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Critical Success Factors for Creating, Delivering and Capturing Value in Connected Cars

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Abstract

The rapid adoption of technologies is driving significant changes in the automotive industry. Connectivity reshapes business models, creating opportunities such as connectivity subscription plans and data monetization. However, the literature on connected cars is still in its early stages, particularly concerning the transition to digital business models and servitization. There are significant gaps in knowledge about business models for connected cars, including the lack of a comprehensive review that considers technological innovations and advances in the services sector. Moreover, there is a lack of structural analysis identifying the critical success factors for these models. In light of this, this study aims to identify critical success factors for value creation, delivery, and capture in business models for connected cars. To this end, a systematic literature review was conducted, where 46 articles, reviews, or reports were analyzed and coded. The results present 16 critical success factors for value creation, 10 for value delivery, and 6 for value capture. For value creation, this work highlights the importance of resources such as digitalization, blockchain, and artificial intelligence, etc. Concerning value delivery, it emphasizes the need for close customer relationships and service personalization. For value capture, it calls attention to the necessity to develop attractive cost structures, flexible payment methods, and investment in the monetization of data generated by connected vehicles. With the identification of critical success factors, practical guidance is provided for automakers and researchers to understand the challenges and opportunities associated with business models for connected cars.

Keywords
Connected cars, Critical success factors, Value capture, Value creation, Value delivery

1. Introduction
The rapid adoption of technologies – such as the Internet of Vehicles (IoVs) – in the automotive industry has led to significant changes in this sector (Sun et al., 2024). The use of technologies like telematics devices is enabling greater computational capabilities and optimized performance of vehicles, contributing to the reduction of accidents, emissions, driver distraction, and the optimization of vehicle maintenance (McDonnell et al., 2021). In this context, the automotive sector is integrating into a broad ecosystem, driving the creation of new business models (Sterk et al., 2024), as this connectivity environment attracts the attention of startups, insurers, and others (Sterk et al., 2024). For example, Upstream is a startup that helps protect over 20 million connected vehicles with cybersecurity software (McKinsey, 2021). Haas Safety Cloud connects vehicles and road workers to emergency responders through vehicle-to-vehicle (V2V) communication (McKinsey, 2021). Thus, automotive connectivity is reshaping business models, creating unprecedented opportunities such as the sale of connectivity subscription plans (Athanasopoulou et al., 2019), data monetization (Ritala et al., 2024), fleet management, and connected infotainment systems (Sterk et al., 2024). These changes directly impact how value is created, delivered, and captured (Osterwalder and Pigneur, 2010), altering how a company creates, transmits, and appropriates value with its stakeholders (Cabrita, 2023).

However, the literature on connected cars is still in its early stages of development and lacks further depth (Skeete, 2018; Turienzo et al., 2023a), particularly regarding the transition of business models toward digital servitization, as the automotive industry points to significant profit opportunities related to services (Sjödin et al., 2024). Furthermore, there are substantial gaps in knowledge regarding business models for connected cars (Sterk et al., 2022), including: (i) the lack of a synthesized consolidation of business models for connected cars (Sterk et al., 2024), (ii) the absence of a comprehensive review of existing business models that highlights the rapid technological innovations and advancements in the services sector (Athanasopoulou et al., 2019), and (iii) the limited scope of discussions on connected cars, which are overly focused on topics such as privacy, ecosystems, and trajectory dependency (Sterk et al., 2022). Additionally, there is a need for a structural analysis that examines the patterns of business models for connected cars (Sterk et al., 2022), such as identifying their critical success factors. Previous studies have identified critical success factors (CSFs) for electric vehicles (Anuar et al., 2023) and CSFs for total quality management in business models for autonomous driving cars (Wang and Meckl, 2020), but no studies have been found in the literature that identify CSFs for business models related to connected cars.

1.1 Objective
The aim of this work is to identify critical success factors for value creation, delivery, and capture in business models for connected cars, through a literature review.

2. Research Methods
The field of connected vehicles is beginning to gain attention in research, but the analysis of business models is still in its early stages (Sterk et al., 2024). Most of the available studies are empirical, primarily focusing on aspects such as cybersecurity (e.g. Vaanchig et al., 2022) or improving the software of connected vehicles through simulation and modeling (e.g. Yuan et al., 2024). This study conducts a systematic literature review following the guidelines of Garousi et al. (2019) and Page et al. (2021), aiming to identify gaps in the existing research. By expanding the scope beyond empirical studies, the review suggests directions for future investigations. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was applied, as shown in Figure 1.

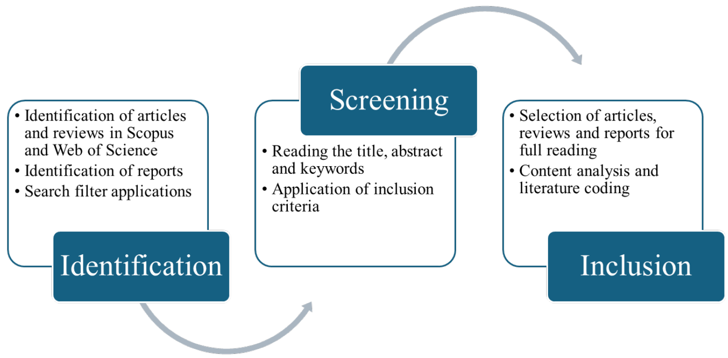

Figure 1. Methodological procedures (based on Page et al., 2021).

As shown in Figure 1, a search was carried out in the Scopus and Web of Science databases, selected because they are the most comprehensive in the literature (Pranckutė, 2021). The following combination of keywords was used: *((“Connected car*” OR “Connected and autonomous car*” OR “Connected automated car*” OR “Car* connectivity”) AND (“Business model*” OR “Critical factor*” OR “Critical success factor” OR “Main partnership*” OR “Main activitie*” OR “Value proposition”OR “Customer relation*” OR “Channel*” OR “Customer segment” OR “Cost structure” OR “Revenue source*”))*. The first part of the search presents terms related to connected cars, and the second part, terms related to business models, based on Osterwalder and Pigneur (2010) and Teece (2018). To build the string, the components of the Business Model Canvas were considered: core partnership, core activities, value proposition, customer relationship, channel, customer segment, cost structure and revenue source.

In the initial search on Scopus and Web of Science, 203 articles were identified. The following search filters were then applied: (i) restriction to “articles” and “reviews” only, (ii) publications between 2015 and 2024 (the last ten years, and where the rise in discussions about connected cars occurred), and (iii) publications in English. Duplicate files were removed using Mendeley® (version 1.19.8), resulting in 46 articles. Next, the titles, abstracts and keywords of the articles and reviews were read to identify those most aligned with the research objective, resulting in the selection of 20 articles and reviews for content analysis. To increase the scope of the search, gray literature was also included (Pedersen and Tingleff, 2023). 20 reports from consultancies such as McKinsey were analyzed, selected using the following criteria: (i) they were published by leading consultancies or companies in technology or engineering services; (ii) they were published between 2015 and 2024; and (iii) they were written in English.

The content analysis was conducted following Bardin's (1977) guidelines. To do so, patterns were identified in the analyzed articles, and literature coding was performed, based on Gioia et al. (2013). For instance, the code “Invest in blockchain to improve factors such as data security, privacy, anonymity, traceability, among others” was generated from the following segment: “One of the latest technologies that can benefit the automotive industry is blockchain, which can improve data security, privacy, anonymity, traceability, accountability, integrity, robustness, transparency, reliability and authentication, as well as provide long-term sustainability and greater operational efficiency for the entire sector” (Fraga-Lamas and Fernández-Caramés, 2019). Since business models represent the way a company creates, delivers, and captures value (Teece, 2010), this classification was used for the coding process. Sixteen critical success factors for value creation were identified.

3. Results and Discussion

3.1 Value Creation

Table 1 shows the critical success factors for value creation.

Table 1. Critical success factors (value creation).

Classification	Code	Critical Success Factors
Key resources	CRV1	Invest in blockchain to improve factors such as data security, privacy, anonymity, traceability, among others
	CRV2	Develop capabilities and resources
	CRV3	Use AI and generative AI to support connectivity
	CRV4	Invest in digital infrastructure
	CRV5	Invest in internet coverage
	CRV6	Invest in cybersecurity
Key partnerships	CRV7	Consider a new ecosystem to encompass connectivity
	CRV8	Adapt the regulatory framework and ensure the support and partnership of government legislators
	CRV9	Develop a flexible IT team
Key activities	CRV10	Encrypt data to ensure privacy treatment
	CRV11	Develop flexible processes
	CRV12	Develop an entrepreneurial mindset
	CRV13	Treat data as a 'product'
	CRV14	Carefully identify the services that should be created internally by OEMs
	CRV15	Ensure security in the face of connectivity
	CRV16	Continuously analyze the competitive landscape

Regarding *key resources*, automakers are migrating to digitalization, which is impacting business models (Sharma et al., 2019). The automotive industry and its stakeholders are using blockchain technology in connected vehicles to achieve scalability, real-time monitoring, and auditability (Sharma et al., 2019) (CRV1). This demonstrates the need for the development of new resources and capabilities (CRV2) and digital infrastructure (CRV4), such as cybersecurity (CRV6) (Sharma et al., 2019), the Internet of Things (Hameed Mir and Filali, 2017), internet coverage and 5G communication (CRV5) (Faisal et al., 2023), artificial intelligence (AI) (CRV3) (Turienzo et al., 2023b), support infrastructure and predictive maintenance (Fraga-Lamas and Fernández-Caramés, 2019), partnerships, and innovation ecosystems (Figueredo et al., 2022). Thus, automakers need highly qualified teams in areas like software development, product design, and technological trend analysis (Lu and Shi, 2023).

Concerning *key partnerships*, they are essential for building an integrated and sustainable ecosystem (Sharma et al., 2019). To achieve this, automakers must consider an ecosystem that includes connectivity (CRV7), expanding their connections with various stakeholders such as telecommunications companies, software developers, and others (Lu and Shi, 2023). In this regard, the development of a flexible IT team is a key partnership (McKinsey, 2023a), given the dynamic nature of automotive technology. Moreover, adapting the regulatory framework is crucial for the success of connected car business models (CRV8) (McDonnell et al., 2021), by analyzing the traffic laws of each region. Thus, it is essential to establish strategic partnerships with government legislators (Usman et al., 2020).

When an automaker transitions from physically-oriented business models to digitally-oriented ones, vehicles are transformed into digital product platforms, leading to the development of new business propositions (Bohnsack et al., 2021). So, key activities are also restructured, involving ensuring data security and privacy (CRV10), through the encryption of information generated by vehicles (Vaanchig et al., 2022), and the development of flexible processes that enable rapid adaptation to technological changes (CRV11). This includes the need for a business mindset focused on innovation (CRV12), involving strategic analysis of the services that should be developed (CRV14), and treating data as valuable products (CRV13) (Ritala et al., 2024). The authors also argue that data represents a powerful opportunity to secure competitive advantage - CRV16 -, enabling the creation of differentiated market value . However, security must be a priority, by developing robust and encrypted systems to protect against cyber threats and ensure data privacy and anonymity (Fraga-Lamas and Fernández-Caramés, 2019).

3.2 Value Delivery

Table 2 shows the critical success factors for value delivery.

Table 2. Critical success factors (value delivery).

Classification	Code	Critical Success Factors
Customer relationship	DEV1	Provide retroactive connectivity to customers with older models that did not have the current level of connectivity
	DEV2	Listen to the voice of the customer and provide personalized services
	DEV3	Work agilely to increase customer acceptance
	DEV4	Explain to customers the benefits of connectivity
	DEV5	Develop a contract and a Service Level Agreement (SLA)
	DEV6	Ensure continuous activation of customers, beyond the first owner of the car
Customer segment	DEV7	Be mindful of the target customer group
	DEV8	Consider regional peculiarities when selling connectivity
Channels	DEV9	Ensure that the value proposition is clearly communicated
	DEV10	Establish co-creation with customers and service providers

Regarding *customer relationship*, connectivity fosters closer ties between automakers, dealerships, and customers, as well as greater customization of products and services (Sharma et al., 2019) (DEV2). This includes providing retroactive connectivity for older models (DEV1) and ensuring continuous activation of connectivity beyond the first owner of the vehicle (DEV6). Given the high volatility associated with connected cars, it is also essential to offer guarantees through dynamic service contracts and service level agreements (SLA) (Faisal et al., 2023) (DEV5). Another key factor is demonstrating the benefits of connectivity to customers (DEV4), such as increased security, personalization, and efficiency (Athanasopoulou et al., 2019; Skeete, 2018), and working agilely to boost customer acceptance (DEV3). This includes (i) automakers developing new services, adapting business models, and creating ecosystems that meet connectivity demands (Sterk et al., 2022); and (ii) dealerships understanding the technologies proposed by automakers and being able to present and sell them to customers (Athanasopoulou et al., 2019).

Concerning *customer segments*, it is essential to pay attention to the target customer group (DEV7) and consider the specific characteristics of each region when selling them (DEV8). For example, North American and German customers prefer convenience and comfort services (McKinsey, 2018). On the other hand, for business clients operating vehicle fleets, performance-based business models can be attractive as they offer reduced downtime (McKinsey, 2021).

Distribution *channels* for connected car business models play a crucial role in how the value proposition is presented to the customer. Therefore, it is essential that the value proposition of connected cars is clearly communicated (DEV9), allowing for a strategic approach to services valued by customers (Bohnsack et al., 2021). Additionally, a strategy that can be adopted is co-creation with customers and service providers (DEV10), in order to create a collaborative environment with automakers, designing service experiences that customers approve of (Capgemini Invent, 2020).

3.3 Value Capture

Table 3 shows the critical success factors for value capture.

Table 3. Critical success factors (value capture).

Classification	Code	CFS – Value capture
Cost structure	CAV1	Make connectivity financially attractive

	CAV2	Retain people and talent
Revenue streams	CAV3	Flexible payment methods for connectivity
	CAV4	Evaluate opportunities for data monetization
	CAV5	Benchmark countries with more advanced connectivity to identify opportunities
	CAV6	Standardize, consolidate, and centralize data for revenue generation

The cost structure must be carefully planned to make connectivity financially attractive for both companies and customers (CAV1). In this regard, providing connectivity packages can be appealing, allowing customers to choose services according to their needs and budgets (Athanasopoulou et al., 2019). To achieve this, it is necessary to create a dedicated and skilled team, retaining talent (CAV2) and capturing value generation opportunities (McKinsey, 2023b). Therefore, it is important to consider different revenue sources by flexibilizing payment methods (CAV3), offering options such as connectivity service subscriptions, annual payments, among others (McKinsey, 2024).

From this context of shifting focus from products to services, new revenue streams emerge (CAV6), and it also requires new value creation activities (Bohnsack et al., 2021). Among them, there is the monetization of data generated by connected cars (CAV4), which creates several opportunities (Ritala et al., 2024). As companies accumulate data and insights, they gain a better understanding of how these can be used to improve processes (Ritala et al., 2024). In this regard, the servitization process enables companies to transform the accumulated knowledge into new data-driven services, which can be sold as complements to products or separately as independent services (Ritala et al., 2024), providing flexibility in terms of payment methods for connectivity (CAV3). Furthermore, companies can monetize their data-driven knowledge and provide improvements in processes and performance outcomes (Firouzi et al., 2022). Thus, it is possible to combine products, services, and data into smart solutions that deliver optimized results to the customer (Ritala et al., 2024). In light of this, it is important to conduct benchmarking with countries where connectivity is more advanced (CAV5), such as China, as it is the region with the highest growth rates in connected cars and the largest number of digital customers (Capgemini Invent, 2019).

4. Concluding Remarks

This study identified critical success factors that directly impact the three dimensions of value: creation, delivery, and capture. For value creation, the importance of resources such as digitalization, the use of blockchain, artificial intelligence (AI), and 5G, as well as strategic partnerships with technology developers and legislators, stands out. For value delivery, the need for a close relationship with customers, service personalization, and maintaining connectivity beyond the first vehicle owner was emphasized. Value capture highlights the need for the development of attractive cost structures, flexibility in payment methods, and the monetization of data generated by connected cars.

Although this study provided a broad overview of the critical success factors, there are limitations that should be acknowledged. Firstly, the exclusively theoretical nature is a limiting factor, as the practical context may present factors not considered in the literature. Secondly, a limited number of documents were considered, selected through the research filters. This may restrict the generalization of the results to different markets and contexts. Based on these limitations, future studies could focus on developing empirical research methods and consider perspectives from different contexts. Bearing in mind that research on the adoption of connected cars in emerging markets would also be recommended to understand regional particularities. Thirdly, a timely update is needed. For example, incorporating recent files on artificial intelligence and its applications would improve this research. Finally, this study's primary contribution to the literature is the identification and organization of critical success factors, providing practical guidance for automakers and researchers to comprehend the challenges and opportunities associated with business models for connected cars.

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