, manufacturers are taking the complementor role. In-car implementation of platform ecosystems has taken a less straight-forward path with repositioning along the way showing a move from a proprietary approach to the formation of an industry standard.

As a result, the research showed that integrating a platform ecosystem into a pipeline business model is complex, with major challenges like the need for industry-wide standardization to compete against tech giants like Google and Apple. A new role, the 'governing integrator,' has emerged, where OEMs adapt platforms to their brand identity, and this role was identified through patterns in the multiple case studies, providing insights into shared problems and solutions across manufacturers.

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ABBREVIATIONS

GmbH	‘Gesellschaft mit beschränkter Haftung', which is the German equivalent of ‘Limited Liability Company (LLC).
AG	‘Aktiengesellschaft’, which is the German name for a company which shares can be traded.
AAOS	Android Automotive Operating System
BMW	Bayerische Motoren Werke (Bavarian Motor Works)
GAS	Google Automotive Services
IBM	International Business Machines Corporation
IVI	In-Vehicle Infotainment
MaaS	Mobility as a Service
NASDAQ	National Association of Securities Dealers Automated Quotations
OEM	Original Equipment Manufacturer
VAG	Volkswagen Aktiengesellschaft (Volkswagen AG, abbreviated as VAG in German)

GLOSSARY

Business Model: A framework outlining product, service, and information flows, including the roles of business actors, their benefits, and revenue sources. Refers to how a company creates, delivers, and captures value (Section 1.1).

Pipeline Business Model: A traditional linear approach to value creation and delivery, where a company creates products or services and directly sells them to customers, often characterized by sequential stages of production and distribution (Referenced implicitly in discussions on evolving business models towards platform ecosystems, Section 1.1 and Section 2.2).

Ecosystem: In a business context, a network of interacting businesses that are interdependent. Indicating a complex network of relationships among various parties involved (Section 1.1).

Platform Ecosystem: A business model characterized by facilitating, orchestrating, and co-creating value among diverse and interconnected participants. It emphasizes multi-way value creation and collaboration beyond traditional producer-consumer roles (Section 2.5).

Product/Internal Platform: A foundational framework for in-house product development, featuring subsystems and standardized interfaces to enable efficient creation and manufacturing of a diverse product range (Section 2.2.1).

Supply-Chain Platform: Similar to internal platforms but involves multiple firms within the supply chain, enhancing efficiency and reducing costs through modular components shared among collaborating firms (Section 2.2.1).

Industry/External Platform: Facilitates the reuse of components and technologies, enabling external innovators to develop complementary innovations within a collaborative ecosystem, often generating network effects (Section 2.3).

Multi-Sided Market Platform: A platform that offers goods or services to multiple customer groups that depend on each other, relying on the platform to facilitate their transactions. It does not fully align with supply-chain or industry platforms, especially regarding external innovation (Section 2.4).

Modularity: The design principle involving the creation of modular components adaptable to various end products and services, promoting cost efficiencies, economies of scale and scope, and customization (Section 2.1.1).

Network Effects: The phenomenon where the value of a product or service increases as more people use it, characterized by direct (one-sided) and indirect (two-sided) network effects, enhancing the platform's value with each additional user or participant (Section 2.5.2).

Platform Governance: The mechanisms and activities employed by platform owners to manage relationships within a platform ecosystem, ensuring its success and sustainability by fostering collaboration and innovation among ecosystem participants (Section 2.5.3).

Digital Transformation: The integration of digital technology into all areas of the automotive indsutry, fundamentally changing how the companies within the industry operate and deliver value to customers, often leading to the development of digital platform ecosystems (Section 3.3).

1. INTRODUCTION

A changing industry

The car industry is changing. Not only the way in which cars are powered is changing, after more than 100 years of Internal Combustion Engine dominance, these changes in the industry go a lot further than just that (Bormann et al., 2018). Four megatrends are changing mobility, these are Urbanisation, Sustainability, Individualisation, and Digitisation (Bormann et al., 2018). According to Bormann et al. (2018) the biggest impact is potentially that of Digitisation.

Digitisation includes networking (connected car infrastructure), automation of driving, sharing mobility, and mobility services (Bormann et al., 2018). This is driven by advancements in connected car technologies that allow cars to collect and interpret large amounts of data from digital sensors and exchange information with other vehicles and backend services (Lovas et al., 2018).

As noted by Jovanovic et al. (2022), digital transformations have significantly changed the way that firms innovate and compete. As the production of vehicles will become less profitable in the future, incumbent firms should leverage digital options thinking and shape their organizational and technological resources to develop generative capabilities (Bormann et al., 2018; Svahn et al., 2015).

Uncertainty about current business model

According to Bormann et al. (2018), there is a rising doubt about the current business models in the car industry. This is not strange when looking at Johnson et al. (2008) who identified five strategic circumstances that indicate a need for business model change, of which four are observable in today's automotive industry. The digitization of cars has led tech companies to acquire firms in the automotive industry to get a foot on the ground (Fletcher et al., 2020). Fletcher et al. (2020) might refer here to the 2016 acquisition of the Harman Group by Samsung (Samsung, 2017; Forbes, 2016). Harman is a large supplier of car audio systems, engineering services, modular cockpit systems, and Over-the-Air (OtA) update solutions (Harman Automotive, 2025). Additionally, Apple and Google have entered the automotive market with Apple Carplay and Android auto respectively. These tech companies entering the market highlight an important moment for the automotive industry, emphasizing the need for innovative business models to adapt to the changing environment.

The concept of "business model" has seen rising attention since the 1990s. Timmers' (1998) defines a business model as an architectural framework of product, service, and information flows, including the roles of business actors, their benefits, and revenue sources. Business model innovations have significantly transformed entire industries, leading to the redistribution of substantial value. Eleven out of 27 companies established in the last 25 years achieved their way into the Fortune 500 through innovative business model strategies (Johnson et al., 2008).

Ecosystem versus pipeline business model

Jacobides et al. (2018) highlight the adoption of the term 'ecosystem', a concept derived from biology, in business model research. In the case of business, it refers to a group of interacting businesses that are interdependent upon each other's activities. This is because information technology advancements made scaling up platforms simpler and cheaper (Van Alstyne et al., 2016). This stream of research emphasizes a movement from the traditional 'pipeline' business model to a platform-based business model within an ecosystem (Jacobides et al., 2018). The latter is often denoted as a 'platform ecosystem' (Van Alstyne et al., 2016; Mody et al., 2020; Jovanovic et al., 2022).

The business model referred to as the 'pipeline' business model, aligns with Porter's (1985) classic value-chain model, as outlined by Van Alstyne et al. (2016) where businesses create value by managing a sequential set of processes. Inputs, like materials from suppliers, are introduced at one end of the sequence and go through various stages of transformation, ultimately resulting in an output of higher value: the finished product (Alstyne et al., 2016).

The business model of a platform ecosystem is characterized by an emphasis on facilitation, co-creation of value, and the orchestration of interactions among diverse participants (Parker et al., 2016). Platform-based ecosystems focus on value sharing through value co-creation and co-capture (Choudary, 2015). The emphasis is on creating an open and collaborative environment where different actors in the ecosystem can contribute to and benefit from the value created (Choudary, 2015).

The main reason for this is that platforms can grow exponentially due to indirect Network effects (Van Alstyne et al., 2016; Jacobides et al., 2018). Network effects are a phenomenon where the value of a product or service increases as the amount of users - on the same or other side of the platform - increases (Jacobides et al., 2018). When a platform business enters an industry, they almost always win from the traditional pipeline competition (Van Alstyne et al., 2016).

The knowledge that platform ecosystem entrants in pipeline industries often win, sends large incumbent pipelines such as General Electric and John Deere rushing to incorporate platforms into their business models (Van Alstyne et al., 2016). Automobile manufacturers are no exception to this. These platforms are however still relatively new and not yet fully developed. According to Jovanovic et al. (2022) these early stages of evolution to platform ecosystems is something that scholars should put more focus on in research.

This research aimed to fill this gap as the entire automotive industry might need to make this shift in the near future. There should be a deeper understanding of the changes that are necessary for car manufacturers to accomplish such a business model change, given the risk of becoming rapidly obsolete when there is a platform entrant that grows exponentially within their industry.

1.1 Research goal

Therefore, the research goal is to address the aforementioned research gap identified by Jovanovic et al. (2022) and thereby advance the strategy literature on business models by exploring the early stages of platform ecosystem implementation in incumbent pipeline organizations, through the example of the automotive industry. The research aims to identify practices for designing a business model that combines characteristics of a pipeline business with those of a platform business.

1.2 (Central) Research Question

"How are incumbent pipeline organizations combining the platform ecosystem business model with their existing business model to transform them into a hybrid between these two different business models?"

To answer this main research question, different sub-questions were formed. These sub-questions act as a guideline of general topics to be discussed in this thesis and are not discussed individually.

1. What are the current applications of platforms in the automotive industry?
2. What is the current business model of automobile manufacturers?
3. How do incumbents change their business model?
4. Which are the current challenges when applying a platform-based business model to automobiles?

1.3 Thesis outline

This thesis explores how incumbent automotive firms integrate platform ecosystems into their traditional pipeline business models. The starts with a theoretical framework that examines the fundamental concepts of pipeline business models, platform ecosystems, and business model transformation. Next, the methodology section outlines the qualitative multiple-case study approach, focusing on BMW and Mercedes-Benz as key case studies. After this, an overview of platforms in the automotive industry is provided. The results section presents within-case and cross-case analyses, identifying key challenges and strategic approaches to platform integration. The discussion reflects on theoretical and practical implications, emphasizing the need for industry-wide standardization and the emerging role of the Governing Integrator. and finally, the conclusion.

2. THEORETICAL FRAMEWORK

There are occasions when pursuing new growth involves not just exploring unfamiliar market landscapes but also delving into uncharted territories regarding business models. When does this occur? Johnson et al. (2008) observed five strategic circumstances that often require business model change:

1. Disruptive innovation presents an opportunity to cater to the requirements of extensive segments of potential customers who are excluded from a market entirely due to the existing solutions being overly expensive or complex for their accessibility.

2. Take advantage of emerging technology or utilize existing technologies in novel markets to achieve business objectives.

3. Introduce a focus on fulfilling the specific job or task that needs to be done in areas where this perspective is currently absent.

4. There is a need to fend off low-end disruptors

5. Adapting to changes in competition becomes essential. Eventually, the criteria that determine an adequate solution within a market will evolve, resulting in the gradual commoditization of core market segments (Johnson et al., 2008).

As already mentioned in the introduction and supported by Jacobides et. al, (2018), there has been a surge in popularity of the term ecosystem in the last few years. What is noted is a shift from the classic ‘pipeline’ business model towards a platform business model with an ecosystem, often contracted into the term ‘platform ecosystem’ (Van Alstyne et al., 2016; Mody et al., 2020). First both the pipeline business model and the platform ecosystem business model will be explained.

2.1 Pipeline business model

Van Alstyne et al. (2016) describe the pipeline business model as the classic value-chain model. This traditional, or pipeline, business model focuses on the production and direct delivery of specific products or services to end consumers within a linear supply chain through the coordination and integration of various stages or components in a value chain to deliver a product or service that is worth more than the input (Hein et al., 2019; Hagiu & Wright, 2015; Van Alstyne et al., 2016). In this model, each stage of the pipeline adds value to the product or service, and the overall value is created through the seamless flow and efficient coordination of these stages. Revenue generation of a pipeline business is one-sided, commonly selling to the customer (Wirtz et al., 2019). Pipeline businesses tend to have high fixed costs resulting from investments in production assets and stock (Wirtz et al., 2019).

The concept of the value-chain was introduced by Porter (1985). Porter (1985) splits a firm's activities in two groups, primary- and support activities. The activities in these groups are of strategic importance, and can therefore result in a competitive advantage when they are executed more cheaply or better compared to the competition.

Value system

A single firm's value chain is situated in a stream of value chains of other firms, both upstream (suppliers) and downstream (channel and eventually the buyer). This stream of value chains is the value system. Competitive advantage is gained and kept through understanding the position of the firm within the value system (Porter, 1985).

According to Jacobides et al. (2018) the value system of the pipeline business model looks like figure 1. A critical note on this is that oftentimes there are firms between the focal firms and the final customer (i.e. a car dealership). Something that is better represented in the value system depicted by Porter (1985), as seen in figure 2.

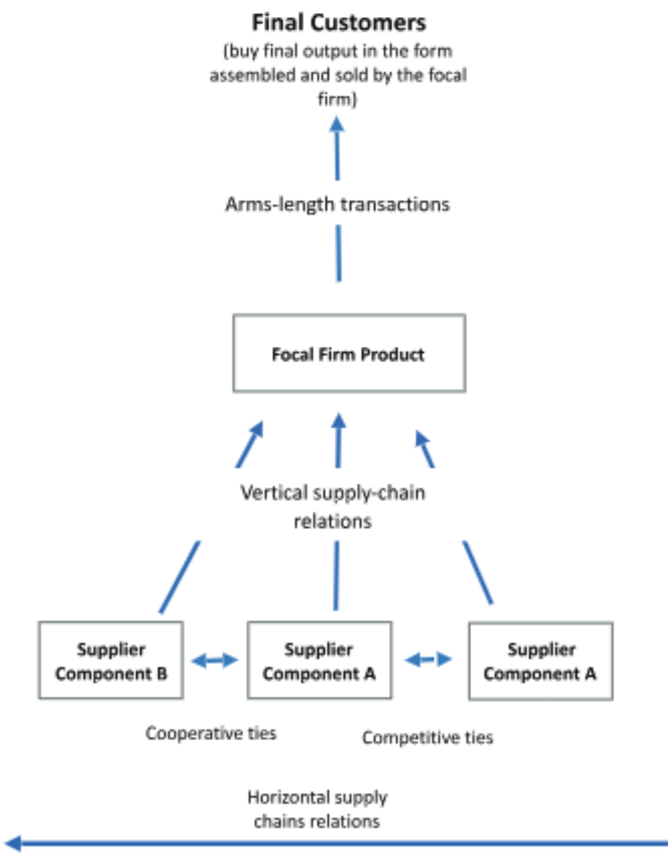

Figure 1 Hierarchy based value system (Jacobides et al., 2018).

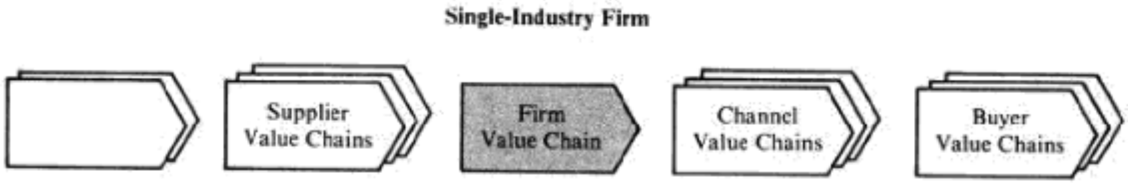

Figure 2 Value system (Porter, 1985).

2.2 Platforms

Understanding the term 'platform ecosystem' requires dissecting its two components: 'platform' and 'ecosystem'. This is important for understanding what a platform ecosystem is. Firstly a background needs to be provided on platforms. There are four different types of platforms, only two of which feature an ecosystem according to multiple authors such as Gawer (2009) and Gawer & Cusumano (2013, 2015). According to Gawer (2009) there are generally four types of platforms:

1. Product or internal platforms
2. Supply-chain platforms
3. Industry or external platforms
4. Multi-sided platforms.

These will be explained below.

2.2.1 Product/internal platform

The term "platform" became popular in product development, referring to reusable components that enable firms to create related products (Gawer & Cusumano, 2015). Product platforms establish a reusable base for in-house development, comprising subsystems and interfaces for creating a variety of products, such as vehicles or electronics (Gawer & Cusumano, 2013). These platforms offer cost savings, streamlined development through modular designs, and flexibility in feature customization, aligning with the concept of "mass customization" (Pine, 1993).

Mass customization merges tailored products with cost-effective mass production by leveraging modularity for strategic advantage (Duray et al., 2000; Kumar, 2004). Modular components enable economies of scale and scope, reducing costs and broadening product ranges (Pine, 1993). They also support extensive customization, allowing customers to configure diverse products (Pine, 1993). However, modularity has limitations. It can hinder product-specific optimization, make products feel overly similar, and increase vulnerability to reverse engineering or reduced innovation (Pine, 1993). Despite these drawbacks, platforms and modularity remain key enablers of efficient, flexible product development.

2.2.2 Supply-chain platform

Although similar, as both internal and supply-chain platforms leverage modular components to improve efficiency and reduce costs, with similar objectives, design rules, and clear end uses for final products, there is a difference (Gawer, 2009; Gawer & Cusumano, 2013).

The primary difference lies in openness of the plaform: internal platforms operate within a single firm, while supply-chain platforms involve collaboration among multiple firms in the supply chain. In supply-chain platforms, external firms design and manufacture specific components, which are then assembled by either the platform owner or another party (Gawer, 2009). These platforms are common in assembly-driven industries like consumer electronics, computers, and automobiles (Brusoni, 2005; Brusoni and Prencipe, 2006; Sako, 2003, 2009; Szczesny, 2003; Tierney, Bawden, and Kunii, 2000; Zirpoli and Becker, 2008; Zirpoli and Caputo, 2002, as cited by Gawer & Cusumano, 2013).

2.2.3 Industry/external platform

Like product and supply-chain platforms, industry platforms facilitate the reuse of modular components and technologies but are aimed at enabling external innovators to create complementary innovations within an ecosystem, fostering collaboration and potentially generating network effects (Gawer and Cusumano, 2013; 2015). The design principles for industry platforms emphasize the stability of platform architecture but differ significantly in execution; the platform serves as a modular framework for innovations whose final form may be uncertain or evolving, shifting away from the firm as the sole designer (Gawer and Cusumano, 2013). Moreover, entities on industry platforms often engage in creating complementary innovations without direct commercial transactions or shared supply chains, marking a distinct difference from supply-chain platforms (Gawer & Cusumano, 2013).
The phenomenon of business ecosystems will be explained in section 2.3.

2.2.4 Multi-sided market platform

The 'multi-sided' market/platform represents a distinct platform type where goods or services cater to multiple customer groups, all interdependent and relying on the platform for facilitating transactions (Evans, 2003; Rochet and Tirole, 2003, 2006, as cited by Gawer & Cusumano, 2013). While similar to supply-chain and industry platforms in facilitating interactions, multi-sided markets do not fully align with either, mainly because they may not always encourage external innovation (Gawer & Cusumano, 2013; 2015). For example, platforms like Uber connect different user groups but do not inherently drive innovation among participants. However, industry platforms, a subset of multi-sided platforms, are designed to stimulate innovation across their ecosystem (Jacobides et al., 2018; Gawer & Cusumano, 2015). Therefore, the emphasis is on understanding multi-sided platforms—including industry platforms—and their ecosystems as they both serve to mediate interactions between varied actor types, addressing similar challenges (Adner, 2017).

2.3 Ecosystem business model

2.3.1 Definition

The term "ecosystem," borrowed from biology, refers to a group of interdependent businesses (Jacobides et al., 2018). Interdependence, as defined by Cambridge Dictionary (2024), means "depending on each other, or consisting of groups that depend on each other." Ecosystems distinguish themselves by coordinating complementarities in production and consumption without requiring vertical integration (Jacobides et al., 2018).

However, Gawer & Cusumano (2013, 2015) argue that ecosystems are absent in product and supply-chain platforms, despite evident interdependence and a lack of vertical integration. In the automotive industry, for example, major suppliers like Bosch or Siemens are not entirely reliant on automakers such as BMW or Mercedes-Benz, nor are they owned by them. Yet, the sudden absence of a key supplier or automaker could disrupt the industry, illustrating a web of interdependencies critical to its functioning.

Jacobides et al. (2018) and Adner (2017) clarify these distinctions. Ecosystems differ from supply chains by lacking residual control over assets by any member. Unlike supply chains, where a hub exercises hierarchical control (e.g., Toyota's procurement system), ecosystems distribute decision-making, as seen in Apple's App Store, where standards and rules are set without dictating specific contributions or pricing beyond acceptable ranges (Jacobides et al., 2018).

Adner (2017) captures this dynamic, defining ecosystems as *"the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize"* (p. 4). Following this definition, ecosystems are alignment structures, necessary only when coordination among partners is required. When alignment already exists, such as in clear buyer-supplier relationships, the ecosystem perspective becomes redundant (Adner, 2017). The "multilateral" aspect of ecosystems reflects complex interdependencies that cannot be reduced to bilateral relationships; if such simplification is possible, an ecosystem view is not needed (Adner, 2017). Ecosystems focus on a shared value proposition, requiring coordinated actions among specific partners. This analysis shifts attention to partners' roles and the coordination needed to realize the value, accounting for differing perspectives and potential conflicts (Adner, 2017).

2.3.2 Platform ecosystem

Now that we have established a clear view of what platforms and ecosystems are, we go back to platform ecosystems.

The conventional business model and the dynamic structure of a platform ecosystem business model differ significantly in terms of their approach to product or service delivery and revenue generation (Hagiu & Wright, 2015). The platform ecosystem presents a distinctive paradigm within the contemporary business landscape, characterized by its emphasis on facilitation, multi-way co-creation of value, the orchestration of dynamic interactions among diverse and interconnected participants, and a focus on value sharing and collaboration (Banerjee & Majumdar, 2020; Choudary, 2015; Parker et al., 2016; Hein et al., 2019). These ecosystems extend beyond the binary producer-consumer roles that typify traditional models, encompassing a spectrum of roles including the platform, producers, consumers, developers, partners, and more (Parker et al., 2016; Jacobides et al., 2018). These actors will be explained after the next section.

Thus, platform ecosystems have a different approach to capturing value compared to traditional business models. Traditional companies often focus on controlling value creation and capture value through vertical and horizontal control-oriented business models (Choudary, 2015). In contrast Choudary (2015) argues, platform-based ecosystems focus on value sharing through value co-creation and co-capture . The emphasis is on creating an open and collaborative environment where different actors in the ecosystem can contribute to and benefit from the value created (Choudary, 2015).

The platform ecosystem business model operates as a multi-sided platform that connects these different stakeholders and facilitates interactions between them (Parker et al., 2016). This means that in a platform ecosystem, value creation is not limited to a single direction but occurs in a multi-way manner (Banerjee & Majumdar, 2020), where different actors contribute to and benefit from the ecosystem, as shown in figure 3.

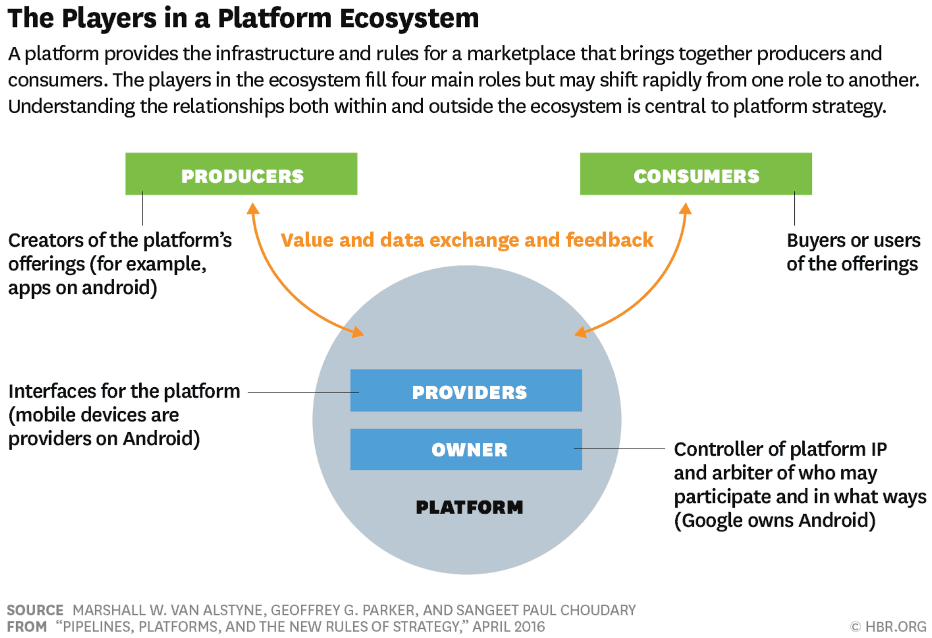

Figure 3 Players in a Platform Ecosystem (Van Alstyne et al., 2016).

Actors

The platform

Van Alstyne et al. (2016) highlight the two roles within the platform itself. Namely, the role of 'platform owner' and 'platform provider'. The platform owner is responsible for the Intellectual Property regarding the platform, the infrastructure of the platform, its business model, and the governance of the platform (Väyrynen et al., 2022; Van Alstyne et al., 2016). Platform governance will be discussed later on.

According to Parker & Van Alstyne (2005), there are generally two markets in a platform ecosystem, the user/consumer market and the producer/developer market. The owner of the platform acts as an intermediary between these two markets, essentially facilitating the exchange of value between the different markets. For example, Booking.com facilitates a transaction between a traveler and a hotel (Parker & Van Alstyne, 2005).

Platform owners in a platform ecosystem foster a loosely-coupled arms-length approach to integrating different parties into their ecosystem (Ghazawneh and Henfridsson 2013, 2015, as cited in Hein et al., 2019). The platform owner provides the infrastructure, rules, and governance necessary for the platform to function effectively. The primary source of revenue in this model is often derived from various sources, including transaction fees, advertising, subscriptions, or data monetization (Evans & Schmalensee, 2016; Gawer & Cusumano, 2014; Parker, Van Alstyne, & Choudary, 2016).

The platform provider on the other hand is the party that provides the tangibility of the platform by providing the product that acts as the platform's interface. The provider usually creates this product through a pipeline business model, such as Samsung who produces a smartphone in a pipeline business model and thereby provides the interface between the user and the platform, in this case Android (Van Alstyne et al., 2016).

Although the 'platform owner' and the 'platform provider' can be different firms, they can also be the same company. An example of this would be Apple, who make their own devices and also are in charge of their own operating systems and respective ecosystems around these operating systems. This is depicted by figure 4, the 'focal firm product' - which serves as the foundation of the platform ecosystem is produced through a pipeline business model with vertical ties in the supply-chain.

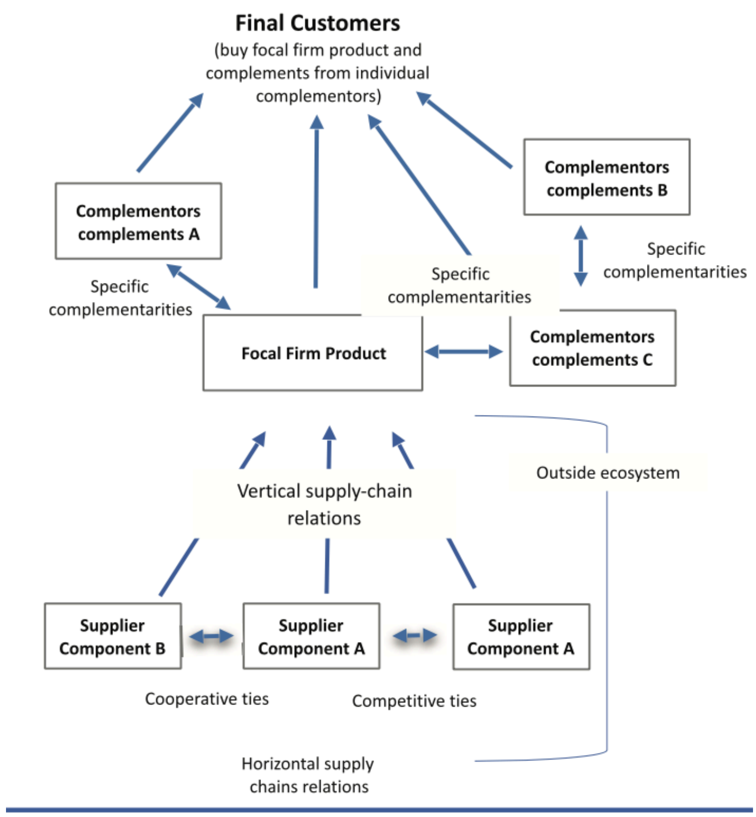

Figure 4 Ecosystem based value system (Jacobides et al., 2018).

Users

As previously mentioned, there are generally two markets in a platform ecosystem (Parker & Van Alstyne, 2005). The first market in the platform ecosystem is the user/consumer group. The user group is the group that uses the platform (products) along with the complementary products or services. The users are the reason the platform and its complementors exist. They create the demand (Parker & Van Alstyne, 2005).

Producers/Complementors

The second market in the platform ecosystem is the Producer/complementor group. Producers are the organizations that provide complementary products/services to the main product. There are two types of complements, unique and Supermodular complements. Unique complements can be divided into two groups, generic and specific complements (Jacobides et al., 2018).

Unique complementarity in its strict definition means that two assets are unproductive when not used together. More generally, unique complementarity is seen as the value of product A is maximized by product B. In the case of specific complementarity, product B needs to be customized to be productive. Generic complementors require no specific coordination in order to successfully add value to the product it complements. Water is a requirement to make tea, however the customer is able to obtain the required water through the market without coordination. Unique complementarity can be one or two-way, meaning that either one needs the other or they both need each other. The latter being the underpinnings of co-specialization (Jacobides et al., 2018).

Supermodular or "Edgeworth" complementarity revolves around the idea of increasing the use or presence of one thing, it makes another thing more valuable. An example of this is where having more apps increases the value of the operating system. Supermodular complementors in consumption are the basis of network effects (Jacobides et al., 2018).

Network effects

The scalability of platform ecosystems is intrinsically tied to the phenomenon of network effects, where the value of the ecosystem increases as more participants join, resulting in a self-reinforcing cycle of growth (Hagiu & Wright, 2015; Clements, 2002). There are two main types of network effects, direct and indirect network effects (Gawer and Cusumano, 2015; Jacobides et al., 2018).

Direct network effects, or one-sided network effects, occur when the value of a product or service increases for an individual user as the number of other users on the same side of the platform increases, the impact is felt directly by users of the same product (Gawer and Cusumano, 2015). This can be seen in social media platforms, where a higher user number makes the platform more valuable for each user (Clements, 2002; (Parker & Alstyne, 2005).

Indirect network effects, or two-sided network effects, refer to situations where the value of a product or service increases for a user group due to the increased adoption by the user group on the other side of the platform. The impact of an increased user group is felt on the other side of the platform (Gawer and Cusumano, 2015). For example, the value of a gaming console increases as more game developers create games for that console (Parker & Alstyne, 2005). Indirect network effects are often associated with consumption externalities from purchasing compatible products (Parker & Alstyne, 2005).

These indirect network effects can result in exponential growth of the Platform, which can be seen in platforms like Uber, where the value for riders increases as more drivers join the platform, and the value for drivers increases as more riders use the platform (Yao & Mo, 2020).

This unique characteristic of network effects lends platforms an inherent adaptability and rapid innovation capacity, driven by a multitude of ecosystem participants (Hagiu & Wright, 2015). Governance mechanisms within platform ecosystems adopt a more decentralized approach, focusing on the establishment of rules, standards, and guidelines that foster collaboration and trust among the heterogeneous array of stakeholders involved (Parker et al., 2016).

Ecosystems prove their utility when a substantial need for coordination exists, surpassing the capabilities of market mechanisms yet not necessitating the authoritative structure of a central actor. This necessity for coordination stems from various types of complementarities within the ecosystem (Jacobides et al., 2018).

Platform Ecosystem Governance

Platform ecosystem governance refers to mechanisms deployed by platform owners to facilitate cooperation, coordination, and integration of the diverse set of actors within a platform ecosystem (Jovanovic et al., 2022). When a platform gets its governance approach right, third parties are incentivized to contribute to the ecosystem, which can make the ecosystem flourish (Schreieck et al., 2018).

According to Schmeiss et al. (2019), management of access and participation is one of the main parts of platform ecosystem governance and is something that Platform owners struggle with. A balance between openness and control is required, which provides somewhat of a paradox (Schmeiss et al., 2019). While platform openness is important for the success and sustainability of the ecosystem by allowing maximum participation and value creation, it also introduces complexity, because the processes of offering, negotiating, engaging in, and capturing value become more challenging as the number of participants increases. Effective platform governance should manage the balance between openness[1] and capturing value[2] to avoid destabilizing the ecosystem (Schmeiss et al., 2019; Wessel et al., 2017).

Through governance mechanisms, platforms aim to have control over participant behavior without putting too much of a constraint on their generativity (Wareham et al., 2014). By managing this, platform owners keep the ecosystem open enough to attract a diverse range of actors while maintaining the necessary level of control and quality (Schmeiss et al., 2019). Platforms try to achieve this by implementing governance mechanisms such as access, control, and incentives to influence the interactions of different actors within the ecosystem (Schmeiss et al., 2019).

Access criteria are put in place to ensure that complementary actors are interacting in order to combine their skillsets for value creation. The platform leader manages which actor types can interact on the platform and assigns decision rights (Schmeiss et al., 2019). Control refers to rules of interaction in the platform ecosystem. Control mechanisms consist of a clearly defined set of values based on which competing actors collaborate. Accountability of individual actors is also something that is covered by Control mechanisms. Lastly, control mechanisms provide consensus when there are conflicting interests (Schmeiss et al., 2019). Incentives are put in place by platform leaders in order to stimulate participations, to trigger specific actions in order to facillitate innovation (Schmeiss et al., 2019, Mei et al., 2021).

As Schreieck et al., (2018) mention, governance involves the platform sponsor's efforts to align the incentives of third-party developers with the goals of the platform owner, by that encouraging their active participation and contribution to the ecosystem. Platform owners may give autonomy to developers while implementing control mechanisms to keep order and ensure compliance with platform standards (Schreieck et al., 2018). Also, Singal (2021) points out that his balance between autonomy and control is crucial for fostering innovation and maintaining the integrity of the ecosystem. Moreover, governance mechanisms

[1] Openness refers to the extent to which the platform allows external actors to access, augment, or distribute its technology (Benlian et al., 2015).

[2] Value capture refers to securing profits derived from value creation and distributing those profits among involved stakeholders, including providers, customers, and partners. Excessive value capture can harm value co-creation, while insufficient value co-creation makes the platform ecosystem unattractive for third-party developers. Balancing these two aspects is highly important for achieving multi-way value creation (Schreieck et al., 2021).

such as pricing and revenue sharing play a role in shaping the monetization streams within the ecosystem and influencing network effects (Floetgen et al., 2022).

Rietveld et al. (2019) extend the understanding of value creation in platform ecosystems by explaining the strategic choices that platform sponsors must make in managing the overall value of the ecosystem. They point out the selective promotion of complements as a means to increase the value of the ecosystem. Through selective promotion, the platform rewards successful complements, bring a spotlight to complements that are underappreciated, and influence the consumer's perception of the ecosystem in terms of its depth and breadth (Rietveld et al., 2019).

2.4 From a latent ecosystem to an active ecosystem

Transitioning from a Product/Internal Platform to an Industry/External or multi-sided Platform involves the change from a pipeline business model towards a platform ecosystem business model. Van Alstyne et al. (2016) note this does not necessarily need to be the case entirely, as firms like Apple show that they can be both a pipeline and a platform.

2.4.1 Why changing

This being said, moving from an internal platform or a supply-chain platform followed by an industry platform might not happen based on intent. As Gawer (2009) illustrates through the example of IBM. IBM developed System/360, which was intended as an internal platform. Based on architectural ground rules, different teams in different locations would be able to develop distinct modules that would be compatible with the system. Unintentionally, this plug compatibility allowed for competition on these modules. Firms within the supply-chain started to gain innovation capabilities, this resulted in IBM losing control over its supply-chain. When this happened, the platform became an industry platform. With platform leaders that are not the firm that developed the platform initially (Gawer, 2009). This is a disadvantage of modularity according to Pine (1993), because the ease of reverse engineering by competitors is increased.

2.4.2 How to activate the ecosystem

Numerous companies struggle to become platform leaders because their strategies inadequately address both the technological and business facets essential for attaining such leadership (Gawer & Cusumano, 2008). Firstly it is important to know that not every product platform can become an industry platform, in order to be able to become one Gawer &

Cusumano (2008) suggest two conditions. 1. The technology should fulfill a fundamental role within what can be defined as a "system of use" or resolve a critical technological challenge within an industry. 2. Additionally, it should facilitate effortless connections or extensions to amplify the system's functionality and accommodate new, possibly unforeseen, end-uses (Gawer & Cusumano, 2008). To assess this, one can examine whether the entire system would be able to operate effectively without the specific product or technology. If the system would fail to function adequately without it, then the product does indeed serve an essential function. To evaluate the ease of connecting to or building upon a product or technology, an approach is to examine whether external companies have managed to create complementary and interoperable products, or have initiated such efforts. This can serve as an indicator of the product's or technology's openness and adaptability (Gawer & Cusumano, 2008).

When the company has established whether its product can be a platform and they have established which part of the product will be the platform, the actual change in business model needs to be initiated. According to Van Alstyne et al. (2016), moving from a pipeline towards a platform ecosystem business model involves three key shifts:

1. A firm needs to go from resource control towards resource orchestration. This involves moving on from the pipeline's resource based view, where the focus is on controlling scarce and valuable (tangible or intangible) assets towards a view where the network of producers and consumers – and their assets respectively – are the primary assets (Van Alstyne et al., 2016).

2. A firm needs to move from internal optimization towards external interaction. The second Pipeline firms structure their internal labor and resources to generate value through streamlining the entire sequence of product activities, spanning from materials acquisition to sales and service. Conversely, platforms generate value by enabling interactions among external producers and consumers. This shift in emphasis moves from imposing procedures to convincing participants, placing a premium on the skill of ecosystem governance (Van Alstyne et al., 2016).

3. The focus needs to be moved from customer value to ecosystem value. Pipelines aim to maximize the long-term value of individual customers of products and services, positioned at the end of a linear process. Conversely, platforms strive to optimize the overall value of a growing ecosystem through a circular, iterative, and feedback-centered approach. Occasionally, this necessitates subsidizing one category of consumer to attract another type (Van Alstyne et al., 2016).

To guide the practical implementation of a shift towards a platform ecosystem, a structured framework is essential. Timmers (1998) suggests dissecting and rebuilding the value chain, as described by Porter (1985), to identify its components and explore ways to connect information throughout the chain. This approach also considers the establishment of electronic markets, now referred to as platforms or platform ecosystems, which can be open or semi-open depending on the number of buyers and sellers involved.

However, while Porter's (1985) value chain effectively explains linear value creation in pipeline models, it is unsuitable for analyzing platform ecosystems. Its focus on traditional manufacturing organizations makes it less applicable to service industries and modern platform ecosystems, where value is co-created and a service layer complements the key value proposition (Stabell & Fjeldstad, 1998; Markfort et al., 2019).

A more appropriate framework is the six-step process proposed by Markfort et al. (2019), as shown in figure 5. This framework is specifically designed for transitions towards platform ecosystems, addressing the unique dynamics of value co-creation and service integration. Detailed explanations of its phases will follow.

Table 2. Framework for transformation toward a platform-based business model

Initiation	1. Analyze the core business
Ideation	2. Ideate services that serve the core business 3. Evaluate the possibilities for monetization
Integration	4. Do not play an All-In-Game 5. Think global, act local
Implementation	6. Fast realization

Figure 5 framework for transformation towards a platform-based business model (Markfort et al., 2019).

“1. Analyzing the core business”

Understand the existing company structure and core revenue drivers. Align the platform with the current key value proposition to leverage potential advantages and accelerate critical mass and monetization. (Markfort et al., 2019)

“ 2. Ideation of the services that complement the core business”

Focus on developing services that align closely with the core business to ensure the platform integrates effectively and adds value while allowing room for innovation (Markfort et al., 2019).

“3. Evaluate the possibilities for monetization”

Assess monetization possibilities early, as immediate profitability may be challenging. A strong link between the platform and the core business enhances the value proposition and ensures long-term success (Markfort et al., 2019).

“4. Do not play an All-In-Game”

Adopt an incremental approach, testing new platform opportunities before full integration. This minimizes risks and facilitates a gradual transition from a linear to a platform business model (Markfort et al., 2019).

“5. Think global, act local”

Start by establishing a local presence to build a community and gather feedback. Following the Uppsala Internationalization Model, expand to proximate markets while learning from early challenges (Markfort et al., 2019).

“6. First come, first serve”

Act quickly to gain a competitive edge and avoid obsolescence. Early movers can adapt to customer needs, innovate their value proposition, and navigate industry consolidations effectively (Markfort et al., 2019).

2.5 Synthesis

To draw some kind of a conclusion to the theoretical framework. A visual representation of the text in chapter 3 is given. The focus is on highlighting the situation of an incumbent firm that is still fully utilizing the pipeline business model wanting to incorporate a platform ecosystem into their business model. Following Adner (2017), the pipeline business model features a latent ecosystem, where consensus exists about each players' roles within the ecosystem. Additionally, the platform types that are associated with a pipeline business model are highlighted, following Gawer (2009) and Gawer & Cusumano (2013, 2015).

In between latent and active ecosystem (Adner, 2017) two models that are associated with business model transition from pipeline to platform are shown, these are the models by Van Alstyne et al. (2016) and Markfort et al. (2019). After this, platform types that feature an active ecosystem following Adner (2017) and thus are platform ecosystems are shown. This is also in accordance with Gawer (2009) and Gawer & Cusumano (2013, 2015).

This framework, as shown in figure 6, acts as a sensitizing framework. This can be effective in providing a framework for the data analysis. As this is an inductive study, the goal of the research is not to test the framework, it merely is a foundation for the analysis of data (Bowen, 2006).

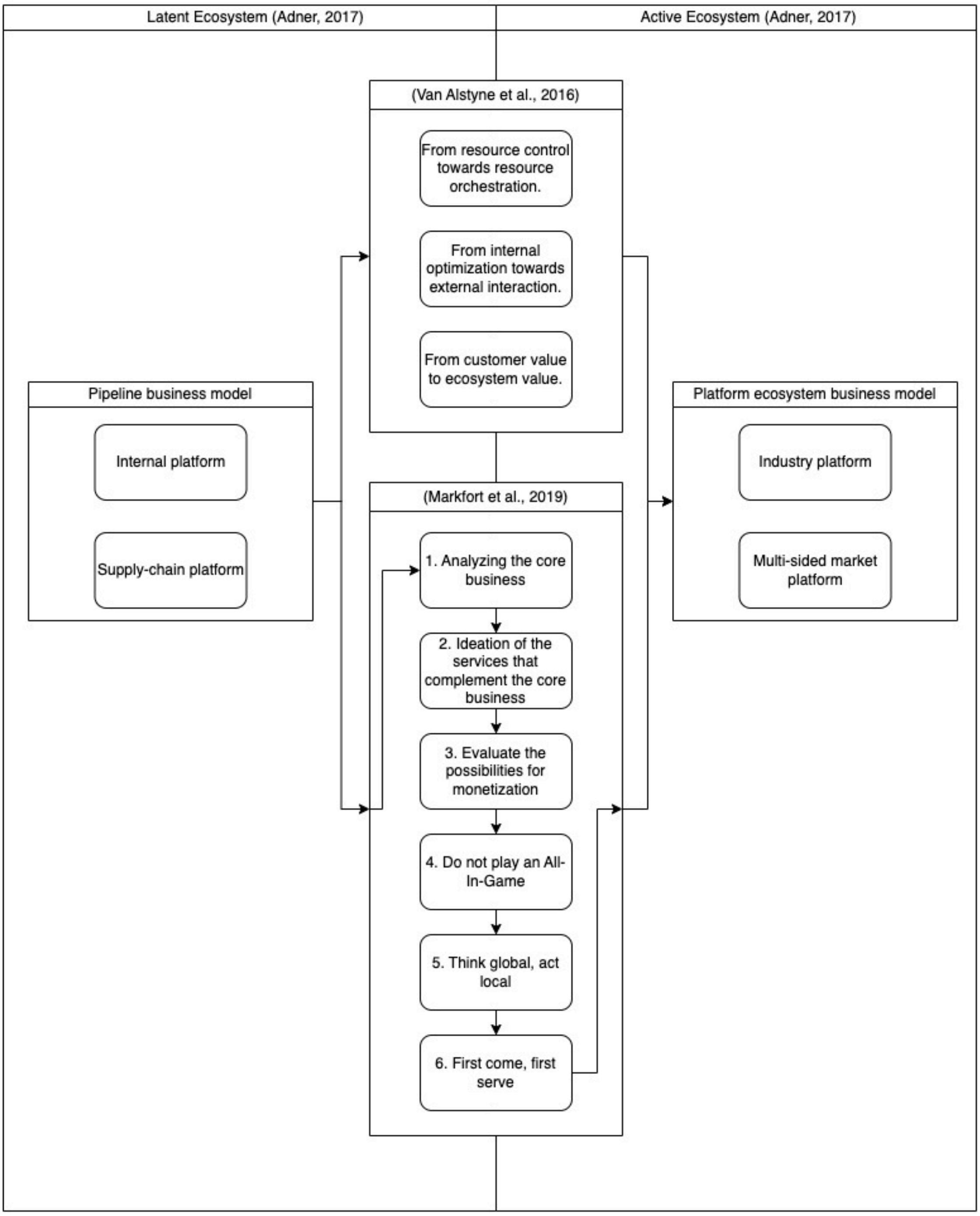

Figure 6 Theoretical framework (self-generated).

3 METHODOLOGY

The goal of this research is to address the aforementioned research gap as identified by Jovanovic et al. (2022) and thereby advance the literature on business models by investigating early stages of platform ecosystem implementation in incumbent pipeline organizations, through the example of the automotive industry. This study examines their business model adaptations in response to digital transformation and the entry of tech companies like Apple and Google. The research seeks to explore practices for designing a business model that combines characteristics of a pipeline business with those of a platform business and evaluate the theoretical frameworks proposed by Markfort et al. (2019) and Van Alstyne et al. (2016) based on real world cases.

The methodology section serves as guide for this study, it detail its processes and procedures. It not only is indicative of the study's credibility but also ensures replicability. It outlines the research design in terms of methods, sampling strategy, data sources, and data analysis techniques.

3.1 Methodology overview

A summary of the methodology of this research is shown in table 1, and a visual representation of the interconnections between the methods is shown in figure 7. In the following sections , the methods chosen to conduct the research are explained in more detail.

Table 1 Methodology overview.

Methodology overview		
Research's approach	Qualitative	
Methods	Literature research	Multiple case study following Eisenhardt method (2021)
Case selection	Not applicable	Purposeful sampling
Data sources	Papers published in academic journals	Secondary data: - Annual/quarterly reports - Strategy plans - Other investor information - Press releases from selected manufacturers - Newspaper/magazine articles - Published interviews with representatives of selected manufacturers - Previously published case studies of the three manufacturers and their approaches to implementing platform ecosystems into their vehicles
Data analysis		- finding, selecting, assessing (interpreting), and combining data (Bowen, 2009) - Skimming (surface-level analysis) and reading (depth analysis) of documents - Coding following Miles et al. (2014) - Comparative analysis to identify similarities, differences, patterns, and relationships (Shevchuk, 2006).
Result	An exploration of how incumbent pipeline organizations are combining a platform ecosystem business model with their existing business model to transform them into a hybrid between these two different business models along with the verification of the theoretical framework proposed by Markfort et al. (2019).	

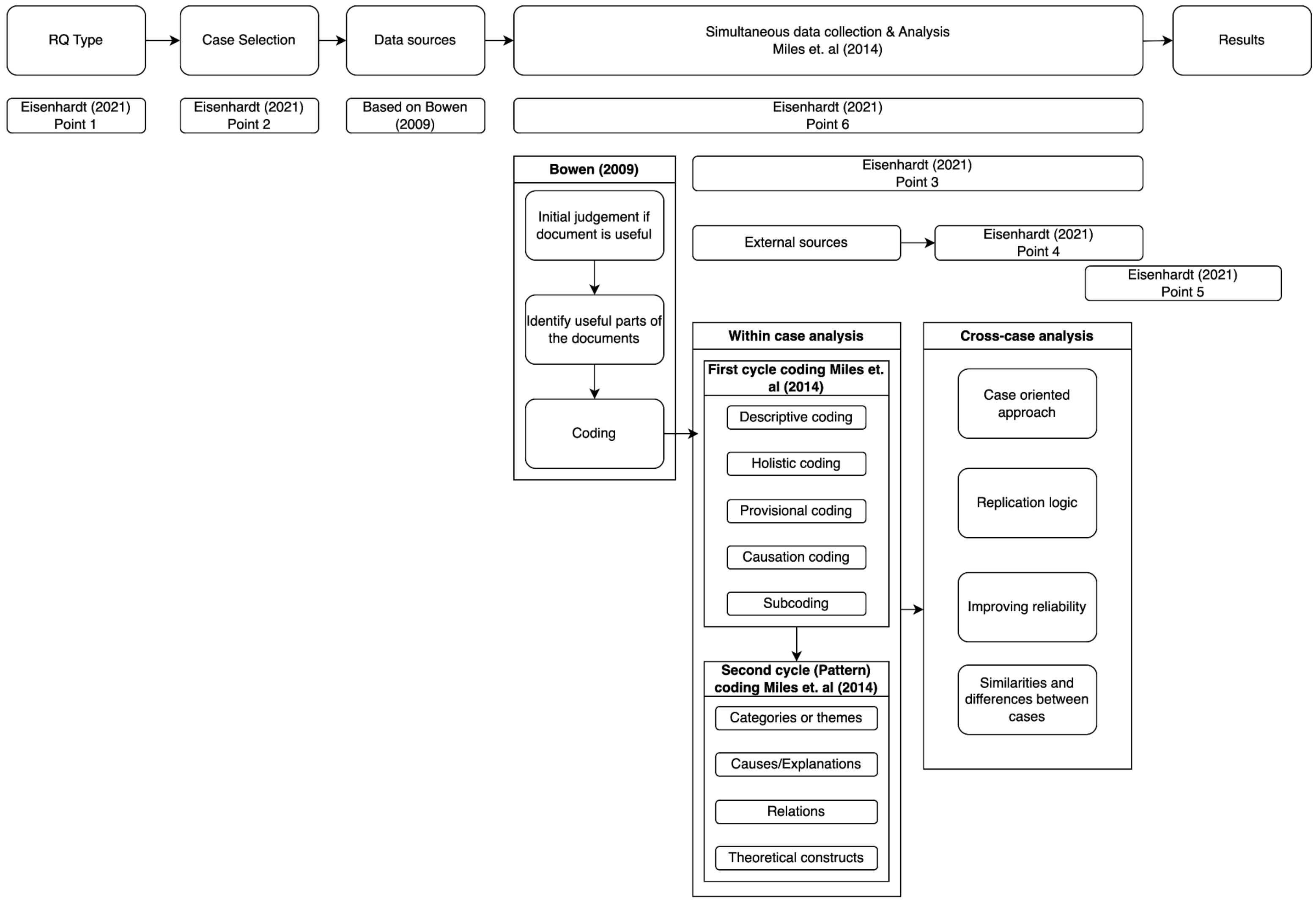

Figure 7 Methods overview (self generated).

3.2 Qualitative research

For this research, a qualitative approach was chosen. Qualitative research focuses on naturally occurring events in natural settings (Miles et al., 2014). According to Miles et al. (2014), qualitative research relies on flexible data collection methods. This can include interviews, observations, historiography, content analysis, and case studies, allowing researchers to explore little-understood phenomena and develop new theories (Lune & Berg, 2017).

Qualitative research helps understanding the meaning behind events, activities, situatitons, and actions. It also is purposeful in understanding the context of actions and the influence of that context on actions. Qualitative research can help researchers identify unanticipated phenomena and influences, generating new theories grounded in the data. Fourthly, it can help to understand the process that leads to a certain outcome. Lastly it is useful for development of causal explanations (Maxwell, 1997, as cited in Sinkovics et al., 2005).

All of these points align well with the research goal as it aims to gain deep insights into the behavior of the collective of people that form a company.

3.3 Multiple case study

A case study aims to provide a comprehensive understanding of the complexities and dynamics of the case being studied (Chaiklin, 1991). According to Yin (2017) case studies are often used when the research question focuses on "how" and "why" certain phenomena occur, and when you have little to no control over behavioral events, this is in line with the research question of this research which is a ‘how’ question and we cannot control the actions and behavior of the research subjects.

By looking at multiple cases, common themes can be identified, as well as variations, and unique aspects within the data. This leads to a more nuanced understanding of the phenomenon (Schoor, 2017). Schoor (2017) says that one of the key advantages of multiple case study research is its ability to enhance the external validity of findings. Also, multiple case study research can contribute to theory development by identifying new patterns, relationships, or theoretical propositions (Schoor, 2017).

A well known method for conducting multiple case study research is what became known as the Eisenhardt Method (Eisenhardt, 2021). Eisenhardt (2021) defined her method on six points, as shown in table 2. Below the table, the applicability of these six points will be explained. It should be noted that these will not fully appear in the order above as the Eisenhardt method is not a step-by-step.

Table 2 Eisenhardt Method points.

Eisenhardt (2021) method points
"The Method addresses research questions for which there is little or conflicting prior theory and/or empirical evidence." (Eisenhardt, 2021, p. 2)
"the Method emphasizes careful case selection (i.e. theoretical sampling). This means choosing cases where the focal phenomenon is likely to occur, and case designs where the similarities and differences across cases are likely to improve theory building." (Eisenhardt, 2021, p. 3).
"The method is particularly explicit about developing (and defining) constructs and measures during the analysis." (Eisenhardt, 2021, p. 5)
"The method emphasizes explicit theoretical arguments (i.e. mechanisms) that support why particular emergent relationships between constructs are likely to hold." (Eisenhardt, 2021, p. 5)
"The method includes identifying boundary conditions and as appropriate, addressing alternative explanations." (Eisenhardt, 2021, p. 6)
"The method emphasizes analysis using constant comparison between the theory and data (Glaser and Strauss, 1967), replication logic (Yin, 1984), and cross-case analysis (Eisenhardt, 1989a)." (Eisenhardt, 2021, p. 6)

3.4 Research question

The first point of the Eisenhardt (2021), is that the method is useful for research questions that are open-ended, focusing on areas where existing theories offer little clarity or are in conflict, presenting a ground for theoretical innovation. Such questions can emerge from various sources, aiming to unearth new phenomena, explore unique settings, or revisit familiar topics from fresh angles (Eisenhardt, 2021). Such as is the case for this research where a unique setting is to be explored.

3.5 Case Selection

Following the limited time available to collect data, not every automobile manufacturer can be researched. Therefore, sampling is needed. Since there is a timeframe of 10 weeks for the second part of the thesis, it was chosen to only include three cases in the research. Despite Eisenhardt (2021) noting that 4 to 10 cases often work well, she also stated that the number of cases is not of primary concern, as pragmatic reasons are to be considered, like availability of data and time.

Eisenhardt (2021) emphasizes the importance of careful case selection, which means selection of cases where the phenomenon is likely to occur. Oftentimes, purposeful sampling is used in qualitative research (Maxwell, 2009). As noted by Yin (2017), cases should be chosen from which the research question is most likely to be answered. Because the research question is a ‘how’ question and not an ‘if’ question, a purposeful sample would be a sample of companies from which it is known that platform ecosystems are incorporated in their business models. This brings in scope the following manufacturers: BMW and Mercedes-Benz.

BMW was chosen as their BMW iDrive infotainment system features third party apps (BMW Nederland, 2024). Similarly Mercedes-Benz also incorporates the option for third party developed apps in their cars’ MBUX infotainment system (Mercedes-Benz Media, 2020).

The selected cases are both premium, German, automobile manufacturers. This increases the concern of limited generalizability. However, the German premium car industry is at the forefront of technological innovation and accounts for 63% of high margin, premium vehicles (Bormann et al., 2018). From this perspective, it makes sense for these developments to be coming from German manufacturers. By focusing on these manufacturers that are on the forefront of implementing Platform Ecosystems, incumbents that are less far with the implementation of Platform Ecosystems could be helped by this research’s outcomes.

3.6 Data Collection & analysis

3.6.1 Within-case Analysis

One practical problem with case study research is that there often is an enormous amount of data to be analyzed, a solution to this, is to keep the cases initially separate during analysis (Eisenhardt, 1989). In practice this means that the data for each company will be collected, coded, and further analyzed individually.

Within-case analysis usually starts with a detailed description of the case. This helps researchers become highly familiar with the cases. This can take multiple forms, but are usually pure descriptions of the cases. This allows for unique patterns to emerge from each case before the findings are tried to be generelized (Eisenhardt, 1989).

Within-case analysis aims to comprehensively describe and understand the dynamics of a single, specific context or "case," such as an individual car manufacturer for this research. This deep dive into a case helps researchers get a nuanced understanding of the reality within the firm, focusing on the unique characteristics and processes within that context (Miles et al., 2014).

Data collection

For this research, data will be gathered from document analysis, which is a systematic approach for the reviewing and evaluation of documents (Bowen, 2009). These documents can be of lots of different forms (Bowen, 2009). In table 3, the included data sources can be found as well as the reason for their inclusion.

Table 3 Data sources.

Data source	**Reason for inclusion**	**Where to retrieve**
Annual/quarterly reports	Annual/Quarterly Reports and Investor Information documents provide detailed information directly from the manufacturers, including financial data, strategic initiatives, and future plans. As annual reports are also forward-looking, directions when it comes to business models are likely to be communicated	**BMW** BMW Group corporate website **Mercedes-Benz** Mercedes-Benz corporate website
Strategy plans	Strategy plans are included because these documents outline the company's direction, they also reveal competitive strategies and how a company plans to navigate both internal capabilities and external market conditions.	**BMW** BMW Group corporate website **Mercedes-Benz** Mercedes-Benz corporate website
Other investor information if available	If useful data of another source is found, it should be included. Oftentimes, investor information contains more than just annual reports and a strategy plans.	**BMW** BMW Group corporate website **Mercedes-Benz** Mercedes-Benz corporate website

Press releases	Incorporating press releases ensures that the research captures the latest updates and developments related to new models, partnerships with partners, and advanced production techniques. As these press releases usually serve as the formal outlet for announcements regarding new technologies and collaborations	**BMW** BMW Group press website **Mercedes-Benz** Mercedes-Benz Media
Newspaper/Magazine articles	The study incorporates external viewpoints and expert analyses by including articles from newspapers and magazines. These sources bring more understanding of the manufacturers' strategies by providing a broader industry context and highlighting how these strategies are perceived and evaluated in the public and professional realms.	Nexis Uni World Wide Web, through Google search engine.
published interviews given by representatives	interviews with company representatives can add to gathering important information on the analysis, offering insights into the thinking of the companies' executives in order to reach conclusions. These interviews can reveal reasoning behind decisions.	Nexis Uni World Wide Web, through Google search engine.
previously published case studies	Reviewing previously published case studies allows for an in depth perspective and understanding of how these manufacturers have evolved their approach to implementing platform ecosystems. This source helps in identifying trends, successes, and areas of concern, facilitating a more nuanced comparison and analysis as these case studies will not be just about what the companies' want to present to the outside world.	Web Of Science Scopus Google Scholar

The aforementioned data sources are considered to be secondary. Making this a strict desk research. This makes data triangulation difficult, therefore the validity will be increased by using data from as close to the source as possible, i.e. a press release will be used over a newspaper article based on that press release. Furthermore reliability of sources will be judged carefully, preferably multiple sources will be used.

Simultaneously with the data collection the data analysis will be done, as is advised by Miles et al. (2014). This is supported by Eisenhardt (2021) who states something similar in the third part of the Eisenhardt method, which is the development of constructs and measures. This iterative process, which transforms raw data into abstract conceptualizations, positions constructs as the foundational elements of theory. It necessitates that their identification and definition are explicitly derived from the data, ensuring the emerging theory is not only grounded in empirical evidence but also remains testable and relevant (Eisenhardt, 2021).

For document analysis, skimming (surface-level analysis), reading (depth analysis), and interpretation are all included in this process. Thus, elements of both content analysis and thematic analysis are combined in this iterative approach (Bowen, 2009). According to Bowen (2009) a preliminary examination of the documents is necessary to find significant and pertinent passages for the content analysis, which is aimed at identifying data that is relevant to the main research questions. This is supported by Miles et al. (2014), who note that in the data there is often lots of content that does not relate to the main research questions. These sections do not need to be coded.

Coding

According to Bowen (2009) a more focused and meticulous rereading and review of the data is then required for thematic analysis, which is a method for finding patterns within the data. In order to identify themes pertinent to a particular phenomenon, the reviewer carefully looks over a subset of the data, codes it, and creates categories based on the features of the data during this phase (Bowen, 2009).

This is similar to what Miles et al. (2014) identified as the two primary phases of coding: First Cycle and Second Cycle coding. This is also close to the third part of the Eisenhardt (2021) method, as she states that regardless of the naming, the common notion is the formation of more abstract conceptualisations. These similarities are because they all take grounded theory as their base. As Eisenhardt (2021), nor Bowen (2009) do not go into detail on the practicalities of the coding process, Miles et al. (2014) will be followed and supported by Eisenhardt (2021) and/or Bowen (2009) where possible.

First cycle coding

In the First Cycle, initial codes are applied to segments of data. These codes are mainly utilized to organize and categorize similar segments of data, allowing researchers to efficiently identify, extract, and group portions relevant to specific research questions, hypotheses, constructs, or themes. This process of clustering and presenting summarized data segments lays the groundwork for more in-depth analysis. Pattern coding, which is the Second Cycle, groups the codes from the first cycle into fewer categories, themes, or ideas (Miles et al., 2014). There are 25 different approaches to first cycle coding, which are not mutually exclusive (Miles et al., 2014). Relevant for this research are:

- Descriptive Coding: Summarizes the basic topic of a qualitative data passage with a word or short phrase, often a noun, facilitating topic inventory and categorization, especially useful for ethnographies and studies with diverse data forms (Miles et al., 2014).
- Holistic Coding: Applies a single code to large data units to grasp the overall content and potential categories, serving as a preliminary approach before detailed coding, useful for initial general investigation (Miles et al., 2014).
- Provisional Coding: Begins with a predetermined list of codes based on the researcher's assumptions about the data, which can be modified as analysis progresses, suitable for studies building on previous research (Miles et al., 2014). When taking a deductive approach, predefined codes may be used (Bowen, 2009). When taking an inductive approach, the codes should be grounded in the data. The latter aligns with the third part of the Eisenhardt method (2021). But as said there is still room to change codes as the analysis progresses, leaving room for new theories to emerge.
- Causation Coding: This is utilized to mark sequences within the data that suggest a cause and effect relationship, thereby identifying how certain conditions, actions, or occurrences may lead to specific outcomes or changes (Miles et al., 2014). According to Eisenhardt's (2021) fourth point, there should be theoretical arguments that explain why relationships between constructs hold, addressing the internal validity and logical coherence of the emerging theory. These arguments can draw from the data, logical deduction, or prior research, including disciplines outside the immediate field of study. They transform observed patterns of association into theoretically robust explanations (Eisenhardt, 2021). When these arguments are drawn from data, Causation coding will be used.

- Subcoding: Adds second-order tags to add detail to, or enrich, primary codes, helping in further indexing, categorizing, and nuanced analysis, applicable across qualitative studies for more precise data organization (Miles et al., 2014).

Second cycle coding

The Second Cycle then involves working with these initial codes to develop more complex, higher level, categorizations. Pattern codes serve as explanatory or inferential tools in qualitative analysis, pinpointing emergent themes, configurations, or explanations. They consolidate substantial amounts of data from First Cycle coding into more meaningful and concise units of analysis, functioning effectively as meta-codes (Miles et al., 2014).

There are 4 main purposes for this:

- Data Condensation: From large quantities of data into fewer analytic units (Miles et al., 2014).
- Early Analysis: Allows for the analysis to be started during the data collection phase, allowing for fieldwork to be more targeted (Miles et al., 2014).
- Cognitive Mapping: Helps develop a cognitive map, an evolving framework that aids in understanding local incidents and interactions (Miles et al., 2014).
- Cross-case Analysis Foundation: Prepares the data for analyzing multiple cases by highlighting common themes and directional processes (Miles et al., 2014).

Second cycle coding, or pattern coding, involves strategic refinement of the codes identified in the first cycle. In the first cycle individual data segments are labeled with codes, capturing specific attributes, emotions, processes, or descriptions. To evolve from this to Pattern codes requires a thoughtful analysis where broad data is distilled into more meaningful and parsimonious units of analysis, codes are clustered based on their inherent similarities or thematic connections. This clustering is done by identifying overarching themes, causes or explanations, relationships, and theoretical constructs that emerge from the data (Miles et al., 2014).

Usually, according to Miles et al. (2014), these pattern codes are of one of four (interrealated) types:

- Categories or themes
- Causes/explanations
- Relationships
- Theoretical constructs.

Coding in practice

All Data sources will be downloaded and assigned a reference number, this will be the file name. for example: Ref.pdf. An Excel file has been kept, on the first tab the information about every file is kept, among this is the tile of the article, as well as the publication date. Conform Bowen (2009), an initial judgement was made upon discovery of the document. For example it could be that the search terms are indeed in the document, but are used in a different context.

Next, for each reference the useful parts have been identified, also in accordance with Bowen (2009). Only these parts will be coded. This will be displayed on another Excel tab. First, the Ref. for the document is displayed in column A, in column B the relevant fragments of text will displayed in chronological order. In column C, there will be first cycle codes. Each code for a fragment will get its own row. This will look like table 4.

Table 4 First-cycle coding.

Column A	**Column B**	**Column C**
Ref x	Fragment 1	Code Cycle 1
		Code Cycle 1
		Code Cycle 1
	Fragment 2	Code Cycle 1
		Code Cycle 1

This tab for first order coding will then be duplicated for the second cycle coding. This will be done as now, the cases will no longer be clustered based on their source, but rather on their codes. If this would be done on the same tab, transparency about the coding process will be partially lost. In this tab second cycle codes will be added. This will look like table 5.

Table 5 Second-cycle coding.

Column A	**Column B**	**Column C**	**Column D**
Ref x	Fragment x	Code cycle 1	Code cycle 2
Ref y	Fragment x	Code cycle 1	

According to Miles et al. (2014), during coding the researcher will gain insights, can be captured by memoing. As the study progresses, structuring these insights becomes necessary, achieved through assertions and propositions (Miles et al., 2014). Assertions offer summative statements grounded in evidence, while propositions present conditional insights, pushing towards theoretical predictions (Miles et al., 2014).

Analysis after coding

Going from these codes to final conclusions in theory building research, is something that is hard to trace, according to Eisenhardt (1989). Accorrding to Eisenhardt (1989), the within case study typically involves detailed write-ups. The goal is to tell the story of each case individually, this story should emerge form the data (Eisenhardt, 1989). According to Eisenhardt (1989), this can be done in a multitude of ways and depends on the researcher. For this research, narrative description was chosen as this will tell the story of the company in the form of a case history. The narrative description will display the data in the following way: Description of the event based on pattern code, text fragment from data, explanation based on first order codes (Miles et al., 2014).

This theory has then to be strengthened by an iterative process of going back to the data, reorganizing an regrouping data to reach higher abstraction levels for the conceptualizations. This way a close fit between data and theory will be reached (Eisenhardt, 2021). This approach not only structures the analysis but also directs subsequent data collection, allowing for adjustments based on emerging evidence. Maintaining and refining a list of these analytical points facilitates a focused research process and leads to a coherent narrative of the study's findings (Miles et al., 2014).

In the end, a theory should emerge from the data. According to Eisenhardt, (2021) this will be the constructs and measures.

3.6.2 Cross-case Analysis

Cross-case analysis is the next step of the analysis. It extends this examination to multiple cases to enhance the generalizability of findings (Miles et al., 2014). Miles et al. (2014) differentiate between a case-oriented approach and a variable-oriented approach. They highlight that a case-oriented approach examines each case as a complete entity, considering its unique configurations and causal relationships before engaging in comparative analysis of a few cases, whereas a variable-oriented approach starts with a theoretical focus on variables across many cases, sidelining detailed case specifics in favor of broad patterns (Miles et al., 2014).

This research follows the Eisenhardt method (2021), who in her sixth point stresses the importance of constantly comparing the theory with the data, replication logic, and cross-case analysis. The iterative process of constant comparison aims to create a close fit between theoretical constructs and empirical observations. Replication logic should be applied by treating each case as an independent observation, pooled logic is irrelevant. Cross-case analysis is meant to improve creativity and reliability of the research, it focuses on explaining why patterns in the data occur (Eisenhardt, 2021). This means that the Case-oriented approach for cross-case analysis should be followed when one follows the Eisenhard (2021) method.

4. PLATFORMS IN THE AUTOMOTIVE INDUSTRY

In the following sections the applications of platforms at automobile manufacturers are described.

4.1 Car as product platform

Since the 1960s, car makers started using shared platforms and designs in order to achieve economies of scale and scope by increasing part sharing between different models (Lampón et al., 2019). In the 1990's automobile manufacturers started the process of designing a single platform for different models, using a large number of standardized components and systems between the different models in the same segment (Lampón et al., 2019). The auto industry was one of the first in adopting a platform strategy, which involves the development of a common architecture that can be used across multiple vehicle models (Steinberg, 2021).

More recently, modular platforms have been adopted in the automotive industry. These modular platforms are based around a single scalable design and allow for the structural dimensions to be adapted for different models in both the same and in different segments of the market (Lampón et al., 2017). In the automobile industry, modularity allows for the creation of modular product architectures and component reuse, leading to increased efficiency and more flexibility in production processes as they reduce the complexity of assembly and allow for greater standardization among components (Lampón et al., 2019; Steinberg, 2021). This approach also facilitates the integration of new technologies and innovations during the models life cycles, as they can be relatively easily incorporated into existing platforms (Muffatto, 1999).

Lampón et al. (2017) found that a higher degree of modularity can lead to a higher number of models per segment, greater flexibility to produce different models at different plants and a larger volume of cars produced on that platform. For the customer, modularization has the advantage of a high degree of product differentiation (Muffatto, 1999). The use of modular platforms also has the disadvantages of higher costs and heavier vehicles (Muffatto, 1999). These platforms often remained closed off to external parties due to the complex integration required between different components; there are only a few modules in cars that are standalone (Muffatto, 1999). Importantly, Jacobides et al. (2018) pointed out that modular design does not necessarily entail openness.

4.2 Supply chain platform

To get a better understanding of the utilization of modularity in the automobile industry, we first have to take a look at the automotive supply chain. Like previously mentioned, automobile manufacturers often make use of supply chain platforms (Gawer, 2009). In this section, some background will be given on that.

Historically, automotive manufacturers have had a high level of vertical integration (Rugraff, 2012). Over the last 30 years, automotive manufacturers have been on an outsourcing journey following globalization (Rugraff, 2012). Through mergers and acquisition of businesses with complementary assets and geographic coverage, suppliers expanded their role in the industry significantly and frequently achieved dramatic increases in competence and geographic coverage (Sturgeon et al., 2008; Rugraff, 2012). This resulted in an oligopoly of a small number of large component manufacturers at the top, that have the capabilities to produce larger and more complex sub-systems, followed by several tiers of smaller companies (Sturgeon et al., 2008; Rugraff, 2012; Larsson, 2002). At the global level, vehicle production increased by 18.4% from 1999 to 2005, while supplier sales grew at more than twice that pace (Sturgeon et al., 2008).

These developments in the organizational landscape resulted in a growing emphasis on a collaborative approach between automotive manufacturers and their suppliers. To enhance production operational efficiency, both parties are required to align with both technological and organizational frameworks (Morris et al., 2004; as cited by Bennett & Klug, 2010). Some component suppliers have been evolving into module providers, providing comprehensive service solutions in addition to specialized manufacturing knowledge (Kemppainen and Vepsalainen, 2003; as cited by Bennett & Klug, 2010). Because of this, suppliers have become more involved in design and, in order to foster collaboration, have set up their own design centers near those of their big clients (Sturgeon et al., 2008).

4.3 Industry platforms in cars

Gawer and Cusumano (2015) note the possibility of embedded industry platforms in cars, where a supplier develops a new technology for a particular automaker. Following that, other automakers adopt the technology. This can result in independent software companies providing new programming that optimizes its performance. Other automotive suppliers adapt their offerings to be compatible with the new system.

Still, with these embedded industry platforms, the automobile manufacturers have the bargaining power, as noted in the previous section. Meaning that the suppliers adapt to the automobile manufacturers' unique standards, information systems, and business procedures (Sturgeon et al., 2008; Gawer, 2009). Thus the developers of the embedded industry platforms are still responsible for the integration of these modules in the supply chain platform, while they only have access to partial information and do not know the intended use[3].

4.4 Car as digital product

As mentioned before four megatrends are changing mobility, among which digitisation which has potentially the biggest impact on the industry (Bormann et al., 2018). Digitisation includes networking (connected car infrastructure), automation of driving, sharing mobility, and mobility services (Bormann et al., 2018). This is driven by advancements in connected car technologies that allow cars to collect and interpret large amounts of data from digital sensors and exchange information with other vehicles and backend services (Lovas et al., 2018).

This shift to digital products is driven by advancements in connected car technologies, which allow cars to collect and interpret large amounts of data from digital sensors and exchange information with other vehicles and backend services (Lovas et al., 2018).

This collection and interpretation of data has been associated with digital platform development by Jovanovic et al. (2022). Platform sponsors tend to invest in product data collection, followed by analytics utilization and lastly artificial intelligence enablement when entering in the platform ecosystem stage. As outlined in section 3.3, automobile manufacturers utilize supply chain platforms, which Jovanovic et al. (2022) classify as the second stage of digital platform development. This aligns with Lovas' et al. (2018) observation of the collection and interpretation of data within cars. This stage, according to Jovanovic et al. (2022), primarily emphasizes the utilization of data analytics, optimizing service development, and expanding the value system (Jovanovic et al., 2022).

As the car industry continues to embrace digital innovation, it is essential for incumbent firms to leverage digital options thinking and shape their organizational and technological resources to develop generative capabilities (Svahn et al., 2015). A logical next step would be digital platform ecosystems, which proves to be something that is happening.

In the automotive industry, digital platform ecosystems can be already be observed in the form of infotainment systems that are open to third-party developers (Schreieck et al.,

[3] https://webinars.sw.siemens.com/en-US/vehicle-system-integration/

2021). An in-vehicle infotainment (IVI) system is a combination of information and entertainment system (Kim & Lee, 2016). These systems provide users with navigation and traffic information, but also entertainment such as music and videos. Because of this, people have started to see their car not only as a means of mobility, but also as a versatile means of satisfying a variety of needs (Kim & Lee, 2016).

4.5 Concluding paragraph

Over the last decades platforms have become an increasingly fundamental part of product development in the automotive industry. With an initial focus on creating economies of scale by using parts across different models in their lineup and to introduce more models with limited investments. The usage of platforms developed gradually towards modular platforms that enabled even greater flexibility, efficiency and product differentiation. Over time the manufacturers transitioned a part of their product development efforts towards their suppliers, allowing them to develop complete subsystems (or modules) for the manufacturers' cars. Which marked the rise of supply chain platforms. Still the bargaining power lies with the OEM, and thus suppliers adhere to the standards imposed by their different customers.

More recently the digitalization of cars, has resulted in platforms in a new dimension of the car, the digital platform. As a result, the vehicle is increasingly turning into a digital product, with a focus on connectivity, data analytics and infotainment systems. There are however still unclarities about how exactly car manufacturers are incorporating and seek to capture value from these digital platforms.

5 RESULTS

5.1 BMW Group

5.1.1 Company History

'Bayerische Motoren Werke' (BMW) is a German company, although the company is the legal successor to a former airplane manufacturer called 'Bayerische Flugzeug Werke' (BFW), the company inherited its name from a manufacturer of airplane engines (Rapp Motorenwerke) which changed names to 'Bayerische Motoren Werke' (BMW) in 1917 (BMW AG, 2019). In 1922, Camillo Castiglione acquired BMW and merged it with BFW. This led to the first BMW motorcycle in 1923 and its first car in 1933. After World War II, BMW stopped manufacturing airplane engines (BMW AG, 2019).

By the 1950s, BMW faced financial difficulties due to declining motorcycle sales and rising car production costs. Herbert Quandt became a key figure in 1959, preventing an acquisition by Daimler-Benz. Quandt increased his stake in BMW, leading to the company's recovery (BMW AG, 2021; Jacobs, 2017). BMW's fortunes improved with the introduction of the BMW 700 model, and the release of the 'Neue Klasse' lineup. These new models contributed to the company's rapid growth in the 1970s and 1980s (BMW AG, 2021).

In 1994, BMW acquired the British Rover Group, including brands like Land Rover and Mini, but sold all brands except Mini by 2000 (BMW Group AG, n.d.). In 1998, BMW and Volkswagen engaged in a bidding war over Rolls-Royce. Volkswagen won most assets but lacked rights to the Rolls-Royce brand name and logo, which BMW purchased separately. BMW began producing Rolls-Royce cars in 2003 (New York Times, 1998). Today, BMW's portfolio includes BMW, Mini, Rolls-Royce, and BMW Motorrad.

5.1.2 BMW's digital platform

Digitalization at BMW started in 1998 with the BMW Telematics and Assist package, offering services like real-time traffic updates and emergency calls via mobile network (BMW Group AG, 2018). In 2001, BMW introduced iDrive, revolutionizing in-car controls by consolidating vehicle settings, entertainment, navigation, and telecommunications into a single digital system operated by a dial, becoming the industry standard. The e65 7-series featured the first iDrive system with voice control (BMW Group AG, 2021). This research focuses on iDrive as BMW's IVI system.

BMW continued advancing iDrive, incorporating capacitive buttons and launching the first head-up display in 2004. Integrated SIM cards enabled online services like weather updates. In 2007, Google search was added, and by 2008, BMW offered in-car internet access (BMW Group AG, 2021). The iDrive system allowed third-party app integration in 2012, followed by the ConnectedDrive store in 2014 for purchasing services like real-time traffic updates (BMW Group AG, 2018).

The Connected app, launched in 2016, let users send navigation information to the car and check car status on their devices. By 2018, the Operating System 7.0 enabled remote updates (BMW Group AG, 2018). In 2021, iDrive 8 offered better app integration, and by 2023, iDrive 8.5 and 9.0 were launched. While iDrive 8.5 remained Linux-based, iDrive 9.0 shifted to the Android Open Source Project, which will eventually replace all Linux-based systems (BMW Group AG, 2023).

5.1.3 How is BMW implementing a platform ecosystem business model

Foundational elements

In the initial phase of platform ecosystem incorporation BMW began with addressing the prerequisites that need to be present for the platform to be able to form or to incorporate an ecosystem. The first prerequisite is mobile network connectivity. To be able to offer the driver the access to a platform ecosystem, the car needs to be connected to the mobile network to gain internet access. This access should be directly from the vehicle to the mobile network, and not through i.e. a smartphone. Data quantities keep growing, therefore the internet speed in the vehicle should be high. For this, the car should be able to connect to the latest generation of mobile networks (5G at the time of writing).

"Today, 8.5 million BMW Group models worldwide are already connected. The vast number of services and infotainment features that can be controlled by voice commands in BMW models have paved the way for the forthcoming connectivity options and new digital services. A smartphone is not required to benefit from Alexa in the car, as all BMW models and selected MINI vehicles come equipped with a built-in SIM card. The resultant provision of online accessibility anywhere, anytime allows the seamless integration of Alexa." (Ref10) (BMW Group, 2018b, p. 1-2)

"5G will therefore be capable of handling the growing volume of data involved in the mobile use of digital services. In its capacity as a new function enabler, 5G represents a vast improvement on what is technically possible today. The BMW Group is developing

technologies and systems that harness this potential now, so that it can start to offer 5G-based functions in production vehicles as early as 2020." (Ref382) (BMW Group, 2018a, p. 3)

"Using 5G offers an insight into what the future holds for customers in terms of entertainment and comfort functions. Exclusive video content can be enjoyed in high quality at resolutions up to 4K. The same is true for video conferences, which require both high data speeds and low latency. However, the biggest winners with 5G are applications. It has so far been virtually impossible to stream in real time from a car. For example, cloud-based gaming now becomes an attractive in-car application thanks to zero-delay streaming." (Ref44) (BMW Group, 2020a, p. 13)

The second prerequisite seems to be the ability to conduct remote software upgrades. Through remote software updates, introduced by BMW in 2018 with operating system 7.0, updates can be installed over the air. While update cycles to the operating system used to span around three years, this was no longer enough to keep up with the rapid pace of development in the digital world. Hence, remote software upgrades were implemented. This enables BMW to keep the software in their cars up-to-date. After implementing remote software upgrades, BMW started to view the car as a digital platform.

In the past, the BMW display and operating system has been overhauled on average every three years, a cycle that is roughly half as long as the complete product development cycle for a vehicle. In the era of fast-paced digital development, it is no longer enough to completely update a model's digital features every three years, and this resulted in a fundamental change of approach in 2018. (Ref292) (BMW Group, 2021b, p. 21)

The arrival of Remote Software Upgrade means the vehicle is now designed and conceived as a digital platform. Both 5G connectivity and Remote software upgrade capabilities were added in 2018. 2018 also marks the year where third party apps were first integrated in the BMW iDrive infotainment system. (Ref292) (BMW Group, 2021b, p. 21)

"Always up to date: Remote Software Upgrade.

Since the introduction of BMW Operating System 7 in 2018, BMW drivers have been able to keep their vehicle up to date with the latest software at all times by means of the Remote Software Upgrade facility. New functions can be imported quickly and easily over the air, either using the car's built-in SIM card or via the My BMW App. The installation files are prepared in the background while the vehicle is on the move. Once this is done, installation can be launched by the customer. The actual installation seldom takes longer than 20 minutes, even for major upgrades." (Ref292) (BMW Group, 2021b, p. 22)

Changing competition

In the end of 2017, BMW stated that both established competition is changing and that new competitors are entering the market. These new enterers are not traditional car companies, but instead digital companies.According to BMW this is happening because of electrification and digitalisation. BMW aimed to counteract these threats by developing their own skills and expertise, but also through partnerships.

"Established competitors are changing, and new ones are trying to secure a market share for themselves. Electrification and digitalisation are the two big game-changers. Our new competitors are mainly digital companies. They focus on future technologies and customer data. To compete with them, we have developed our skills and expertise, adapted our processes and forged intelligent partnerships." (Ref21) (BMW Group, 2017b, p. 2)

Software joint venture

This is likely the reason why in 2018, BMW launched a joint venture dedicated to software development together with Critical Software called Critical Techworks. This venture focuses on in-car infotainment and digital services, which significantly accelerated the incorporation of third-party services into BMW vehicles. This joint venture allows BMW to develop its software in an organizational culture and structure that is akin to software companies, enabling them to develop software with higher agility.

"Critical TechWorks will be bringing its expertise to bear in vehicle connectivity, cloud-based IT solutions and the digitalisation of corporate processes. The joint venture seeks to initiate interdisciplinary collaboration both in the customer-relevant fields of infotainment and digital services, and when it comes to the digitalisation and automation of product development, production and sales." (Ref21) (BMW Group, 2018c, p. 1)

"BMW Group brings its technology-centric challenges, loyalty, and industry expertise on how to make hi-tech and ultra-reliable cars. Critical Software brings its culture, values, software development talent and proven agile methodologies." (Critical Techworks, 2024, about section)

(Shared) Platform ownership

Another outcome was the decision to merge their mobility services in 2018 with main rival Mercedes-Benz. This company would become a platform for a number of different mobility services such as multimodal mobility, carsharing, ride-hailing, parking, and charging (BMW Group & Daimler AG, 2018). With this BMW and Mercedes-Benz were platform owners. Interesting is the decision to work together with the main rival on the core business. BMW and Mercedes-Benz made it clear in the press statement about the merger that they would remain to be competitors on the core business but would work together to grow the platform ecosystem for mobility services (BMW Group & Mercedes-Benz Media, 2018).

““As premium manufacturers, we have long been setting standards in the automotive industry and for our customers. In the premium vehicle business, we will continue to compete for customers. But our new portfolio for individual urban mobility on demand represents a logical extension to the value chain. Ultimately, we want to offer our customers as many options as possible for getting from A to B. In short, this is about driving, riding or being driven," said Zetsche.” (Ref32) (BMW Group & Mercedes-Benz media, 2019, p. 4)

While this is not necessarily interesting from the perspective of the focus of this study on the area of the connected car it does show us that competitors sometimes should work together in order to grow an ecosystem. Why this is interesting will become clear later on in the cross case analysis.

Platform complementation

Next to explore is the position that BMW chooses to take in Platform Ecosystems. First BMW started with BMW Connected, through BMW connected information about and control of the car was made available in 2017 through various digital touch points such as Amazon Alexa, Google Assistant, Tizen smart TV OS, and in 2018 Baidu in China. Additionally, apps for smartphones and smart watches were introduced. BMW thus effectively took the role of complementor to these different platform ecosystems, following the platform roles defined by Van Alstyne et al. (2016).

However, the user also has a perceived value increase of the car when this is possible. This suggests a two-way complementarity as described by Jacobides et. al (2018), where the addition of one, increases the value of the other and vice versa. In BMW’s view, the customer has their own digital life (or ecosystem) that they access through digital touch points. In this phase, the focus of BMW is on making access to the car available through as many of these touch points as possible to offer availability to all customers.

“Starting in September, users in the USA will also be able to access BMW Connected via an Alexa skill for Amazon Echo, enabling them to get vehicle status like remaining range and execute remote commands like ‘door lock’, all through voice interaction.” (Ref2) (BMW Group, 2016a, p. 4)

“BMW Connected ensures customers’ cars can be fully connected with an ever-increasingly number of digital touchpoints. And now with the Google Assistant, customers can enable easy and convenient operation of vehicle functions – from their

customer's home with voice-activated speakers like Google Home or while on the move via eligible Android phones and iPhones." (Ref11) (BMW Group, 2017a, p. 1)

"In addition to support for popular Samsung smartphones, Samsung presented the inclusion of BMW Connected into the Tizen ecosystem as well as the direct integration of the technology into the latest Gear S3 smartwatch." (Ref3) (BMW Group, 2016b, p. 1)

"At the CES Asia 2018, BMW China and Baidu announced the signing of an agreement between BMW Connected and Baidu Internet of Vehicles on a home-to-vehicle cooperation. This will further expand the application of BMW Connected – from vehicles and mobile devices into the digital lives of customers. This service enables customers to access vehicle information by voice control and operate relevant functions easily from their home. For example, they can check fuel levels, lock their car doors via remote control, search for mobility information stored by BMW Connected and plan routes and departure times in advance. The voice control function can be activated simply using certain wake-up words." (Ref19) (BMW Group, 2018b, p. 1)

"BMW Connected seamlessly integrates the vehicle into the user's digital life via multiple touchpoints, such as an iPhone, Apple Watch, Android smartphone or smartwatch." (Ref395) (BMW Group, 2017a, p. 5)

Platform provider

Around this time, BMW also started integrating various platform ecosystems into its cars, positioning itself as a platform provider. This role involved providing an interface between the driver and the platform ecosystems, following the platform roles defined by Van Alstyne et al. (2016). For instance, BMW integrated several digital voice assistants, including Amazon Alexa and Tmall Genie (in China), into its cars through the infotainment system. According to Weiß et al. (2022), BMW integrated third-party applications as well, although the integration work was done by BMW itself.

"The BMW Group is systematically expanding the intelligent connectivity capabilities of its vehicles by seamlessly integrating the highly versatile Alexa, Amazon's voice-controlled personal assistant, into all BMW and MINI models from mid-2018. The innovative inclusion of a cloud-based voice service will enable BMW Group customers to access a variety of services, entertainment features and shopping facilities while on the move by simple voice interaction. Tens of thousands of Alexa skills that can be accessed from Echo devices will now be available for in-car use, too." (Ref10) (BMW Group, 2018b, p. 1)

"Seamless integration of Amazon Alexa is now available for a host of BMW and MINI models, enabling customers to access many of the Alexa functions they already use at home

while out and about in their car. They can ask Alexa questions, get weather forecasts and traffic information, catch up on sporting events, listen to tracks from Amazon Music or TuneIn, or check out audio books from Audible. Appointments and to-do lists or shopping lists can likewise be managed simply by speaking. Added to which, the Control Display in the BMW or MINI also provides visual feedback for the selected content. And Alexa even makes it possible for customers to operate compatible smart-home devices, such as lamps, thermostats and automatic garage doors, from their car." (Ref37) (BMW Group, 2019b, p. 1)

"This latest move by the BMW Group follows integration of BMW Connected into Alibaba's Chinese ecosystem. It allows BMW customers who have a Tmall Genie-compatible device at home to operate vehicle functions easily and conveniently, and to call up appointments saved in the BMW Connected mobility agenda. BMW Connected was launched in China in December 2016 and is currently used by 1.5 million customers. Now the integration of Tmall Genie into BMW vehicles enables customers to access functions on the move they are already accustomed to using at home on the move." (Ref29) (BMW Group, 2019a, p. 1)

At this point, the car was increasingly viewed as a digital touchpoint, much like a smart home device, connecting the driver to platform ecosystems. BMW affirms their belief that their customers operate within their own digital ecosystems, which they access through various touchpoints, with the car becoming one of these essential access points. Besides personal, BMW considers digital ecosystems to be local — tailored to the region in which the customer lives and their individual preferences. As such, BMW views the car as an integrative device that connects various platform ecosystems to meet the needs of the customer, based on their location and personal choices.

"One of the major consequences of digitalisation is that the vehicle itself has turned into a touchpoint, making it a central hub of the customer experience that is so important to the BMW Group." (Ref28) (BMW Group, 2018e, p. 1)

"Connecting the vehicle to the customer's digital ecosystem.

The new BMW iDrive system integrates many digital products and services that intelligently connect the vehicle with the customer's everyday digital life." (Ref74) (BMW Group, 2021f, p. 6)

"At the BMW Group, a team of digital experts strive for perfection as they work together eagerly to integrate groundbreaking technologies into a car and fuse hardware and software to harmonious effect. They interconnect mobility and the digital world and turn the

vehicle into a highly integrated, integrative device that dovetails seamlessly with the customer's digital ecosystem." (Ref49) (BMW Group, 2020b, p. 9)

"The cooperation between BMW Connected and Baidu Internet of Vehicles provides further evidence of BMW's "In China, for China" R&D strategy. BMW has been actively building and integrating China's digital ecosystem, expanding the implementation of its open innovation cooperation with leading Chinese high- tech companies, and is committed to creating a diversified and smart mobility experience for Chinese consumers." (Ref19) (BMW Group, 2018c, p. 1)

In 2021 operating system 8 was introduced. Operating system 8 was still based on Linux, which has been the base of the BMW operating system since 2013. With this generation of operating system, accompanied by the iDrive 8 interface, more focus was put on the integration of third-party apps and projected modes[4] through making the operating system more flexible. Apple Carplay and Android Auto were integrated deeper in the operating system. For China Alibaba and Tencent were integrated more deeply. Additionally, Music streaming services and communication apps were integrated in the operating system. Important to mention is that all aforementioned third-party services are platforms. BMW acts as the platform provider following Van Alstyne et al. (2016). BMW provides the interface between the user and the platforms.

"The BMW Group has been developing the central control unit and software integration platform entirely on Linux and in-house since 2013." (Ref292) (BMW Group, 2021a)

"More apps, greater diversity: optimised third-party integration.

The new-generation BMW iDrive offers new opportunities for seamlessly incorporating customers' habits and preferences into the operating system. The system's higher degree of flexibility will additionally make in-car use of third-party apps even simpler and more convenient in future. BMW Operating System 8 again ensures full integration of Apple CarPlay and Android Auto, while the new BMW iDrive will also enable extensive integration of the Alibaba and Tencent services for customers in China." (Ref292) (BMW Group, 2021a, p. 24)

"And music streaming and communications apps are now deeply integrated within BMW Operating System 8. They are displayed as original sources in the main menu, enabling

[4] Projected modes means third-party operating systems such as Apple Carplay and Android Auto that run on the driver's smartphone and are projected onto the infotainment screen.

customers to make full use of their apps' functions while driving their car." (Ref292) (BMW Group, 2021a, p. 25)

This focus on specific markets is still present at this stage, suggesting that the view of the digital ecosystem being something that is country-specific. Also, wording such as '*Market-specific applications and services have also been integrated seamlessly into the vehicle's operating system.*' suggest that adding apps requires effort from BMW. This finding is supported by Weiss et al. (2022).

"Market-specific applications and services have also been integrated seamlessly into the vehicle's operating system. Display and operation here will be familiar to customers from their smartphones. As well as the offerings from Apple and Google, apps relevant to the Chinese market provided by local platforms are also integrated. The introduction of BMW Operating System 8 and the latest iDrive generation takes the integration of services from Chinese platform Tencent, in particular, to a new level." (Ref285) (BMW Group, 2021b, p. 3)

Shortcomings identification

In the development of Operating system 7 and 8 BMW had to do a lot of the integration work for third party apps themselves. Probably this is due to a lack of standardisation in the industry. This lack of industry standards means that the development of applications are often completely non-fungible and thus means that a developer who wants to multihome, needs to start from scratch again for another manufacturer. While for conventional suppliers this might be an acceptable practice, from a platform ecosystem perspective it is not, and makes a platform unattractive for third-party developers. Therefore, BMW called for standardisation in infotainment basic elements, utilizing an existing ecosystem.

"Standardisation is key to the digitisation of cars. We believe it makes sense to develop common, standardised basic elements for vehicle operating systems in conjunction with other OEMs and suppliers. The use of open-source software is highly relevant in this respect – to make sure we are all speaking the same language. There is no need to reinvent the wheel. We can ensure a high level of economic efficiency and, at the same time, make use of existing digital ecosystems, such as Google's Android Open-Source Project." (Ref81) (BMW Group, 2021b, p. 7-8)

Platform role repositioning phase

This is why BMW introduced Operating system 9 in 2023. This version marks the transition from Linux to Android Open Source Project after 10 years. Through this new Android based operating system, BMW can offer more third-party apps since the car can hook onto the already existing ecosystem around the Android operating system.

“From 2023, the BMW Group will be launching an infotainment system based on Android Open Source for the first time — the “BMW Operating System 9”. The announcement was made by Stephan Durach, Senior Vice-President Connected Company and Development Technical Operations at the BMW Group, at the Automobil-Elektronik Kongress in Ludwigsburg. In this new variant of the “BMW Operating System”, the user experience, applications and user interface design are also developed and implemented in a BMW specific way.” (Ref241) (BMW Group, 2022, p. 1)

"BMW Operating System 9 was developed in-house by the BMW Group and is based on an Android Open Source Project (ASP) software stack for the first time.
It provides the basis for a broader offering of digital content that serves information and entertainment, shorter function update cycles and improved accessibility to a host of specific online services." (Ref199) (BMW Group, 2023a, p. 2)

At first glance, BMW’s role in the IVI platform ecosystem appears to align with the platform provider role, as defined by Van Alstyne et al. (2016), where BMW acts as the interface between the platform user and the platform itself. However, the reality is more complex and does not fit neatly into the traditional platform provider or platform owner roles. Instead of adopting the more predictable Google Play app store, BMW has chosen the Faurecia-Aptoide app store. While BMW is not the owner of this platform, it retains more control over the ecosystem than is typical for a platform provider. BMW customizes the app store’s interface to match its brand identity and standards, while also controlling the app offerings. This hybrid approach blurs the lines between provider and owner roles, allowing BMW to shape the user experience and exert a level of control that is unusual for a traditional platform provider. This enables BMW to have an app store that feels integrated into its brand while benefiting from the larger user base of a cross-OEM platform, which could make the app store more appealing to third-party developers through indirect network effects.

“We created a scalable, adaptive white-label Android Apps Market that fits the expectations of our OEM partners. The Apps Market is completely customizable and fully managed by the OEM, from its look and feel to the apps included.” (Faurecia Aptoide, 2024b, homepage, para. 5)

New platform roll out phase

First the new Android based operating system 9 was introduced on lower-level models, while higher level models got an updated version of the Linux-based operating system 8, version 8.5. BMW models running operating system 8 got an over-the-air update to version 8.5 as well. The choice of introducing this new operating system on lower-level models is likely because of possible bugs or other performance issues being less acceptable in the higher-range vehicles. The operating 8.5 system seems to be a stop-gap measure, to keep the higher level car customers satisfied while the lower level models get the new operating system. Models that are running Operating System 8 or earlier cannot be updated to Operating System 9, as this requires different hardware (Padeanu, 2023).

Operating system 8.5 made the user interface of operating system 8 the same as the Android based operating system 9. Additionally, more third-party services were introduced, also seemingly mimicking the Android based operating system 9. This included a platform for in-car gaming, and a video-streaming platform. The reason for inclusion of these types of platforms that are only really useful when the car is stationary, seems to be to pass the time while charging Battery Electric Vehicles. In the future, when autonomous driving becomes available, video streaming and games will likely also be possible when the car is on the move and driving in an autonomous mode.

An alternative explanation is that Operating System 8.5 reflects a mimicking strategy by BMW, similar to the competitive actions observed by Reischauer et al. (2024), where a European premium car manufacturer adopted approaches used by tech giants like Google and Apple. From the perspective of competitive actions, BMW may be following a 'slipstream strategy,' as proposed by Reischauer et al. (2024), where the company maintains its Linux-based alternative while incrementally replicating features of the Android system to eventually surpass it. However, the stop-gap theory is reinforced by the recent release of a higher-end model featuring Operating System 9, signaling BMW’s intent to transition its premium lineup to the new platform. This was further confirmed by a BMW communications employee in a personal communication on August 13, 2024, who stated that the Linux system will gradually be phased out.

“Since the end of 2023, customers driving compact models with BMW Operating System 9 have also been able to access the Video App with BMW Digital Premium. These will be followed by further models over the course of 2024, such as the BMW X2 and all models in the new MINI family.” (Ref193) (BMW Group, 2024a, p. 3)

“The advanced BMW Operating System 8 used in current BMW models with BMW Curved Display is used as the basis for the new BMW iDrive with “QuickSelect”. It is called BMW Operating System 8.5, continues to be based on Linux and uses the latest generation of infotainment head units in the BMW mid-range and luxury class segment vehicles, which are responsible for graphics computing, among other things. The new edition of the business sedan represents not only a new dimension of driving pleasure and long-distance comfort with

different forms of drive, but also the current progress in the field of digitalisation." (Ref109) (BMW Group, 2023a, p. 39-40)

"The Remote Software Upgrades bring existing digital functions right up to date. At the same time, new features and improvements to quality can also be imported into the car over the air. The latest in-car gaming and video-streaming services for BMW models will be made available in this way for the majority of vehicles with BMW Operating System 8.5 in autumn 2023." (Ref199) (BMW Group, 2023a, p. 4)

"In addition, the BMW Group will expand its entertainment package in collaboration with Xperi to include the TiVo video streaming platform. This will give customers access to a continuously growing amount of aggregated video content, such as live and on-demand streaming services, which include a variety of country-specific channels with news, movies and access to media libraries. The video streaming portal will be made available over-the-air to customers of the new BMW 5 Series and other models equipped with the latest BMW infotainment system by the end of 2023." (Ref109) (BMW Group, 2023a, p. 41)

"In a cooperation with the gaming platform AirConsole, BMW presents a new and unique form of in-car gaming in the new BMW 5 Series Sedan. Driver and passengers can play so-called casual games while the vehicle is stationary, for example to bridge waiting times while charging the high-voltage battery of the BMW i5." (Ref109) (BMW Group, 2023a, p. 41)

"Besides audio streaming, BMW Digital Premium also lets the occupants enjoy a wide variety of video streaming services (powered by Xperi TiVo) on the control display while the car is stationary." (Ref199) (BMW Group, 2023a, p. 3)

"The new BMW X3 provides further evidence of the relentless progress being made in the field of digitalisation with the introduction of BMW Operating System 9." (BMW Group, 2024c, p. 36)

A visualization of the incorporation of platform ecosystems at BMW is given in figure 8.

Monetization strategy

BMW monetized the platform through a monthly or annual subscription service. When a new car with operating system 9 is delivered, it gets a free three-month trial perdiod. After these three months the owner has to pay a monthly subscription fee of €9.98 a month or an annual fee of €99. In this package data use is also covered. Through restricting access to the platform ecosystem, the platform provider is also able to monetize the platform, despite not being the platform owner.

"This new offering is designed to allow customers to put together a customised selection of digital services from the growing variety on offer - one that is perfectly suited to their personal requirements. BMW Digital Premium is available in Germany, for example, for €9.98 a month or from mid-2024 (provisionally) for an annual fee of €99 (both including VAT). The package also covers data usage for all digital services and the apps available from the BMW ConnectedDrive Store, including music and video streaming. Customers can take advantage of a free three-month trial period that will allow them to sample all the BMW Digital Premium services and content." (Ref199) (BMW Group, 2023a, p. 2-3)

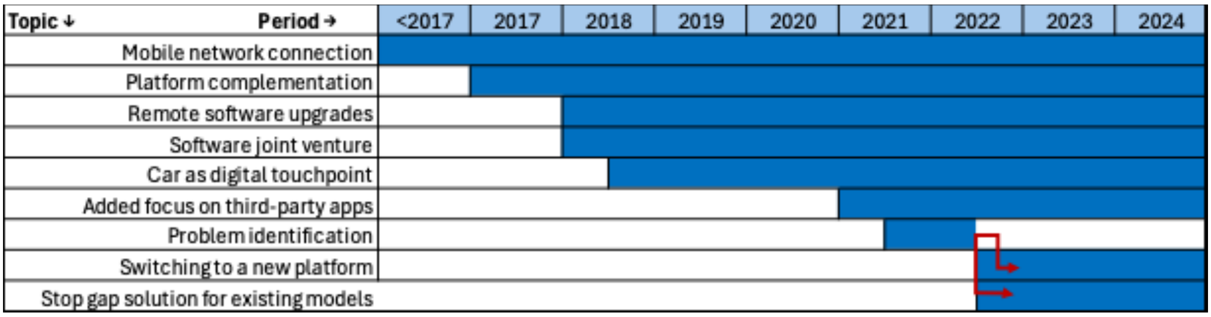

Figure 8 timeline of platform ecosystem incorportation at BMW (self generated).

5.2 Mercedes-Benz Group

5.2.1 Company History

In 1885, Carl Benz completed the world's first automobile, for this invention he filed for a patent in January 1886. That same year, Gottlieb Daimler introduced the first four-wheeled automobile (Mercedes-Benz Group, 2024). Both Benz and Daimler continued to develop their inventions. In 1901, Daimler produced a car for Emil Jellinek, named after his daughter, Mercedes, and trademarked the name in 1902 (Mercedes-Benz Group, 2024a).

In 1909, Mercedes cars introduced the three-pointed star, symbolizing mobility on land, water, and air, as Daimler also produced aircraft and marine engines (Mercedes-Benz Group, 2024a). Economic difficulties after World War 1 led Daimler and Benz to merge their operations in 1926, forming Daimler-Benz AG to achieve economies of scale (Mercedes-Benz Group, 2024a).

In the decade after World War 2, Daimler-Benz expanded globally, establishing production facilities in Argentina, Brazil, and India, and focused on the U.S. market (Mercedes-Benz Group, 2024d). This growth continued in the 1960-1980 period. This included acquisition of Hanomag-Henschel and Freightliner, and entering the lower car segments with the 190 model in the late 1970s (Mercedes-Benz Group, 2024e). In the 1980s, the company diversified by acquiring stakes in companies from other industries.

Due to unmet expectations these efforts were undone in the period from 1995 to 2007, during this period Daimler-Benz underwent strategic realignment, divesting non-core businesses (Mercedes-Benz Group, 2024f; Mercedes-Benz Group, 2024h). This strategic realignment included merging with Chrysler Corporation in 1998 to form DaimlerChrysler AG (Mercedes-Benz Group, 2024h). Despite the introduction of new model series like the A, B, and M-Class, and the revival of the Maybach brand, the merger with Chrysler was dissolved in 2007 due to unmet expectations (Mercedes-Benz Group, 2024h).

5.2.2 Mercedes-Benz's digital platform

The first step towards Mercedes-Benz's digital platform was the introduction of Auto Pilot System in the W140 S-class in 1995. This was a quite rudimentary infotainment system. Through a small screen in the centre console of the car, the driver could find navigation features combined with entertainment functions such as radio and CD (Mercedes-Benz Group, 1995). This system was superseded in 1998 by the Comand system, this system combined radio, telephone, navigation and TV in one system (DaimlerBenz AG, 1998).

From there on Mercedes-Benz continued improvements to the Comand system, in 2004 a Sim-card for mobile network connectivity was added and in 2010 they added internet access through COMAND Online (DaimlerChrysler Communications, 2004; Daimler Communications, 2010). Mercedes-Benz Comand was replaced by Mercedes-Benz User Experience (MBUX) in 2018.

With MBUX, Mercedes-Benz introduced a completely new infotainment system with a new user interface. Through Artificial Intelligence the system was able to learn about its user. Additionally it featured natural speech recognition and a digital voice assistant (Mercedes-Benz Group, 2018a). This new generation of infotainment also featured remote software updates, through which new content could be made available online (Mercedes-Benz Group, 2018b).

With the second generation of MBUX in 2021, Mercedes-Benz introduced third paty music streaming services (Mercedes-benz Group, 2020). In 2023, the third generation of MBUX was introduced. With the third-generation more emphasis was put on external complementary applications (Joire, 2023). In 2025 MBUX will be replaced by the next generation of IVI-system. This will be called MB.OS, MBUX 3 serves as a precursor to

MB.OS (Mercedes-Benz Group, 2023). MBUX is what today is Mercedes-Benz's digital platform and will be the primary subject of the Mercedes-Benz case study.

5.1.3 How is Mercedes-Benz implementing a platform ecosystem business model

Foundational elements

Remote software upgrades and mobile network connectivity are prerequisites for realizing a platform ecosystem business model within and/or around the car. Remote software upgrades mean that hardware cycles are no longer tied to software, innovation cycles are thus shortened and flexibility is increased. Not only can innovations be implemented, also possible problems in the cars' software can be addressed without the car having to go to a dealership. Remote software upgrades were introduced by Mercedes in 2018, simultaneously with the introduction of the MBUX infotainment system.

Mobile network connectivity allows these remote software updates to be delivered to the car. Furthermore the mobile network connectivity enables Mercedes-Benz to offer entertainment features through the IVI-system. This mobile network connectivity is enabled through a communications module that is built into the car.

"The technological foundation of MB.OS further enhances the opportunities for software-enabled upgrades. The Mercedes-Benz Operating System decouples hardware from software, allowing for faster innovation cycles, increasing the flexibility and speed of updates." (Ref565) (Mercedes-Benz, 2023b, p. 3)

"As soon as a new software update for the GLE or GLE Coupé becomes available from Mercedes-Benz, a message appears in MBUX. The update is downloaded and installed in the background. The user must then explicitly agree again to the activation of the update. New features can also be uploaded to already sold vehicles by over-the-air updates. To transfer the data, Mercedes-Benz relies on mobile communications technology and the communication module installed in the vehicle due to the high security standard." (Ref549) (Mercedes-Benz AG, 2023a, p. 5)

"The name MBUX for the new infotainment system signals that the user experience (UX) is to the fore. A unique feature of this system is its ability to learn thanks to artificial intelligence. MBUX can be individualised and adapts to suit the user. It thus creates an emotional connection between the vehicle, driver and passengers. At the same time updates "over the air" are possible. It also heralds a new era at Mercedes me Connectivity." (Ref572) (Daimler Communications, 2018a, p. 2)

“The best-selling Mercedes-Benz C-Class and GLC models are becoming even more intelligent and individualised. They have the latest-generation MBUX (Mercedes-Benz User Experience) infotainment system with fast 5G data transmission[1], offering an interactive entertainment programme.” (Ref571) (Mercedes-Benz AG, 2024, p. 1)

Software subsidiary

In 2017, Mercedes-Benz launched its software subsidiary ‘MBition’, with this subsidiary Mercedes-Benz aimed to combine start-up flexibility with resources of a large corporation. The goal of this subsidiary is to develop the next generation of IVI with a focus on platform ecosystems.

“Gregor Zetsche, CEO of MBition: "MBition is an integral part of Daimler's international research and development network, and is set to grow strongly in the next few years. As a hive of creativity and innovation right in the centre of Europe, Berlin is an ideal location for finding the best international brains and creating innovative software.”” (Ref527) (Daimler communications, 2019, p. 1)

“At the same time MBition is creating an eco-system with the aim of being able to respond flexibly and rapidly together with recognised external software specialists and cooperation partners.” (Ref527) (Daimler communications, 2019, p. 2)

Platform complementation

In 2017, Mercedes-Benz started integrating its cars into third-party platform ecosystems. Predominantly to make controls and information of certain elements of the car available through smart (home) devices such as smartphones, Google Home, and Amazon Alexa. With this, Mercedes-Benz was effectively complementing these platform ecosystems. although again this complementarity is two-way, because Mercedes-Benz cars are offering more value to the customer by being available through these ecosystems, Mercedes-Benz is the complementor to the platform ecosystem by developing the compatibility.

“Well, as you know, the whole world is now available to you through your smartphone. As a result, we have made the world of Mercedes-Benz available, too – from anywhere at any time. The Mercedes me app provides our customers with a digital ecosystem of countless value added services. You can do things like check your vehicle's data, activate and deactivate different services and features of your car, shop for connected services or book service appointments. Essentially, any vehicle related service and beyond is made easier. We have already made so much possible with our current app, but with the new version of our app, we are able to add more every day.” (Ref531) (Mercedes-Benz Media, 2020a)

"Sunnyvale, USA. Mercedes-Benz today announced the integration of the Google Assistant on Google Home. Google Home, a voice-activated personal assistant, makes it possible to interact with the Mercedes-Benz vehicle from home. The feature will be available to Mercedes-Benz customers in 2017." (Ref504) (Daimler communications, 2016b, p. 1)

"As soon as early 2017, Mercedes-Benz customers in certain markets will be able to communicate with their vehicles via Google Home and Amazon Alexa: this will enable them to check a vehicle's fuel level or the charge status of an electric vehicle, to check whether their car is locked, or even to send navigation destinations directly to the vehicle from the comfort of their own home." (Ref505) (Daimler communications, 2017, p. 4)

Car as digital touchpoint

With the introduction of the MBUX operating system in 2018, third-party apps came to Mercedes-Benz vehicles. These apps included music streaming service Tidal for Europe, and Kuwo for China. Additionally there was integration of Baidu Wiki in China. Possibly, this resulted from the founding of a subsidiary for software development, MBition. This subsidiary was formed in late 2017.

"- Integration of online music (TIDAL) in Europe

- Extended range of apps, for example, specific functions for individual regions. Online music is available via the provider Kuwo in China, for example. Extensive information about points of interest (POIs) is made available by Baidu Wiki in China." (Ref573) (Daimler communications, 2018b, p. 7)

"Berlin – Today the Daimler subsidiary MBition founded in autumn 2017 occupied its new premises in the German capital, and has therefore officially arrived in Berlin. This is where a constantly growing, high-calibre team will develop future software for the entire vehicle in close collaboration with Mercedes-Benz Development in Sindelfingen, and lay the in-house foundations for the next generation of the current multimedia system MBUX (Mercedes-Benz User Experience)." (Ref527) (Daimler communications, 2019, p. 1)

"Our vehicles are platforms for digital progress. MBition combines the flexibility of a startup with the resources of a global corporation, and greatly assists us in meeting the expectations of our customers with agile software development," says Ola Källenius, Member of the Board of Management of Daimler AG for Group Research & Mercedes-Benz Cars Development" (Ref527) (Daimler communications, 2019, p. 1-2)

In 2020 Mercedes-Benz introduced the second generation of its MBUX operating system. With this second generation came more third-party apps like Spotify and TuneIn. What is interesting here by the choice of words it seems that in fact Mercedes-Benz is doing the integration work. From this it can be concluded that platform ecosystem formation is not yet the case.

"Mercedes-Benz has also integrated the music streaming service Spotify and Tuneln internet radio into the new S-Class. TIDAL and Amazon Music continue to be available as well. MBUX allows access to the usual songs and playlists as on a smartphone or other mobile device. Operation is intuitive, using the MBUX voice assistant "Hey Mercedes"." (Ref574) (Mercedes-Benz Media, 2020a, p. 4)

Platform ownership phase

Also in 2020 Mercedes-Benz introduced Mercedes Me. Mercedes Me was intended as a digital brand for digital services in and surrounding the car. With this customers could subscribe to certain services from Mercedes-Benz and additionally there was the possibility for third-parties to developing services surrounding the car through a software development kit, this was not intended for apps accessible in the car, but rather for creating an ecosystem of apps which provide control and information over the car from a smartphone. So this is Integration into third-party services rather than integration of third-party services. The integration of third-party services was something that Mercedes intended to add later.

"Well, as you know, the whole world is now available to you through your smartphone. As a result, we have made the world of Mercedes-Benz available, too – from anywhere at any time. The Mercedes me app provides our customers with a digital ecosystem of countless value added services. You can do things like check your vehicle's data, activate and deactivate different services and features of your car, shop for connected services or book service appointments. Essentially, any vehicle related service and beyond is made easier. We have already made so much possible with our current app, but with the new version of our app, we are able to add more every day." (Ref531) (Mercedes-Benz Media, 2020a, 1:13-1:52)

"Mercedes-Benz is presenting the new generation of Mercedes me Apps and its own, standardised developer platform. This sees the Mercedes me App, which links the vehicle with the smartphone and was unveiled in 2015, turning into a digital ecosystem. On this joint basis, new services can be developed flexibly and individually in future. The offer initially encompasses three apps: Mercedes me, Mercedes me Store and Mercedes me Service." (Ref532) (Mercedes-Benz media, 2020, p. 1)

"Before we come to the third app, I want to say, the Mercedes me store app will be a marketplace in the future, that's something we are currently working on. " (Ref531) (Mercedes-Benz Media, 2020a, 6:04-6:12)

Following from this Mercedes-Benz introduced the in-car coding community in early 2021, with this Mercedes-Benz aimed to activate external developers, which could be Developers, start-ups, companies, data scientists and software agencies to join a competition to develop digital services and apps around the Mercedes Me digital brand and for the MBUX infotainment system. The in-car coding community was intended to form an ecosystem of services and apps that would be continuously expanding.

"The In-Car Coding Community is an international platform announced by Mercedes-Benz, with the support of employees in Group Research. "With the In-Car Coding Community, we offer an entire ecosystem around the topic of software as well as continuous exchange and close cooperation during the development process – between external developers and our internal experts," says Jasmin Eichler, Director of Future Technologies in Group Research. "The focus of the new community is entirely on the application. For us at Mercedes, this is a great opportunity to develop software together with external partners and to work jointly on new services." (Ref540) (Mercedes-Benz media, 2021a, p. 1)

"An important component of MBUX is the new generation of the Mercedes me apps. These are on the Mercedes me platform – exclusive to Mercedes-Benz and their cooperation partners. The apps ensure the intelligent and emotional networking of driver and vehicle, and bundle products as well as services which can be called up via the MBUX or the smartphone. Access to this digital ecosystem is available following an on-off registration on the Mercedes-Benz website or directly in the Mercedes me app. The car journey becomes an individual driving experience with MBUX and Mercedes me." (Ref540) (Mercedes-Benz media, 2021a, p. 2)

"The offers from Mercedes me are to be continuously expanded. This is exactly where the In-Car Coding Community comes into play. With its open innovation approach, it is aimed at a wide range of applicants. Developers, start-ups, companies, data scientists and software agencies are called upon to co-shape and drive ahead with the mobility of the future together with Mercedes-Benz. To ensure that this takes place as smoothly as possible and that the developers can fully concentrate on developing new codes, Group Research is making the Software Development Kit (SDK) available to applicants, which gives them access to the MBUX infotainment system." (Ref540) (Mercedes-Benz media, 2021a, p. 2)

This however did not seem to be very successful as, this press release was the last mention of the in-car coding community by Mercedes-Benz that was found. Additionally, the website in-car-coding.com that was mentioned in the video accompanying the launch is no longer online. A possible explanation of why this failed can be found in indirect network effects, or better, the lack thereof.

At Mercedes-Benz, the third-party services that are being added are at this point services that are useful on the road, like music streaming services such as Amazon Music, Apple Music, Spotify, Tidal, and TuneIn. From the wording it can be deducted that Mercedes-Benz did the integration work themselves.

"Mercedes-Benz has also integrated the music streaming service Spotify and Tuneln internet radio into the new S-Class. TIDAL and Amazon Music continue to be available as well. MBUX allows access to the usual songs and playlists as on a smartphone or other mobile device. Operation is intuitive, using the MBUX voice assistant "Hey Mercedes"." (Ref574) (Mercedes-Benz Media, 2020a, p. 4)

"Stuttgart. Mercedes-Benz has teamed up with Apple Music to provide the full integration of Apple Music into the Mercedes me connect service "Online Music" and the MBUX infotainment system." (Ref575) (Mercedes-Benz media, 2021b, p. 1)

Platform role repositioning phase

In mid-2022, Mercedes-Benz revised its strategy for integration of third-party services by announcing a partnership with Zync. This strategic shift likely resulted from the realization that attracting third-party developers to create apps for its proprietary infotainment system was challenging. Zync serves as a platform that consolidates a diverse array of third-party services into a single interface, which is then incorporated into the manufacturer's infotainment system. This approach allows car manufacturers to integrate multiple third-party services simultaneously. Additionally, for developers from third-party streaming services, this model is more appealing as they only need to develop an application for the Zync platform once, ensuring broader compatibility and reducing development effort.

"Mercedes-Benz Group AG has agreed to a partnership with ZYNC. The California-based tech company will provide the world-first implementation of its premium in-car digital entertainment platform for Mercedes-Benz. By aggregating a wide range of owned and 3rd-party digital content onto a single turnkey platform, ZYNC will provide the platform as well as the interface between content partners and existing compatible Mercedes-Benz hardware." (Ref576) (Mercedes-Benz media, 2022, p. 1)

"The partnership with ZYNC leverages and maximises the inherent benefits of the advanced UI/UX of Mercedes-Benz infotainment systems, such as the MBUX Hyperscreen. The aggregation of content means 3rd-party partners integrate once into the ZYNC platform.

The highly scalable cloud-native platform is optimised for low latency on Mercedes-Benz vehicle hardware." (Ref576) (Mercedes-Benz media, 2022, p. 2)

Incorporation of these new apps was brought to market with the third-generation MBUX infotainment system in 2023, which features a compatibility layer for Android Apps. There is no Android App store however, Mercedes-Benz makes use of the Faurecia-Aptoide app store. Mercedes-Benz designed this version of the operating system to have a user experience similar to the ones found in popular smartphones, like with BMW this could be seen as mimicking the competition as part of the 'slipstream strategy' proposed by Reischauer et al. (2024).

"The entertainment programme in the E-Class is more interactive than ever. The software experts at Mercedes-Benz have developed a new compatibility layer that allows the installation of third-party apps4. The following apps are available on the central display on the launch of the E-Class5: the entertainment platform "TikTok", the game "Angry Birds", the collaboration application "Webex", the office application "Zoom" and the browser "Vivaldi". In addition, the ZYNC entertainment portal6 (optionally) offers video streaming, on-demand content, interactive experiences, local video programmes, sports, news, games and much more on the central and passenger displays, via one user interface." (Ref570) (Mercedes-Benz media, 2023a, p. 3)

"By integrating TikTok, Webex and Zoom Meetings into a vehicle and a Mercedes-Benz E-class for the first time this in-car experience enables users to have a mix of entertainment, video conferencing, webinars, and collaboration sessions, facilitating professionals and remote workers to join business meetings or catching up with friends and family. This demonstrates Faurecia Aptoide's dedication to staying at the forefront of automotive technology while making life on the road safer, efficient, and ensuring users stay connected." (Ref577) (Faurecia Aptoide, 2024a, p. 1)

In 2020, Mercedes-Benz has announced the development of a new proprietary operating system, called MB.OS. The first car with this operating system will be announced in 2024. As MBUX 3 has been called a precursor to MB.OS, it is likely that this new operating system will also feature this Android layer.

"In the area of car software, Mercedes-Benz has announced its own proprietary MB.OS operating system. This will be developed in-house and is scheduled for launch in 2024. It will allow Mercedes-Benz to centralize the control of all the vehicles' domains and also its consumer interfaces. Proprietary software development will allow greater speed and

more frequent updates, and will be designed around scalable architectures that will control future development costs." (Ref560) (Mercedes-Benz media, 2020b, p. 3)

"A precursor to MB.OS will already be available in the new E-Class starting in 2023 with the third generation of MBUX. A new MBUX API for Android allows the installation of third-party apps, offering a better user experience compared to mirrored apps." (Ref565) (Mercedes-Benz, 2023b, p. 2)

A visualization of the incorporation of platform ecosystems at Mercedes-Benz is given in figure 9.

Monetization strategy

The monetization strategy for the platform at Mercedes-Benz is implemented via a subscription service. Upon initial activation, customers receive a complimentary twelve-month trial period. Following this trial period, users are required to pay for continued access. This subscription package includes coverage for data usage. Additionally, by restricting access to the platform's ecosystem, the platform provider can generate revenue, even though they are not the platform owner.

"The new MBUX infotainment system enables the installation of third-party apps[3]. In conjunction with the MBUX Entertainment Package Plus, this means a new level of digital experience – with third-party apps from the category video streaming, video conferencing, games, travel planning, knowledge platform and much more. The apps can be downloaded "over the air" from the Mercedes me Store. The main icons on the redesigned central display are now presented more simply and are arranged to match smartphones tiles for pleasant usability and ease of intuitive operation." (Ref571) (Mercedes-Benz AG, 2024, p. 1)

"The Entertainment package (MBUX Entertainment Plus) will be available for the new E-Class. It includes Mercedes me connect services1 and a data package from a third-party provider. Depending on the market, a communication module with 5G as the transmission technology is used2. The mobile phone standard 5G makes much faster data rates possible than LTE/UMTS3." (Ref570) (Mercedes-Benz media, 2023a, p. 2)

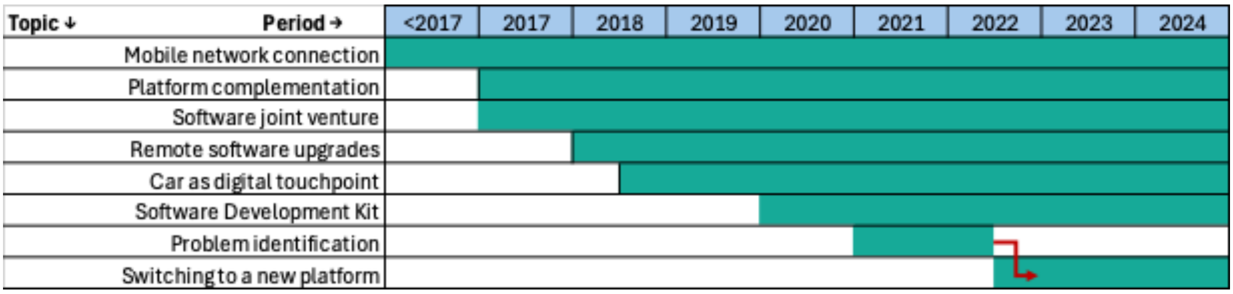

Figure 9 timeline of platform ecosystem incorportation at Mercedes-Benz (self generated).

5.3 Cross case-analysis

5.3.1 Evolution of In-Vehicle Infotainment (IVI) Systems

Since the second half of the 1990s in-vehicle infotainment (IVI) systems have played an increasingly important role in the the automotive industry. Both BMW and Mercedes-Benz have pursued distinct but parallel paths in developing their IVI platforms, evolving from early, rudimentary infotainment systems to the sophisticated systems of today. BMW's IVI began in 1998 with the BMW Telematics and Assist package, later revolutionizing in-car controls with the introduction of iDrive in 2001, which became an industry standard. Similarly, Mercedes-Benz laid its digital foundation with the Auto Pilot System in 1995, followed by the launch of COMAND in 1998, which integrated navigation, media, and communication features.

IVI systems provided a new opportunity for automobile manufacturers to build a competitive advantage over their competitors. Therefore, manufacturers (especially in the premium segment) chose to develop their own proprietary systems. Over the years, both manufacturers expanded their systems with internet connectivity, third-party app integration, and over-the-air (OTA) software updates, marking a shift towards connected and intelligent vehicles. This happened in the same time frame as the rise of smartphones. While the smartphone market would become dominated by two operating systems, Apple's IOS and Google owned Android, the IVI-systems in cars remained to be largely brand specific.

Although developed separately, the functionalities of both systems have converged over time, driven by a cycle of innovation and competitive imitation. This dynamic is shown in the near-simultaneous introduction of new system generations, where each iteration closely mirrors the advancements of the other. With each update, both BMW and Mercedes-Benz integrate highly similar functionalities, showing a shared trajectory in the evolution of their IVI-systems.

5.3.2 Expanding Competition: From Automakers to Tech Giants

This competition between (amongst others) BMW and Mercedes-Benz is to be expected as they have traditionally operated in a competitive landscape comprised of their automotive peers. Today however, the competition extends to large technology companies such as Apple and Google, which are organized as platforms and have developed extensive ecosystems of complementary services. These companies have entered the IVI system market quite effectively with Apple Carplay and Android Auto.

On the one hand, these technology companies can add significant value to the car manufacturers' products by bringing a mature ecosystem to cars without a big investment; on the other, they pose a competitive threat as manufacturers will miss out on capturing value from IVI with these systems.

5.3.3 Adapting to a Platform Economy: Organizational Culture and Ecosystem Integration

To adress the challenge of competition from an entirely different industry with a fundamentally different business model, both BMW and Mercedes-Benz established software development subsidiaries around 2017/2018. These subsidiaries were designed to operate separately from the parent organizations, fostering an organizational culture better aligned with the dynamics of tech-driven platform business models. This cultural shift requires moving away from the traditional focus on resource control, and embracing resource orchestration as suggested by Van Alstyne et al. (2016). By doing so, these subsidiaries can focus on agility, enabling them to respond quickly to changing market conditions..

5.3.4 Complementing other platforms

The first visible results from these subsidiaries was BMW's and Mercedes-Benz's initiatives to introduce apps for smartphones and smart home devices, allowing users to view/hear vehicle information and control certain vehicle functions remotely. Thereby both manufacturers effectively took the role of complementor to these different platform ecosystems following the platform roles defined by Van Alstyne et al. (2016). However, the user also has a perceived value increase of the car when this is possible. This suggests a two-way complementarity as described by Jacobides et. al (2018), where the addition of one, increases the value of the other and vice versa.

5.3.5 Platform provider/ownership

From 2018 on, BMW also started working on integrating these same platform ecosystems in the car, putting BMW in the platform provider role by providing the interface between the user (driver of the car) and the platform ecosystem again following the platform roles by Van Alstyne et al. (2016). Contrary to this, Mercedes-Benz at this point had more of a focus on creating an own platform ecosystem by integrating third-party apps for music streaming and by integration of IoT home devices such as intelligent thermostats. Mercedes-Benz was thus more focusing on being a platform owner and provider following the platform roles defined by Van Alstyne et al. (2016).

in late 2020, Mercedes-Benz introduced the second generation of the MBUX infotainment system, with this version Mercedes-Benz expanded the offering of third-party apps, albeit still focused on music streaming services. Shortly after, in early 2021, BMW introduced a new version of it's operating system, version 8.0. Mercedes-Benz expanded the offering of third-party services by adding more music streaming services and BMW also started offering more third-party music streaming apps on this version of the operating system. The focus of both on music streaming apps can be explained from the use case of the car, making these services the most complementary to the driving experience at this point.

5.3.6 Diverging platform strategies

While for Mercedes-Benz, the formation of a platform for an app ecosystem seemed at this point like the perceived way forward, BMW seems to have done this to match the competition in their offering. As mentioned in the BMW within case analysis, when BMW wanted to introduce some third-party apps in their operating system 7, had to do all integration work themselves according to Weiß et al. (2022).

This could have contributed for BMW to identify the problem early while Mercedes-Benz launched a Software Development Kit with an in-car coding community in early 2021, with the goal of creating an ecosystem of complementors that develop apps for the MBUX infotainment system. As mentioned in the within case analysis it does not seem this was successful. BMW likely anticipated the problem of too small of a potential user base, as they made no such efforts, and instead called for standardization across the industry in late 2021. In this, BMW suggested moving in the direction of a common standard for operating system foundations though open source software. According to BMW there is no need to develop a proprietary digital ecosystem, but instead manufacturers should focus on existing ones, such as Android Open Source Project.

"Standardisation is key to the digitisation of cars. We believe it makes sense to develop common, standardised basic elements for vehicle operating systems in conjunction with other OEMs and suppliers. The use of open-source software is highly relevant in this respect – to make sure we are all speaking the same language. There is no need to reinvent the wheel. We can ensure a high level of economic efficiency and, at the same time, make use of existing digital ecosystems, such as Google's Android Open-Source Project." (Ref81) (BMW Group, 2021b, p. 7-8)

5.3.7 The Scalability Dilemma: limited user base and high investment

A manufacturer-specific infotainment system inherently has a limited user base, only those who own that brand's vehicles equipped with a compatible generation of the system. Additionally, not all of these users will actively adopt the platform ecosystem, as their primary use of the car remains transportation. This market fragmentation, where each manufacturer maintains its own proprietary infotainment system and app ecosystem, leads to high development and maintenance costs for applications relative to their potential return.

This challenge is also acknowledged by Kessels (2024), who states, "Even though there are carmakers who are convinced that developers will submit to their specific app store, it will obviously not work" (Kessels, 2024, You get an app store,… section, para. 5).

From a developer's perspective, platform ecosystems like Apple CarPlay and Android Auto are far more attractive due to their significantly larger user base, spanning across multiple car brands and consisting of Apple iPhone and Android users who drive regularly. Developers only need to create and maintain a single app, adapted from their existing smartphone app, which can then be used across all brands supporting Apple CarPlay or Android Auto.

5.3.8 The Case for Industry-Wide Cooperation

Incumbent car manufacturers thus seem to lack the critical mass to build a successful platform ecosystem for IVI, as the potential user base is directly tied to the number of compatible vehicles produced. This challenge can be (partially) addressed through cooperation among multiple manufacturers. This cooperation is something that BMW and Mercedes-Benz already did when growing their mobility services platform.

""As premium manufacturers, we have long been setting standards in the automotive industry and for our customers. In the premium vehicle business, we will continue to compete for customers. But our new portfolio for individual urban mobility on demand represents a logical extension to the value chain. Ultimately, we want to offer our customers as many

options as possible for getting from A to B. In short, this is about driving, riding or being driven," said Zetsche." (Ref32) (BMW Group & Mercedes-Benz media, 2019, p. 4)

"bp has become the third shareholder of Digital Charging Solutions GmbH (DCS) following the successful closing of the M&A transaction. bp gained a 33.3% stake as part of a capital increase. BMW Group and Daimler Mobility AG remain shareholders owning a 33.3% stake each." (Ref543) (BMW Group & Daimler communications, 2021, p. 1)

Reischauer et al. (2024) support this cooperative approach with direct competitors, citing statements from OEM managers emphasizing the necessity of collaboration to compete with dominant tech platforms.

"Where high scalability is more important than exclusivity, we rely on strong partners, even rivals, to compete against platforms." (Reischauer et al., p. 9, 2024)

"What we did back then together with rival OEMs – investing in [technology provider] – was to provide a counterbalance to Google, because we understood we can only do it together as Google is so dominant." (Reischauer et al., p. 16, 2024)

"Our mission is to continuously launch innovations. […] we cannot be successful anymore without cooperating even with our strongest rivals." (Reischauer et al., p. 16, 2024).

5.3.9 Lack of industry standards

While the need for incumbent manufacturers to work together arose, the lack of industry standards in IVI-systems that resulted from the automotive manufacturer peer-to-peer competition made this virtually impossible. This lack of industry standards is also acknowledged by Fletcher et al. (2020) in their article for McKinsey & Company and according to Rugraff (2012), who state the absence of industry-wide standards and codification schemes is the primary obstacle hindering the development of modular linkages that enable suppliers to provide comprehensive "turn-key services". This shortfall in adopting open standards can be attributed to two main factors according to Rugraff (2012).

The initial factor is of a technical nature: the intricate interrelation of vehicle performance aspects such as noise, vibration, and handling creates a scenario where alterations in one component frequently affect other parts of the vehicle. And while NVH levels are not necessarily applicable to IVI systems, there is still a similar problem according to Fletcher et al. (2020). They state that any modification to a specific software module frequently necessitates significant integration rework. It is common for these systems to lack backward compatibility, leading to the need for extensive redevelopment every few years in order to keep up with new features and performance.

The second factor is structural: historically, manufacturers have dominated the value chain, imposing their proprietary standards on suppliers (Rugraff, 2012). Sturgeon et al. (2008) argue that each automobile manufacturer leverages its purchasing power to force suppliers to conform to its unique standards, information systems, and business processes.

This rigid, top-down control has not only hindered the development of modular linkages across the industry but also presents significant challenges for manufacturers attempting to establish their IVI platform ecosystems. The hierarchical structures, designed for traditional supply chains, are inherently misaligned with the openness and agility required for digital innovation. Suppliers have long been conditioned to adapt to the proprietary ecosystems of individual manufacturers, a practice rooted in an era when automakers held dominant bargaining power (Gawer, 2009). In contrast, external development partners from industries that operate with greater flexibility are unfamiliar with these rigid constraints.

The absence of industry-wide standards magnifies the problem. Applications developed for one manufacturer are frequently incompatible with those of another, forcing developers who wish to 'multihome' to start from scratch for each system. While traditional suppliers may accept this approach, it significantly reduces the appeal of a platform ecosystem for third-party developers. As a result, the structural advantage that once secured manufacturers' control over the value chain now acts as a barrier to innovation and competition in an increasingly digital market. IVI ecosystems rely on network effects, a self-reinforcing cycle of growth. Yet, without interoperability across manufacturers, this potential remains constrained, as platform adoption is limited to the sales volume of a single automaker.

BMW and Mercedes-Benz have attempted to address these organizational challenges by establishing dedicated software subsidiaries with more agile, digitally oriented cultures. However, while this approach improves internal operational flexibility, it by itself fails to tackle the core issue: the lack of industry-wide standards. Without common frameworks ensuring interoperability, these subsidiaries risk developing yet another set of proprietary silos, ultimately failing to attract third-party developers to generate the network effects essential for a thriving IVI ecosystem, similar to the fate of Mercedes-Benz's Software Development Kit. BMW recognized this issue and therefore called for standardisation in infotainment basic elements, utilizing an existing ecosystem. This is an interesting difference by itself, where Mercedes-Benz 'tried and found out' it would not work, BMW recognized the shortcoming without trying. This experimental approach by Mercedes-Benz could be overconfidence. It could also be Mercedes-Benz trying to implement a start-up approach which includes trying and failing to find out what works, as described by Thomke (2023).

"Standardisation is key to the digitisation of cars. We believe it makes sense to develop common, standardised basic elements for vehicle operating systems in conjunction with other OEMs and suppliers. The use of open-source software is highly relevant in this respect – to make sure we are all speaking the same language. There is no need to reinvent the wheel. We can ensure a high level of economic efficiency and, at the same time, make use of existing digital ecosystems, such as Google's Android Open-Source Project." (Ref81) (BMW Group, 2021b, p. 7-8)

5.3.10 Towards an industry standard

Recognizing (BMW) or discovering (Mercedes-Benz) the limitations of their internal optimization strategies, both manufacturers are now shifting towards operating system (layers) that support more open and collaborative ecosystems. By adopting platforms that encourage external development and interaction, they can integrate a wider range of apps and services from third-party developers and service providers. This transition enhances the variety of digital experiences available to customers through innovation the broader developer community.

In line with this strategy, BMW introduced its new Operating System 9.0 in 2022, built on the Android Open Source platform, with market implementation following in 2023. Mercedes-Benz soon followed suit, announcing the new MBUX 3, which includes a layer supporting Android apps. Although their approaches differ, BMW developing a complete IVI operating system on a shared foundation, while Mercedes-Benz focuses on making common-base apps functional for its vehicles. Although different in their approach which will be explained later, the level of cross-manufacturer compatibility within the ecosystem remains the same.

What is particularly interesting is that Mercedes-Benz, despite initially taking a more experimental approach than BMW with the launch of a Software Development Kit, now appears to struggle more with letting go of its legacy approach to internal integration. Instead of fully embracing an open platform, Mercedes-Benz has opted to introduce only a compatibility layer for Android apps, maintaining a degree of control over its operating system. In contrast, BMW has deliberately moved away from this proprietary approach, recognizing its limitations and choosing to invest in a more open, platform-based strategy. By adopting Android Open Source as the foundation for its Operating System 9.0, BMW signaled a clear departure from traditional internal integration, with this action and their call for standardisation in 2021, it is clear their standpoint is that the future of IVI lies in a common standard in the industry with existing ecosystems.

Android has a user base that is not limited to a single manufacturer, but instead is used across multiple car brands and even consumer electronic devices. By using a common standard, the platform becomes more attractive to third-parties as they have a larger potential user base for their complementary product or service. An alternative explanation could be mimicking as a competitive move against Google and Apple as part of the 'slipstream strategy' proposed by Reischauer et al. (2024).

By moving away from IVI operating systems that have been developed to best suit the internal needs and specifications of the company, towards one that has a better platform ecosystem potential, BMW and Mercedes-Benz are shifting their focus from internal optimization towards facilitating external interactions as suggested by Van Alstyne et al. (2016). Traditionally, the proprietary IVI systems were designed by these companies with a focus on meeting their own specific requirements, remaining in tight control over software, features, and user experience. However, this approach obstructs the integration of third-party applications and services, thereby limiting external interaction to a minimum which in turn limits the digital offerings available to the end-users.

As can be seen on figure 10, the approach that Mercedes-Benz (Android app layer) and BMW (Android Automotive OS) took, requires different levels of development efforts for the IVI-system from the manufacturer. In return however the level of dependence on Google is different. Below the levels are explained more deeply.

Android App layer

With an Android App layer in the proprietary operating system of the manufacturer, the operating system remains to be fully developed by the car manufacturer which is based on Linux in the case of Mercedes-Benz (Joire, 2023). Only, a layer is implemented on which Android Apps are compatible in a containerized environment (Joire, 2023). This preserves the manufacturer's ability to innovate and differentiate its IVI system through proprietary development while also utilizing the extensive Android app ecosystem.

Android Automotive OS

Android Automotive is an open-source platform built on the standard Android OS but designed specifically for IVI systems (Android Open Source Project, n.d.). Android Automotive runds directly on the car's hardware and is scaleable over multiple vehicle brands. Being Open Source, the platform offers extensive options for customization which allows car manufacturers to tailor the system to their needs and wishes while leveraging the existing Android ecosystem, including apps and developer tools (Android Open Source Project, n.d.). The manufacturer can choose to what extent they want to deviate from the base AAOS, albeit this imposes the risk that future updates are not compatible. Android suggests the use of 'Overlays' instead of source code alterations (Android Open Source Project, n.d.-a).

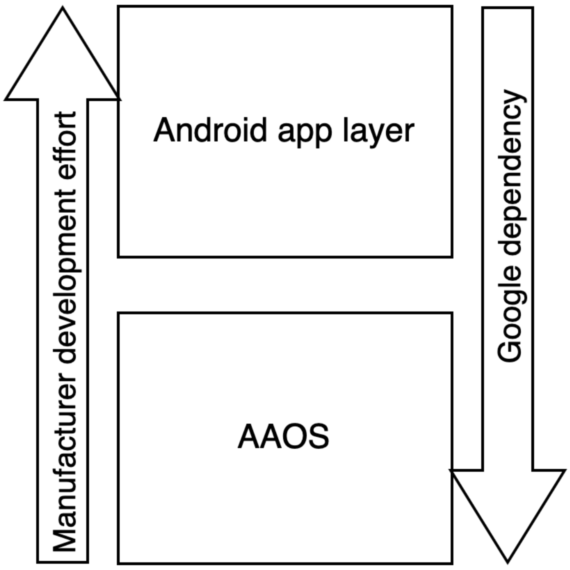

Figure 10 Development effort versus Google dependency in Android ecosystem for IVI (self-generated).

5.3.11 Platform role positioning with industry standards

After the formation of an industry standard, the next challenge in incorporating a platform ecosystem business model is selecting the appropriate role within that platform ecosystem. Car manufacturers must decide whether to position themselves as platform owners or platform providers. The platform owner role allows manufacturers to exert maximum control over the ecosystem's design and governance but also requires significant investment in governance and infrastructure. The platform owner is responsible for many tasks that are not necessarily part of their core capabilities nor do they have a large enough user base to generate indirect network effects, as exemplified by the failure of the attempt of platform ownership by Mercedes-Benz.

On the other hand, as platform providers, manufacturers can solely focus on developing and delivering the tangible interfaces, i.e. their vehicles, that enable the users to interact with the platform. This role is in line with their existing manufacturing strengths but requires integration with broader ecosystems which are often owned by tech companies or suppliers.

In accordance with Van Alstyne et al. (2016), a firm needs to move from resource control to resource orchestration. And as the point already suggests, this involves giving up control over certain areas of the system, at least partially, allowing use scenarios to arise that were not foreseen by the manufacturer. As previously mentioned, car manufacturers have historically been in tight control over the entire value system, from suppliers to dealerships. From the case study in a similar (possibly the same) setting by Reischauer et al. (2024), this giving up control seems hard. Incorporating a platform ecosystem business model involves letting go of this control partially. Since this has proven to be difficult, likely because of the organizational legacy, both BMW and Mercedes-Benz have launched software joint ventures/subsidiaries to focus on this area of the car.

With Android being open source, the operating system can be fully customised to the manufacturers wishes, although the modifications to the user interface makes updating in the future harder (Android Open Source Project, n.d.-a). BMW and Mercedes-Benz are thus not dependent on Google when opting for an Android based operating system or an Android App Layer respectively. Developing an operating system with Android as a base or a compatibility layer for the IVI system allows for running Android Apps in the car while the manufacturer still has a choice if or for which apps for navigation and which app-store they are going to choose, with BMW and Mercedes-Benz both choosing the Faurecia-Aptoide automotive app store. Along with this, the manufacturer has the option to choose a different, or multiple voice assistants, such as BMW choosing a localised approach with Amazon Alexa for western markets and Tmall Genie for China. For Android apps, multiple white label platforms are emerging through which apps are offered in the car (Kessels, 2024). These app stores are specifically intended for cars, and compared to other app stores, offer control to the manufacturer in terms of the look and feel, as well as the offering (Faurecia Aptoide, 2024b). A schematic overview of the different options for Android app integration is given in figure 11.

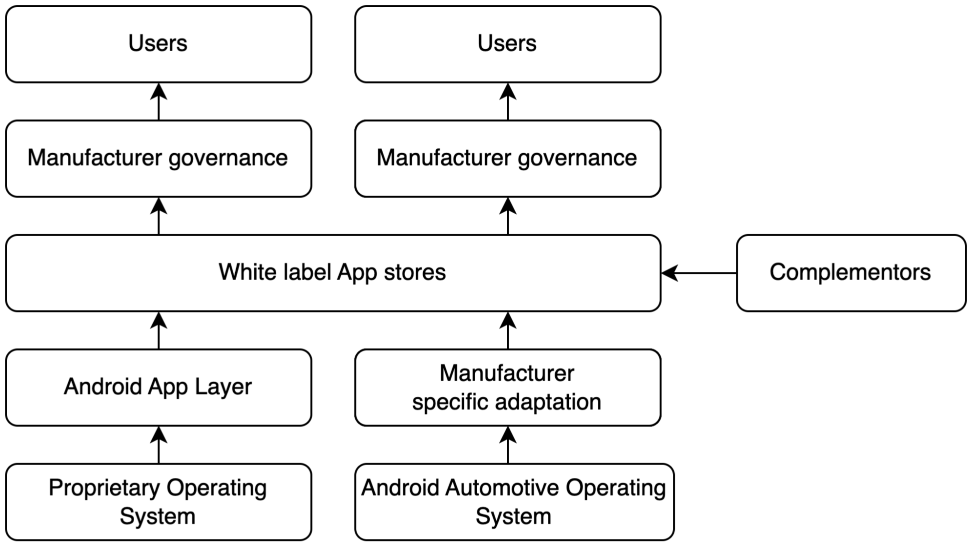

Figure 11 Possibilities for Android app ecosystem on IVI systems (self-generated).

5.3.12 Introducing the Governing Integrator: A New Platform Role for Automakers

This position does not align with the conventional platform roles of Platform Owner and Platform Provider as defined by Van Alstyne et al. (2016). While the car manufacturer does not own the platform, it retains significantly more control over the platform and its ecosystem than is typically expected for a Platform Provider. From the Platform Provider perspective, the car manufacturer integrates the third-party app store into its vehicles, ensuring that apps and services are accessible to customers.

However, the manufacturer goes beyond this standard role by introducing a white-label app store, customizing the interface, look, and feel to align with its brand identity and user experience standards. More importantly, the manufacturer retains the ability to moderate the offering, exerting influence over which apps and services become available within its ecosystem.

To better reflect this unique position, I propose the role of Governing Integrator. This role enables the manufacturer to maintain control over the user experience, ensure that apps meet quality and design criteria, and exert governance over the platform's offering. Thereby fulfilling responsibilities that traditionally fall under the Platform Owner role, without actually owning the platform. The Governing Integrator role allows car manufacturers to shape the ecosystem in their cars while the actual ecosystem reaches across multiple manufacturers.

6 DISCUSSION

6.1 Discussion and Analysis

In this section, I will analyze this thesis findings, in order to answer the research question *"How are incumbent pipeline organizations combining the platform ecosystem business model with their existing business model to transform them into a hybrid between these two different business models?"*. Both BMW and Mercedes-Benz are not transitioning from a pipeline to a platform ecosystem business model. If anything it is adding a platform business model on top of their pipeline business model. This however is not fully the case as neither BMW nor Mercedes-Benz are taking on the platform owner role in present time. Despite this, their role does allow them to exert control over the ecosystem and capture value from it through monetization. In the next paragraphs, this will be explained in more detail and linked to other research on similar topics.

The cross-case analysis highlights how BMW and Mercedes-Benz developed their in-vehicle infotainment (IVI) systems in parallel but with distinct strategic approaches. The findings aligns with Bayram (2021), who emphasized the importance of decoupled hardware and software cycles, the challenge of organizational legacy in software development, and the establishment of software subsidiaries. This study extends those insights by identifying two key preconditions for hardware and software decoupling: mobile network connectivity and remote software upgrades.

Furthermore, this study identifies a shift in competition within the automotive industry, as Apple and Google have emerged as key players in the IVI space. In response, automotive manufacturers have launched software subsidiaries to foster a culture more aligned with the platform ecosystem business model. As platform ecosystem efforts increased, BMW and Mercedes-Benz pursued distinct strategies: BMW developed proprietary apps while advocating for industry-wide standardization, whereas Mercedes-Benz introduced a Software Development Kit (SDK) to encourage third-party development. Despite their initial divergence, both companies eventually recognized the need of industry standards for scalability through network effects.

An interesting aspect of this evolution is the contrast in how BMW and Mercedes-Benz arrived at this realization. BMW adopted a conservative, research-driven approach, while Mercedes-Benz took an experimental path. The latter's SDK-based strategy aligns with the culture of experimentation described by Thomke (2023), as seen in major tech companies such as Amazon, Microsoft, and Google. This broader trend of automakers mirroring tech industry strategies is also noted by Reischauer et al. (2024).

Contrary to Bayram's (2021) findings, this study suggests that scaling the platform through a brand portfolio alone was insufficient to attract third-party complementors. Instead, the research shows the necessity of industry standards to generate the network effects crucial for a thriving platform ecosystem, as the ecosystem should span across multiple car brands. The absence of such standards leads to nonfungibility in design efforts by third-party developers. This contradicts Jacobides et al. (2018), who argued that platforms could leverage this nonfungibility to create lock-in effects for complementors. This study found that nonfungibility serves as an entry barrier, making it difficult for new platforms to gain traction.

To counter this problem of scalability because of a lack of potential network effects, cooperation among manufacturers emerged as a strategic necessity. This is something that BMW and Mercedes-Benz had previously engaged in with their Mobility Services platform. Reischauer et al. (2024) also support this need for collaborative efforts. However, in practice, such cooperation was hindered by the absence of industry-wide standardization.

From this perspective the conditions identified by Gawer and Cusumano's (2008) for formation of industry platforms are met. They outline two key preconditions for industry platforms: 1. The platform should perform an essential function within a "system of use" or solve a critical technological problem in the industry. 2. The platform should be easy to connect to or build upon, enabling system expansion and unforeseen end-use cases.

The lack of standardization has complicated third-party developers' efforts to integrate with the diverse infotainment platforms that have emerged over the past two decades. Historical precedents for overcoming similar standardization challenges exist in other industries—for example, IBM's introduction of the System/360, which replaced fragmented, custom-built computing systems with a modular and scalable industry platform (Gawer, 2009).

A clear industry standard is now emerging with Android Automotive OS (AAOS). Beyond BMW and Mercedes-Benz, Volkswagen AG's software division CARIAD has also adopted Android (CARIAD, 2024), along with Volvo, Ford (Ford Motor Company, n.d.), and General Motors (GM Developers, n.d.).

Although the BMW and Mercedes-Benz case study initially suggested two levels of Android integration with Mercedes-Benz who has implemented an Android app compatibility layer within its proprietary IVI system and BMW has fully integrated AAOS as the core of its IVI platform. Further investigation however, identified a third: Android Automotive OS with

Google Automotive Services (GAS). GAS includes Google Maps, the Google Play Store, and Google Assistant, but its implementation requires a commercial agreement with Google. Additionally, manufacturers adopting GAS must comply with Google's technical requirements, such as passing the Automotive Test Suite (ATS) and meeting specific hardware criteria. This deepens dependency on Google, reducing manufacturers' control over their IVI systems' future (Kessels, 2024). It also grants Google access to vast amounts of data that manufacturers would prefer to retain (Reischauer et al., 2024).

A final key insight from this research is the emergence of a new platform role, the Governing Integrator. Unlike traditional platform owners, neither BMW nor Mercedes-Benz fully controls the platform, yet they exert more influence than a standard platform provider.

The Governing Integrator role describes manufacturers that facilitate ecosystem integration while retaining control over critical aspects such as app store moderation and user experience. This balance allows them to participate in the platform economy without fully relinquishing control to dominant tech firms like Google. This role expands upon Van Alstyne et al.'s (2016) platform framework, highlighting how legacy industries can navigate the complexities of digital transformation while maintaining strategic autonomy.

This position differs from for example manufacturers of Android phones such as Samsung, who typically use the Google play store. The cannot exert governance over the ecosystem, meaning the manufacturer does not have control over i.e. the offering in that app store. Google, as a trademark holder of Android severely limits the autonomy of these manufacturers through Anti-Fragmentation Agreements (AFAs) and Mobile Application Distribution Agreements (MADAs) (Bassali et al., 2020). While Android is open source, in order to use the logo and name of Android, these agreements are required by Google (Bassali et al., 2020).

It is however questionable whether this intensive moderation of the platform offering on their products is desired from the perspective of third-party complementor attractiveness. As previously discussed, the problems that manufacturers are facing is scale. This is especially true as a sole manufacturer, but also as an industry as a whole compared to the smartphone industry, for which Android apps are predominantly used (Kessels, 2024). If manufacturers want well populated app stores available to their customers, they need to think about the extent of their moderation.

6.2 Academic Relevance

By investigating the initial phases of platform ecosystem implementation, this research contributes to the academic literature by specifically addressing the research gap identified by Jovanovic et al. (2022) regarding the incorporation of platform ecosystems within traditional pipeline-based organizations undergoing digital transformation.

The automotive industry presents a unique case for this analysis due to the complexity of its products and the multitude of stakeholders involved (Su et al., 2018). Furthermore, this research expands on Van Alstyne et al.'s (2016) platform framework by introducing the concept of the Governing Integrator, a role that enables manufacturers to facilitate ecosystem integration while retaining strategic control.

6.3 Practical Relevance

From a managerial perspective, this research provides actionable insights for automotive incumbents navigating the shift toward platform ecosystems. By examining how leading manufacturers such as BMW and Mercedes-Benz approach platform integration, this study offers strategic guidance for firms seeking to balance digital transformation with legacy business models.

The findings underscore the importance of industry-wide standardization to achieve network effects, as isolated platform initiatives may struggle to attract third-party developers. This has direct implications for strategic alliances and industry collaborations, reinforcing the necessity of cross-manufacturer partnerships to enhance platform scalability. Additionally, the concept of the Governing Integrator provides a potential blueprint for firms aiming to maintain brand identity while leveraging external platform capabilities.

Moreover, this study highlights emerging business opportunities, such as the monetization of in-car services and the creation of digital marketplaces within vehicles. As platform ecosystems facilitate new revenue streams, manufacturers can develop competitive strategies that extend beyond vehicle production, including data-driven services and customer engagement models.

With a forward looking perspective, the evolution of in-vehicle infotainment (IVI) systems might provide a precedent for how autonomous driving technology may develop within the automotive industry. Initially, IVI was a point of differentiation. Manufacturers developed proprietary systems to outperform their competitors in terms of performance, functionalities, and user experience. However, as systems of all manufacturers improved, this differentiating power was lost. This might be repeated as autonomous systems, which are now being developed as proprietary solutions, mature and reach a high level of reliability across the industry.

Additionally, tech firms such as Google (Waymo) and NVIDIA are also entering in the autonomous market. These companies are building platform-based autonomous driving ecosystems, leveraging data-driven network effects to refine self-driving algorithms at a pace that individual automakers may struggle to match. If history repeats itself, the lack of standardization in early AV systems could create fragmented ecosystems. This could lead to car manufacturers such as BMW and Mercedes-Benz once again finding themselves struggling with scalability issues, leaving room for an industry standard to emerge where they have no control over. It might be best for them to give up control over the full system in an early stage, and form an industry standard. With choosing the role of governing integrator once more, they can still exert control over the ecosystem while not facing the same scalability issues.

6.4 Research Limitations & Recommendations

To be considered are the limitations of document analysis, which are that documents are not produced for another reason then this research, and can thus have an insufficient level of detail (Bowen, 2009). Not all documents are retrievable and are thus not included in the analysis (Bowen, 2009). Lastly, there is the risk of 'biased selectivity'. This is a bias occurring from using information that is coming from a company that has a certain agenda when it comes to information that they put out (Bowen, 2009). As information around possible future business models is strategically important for manufacturers, manufacturers might be intentionally putting out inaccurate or incomplete information in order to maintain a strategic advantage. It is therefore advised to conduct research of a similar kind where the method of data collection is different. For example by conducting in-depth interviews with managers at the organizations that are studied.

As this research is a master thesis project, there are inherent time constraints for conducting the research. Following from this certain searchwords have been used in the research in order to find suitable documents. There is a possibility that these searchwords are not present in certain documents resulting in some relevant information might not have been found. Additionally, the amount of cases that could be studied was also limited due to this time constraint. This is why it is recommended to repeat this case study with more than two cases. Possibly, the cases could even be from different industries to generate more generalizeable results.

Another possible limitation is the fact that both BMW and Mercedes-Benz are German manufacturers that operate in the ‘premium’ segment of the car market. This market segment has higher margins and are generally on the forefront of innovations in the industry (Bormann et al., 2018). While this focus was a deliberate choice, based on the expectation that business model innovations are more likely to emerge in this context, it may also limit the generalizability of the findings as the results might not be transferable to market segments that operate under lower margins. Additionally, the outcome may have been different if non-German manufacturers were studied.

Future research should focus on the strategic lock-in through non-fungibility of development efforts by complementors vs the attractiveness for third-party developers to join the platform. This is suggested as Jacobides et. al (2018) suggested this non-fungibility is a good thing as it keeps the complementor from multihoming, while this research found it to be counterbeneficial as it can prevent them from joining the platform in the first place.

Another suggested topic of future research is an in-depth study of the governing integrator role. More research shoul be conducted in finding out the platform dynamics in a situation where the platform’s governance lies not solely with the platform owner.

Lastly an interesting area of future research could be an exploration of whether a similar pattern of platform ecosystem integration can be observed on autonomous driving platforms. While these platforms are relatively new, manufacturers might be taking a more collaborative approach from the start compared to the approach they took on IVI-systems.

7 CONCLUSION

This thesis has explored the early stages of platform ecosystem implementation in incumbent pipeline organizations within the automotive industry. Through a multiple case study approach, the research examined how traditional automotive manufacturers are adapting their business models to integrate platform-based ecosystems in response to digital transformation and increasing competition from tech companies.

The findings reveal that the incorporation of a platform ecosystem business model to a pipeline is not a straightforward path. Incumbent automotive manufacturers face significant challenges, including most importantly, the need to standardize software architectures across the industry in an effort to collectively fend of competition with new platform competition such as Google and Apple. This is needed as the tech company competition has a larger user base compared to sole automotive OEMs, and to compete with them, joining forces is a necessity.

OEMs are not taking the role of either platform owner or platform provider, but have rather given rise to a new role through white label solutions. This new role is proposed in this research as the 'governing integrator' who is not the owner of the platform but rather adapts the platform to their brand identity and moderates the offering.

Because of the multiple case study approach taken in this research, patterns among different manufacturers were recognized, including common problems, shared solutions, but also differences, the general way in which the industry is incorporating platform ecosystems was identified. By cross-verifying these emerging patterns with multiple data sources, such as insights from technology companies and findings from other research papers, as part of the Eisenhardt method, the results were made more robust and reliable.

The findings not only offer insight into how platform ecosystems are beginning to take shape within a pipeline industry but also contribute to a broader understanding of business model transformation in the face of digital disruption. As the automotive industry continues to become increasingly digital, the ability of incumbent firms to balance openness, control, and collaboration will likely determine their long-term relevance. This study provides a foundation for future research into hybrid business models and highlights the importance of strategic role redefinition in navigating platform-based competition.

BIBLIOGRAPHY

Adner, R. (2017). Ecosystem as structure. Journal of Management, 43(1), 39–58. https://doi.org/10.1177/0149206316678451

Ajgaonkar, S., Neelam, N., & Wiemann, J. (2021). Drivers of workforce agility: a dynamic capability perspective. The International Journal of Organizational Analysis, 30(4), 951–982. https://doi.org/10.1108/ijoa-11-2020-2507

Alptekinoğlu, A., & Corbett, C. J. (2008). Mass Customization vs. Mass Production: Variety and Price Competition. Manufacturing & Service Operations Management, 10(2), 204–217. https://doi.org/10.1287/msom.1070.0155

Anderson, E. G., Bhargava, H. K., Boehm, J., & Parker, G. G. (2022). Electric vehicles are a platform business: What firms need to know. California Management Review, 64(4), 135–154. https://doi.org/10.1177/00081256221107420

Android Open Source Project. (n.d.-a). Implement the system UI. https://source.android.com/docs/automotive/hmi/system_ui

Android Open Source Project. (n.d.-b). What is Android Automotive? https://source.android.com/docs/automotive/start/what_automotive

Aspers, P., & Corte, U. (2019). What is Qualitative in Qualitative Research. Qualitative Sociology, 42(2), 139–160. https://doi.org/10.1007/s11133-019-9413-7

Banerjee, R., & Majumdar, S. (2020). Determinants of shareholder value creation - platform versus traditional business models. International Journal of Business Performance Management. https://doi.org/10.1504/ijbpm.2020.10027633

Bassali, D., Kinkley, A., Ning, K., Skeen, J., & Yale University Thurman Arnold Project. (2020). Google's anticompetitive practices in mobile: Creating monopolies to sustain a monopoly. In Digital Platform Theories of Harm [Report]. https://som.yale.edu/sites/default/files/2022-01/DTH-GoogleMobile.pdf#:~:text=mobile%20app%20market,%E2%80%98Home%E2%80%99%20button%20on%20Devices%20with

Bayram, D. (2021). A HYBRID BUSINESS MODEL SOLUTION: MULTI-SIDED BUSINESS PLATFORMS AS DRIVERS OF CHANGE [Master thesis, University of Twente]. https://essay.utwente.nl/85521/1/Summary%20-%20Master%20Thesis%20Dilan%20Bayram%20%28s2431394%29.pdf

Benlian, A., Hilkert, D., & Heß, T. (2015). How open is this Platform? The Meaning and Measurement of Platform Openness from the Complementers' Perspective. Journal of Information Technology, 30(3), 209–228. https://doi.org/10.1057/jit.2015.6

Bennett, D., & Klug, F. (2010). Automotive supplier integration from automotive supplier community to modular consortium. In Logistics Research Network 2009 Conference Proceedings (pp. 698–705). http://nrl.northumbria.ac.uk/8599/1/Supplier_Integration.pdf

Benoot, C., Hannes, K., & Bilsen, J. (2016). The use of purposeful sampling in a qualitative evidence synthesis: A worked example on sexual adjustment to a cancer trajectory. BMC Medical Research Methodology, 16(1). https://doi.org/10.1186/s12874-016-0114-6

Bernstein, F., DeCroix, G. A., & Keskin, N. B. (2021). Competition between Two-Sided platforms under demand and supply congestion effects. Manufacturing & Service Operations Management, 23(5), 1043–1061. https://doi.org/10.1287/msom.2020.0866

Blenkinsop, P. (2023, September 13). EU to investigate “flood” of Chinese electric cars, weigh tariffs. Reuters. https://www.reuters.com/world/europe/eu-launches-anti-subsidy-investigation-into-chinese-electric-vehicles-2023-09-13/

BMW AG. (2019a, June 4). BMW Isetta: The history of a saviour, icon, and everyday hero. Retrieved June 4, 2024, from https://www.bmw.com/en/automotive-life/history-BMW-isetta.html

BMW AG. (2019b, August 1). The BMW name and its history. Retrieved June 4, 2024, from https://www.bmw.com/en/automotive-life/BMW-name-meaning-and-history.html

BMW AG. (2019c, December 18). The 10-Hour Race for BMW: the BMW 1959 Shareholders Meeting. [Video]. press.bmwgroup.com. https://www.press.bmwgroup.com/global/video/detail/PF0007302/_the-10-hour-race-for-bmw_-the-bmw-1959-shareholders-meeting?forceSitePreference=DESKTOP

BMW AG. (2020, May 14). Learning from crises, mastering challenges [Press release]. BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0308462EN/learning-from-crises-mastering-challenges?language=en

BMW AG. (2021, October 21). The Neue Klasse: Trailblazing a bright future. Retrieved June 4, 2024, from https://www.bmw.com/en/automotive-life/the-neue-klasse-from-bmw.html

BMW Group. (n.d.). BMW Group History. bmwgroup.com. https://www.bmwgroup.com/en/company/history.html#ace-1125526531

BMW Group. (2016a, July 29). BMW Connected – the personalised digital mobility companion from BMW – celebrates its premiere. [Press release]. BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0262528EN/bmw-connected-%E2%80%93-the-personalised-digital-mobility-companion-from-bmw-%E2%80%93-celebrates-its-premiere?language=en

BMW Group. (2016b, September 6). BMW Connected coming to Android smartphones. Teaming up with Samsung to premiere the Android version at the IFA 2016. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0263458EN/bmw-connected-coming-to-android-smartphones-teaming-up-with-samsung-to-premiere-the-android-version-at-the-ifa-2016

BMW Group. (2017a, April 27). The BMW 530e iPerformance [Press release]. https://www.press.bmwgroup.com/netherlands/article/detail/T0266728NL/de-bmw-530e-iperformance?language=nl

BMW Group. (2017b, September 7). Statement by Klaus Fröhlich, Member of the Board of Management of BMW AG for Development, IAA Preview 2017 [Press release]. BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0274210EN/statements-by-harald-krueger-chairman-of-the-board-of-management-of-bmw-ag-and-klaus-froehlich-member-of-the-board-of-management-of-bmw-ag-development-iaa-preview-2017?language=en

BMW Group. (2017c, September 7). Statement Harald Krüger Chairman of the Board of Management of BMW AG Preview IAA 2017 7 September 2017 [Press release].

BMW Group. (2017d, November 7). BMW Connected further expands its digital ecosystem. BMW is now integrated with the Google Assistant. [Press release]. BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0275804EN/bmw-connected-further-expands-its-digital-ecosystem-bmw-is-now-integrated-with-the-google-assistant?language=en

BMW Group. (2018a, April 17). BMW Group Digital Day 2018. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0280143EN/bmw-group-digital-day-2018?language=en

BMW Group. (2018b, June 14). BMW Connected joins forces with Baidu Internet of Vehicles on home-to-vehicle cooperation. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0282113EN/bmw-connected-joins-forces-with-baidu-internet-of-vehicles-on-home-to-vehicle-cooperation?language=en#:~:text=At%20the%20CES%20Asia%202018,the%20digital%20lives%20of%20customers.

BMW Group. (2018c, June 14). BMW Connected joins forces with Baidu Internet of Vehicles on home-to-vehicle cooperation. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0282113EN/bmw-connected-joins-forces-with-baidu-internet-of-vehicles-on-home-to-vehicle-cooperation?language=en#:~:text=At%20the%20CES%20Asia%202018,the%20digital%20lives%20of%20customers.

BMW Group. (2018d, June 18). The BMW Group and CRITICAL Software are expanding their cooperation [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0282129EN/the-bmw-group-and-critical-software-are-expanding-their-cooperation?language=en

BMW Group. (2018e, September 27). Digital lifestyle at the BMW Group: seamless in-car integration of Amazon Alexa. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0274792EN/digital-lifestyle-at-the-bmw-group:-seamless-in-car-integration-of-amazon-alexa-in-bmw-and-mini?language=en

BMW Group. (2018f, December 19). Focusing on the customer: the BMW Group's digital ecosystem. In conversation with Dieter May, Senior Vice President Digital Products and Services. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0288859EN/focusing-on-the-customer:-the-bmw-group%E2%80%99s-digital-ecosystem-in-conversation-with-dieter-may-senior-vice-president-digital-products-and-services?language=en

BMW Group. (2019a, January 7). Premiere in China: Alibaba voice assistant introduced into BMW vehicles. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0289423EN/premiere-in-china:-alibaba-voice-assistant-introduced-into-bmw-vehicles?language=en#:~:text=The%20intelligent%20voice%20assistant%20from,by%20the%20end%20of%202019.

BMW Group. (2019b, June 25). BMW Group digital services at #NEXTGen [Press release]. https://www.press.bmwgroup.com/netherlands/article/detail/T0297626NL/bmw-group-digital-services-op-nextgen?language=nl

BMW Group. (2020a, January 7). The BMW Group at the Consumer Electronics Show (CES) 2020 – taking place in Las Vegas on 7 – 10 January 2020 – the BMW Group will be presenting its visionary approaches to creating the mobility experience of the future. [Press release]. BMW Group PressClub.

https://www.press.bmwgroup.com/global/article/detail/T0304187EN/the-bmw-group-at-the-consumer-electronics-show-ces-2020-in-las-vegas?language=en

BMW Group. (2020b, November 11). #NEXTGen 2020. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0320230EN/nextgen-2020?language=en

BMW Group. (2021a, March 15). The all-new BMW iDrive. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0327315EN/the-all-new-bmw-idrive?language=en

BMW Group. (2021b, March 15). The all-new BMW iDrive. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0327315EN/the-all-new-bmw-idrive?language=en

BMW Group. (2021c, March 17). Statement Oliver Zipse Chairman of the Board of Management of BMW AG Annual Conference for the Business Year 2020 Munich, 17 March 2021, 09.00 a.m. [Press release].

BMW Group. (2021d, March 17). Statement Oliver Zipse, Chairman of the Board of Management of BMW AG, BMW Group Annual Conference 2021 [Press release]. https://www.press.bmwgroup.com/united-kingdom/article/detail/T0327972EN_GB/statement-oliver-zipse-chairman-of-the-board-of-management-of-bmw-ag-bmw-group-annual-conference-2021?language=en_GB

BMW Group. (2021e, April 19). World premiere for the BMW iX and the latest generation of BMW iDrive with new digital services for China. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0330012EN/world-premiere-for-the-bmw-ix-and-the-latest-generation-of-bmw-idrive-with-new-digital-services-for-china?language=en

BMW Group. (2021f, September 7). IAA Mobility 2021 - BMW Group Innovation Workshop 2021. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0342332EN/iaa-mobility-2021-bmw-group-innovation-workshop-2021?language=en

BMW Group. (2022, June 28). BMW Group to build on Android Open Source Project (AOSP) for "BMW Operating System 9" [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0401875EN/bmw-group-to-build-on-android-open-source-project-aosp-for-%E2%80%9Cbmw-operating-system-9%E2%80%9D?language=en

BMW Group. (2023a, May 24). The new BMW 5 Series Sedan. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0416261EN/the-new-bmw-5-series-sedan?language=en

BMW Group. (2023b, September 27). BMW model update measures for autumn 2023. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0437251EN/bmw-model-update-measures-for-autumn-2023

BMW Group. (2024a, January 8). Generative AI, Augmented Reality and Teleoperated Parking – the Digital Experience in the BMW of the Future at the Consumer Electronics Show (CES) 2024. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0438824EN/generative-ai-augmented

-reality-and-teleoperated-parking-%E2%80%93-the-digital-experience-in-the-bmw-of-the-future-at-the-consumer-electronics-show-ces-2024?language=en

BMW Group. (2024b, February 7). The new BMW 5 Series Touring [Press release].

BMW Group. (2024c, June 19). The new BMW X3. [Press release]. https://www.press.bmwgroup.com/global/article/detail/T0442377EN/the-new-bmw-x3

BMW Group AG. (2018, May 8). 20 years at the cutting edge: BMW ConnectedDrive. [Press release]. BMW Group PressClub. Retrieved June 6, 2024, from https://www.press.bmwgroup.com/global/article/detail/T0280837EN/20-years-at-the-cutting-edge:-bmw-connecteddrive?language=en

BMW Group AG. (2019). BMW Group Annual Report 2018. In BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0293372EN/bmw-group-annual-report-2018?language=en

BMW Group AG. (2021a, January 11). Twenty Years of BMW iDrive [Press release]. BMW Group PressClub. Retrieved June 6, 2024, from https://www.press.bmwgroup.com/usa/article/detail/T0323933EN_US/twenty-years-of-bmw-idrive?language=en_US

BMW Group AG. (2021b, March 15). The all-new BMW iDrive. [Press release]. BMW Group PressClub. Retrieved June 6, 2024, from https://www.press.bmwgroup.com/global/article/detail/T0327315EN/the-all-new-bmw-idrive

BMW Group AG. (2023, March 8). Big stage for interaction and information: BMW presents the newest version of the BMW iDrive system. [Press release]. BMW Group PressClub. Retrieved June 6, 2024, from https://www.press.bmwgroup.com/netherlands/article/detail/T0410403NL/bmw-presenteert-de-nieuwste-versie-van-het-bmw-idrive-systeem?language=en

BMW Group AG. (2024a). BMW Group Annual Report 2023. In bmwgroup.com.

BMW Group AG. (2024b). BMW GROUP REPORT 2023. https://www.bmwgroup.com/content/dam/grpw/websites/bmwgroup_com/ir/downloads/en/2024/bericht/BMW-Group-Report-2023-en.pdf

BMW Group & Daimler AG. (2018, December 19). BMW Group and Daimler AG plan next steps for joint mobility company. Competition authorities approve merger of mobility services. [Press release].

BMW Group & Daimler communications. (2021, October 14). Paving the way for sustainable mobility: bp, BMW Group and Daimler Mobility announce successful closing of transaction that makes bp third shareholder of Digital Charging Solutions GmbH (DCS) [Press release].

BMW Group & Mercedes-Benz Media. (2018, March 28). BMW Group and Daimler AG agree to combine mobility services. BMW Group PressClub. https://www.press.bmwgroup.com/global/article/detail/T0279654EN/bmw-group-and-daimler-ag-agree-to-combine-mobility-services

BMW Group & Mercedes-Benz media. (2019, February 22). BMW Group and Daimler AG invest more than €1 billion in joint mobility services provider [Press release].

BMW Nederland. (2024). BMW iDrive. BMW.nl. https://www.bmw.nl/nl/content/aftersales/bmw-connected-drive/bmw-idrive.html

Bombak, A. E., & Hanson, H. (2016). Qualitative Insights from the Osteoporosis Research: A Narrative Review of the Literature. Journal of Osteoporosis, 2016, 1–17. https://doi.org/10.1155/2016/7915041

Bormann, R., Fink, P., Holzapfel, H., Rammler, S., Sauter-Servaes, T., Tiemann, H., Waschke, T., Weirauch, B., & Friedrich-Ebert-Stiftung. (2018). THE FUTURE OF THE GERMAN AUTOMOTIVE INDUSTRY. In WISO DISKURS. https://library.fes.de/pdf-files/wiso/14450.pdf

Bowen, G. A. (2006). Grounded theory and sensitizing concepts. International Journal of Qualitative Methods, 5(3), 12–23. https://doi.org/10.1177/160940690600500304

Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative Research Journal, 9(2), 27–40. https://doi.org/10.3316/qrj0902027

Cambridge Dictionary. (2024). interdependent. In Cambridge Dictionary. https://dictionary.cambridge.org/nl/woordenboek/engels/interdependent

CARIAD. (2024, July 1). How to bring your app into Volkswagen Group vehicles [Press release]. https://cariad.technology/de/en/news/stories/bringing-apps-into-volkswagen-group-vehicles.html

Cennamo, C., Özalp, H., & Kretschmer, T. (2018). Platform architecture and quality trade-offs of multihoming complements. Information Systems Research, 29(2), 461–478. https://doi.org/10.1287/isre.2018.0779

Chaiklin, H. (1991). Case study research: Design and methods. Journal of Nervous and Mental Disease, 179(2), 115. https://doi.org/10.1097/00005053-199102000-00025

Chen, L., Yi, J., Li, S., & Tong, T. W. (2021). Platform Governance Design in platform ecosystems: Implications for Complementors' multihoming decision. Journal of Management, 48(3), 630–656. https://doi.org/10.1177/0149206320988337

Choudary, S. P. (2015, August 7). Why Business Models Fail: Pipes vs. Platforms. WIRED. https://www.wired.com/insights/2013/10/why-business-models-fail-pipes-vs-platforms/

Clements, M. T. (2002). Direct and indirect network effects: Are they equivalent? Social Science Research Network. https://doi.org/10.2139/ssrn.313928

Cotugno, F. (n.d.). Disruptive. Big Tech in the auto industry. Infrajournal.

Coyne, I. (1997). Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? Journal of Advanced Nursing, 26(3), 623–630. https://doi.org/10.1046/j.1365-2648.1997.t01-25-00999.x

Critical Techworks. (2024). About. https://www.criticaltechworks.com/about/

Cusumano, M. A. (2022). The evolution of research on industry platforms. Academy of Management Discoveries, 8(1), 7–14. https://doi.org/10.5465/amd.2020.0091

Daimler Communications. (2010, December 23). Die neue generation der C-Klasse [Press release]. https://mercedes-benz-publicarchive.com/marsClassic/searchresult/searchresult.xhtml?searchString=%22comand+online%22&searchId=0&searchType=detailed&resultInfoTypeId=175&thumbScaleIndex=1&rowCountsIndex=5&sortDefinition=DISPDATE-1&rowStart=0#prevId=1604262

Daimler communications. (2016a, September 29). Generation EQ – mobility revisited [Press release].

Daimler communications. (2016b, December 16). Mercedes-Benz delivers integration of the Google Assistant [Press release].

Daimler communications. (2017, January 5). Mercedes-Benz and smart present the future [Press release].

Daimler Communications. (2018). Mercedes-Benz at CES 2018 [Press release].

Daimler communications. (2018, September 12). The SUV trendsetter completely reconceived [Press release].

Daimler communications. (2019, February 21). Daimler is making Berlin the software capital for the car-driving of the future [Press release].

DaimlerBenz AG. (1998, July 13). Ab Herbst auf dem Markt: Die neue Mercedes-Benz S-Klasse [Press release]. https://mercedes-benz-publicarchive.com/marsClassic/searchresult/searchresult.xhtml?searchString=Comand&searchId=1&searchType=detailed&resultInfoTypeId=175&thumbScaleIndex=1&rowCountsIndex=5&sortDefinition=DISPDATE-1&rowStart=0#prevId=177353325

DaimlerChrysler Communications. (2004, September 25). Mercedes-AMG - 2004 [Press release]. https://mercedes-benz-publicarchive.com/marsClassic/en/instance/print/Press-Information-September-25-2004.xhtml?oid=190629507&ls=L3NlYXJjaHJlc3VsdC9zZWFyY2hyZXN1bHQueGh0bWw_c2VhcmNoU3RyaW5nPSUyMnNpbStjYXJkJTIyJnNlYXJjaElkPTExJnNlYXJjaFR5cGU9ZGV0YWlsZWQmcmVzdWx0SW5mb1R5cGVJZD0xNzUmc29ydERlZmluaXRpb249RElTUERBVEUtMSZyb3dTdGFydD0wJnZpZXdUeXBlPXRodW1icyZ0aHVtYlNjYWxlSW5kZXg9MSZyb3dDb3VudHNJbmRleD01I3ByZXZJZD0xOTA2Mjk1MDc!&rs=0

Duray, R., Ward, P. T., Milligan, G. W., & Berry, W. L. (2000). Approaches to mass customization: configurations and empirical validation. Journal of Operations Management, 18(6), 605–625. https://doi.org/10.1016/s0272-6963(00)00043-7

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. ˜the œAcademy of Management Review, 14(4), 532. https://doi.org/10.2307/258557

Eisenhardt, K. M. (2021). What is the Eisenhardt Method, really? Strategic Organization, 19(1), 147–160. https://doi.org/10.1177/1476127020982866

Evans, D. S., & Schmalensee, R. L. (2016, July 28). Matchmakers: The new Economics of Multisided Platforms. Harvard Business Review. https://hbr.org/webinar/2016/06/matchmakers-the-new-economics-of-multisided-platforms

Faurecia Aptoide. (2024a, January 11). FAURECIA APTOIDE UNVEILS THE WORLD PREMIERE OF TIKTOK, WEBEX AND ZOOM MEETINGS INTEGRATION INTO ITS APPS MARKET [Press release].

Faurecia Aptoide. (2024b, October 10). Faurecia Aptoide – Automotive App Store. https://faurecia-aptoide.com/

Fletcher, R., Mahindroo, A., Santhanam, N., & Tschiesner, A. (2020, January 16). The case for an end-to-end automotive-software platform. McKinsey & Company. https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-case-for-an-end-to-end-automotive-software-platform

Floetgen, R. J., Ziegler, U., Weking, J., Hoefler, M., Riasanow, T., & Böhm, M. (2022). B2B App Store Governance in Software Platform Ecosystems: Dimensions and Types. Proceedings of the . . . Annual Hawaii International Conference on System Sciences. https://doi.org/10.24251/hicss.2022.808

Forbes (Ed.). (2016, November 16). Why Samsung is buying Harman. Forbes. https://www.forbes.com/sites/greatspeculations/2016/11/16/why-samsung-is-buying-harman/?sh=2fe3c11c52e5

Ford Motor Company. (n.d.). Enhance Your Drive With the New Ford and Lincoln Digital Experience. media.ford.com. https://media.ford.com/content/fordmedia/fna/us/en/news/2024/01/22/enhance-your-drive--introducing-the-all-new-ford-and-lincoln-dig.html

Gawer, A. (2009). Platform dynamics and strategies: from products to services. In Edward Elgar Publishing eBooks. https://doi.org/10.4337/9781849803311.00009

Gawer, A. (2021). Digital platforms' boundaries: The interplay of firm scope, platform sides, and digital interfaces. Long Range Planning, 54(5), 102045. https://doi.org/10.1016/j.lrp.2020.102045

Gawer, A., & Cusumano, M. A. (2008). How companies become platform Leaders. MIT Sloan Management Review, 49(2), 28–35. http://epubs.surrey.ac.uk/id/eprint/810910

Gawer, A., & Cusumano, M. A. (2013). Industry platforms and ecosystem innovation. Journal of Product Innovation Management, 31(3), 417–433. https://doi.org/10.1111/jpim.12105

Gawer, A., & Cusumano, M. A. (2015). Business platforms. In Elsevier eBooks (pp. 37–42). https://doi.org/10.1016/b978-0-08-097086-8.73012-1

Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2012). Seeking qualitative rigor in inductive research. Organizational Research Methods, 16(1), 15–31. https://doi.org/10.1177/1094428112452151

GM Developers. (n.d.). https://developer.gm.com/in-vehicle-apps

Goodall, W., Dovey Fishman, T., Bornstein, J., Bonthron, B., Deloitte, & Deloitte Development LLC. (2017). The rise of mobility as a service. Deloitte Review, 112–115. https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/consumer-business/deloitte-nl-cb-ths-rise-of-mobility-as-a-service.pdf

Hagiu, A., & Wright, J. (2015). Multi-sided platforms. International Journal of Industrial Organization, 43, 162–174. https://doi.org/10.1016/j.ijindorg.2015.03.003

Harman Automotive. (2025). HARMAN Automotive. Connected by HARMAN. https://car.harman.com/

Haug, A., Ladeby, K. R., & Edwards, K. (2009). From engineer‐to‐order to mass customization. Management Research News, 32(7), 633–644. https://doi.org/10.1108/01409170910965233

Hein, A., Schreieck, M., Riasanow, T., Setzke, D. S., Wiesche, M., Böhm, M., & Krcmar, H. (2019). Digital platform ecosystems. Electronic Markets, 30(1), 87–98. https://doi.org/10.1007/s12525-019-00377-4

Hein, A., Weking, J., Schreieck, M., Wiesche, M., Böhm, M., & Krcmar, H. (2019). Value co-creation practices in business-to-business platform ecosystems. Electronic Markets, 29(3), 503–518. https://doi.org/10.1007/s12525-019-00337-y

Hermes, S., Riasanow, T., Clemons, E. K., Böhm, M., & Krcmar, H. (2020). The digital transformation of the healthcare industry: exploring the rise of emerging platform ecosystems and their influence on the role of patients. Business Research, 13(3), 1033–1069. https://doi.org/10.1007/s40685-020-00125-x

Hua, B. T. E. H. Z. S. (2021). Two-Sided Platform Ecosystems' Structure, Architecture and Mechanism: an Integrated View--Under the Background of Industry 4.0. Converter, 514–528. https://doi.org/10.17762/converter.204

Huang, Q., Mao, G., Liu, Y., Wang, Y., Luo, X., & Wang, J. (2022). A Deep Dive into the China's Gen Z: How They Use and What They Expect for Their Cars. In Lecture Notes in Computer Science (pp. 167–183). https://doi.org/10.1007/978-3-031-04987-3_11

Huber, M., Zimmermann, S., Rentrop, C., & Felden, C. (2018). Conceptualizing Shadow IT Integration Drawbacks from a Systemic Viewpoint. Systems, 6(4), 42. https://doi.org/10.3390/systems6040042

Inoue, Y. (2019). Winner-Takes-All or Co-Evolution among Platform Ecosystems: A Look at the Competitive and Symbiotic Actions of Complementors. Sustainability, 11(3), 726. https://doi.org/10.3390/su11030726

Jacobides, M. G., Cennamo, C., & Gawer, A. (2018). Towards a theory of ecosystems. Strategic Management Journal, 39(8), 2255–2276. https://doi.org/10.1002/smj.2904

Jacobides, M. G., & Lianos, I. (2021). Ecosystems and competition law in theory and practice. Industrial and Corporate Change, 30(5), 1199–1229. https://doi.org/10.1093/icc/dtab061

Jacobs, F. (2017, June 10). ACHTERGROND: BMW-FAMILIE QUANDT. Autoweek. Retrieved June 4, 2024, from https://www.autoweek.nl/autonieuws/artikel/achtergrond-bmw-familie-quandt/

Johnson, M., Christensen, C. M., & Kagermann, H. (2008). Reinventing your business model. Harvard Business Review, 86(12).

http://safarisoftsolutions.com/wp-content/uploads/downloads/2010/10/Harvard-Business-Review-Reinventing-Your-Business-Model.pdf

Joire, M. (2023, February 28). Hands on with Mercedes' new Third-Gen MBUX infotainment with Android apps. Motor1.com. https://www.motor1.com/features/654869/mercedes-benz-mbux-android-infotainment-feature/

Jovanovic, M., Sjödin, D., & Parida, V. (2022). Co-evolution of platform architecture, platform services, and platform governance: Expanding the platform value of industrial digital platforms. Technovation, 118, 102218. https://doi.org/10.1016/j.technovation.2020.102218

Kessels, C. (2024, February 7). The state of Android Automotive in 2024 - Snapp Automotive. Snapp Automotive. https://www.snappautomotive.io/blog/the-state-of-android-automotive-in-2024

Kim, D., & Lee, H. (2016). Effects of user experience on user resistance to change to the voice user interface of an in-vehicle infotainment system: Implications for platform and standards competition. International Journal of Information Management, 36(4), 653–667. https://doi.org/10.1016/j.ijinfomgt.2016.04.011

Kim, J., & Yoo, J. (2019). Platform Growth Model: The four stages of growth model. Sustainability, 11(20), 5562. https://doi.org/10.3390/su11205562

Kumar, A. (2004). Mass customization: metrics and modularity. International Journal of Flexible Manufacturing Systems, 16(4), 287–311. https://doi.org/10.1007/s10696-005-5169-3

Lakemond, N., Holmberg, G., & Pettersson, A. (2022). Digital transformation in complex systems. IEEE Transactions on Engineering Management, 1–13. https://doi.org/10.1109/tem.2021.3118203

Lampón, J. F., Cabanelas, P., & González-Benito, J. (2017). The impact of modular platforms on automobile manufacturing networks. Production Planning & Control, 28(4), 335–348. https://doi.org/10.1080/09537287.2017.1287442

Lampón, J. F., Frigant, V., & Cabanelas, P. (2019). Determinants in the adoption of new automobile modular platforms. Journal of Manufacturing Technology Management, 30(4), 707–728. https://doi.org/10.1108/jmtm-07-2018-0214

Larsson, A. (2002). The development and regional significance of the automotive industry: supplier parks in western Europe. International Journal of Urban and Regional Research, 26(4), 767–784. https://doi.org/10.1111/1468-2427.00417

Lewis, S. (2015). Qualitative inquiry and research design: choosing among five approaches. Health Promotion Practice, 16(4), 473–475. https://doi.org/10.1177/1524839915580941

Lovas, R., Farkas, A., Marosi, A. C., Ács, S., Kovács, J., Szalóki, Á., & Kádár, B. (2018). Orchestrated platform for Cyber-Physical systems. Complexity, 2018, 1–16. https://doi.org/10.1155/2018/8281079

Lune, H., & Berg, B. L. (2017). Qualitative research methods for the Social Sciences. Pearson Education Limited. http://law.gtu.ge/wp-content/uploads/2017/02/Berg-B.-Lune-H.-2012.-Qualitative-Research-Methods-for-the-Social-Sciences.pdf

Markfort, L., Haugk, S., & Tangour, C. (2019). So you want to be a platform: where to start? In Lecture notes in business information processing (pp. 387–396). https://doi.org/10.1007/978-3-030-30874-2_30

Maxwell, J. A. (2009). Designing a qualitative study. In SAGE Publications, Inc. eBooks (pp. 214–253). https://doi.org/10.4135/9781483348858.n7

Mei, J., Zheng, G., & Zhu, L. (2021). Governance mechanisms implementation in the evolution of digital platforms: a case study of the Internet of Things platform. R & D Management, 52(3), 498–516. https://doi.org/10.1111/radm.12494

Mercedes-Benz AG. (2023a, January 31). The latest news on the GLE and GLE Coupé: Bestsellers now even better [Press-release]. https://www.mercedes-benz.com

Mercedes-Benz AG. (2023b). Software architects: Mercedes-Benz previews its operating system MB.OS.

Mercedes-Benz AG. (2024). Fresh colours and even more individual entertainment for the C-Class and GLC [Press-release]. https://www.mercedes-benz.com

Mercedes-Benz Group. (1995, May 15). Auto-Pilot-System (APS) navigation system available as option. Mercedes-Benz Public Archive. https://mercedes-benz-publicarchive.com/marsClassic/en/instance/ko/Auto-Pilot-System-APS-navigation-system-available-as-option.xhtml?relId=1001&fromOid=4912759&resultInfoTypeId=172&styleId=5009&viewType=grid&sortDefinition=manualsort-1&oid=4912759&thumbScaleIndex=1&rowCountsIndex=5

Mercedes-Benz Group. (2016). Annual Report 2015. https://group.mercedes-benz.com/documents/investors/berichte/geschaeftsberichte/daimler/daimler-ir-annual-report-2015.pdf

Mercedes-Benz Group. (2018a, January 26). Witness the world premiere live online: Big debut for the new A-Class [Press release]. Mercedes-Benz Media. https://media.mercedes-benz.com/article/70fe575c-5d9d-4a2d-911b-93539d31291d

Mercedes-Benz Group. (2018b, February 2). The Mercedes-Benz A-Class: The benchmark in the compact class [Press release]. Mercedes-Benz Media. https://media.mercedes-benz.com/article/a652e8fc-c596-4410-a372-83488f8c7d65

Mercedes-Benz Group. (2018c). Annual Report 2017. In group.mercedes-benz.com.

Mercedes-Benz Group. (2020, February 21). Full year results & Annual Report 2019 | Mercedes-Benz Group. https://group.mercedes-benz.com/investors/reports-news/annual-reports/2019/

Mercedes-benz Group. (2020, September 2). The MBUX (Mercedes-Benz User Experience) infotainment system [Press release]. Mercedes-Benz Media. https://media.mercedes-benz.com/article/575c2af4-af10-4a23-8718-e65aa9e9914f

Mercedes-Benz Group. (2022, March 11). Full year results & Annual Report 2021 | Mercedes-Benz Group. https://group.mercedes-benz.com/investors/reports-news/annual-reports/2021/

Mercedes-Benz Group. (2023, February 22). Mercedes-Benz today detailed its plans as the architect of its own operating system MB.OS, which will be introduced mid-decade with the new MMA platform (Mercedes Modular Architecture). group.mercedes-benz.com. https://group.mercedes-benz.com/investors/events/2023-02-mercedes-benz-group-strategy-update.html#:~:text=A%20precursor%20to%20MB.,experience%20compared%20to%20mirrored%20apps.

Mercedes-Benz Group. (2024a). Beginnings of the automobile: The predecessor companies (1886-1920) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1886-1920.html

Mercedes-Benz Group. (2024b). Benz Patent Motor Car: The first automobile (1885–1886) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1885-1886.html

Mercedes-Benz Group. (2024c). Daimler-Benz in the Nazi era (1933 - 1945) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1933-1945.html

Mercedes-Benz Group. (2024d). Economic miracle and return to the world market (1949 - 1960) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1949-1960.html

Mercedes-Benz Group. (2024e). Growth in all areas: from the 1960s to the mid-1980s | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1960-1980.html

Mercedes-Benz Group. (2024f). Integrated technology group (1984 - 1995) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1984-1995.html

Mercedes-Benz Group. (2024g). Reconstruction (1945 - 1949) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1945-1949.html

Mercedes-Benz Group. (2024h). The merger between Daimler-Benz and Chrysler to DaimlerChrysler AG (1995 - 2007) | Mercedes-Benz Group. Retrieved June 21, 2024, from https://group.mercedes-benz.com/company/tradition/company-history/1995-2007.html

Mercedes-Benz Group. (2024i, February 22). Full year results and Annual Report 2023 | Mercedes-Benz Group. https://group.mercedes-benz.com/investors/reports-news/annual-reports/2023/

Mercedes-Benz media. (2020a, August 4). From the app to the digital ecosystem: the new generation of Mercedes me Apps launches [Press release].

Mercedes-Benz Media. (2020a, August 4). Mercedes-Benz Media. https://media.mercedes-benz.com/article/559e6c0d-34a5-4345-bc61-ac895475494e

Mercedes-Benz Media. (2020b, August 4). The new Mercedes Me apps [Video]. Mercedes-Benz Media. https://media.mercedes-benz.com/meetmercedesdigital?video=342bcbdf-4460-408b-82eb-a4a00994259d

Mercedes-Benz Media. (2020c, September 2). The MBUX (Mercedes-Benz User Experience) infotainment system [Press release]. https://media.mercedes-benz.com/article/575c2af4-af10-4a23-8718-e65aa9e9914f

Mercedes-Benz media. (2020b, October 6). New Mercedes-Benz strategy announced - targeting structurally higher profitability [Press release].

Mercedes-Benz media. (2021a, January 14). On the way to “Lead in Car Software” – participate now with your own programming ideas at the Mercedes-Benz In-Car Coding Community [Press release].

Mercedes-Benz media. (2021b, June 2). Mercedes-Benz adds Apple Music in EQS, C-Class and S-Class [Press release].

Mercedes-Benz media. (2022, June 22). Mercedes-Benz lifts in-car entertainment experience to a new level with ZYNC [Press release].

Mercedes-Benz media. (2023a, February 22). The new E-Class: the entertainment experience and interior design [Press release].

Mercedes-Benz media. (2023b, March 6). World premiere of Mercedes pay+: Mercedes-Benz Mobility turns the car into a payment device [Press release].

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). Qualitative data analysis. SAGE.

Mody, M., Wirtz, J., So, K. K. F., Chun, H. H. E., & Liu, S. Q. (2020). Two-directional convergence of platform and pipeline business models. Journal of Service Management, 31(4), 693–721. https://doi.org/10.1108/josm-11-2019-0351

Moser, A., & Korstjens, I. (2017). Series: Practical guidance to qualitative research. Part 3: Sampling, data collection and analysis. European Journal of General Practice, 24(1), 9–18. https://doi.org/10.1080/13814788.2017.1375091

Muffatto, M. (1999). Introducing a platform strategy in product development. International Journal of Production Economics, 60–61, 145–153. https://doi.org/10.1016/s0925-5273(98)00173-x

New York Times. (1998, July 29). INTERNATIONAL BUSINESS; BMW to Get Rolls-Royce After All by Acquiring the Name. NY Times. https://www.nytimes.com/1998/07/29/business/international-business-bmw-to-get-rolls-royce-after-all-by-acquiring-the-name.html

Nuttall, C. (2020, June 24). Nvidia to drive Mercedes cars. Financial Times. https://www.ft.com/content/090499f6-113d-4e91-a3cc-7bddf26b88d3

Osterwalder, A., Pigneur, Y., & Tucci, C. L. (2005). Clarifying business models: origins, present, and future of the concept. Communications of the Association for Information Systems, 16. https://doi.org/10.17705/1cais.01601

Padeanu, A. (2023, May 1). BMW shows how the iDrive 9 will work in the X1: videos. BMW BLOG. https://www.bmwblog.com/2023/05/01/bmw-idrive-9-demonstration-videos/

Park, E., Kim, H., & Ohm, J. Y. (2014). Understanding driver adoption of car navigation systems using the extended technology acceptance model. Behaviour & Information Technology, 34(7), 741–751. https://doi.org/10.1080/0144929x.2014.963672

Parker, G. G., Van Alstyne, M. W., & Choudary, S. P. (2017). Platform Revolution: How Networked Markets are Trasnforming the Economy - and How to Make Them Work For You. National Geographic Books.

Parker, G., & Van Alstyne, M. W. (2005). Two-Sided Network Effects: A Theory of Information Product design. Management Science, 51(10), 1494–1504. https://doi.org/10.1287/mnsc.1050.0400

Petrovic, O., Kittl, C., & Teksten, R. D. (2001). Developing business models for ebusiness. Social Science Research Network. https://doi.org/10.2139/ssrn.1658505

Pikkarainen, M., Kemppainen, L., Xu, Y., Jansson, M., Ahokangas, P., Koivumäki, T., Gu, H. H., & Gomes, J. F. (2022). Resource integration capabilities to enable platform complementarity in healthcare service ecosystem co-creation. Baltic Journal of Management, 17(5), 688–704. https://doi.org/10.1108/bjm-11-2021-0436

Pine, B. J. (1993). Mass customizing products and services. Planning Review, 21(4), 6–55. https://doi.org/10.1108/eb054420

Pires, S. R. I., & Simon, M. L. (2020). Twenty-two years of the modular Consortium in the automotive industry. International Journal of Logistics: Research and Applications, 23(5), 508–519. https://doi.org/10.1080/13675567.2020.1721447

Porter, M. E. (1985). Competitive advantage: creating and sustaining superior performance. http://ci.nii.ac.jp/ncid/BA00852365

Pushpananthan, G., & Elmquist, M. (2022). Joining forces to create value: The emergence of an innovation ecosystem. Technovation, 115, 102453. https://doi.org/10.1016/j.technovation.2021.102453

Raivio, Y., & Luukkainen, S. (2011). Mobile Networks as a Two-Sided Platform - Case Open Telco. Journal of Theoretical and Applied Electronic Commerce Research, 6(2), 15–16. https://doi.org/10.4067/s0718-18762011000200008

Reischauer, G., Engelmann, A., Gawer, A., & Hoffmann, W. H. (2024). The slipstream strategy: How high-status OEMs coopete with platforms to maintain their digital extensions' edge. Research Policy, 53(7), 105032. https://doi.org/10.1016/j.respol.2024.105032

Rietveld, J., Schilling, M. A., & Bellavitis, C. (2019). Platform strategy: Managing ecosystem value through selective promotion of complements. Organization Science, 30(6), 1232–1251. https://doi.org/10.1287/orsc.2019.1290

Rochet, J. C., & Tirole, J. (2003). Platform competition in Two-Sided markets. Journal of the European Economic Association, 1(4), 990–1029. https://doi.org/10.1162/154247603322493212

Rugraff, É. (2012). The new competitive advantage of automobile manufacturers. Journal of Strategy and Management, 5(4), 407–419. https://doi.org/10.1108/17554251211276371

Samsung. (2017, March 11). Samsung Electronics completes acquisition of HARMAN [Press release]. Samsung Newsroom. Retrieved May 2, 2024, from https://news.samsung.com/global/samsung-electronics-completes-acquisition-of-harman

Schmeiss, J., Hoelzle, K., & Tech, R. P. G. (2019). Designing Governance Mechanisms in Platform Ecosystems: Addressing the Paradox of Openness through Blockchain Technology. California Management Review, 62(1), 121–143. https://doi.org/10.1177/0008125619883618

Schreieck, M., Wiesche, M., & Krcmar, H. (2018). Multi-Layer governance in platform ecosystems of established companies. Proceedings - Academy of Management, 2018(1), 10068. https://doi.org/10.5465/ambpp.2018.16

Schreieck, M., Wiesche, M., & Krcmar, H. (2021). Capabilities for value co-creation and value capture in emergent platform ecosystems: A longitudinal case study of SAP's cloud platform. Journal of Information Technology, 36(4), 365–390. https://doi.org/10.1177/02683962211023780

Seghezzi, A., Winkenbach, M., & Mangiaracina, R. (2021). On-demand food delivery: a systematic literature review. The International Journal of Logistics Management, 32(4), 1334–1355. https://doi.org/10.1108/ijlm-03-2020-0150

Shevchuk, A. (2006). Comparative analysis of economic systems. Экономическая Социология, 7(1), 128–142. https://doi.org/10.17323/1726-3247-2006-1-128-142

Shibboleth Authentication Request. (n.d.). https://www-sciencedirect-com.ezproxy2.utwente.nl/science/article/pii/S0024630120302442?via%3Dihub

Singal, A. K. (2021). Designing platform ecosystems for collaboration, innovation and growth. Benchmarking: An International Journal, 29(9), 2806–2821. https://doi.org/10.1108/bij-12-2020-0619

Sinkovics, R. R., Penz, E., & Ghauri, P. N. (2005). Analysing textual data in international marketing research. Qualitative Market Research: An International Journal, 8(1), 9–38. https://doi.org/10.1108/13522750510575426

Sjödin, D., Parida, V., Jovanovic, M., & Visnjic, I. (2020). Value creation and Value capture alignment in Business model innovation: A Process View on Outcome‐Based Business Models. Journal of Product Innovation Management, 37(2), 158–183. https://doi.org/10.1111/jpim.12516

Stabell, C. B., & Fjeldstad, Ø. D. (1998). Configuring value for competitive advantage: on chains, shops, and networks. Strategic Management Journal, 19(5), 413–437. https://doi.org/10.1002/(sici)1097-0266(199805)19:5

Stalp, M. C. (2008). Case study research: Principles and practices. Contemporary Sociology, 37(1), 76–77. https://doi.org/10.1177/009430610803700146

Steinberg, M. (2021). From Automobile Capitalism to Platform Capitalism: Toyotism as a prehistory of digital platforms. Organization Studies, 43(7), 1069–1090. https://doi.org/10.1177/01708406211030681

Stellantis. (2021, August 24). FIH Mobile and Stellantis establish joint venture to deliver disruptive, smart cockpit solutions for the automotive industry. Corporate

Communications | Stellantis.
https://www.media.stellantis.com/em-en/corporate-communications/press/fih-mobile-and-stellantis-establish-joint-venture-to-deliver-disruptive-smart-cockpit-solutions-for-the-automotive-industry

Sturgeon, T. J., Van Biesebroeck, J., & Gereffi, G. (2008). Value chains, networks and clusters: reframing the global automotive industry. Journal of Economic Geography, 8(3), 297–321. https://doi.org/10.1093/jeg/lbn007

Su, Y., Zheng, Z. X., & Chen, J. (2018). A multi-platform collaboration innovation ecosystem: the case of China. Management Decision, 56(1), 125–142.
https://doi.org/10.1108/md-04-2017-0386

Suarez, F., & Cusumano, M. (2008, October 3). The role of services in platform markets. https://ssrn.com/abstract=2363698

Svahn, F., Lindgren, R., & Mathiassen, L. (2015). Applying Options Thinking to Shape Generativity in Digital Innovation: An Action Research into Connected Cars. 2015 48th Hawaii International Conference on System Sciences.
https://doi.org/10.1109/hicss.2015.497

Teece, D. J. (2018). Profiting from innovation in the digital economy: Enabling technologies, standards, and licensing models in the wireless world. Research Policy, 47(8), 1367–1387. https://doi.org/10.1016/j.respol.2017.01.015

Thomke, S. (2023, September 27). Building a culture of experimentation. Harvard Business Review. https://hbr.org/2020/03/building-a-culture-of-experimentation

Thomson Reuters Corporation. (n.d.). Will electric vehicles really create a cleaner planet?

https://www.thomsonreuters.com/en/reports/electric-vehicles.html?_gl=1*1eg34e2*_ga*MTg5NDAxNzM4My4xNzA2MDA2OTk5*_ga_K1B15MJKY8*MTcwNjAwNjk5OS4xLjEuMTcwNjAwNjk5OS4wLjAuMA..

Timmers, P. (1998). Business models for electronic markets. Electronic Markets, 8(2), 3–8. https://doi.org/10.1080/10196789800000016

Van Alstyne, M. W., Parker, G., & Choudary, S. (2016, April). Pipelines, platforms, and the new rules of strategy. Harvard Business Review. https://hbr.org/2016/04/pipelines-platforms-and-the-new-rules-of-strategy

Van Schoor, B. (2017). Multiple-Case study analysis. In Springer eBooks (pp. 99–153). https://doi.org/10.1007/978-3-658-17838-3_4

Väyrynen, H., Helander, N., & Jalonen, H. (2022). Public innovation and digital transformation.

Venkataraman, V., Ceccagnoli, M., & Forman, C. (2017). Multi-homing within platform ecosystems: The strategic role of human capital. Proceedings - Academy of Management. https://doi.org/10.5465/ambpp.2017.14657abstract

Wareham, J., Fox, P. B., & Giner, J. L. C. (2014). Technology ecosystem governance. Organization Science, 25(4), 1195–1215. https://doi.org/10.1287/orsc.2014.0895

Weiß, N., Wiesche, M., Schreieck, M., & Krcmar, H. (2022). Learning to be a Platform Owner: How BMW Enhances App Development for Cars. IEEE Transactions on Engineering Management, 69(6), 4019–4035. https://doi.org/10.1109/tem.2020.3017051

Wessel, M., Thies, F., & Benlian, A. (2017). Opening the Floodgates: The implications of increasing platform openness in crowdfunding. Journal of Information Technology, 32(4), 344–360. https://doi.org/10.1057/s41265-017-0040-z

Wirtz, J., So, K. K. F., Mody, M., Liu, S. Q., & Chun, H. E. H. (2019). Platforms in the peer-to-peer sharing economy. Journal of Service Management, 30(4), 452–483. https://doi.org/10.1108/josm-11-2018-0369

Yao, C., & Mo, Y. (2020). A study on online platforms' price discrimination behavior and the same-side network effects. Kybernetes, 50(11), 3037–3057. https://doi.org/10.1108/k-06-2020-0353

Yin, R. K. (2017). Case Study Research and Applications: Design and methods. http://cds.cern.ch/record/2634179

Zahra, S. A., & Nambisan, S. (2011). Entrepreneurship in global innovation ecosystems. AMS Review, 1(1), 4–17. https://doi.org/10.1007/s13162-011-0004-3

Zahra, S. A., & Nambisan, S. (2012). Entrepreneurship and strategic thinking in business ecosystems. Business Horizons, 55(3), 219–229. https://doi.org/10.1016/j.bushor.2011.12.004