

Analysis of the Global Market for Digital Transformation Technologies in the Automotive Industry until 2030

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Abstract

The automotive industry is undergoing a major transformation due to digital advancements. This paper examines the global market for automotive digital transformation technologies, focusing on how digital technology is reshaping manufacturing, operations, and consumer experiences, with projections to 2030. By analyzing trends, growth drivers, challenges, and opportunities, the study provides a comprehensive view of the evolving landscape. Combining insights from industry reports, market studies, and expert analyses, it explores advancements in AI, blockchain, robotics, and cybersecurity, assessing potential models that could influence the future. Findings show that these technologies significantly enhance vehicle connectivity, safety, and production efficiency.

Key word : Automotive, Digital transformation, technologies, Robotics, artificial Intelligence.

Analyse du marché mondial des technologies de transformation numérique dans l'industrie automobile jusqu'en 2030

Résumé

L'industrie automobile subit une transformation majeure en raison des avancées numériques. Ce document examine le marché mondial des technologies de transformation numérique dans l'automobile, en se concentrant sur la manière dont ces technologies redéfinissent la fabrication, les opérations et l'expérience des consommateurs, avec des projections jusqu'en 2030. En analysant les tendances, les moteurs de croissance, les défis et les opportunités, l'étude offre une vue d'ensemble complète de ce paysage en évolution. En combinant les perspectives des rapports sectoriels, des études de marché et des analyses d'experts, elle explore les avancées en intelligence artificielle, blockchain, robotique et cybersécurité, en évaluant les modèles potentiels qui pourraient influencer l'avenir. Les résultats montrent que ces technologies améliorent considérablement la connectivité des véhicules, leur sécurité et l'efficacité de la production.

Mots-clés: Automobile, transformation numérique, technologies, véhicules autonomes, intelligence artificielle.

Introduction

The automotive industry is currently going through a period of change, driven by continuous advancements in digital technology. In a time characterized by technological changes, the arrival of digital transformation technologies is set to revolutionize the automotive manufacturing, operations, and consumer experiences. This paper explores the complex dynamics of the Automotive Digital Transformation Technologies Market, with a specific focus on its evolution and future predictions until 2030.

With remarkable progress in AI, blockchain, robotics, and cybersecurity, the automotive industry is positioned at the forefront of this technological revolution. The integration of digital technologies is transforming every aspect of the automotive ecosystem, from improving vehicle connectivity and safety to optimizing manufacturing processes. With this background, our analysis is focused on giving a thorough summary of the worldwide market for digital transformation technologies in the automotive industry. By carefully analyzing market trends, factors driving growth, challenges, and opportunities, we aim to understand the complex set of factors that influence the industry's direction.

From the previous data given, the following question emerges: How can in-depth analysis drive the global projection of the Automotive Digital Transformation Technologies Market by 2030?

By combining information from industry reports, market research, and expert analyses, we aim to provide valuable perspectives on the forces propelling the automotive sector into the future. Moreover, we go beyond just observing and instead work to understand the impact of these technological advancements on industry players such as manufacturers, suppliers, policymakers, and consumers.

Our projections, looking ahead to 2030, seek to shed light on the possible directions and models that could shape the future of digital transformation in the automotive industry. Through mapping out the path of new ideas and disturbances, our goal is to provide industry participants with valuable information to successfully navigate the challenges and take advantage of the possibilities offered by this ever-changing environment.

1. Understanding Digital Transformation in the Automotive Industry

Simply put, automotive digital transformation involves using digital tools and techniques to improve manufacturing efficiency and lower labor expenses. Robotics and automation are already incorporated into manufacturing processes at car companies, allowing for greater

efficiency. Current digital technologies allow for proactive monitoring of equipment in order to identify faults or errors in advance of their occurrence.

Moreover, digital transformation focuses heavily on utilizing data-driven insights and artificial intelligence (AI) to understand the manufacturing process better. This makes production planning optimization easier and highlights areas where quality improvements are necessary (C. Dilmegani, 2024, p.1).

Embracing digital transformation in the automotive sector boosts efficiency, innovation, and the creation of intelligent vehicles, enhancing production processes and driving quality while meeting customer needs and maintaining a competitive edge in a constantly changing market (D. Sheremetieva, 2023, p.3). Key advantages include a broadened online reach for targeting larger audiences, improved customer satisfaction through connectivity and infotainment, enhanced product quality via real-time monitoring, increased productivity through automation and data analysis, and optimized supply chains with predictive analytics for demand forecasting and supplier quality monitoring.

2. Methods

This study employs a comprehensive research methodology that combines qualitative and quantitative approaches to analyze the digital transformation technologies in the automotive industry and project their market growth until 2030. The following steps outline the core methodology used in the study:

- Literature Review A thorough review of existing literature forms the basis for understanding the current landscape of digital transformation in the automotive sector. Academic journals, industry reports, and expert analyses are consulted to identify key technologies, market trends, challenges, and opportunities. This review covers areas such as artificial intelligence (AI), robotics, blockchain, cybersecurity, and their roles in shaping the automotive industry.

- Data Collection Data for the study is gathered from a variety of sources: Industry Reports: Recent reports from market research firms and industry experts are analyzed to understand the market size, growth potential, and technological advancements. Secondary Data: Publicly available statistics and forecasts from credible sources like the International Energy Agency (IEA), Automotive Reports, and relevant market studies are utilized.

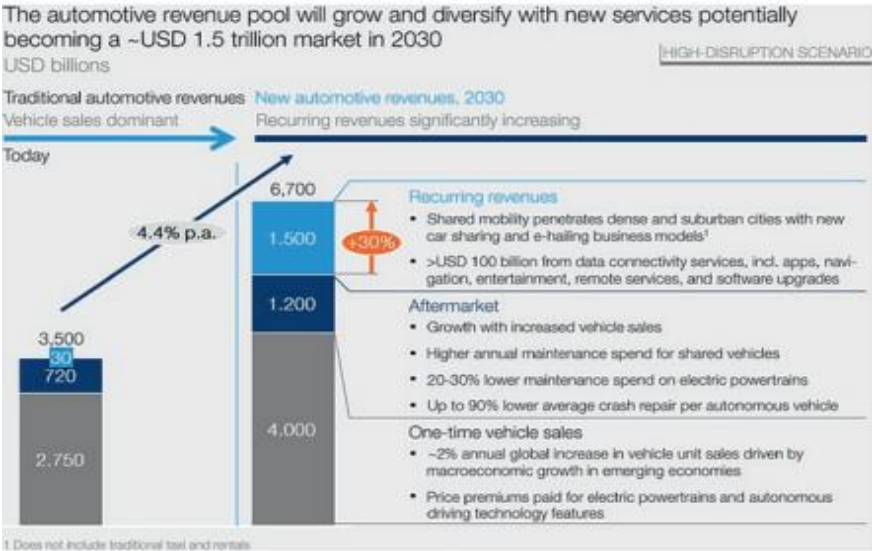
- Market Forecasting The growth projections for key technologies (AI, robotics, blockchain, cybersecurity) within the automotive sector are derived using market analysis tools,

including: Compound Annual Growth Rate (CAGR): Estimates of market growth over the period from 2023 to 2030 are calculated for each segment (e.g., automotive AI, robotics, blockchain, cybersecurity). Trend Analysis: Trends from historical data are used to predict future developments and the adoption rate of new technologies, factoring in market conditions, regulatory changes, and consumer demands.

3. The outlook for the Automotive Industry in 2030 with digital advancements

According to in-depth expert interviews carried out in Asia, Europe, and the USA, the research predicts that global automotive industry revenue will grow from about \$3.5 trillion in 2015 to roughly \$6.7 trillion by 2030(U.Winkelhake, 2018,p.78). This shows a yearly increase of 4.4%. Significantly, a key factor driving growth within the total turnover is the increasing demand for new mobility options and the rising revenues generated from Connected Services, both experiencing a fast-paced annual growth rate of 30%. In spite of the obstacles, the revenue from traditional vehicle sales is seeing a modest increase of 2%, matching the growth in after-sales business revenue which has risen from \$720 billion to \$1200 billion. Despite the decrease in service costs for electric vehicles and revenue from accident repairs due to fewer accidents in the world of autonomous vehicles, this growth continues. The rise in vehicle quantity and extra offerings within the "shared vehicles" category balanced out the decrease in revenue.

Figure 1. Growth of the car industry by the year 2030.



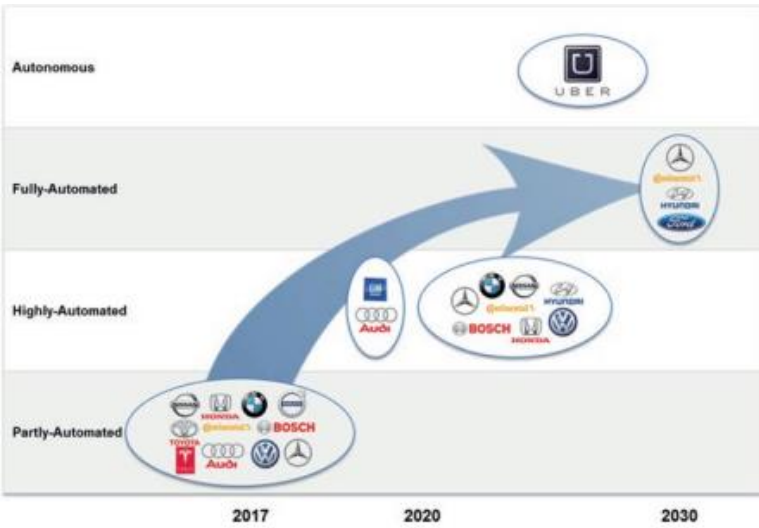
Source: U.Winkelhake, 2018,p.79

The picture shows the vital technologies needed for incorporating automated driving, including both the internal and external parts of vehicles. The technical maturity and innovation

potential of each component are assessed, with sensor technology, communication capabilities, and map materials usually found to be in the upper-middle range or "near-series state" in terms of maturity. However, the potential for innovation is still predominantly high.

Experts predict that it will not be until 2030 that autonomous vehicles with current speeds and performance will be for sale on the market for public roads. Nevertheless, advancements in self-driving transportation and vehicle innovations in specific use cases or with restricted capabilities (such as low speeds and private locations) may be achieved pre-2030, (A.Cacilo et al., 2015,p.107), as indicated by the research conducted by the IAO study and visually represented in Figure 2.

Figure 2. Roadmaps for automated driving



Source: A.Cacilo et al., 2015,p.107

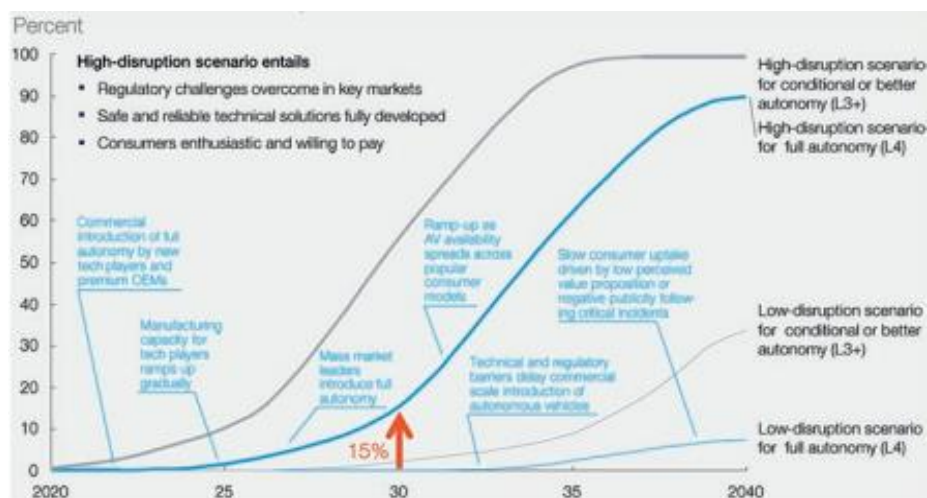
The chart shows the schedules given by car makers and parts suppliers for when vehicles will reach production maturity at different automation levels. The assumption that fully automated vehicles will be achieved by 2030 is reasonable, despite small obstacles, due to competitive pressures and numerous announcements.

Established manufacturers have made evolutionary progress, while new entrants like Uber and Tesla, along with anticipated future suppliers such as Baidu and Alibaba, will also contribute to the advancement of autonomous driving technology. By the year 2030, the continued talks about the legal structure will have led to specific rules dealing with responsibility concerns. Communication infrastructure's operational effectiveness will also be ensured to enable essential dialogues among vehicles, manufacturers, and potential new business partners.

Because of technological advancements and growing opportunities, autonomous vehicles are becoming increasingly common in the new car market. Figure 7 presents a forecast

demonstrating the trajectory of acceptance of autonomous vehicles in the upcoming automotive market until the year 2040. The forecast considers four various scenarios, each reflecting distinct levels of market receptiveness to innovative technologies and business strategies. The anticipation is that the existing legal barriers and technological challenges will be addressed. In this situation, it is projected that by 2030, there will be a 15% market share in the moderate scenario, 4% in the conservative scenario, and 50% in the progressive scenario. Furthermore, it is anticipated that there will be a substantial rise in market visibility post-2030, driven in part by quick expansion trends (U.Winkelhake, 2018, p.95).

Figure 3. Share of autonomous vehicles in the new car business by 2030



Source: U.Winkelhake, 2018, p.95

In addition to the progress made by existing companies, new players such as Uber and Tesla, along with future suppliers like Baidu and Alibaba, will play a key role in advancing autonomous driving technology. It is anticipated that precise regulations targeting liability concerns will emerge by 2030 as a result of ongoing talks on the legal framework. Furthermore, the effectiveness of the communication infrastructure will be enhanced to support crucial discussions among vehicles, manufacturers, and potential new business partners.

4. Automotive digital transformation technologies market

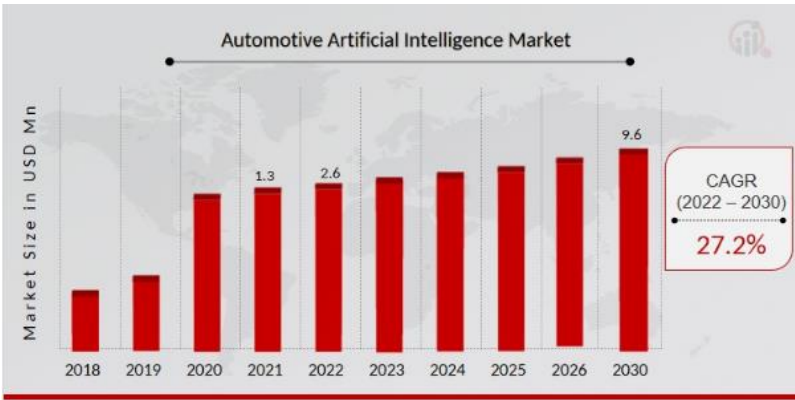
The Automotive Digital Transformation market is poised for substantial growth, with an expected compound annual growth rate of 6.5% between 2023 and 2030. Automotive Digital Transformation is crucial in creating linked, efficient, and customer-oriented mobility solutions as digital technologies revolutionize the automotive industry (MarkWide Research, 2024, p.1).

- **Automotive Artificial intelligence market:** In 2021, the Automotive Artificial Intelligence market was valued at USD 1.3 billion. There is expected to be significant growth

in the industry, with estimates showing a rise from USD 2.6 billion in 2022 to USD 9.6 billion by 2030. The increase signifies a 27.2% compound annual growth rate (CAGR) between 2022 and 2030, as projected by Palwe in 2024.

In the past few years, there has been substantial growth in the autonomous vehicle industry. AI integration in autonomous vehicles is progressing from needing driver assistance to achieving full autonomy, with improved user experience and convenience features, making driverless cars a more realistic concept. Self-driven or driverless vehicles, also called autonomous vehicles, rely on AI software, LiDAR, computer vision, GPS, RADAR technology, and sensors to function autonomously without human interference.

Figure 4. Automotive Artificial intelligence market

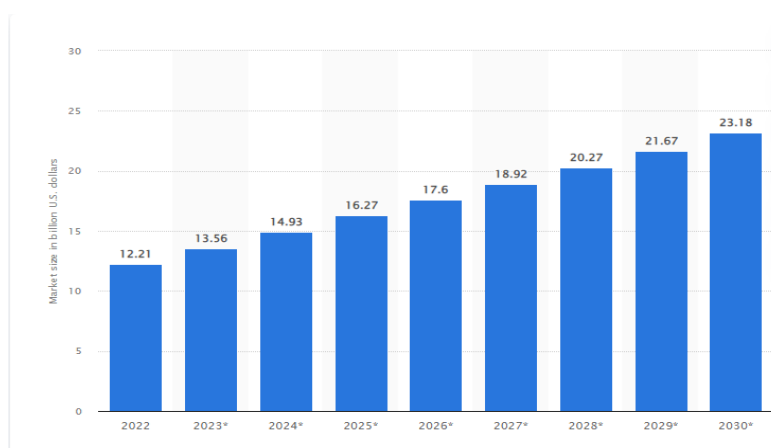


Source: S.Palwe, 2024,p.111

The Human Machine Interface (HMI) application is currently at the forefront of the automotive artificial intelligence market. HMI acts as a tool for human-machine interaction and communication between machines and humans (T.H.T.Maryadi et al., 2021, p.2). The electromechanical devices such as pointing devices, keyboards, and indicators are used in the human-machine interface to maintain the driver's connection with the vehicle. It helps with interactions like understanding natural speech, different gestures, and even tracking the eyes of the driver. Machine learning is ranked second in the automotive artificial intelligence market. Machine learning enables vehicles to examine and gain knowledge from a variety of driving situations, thus improving safety and reducing accidents (M.Ćosić et al., 2023, p.6)

-Automotive Robotics market: A recent research by Statica found that the Automotive Robotics market globally was valued at USD 12.21 billion in 2022, with forecasts suggesting it will reach USD 23.18 billion by 2030, showing an 8.0% Compound Annual Growth Rate (CAGR) from 2023 to 2030.

Figure 5. Automotive Robotics market



Source: B.Thormundsson, 2023, p.1

The increase in automotive robotics usage is mainly attributed to the broad acceptance of electric vehicles (EVs) and the rollout of EV models by different manufacturers. In November 2021, the U.S., Canada, Mexico, and the U.K. governments promised to switch their 120,000 vehicles to electric ones by 2040 to cut greenhouse gas emissions (NMSC, 2023, p.292)

Additionally, the growing need for electric vehicles worldwide has been driven by increasing worries about the environment and climate change due to carbon emissions. This rise in popularity of electric cars has led to a greater requirement for robotics in the automotive sector. The International Energy Agency (IEA) estimates that there will be 250 million electric vehicles (EVs) globally, playing a significant role in decreasing environmental pollution.

The incorporation of robotics is a crucial moment in the evolution of the automotive sector. The rise in automation allows companies to focus on improving efficiency to reduce expenses, save time, produce high-quality goods, and boost productivity in order to stay competitive.

Automation and robotics are technologies that can improve human assistance in a variety of tasks. The automotive sector is distinctive for its widespread use of robots, including CNC machine tools and industrial robots, to automate manufacturing processes. Robots used in car manufacturing facilities are essential in a variety of tasks such as welding, assembling, painting, and testing for quality control. Robots are beneficial for performing tasks that are repetitive or dangerous, leading to improved safety and reducing the reliance on human operators (Renub Research, 2024, p.210).

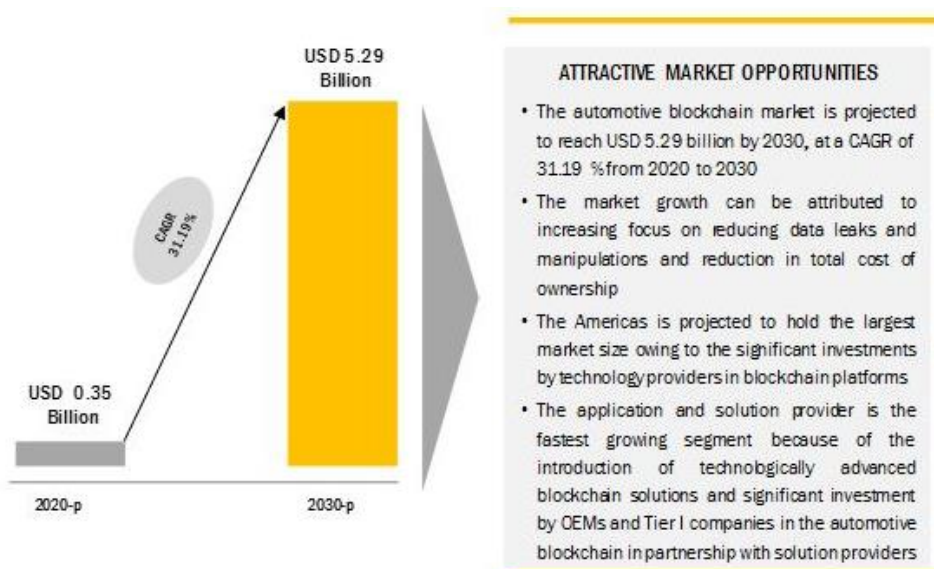
However, the significant upfront cost needed for implementing robotics poses a challenge to the growth of the market. The beginning of digital transformation brings hopeful opportunities to the market in the upcoming years. Digital transformation relies heavily on

robotics to establish a connected ecosystem for efficient manufacturing and streamlined supply chain management. Robots are crucial in enabling digital connections and have sensors that enhance their ability to withstand disturbances. Therefore, companies involved in the automotive robotics market can expect positive growth opportunities by embracing digital transformation.

-Automotive Blockchain market: Blockchain technology in the automotive sector helps enhance efficiency, transparency, and security by utilizing a distributed ledger system. Blockchain has the ability to monitor the transportation of vehicles and components, handle the supply chain, and facilitate transactions. It can also serve as a storage and sharing platform for information regarding vehicle upkeep, insurance, and recalls (Market Research Future, 2021, p.11)

The automotive blockchain market is expected to grow substantially, rising from USD 0.35 billion in 2020 to USD 5.29 billion by 2030. This increase demonstrates a Compound Annual Growth Rate (CAGR) of 31.19% throughout the projected timeframe. Factors that are driving this growth consist of an increased focus on preventing data manipulation, improved quality control steps, and the need for faster business dealings in the automotive blockchain industry (Markets And Markets, 2019, p.1).

Figure 6. Automotive Blockchain market



Source: Markets and Markets, 2019, p.1

Blockchain technology, a new innovation, has the potential to transform the automotive industry by moving from a centralized to a decentralized system. The integration of blockchain in the automotive sector removes the necessity of middlemen, which are currently vital for a

range of services. This change offers the potential to improve the efficiency of operations in the automotive industry while also lowering costs. The automobile industry's functions such as design, production, distribution, marketing, selling, finance, and vehicle service will become more adaptable with the integration of blockchain technology, leading to increased efficiency in supporting the industry's growth as a whole.

Several key factors are driving the imminent growth of the automotive blockchain market. The increasing need for transparent and secure data handling in the automotive supply chain is driving the uptake of blockchain technology. Also, the increasing number of electric and autonomous vehicles offers potential for utilizing blockchain technology to handle complex data transactions and protect communication networks (Persistence Market Research, 2023, p.187).

Furthermore, increased traceability and compliance regulations also contribute to driving the market. There are many chances to use blockchain for verifying vehicle identities, executing smart contracts in automotive transactions, and promoting smooth collaboration among stakeholders. During the digital transformation of the automotive industry, the automotive blockchain market leads the way in driving innovation, efficiency, and security in the ever-changing automotive sector.

-Automotive cyber security market: The worldwide automotive cybersecurity market includes technologies, solutions, and services that aim to safeguard vehicles, automotive systems, and connected car platforms from cyber threats, unauthorized access, data breaches, and malicious activities. The goal of these measures is to ensure the security, privacy, and accessibility of automotive electronic systems, in-vehicle networks, and data communications (The Brainy Insights, 2022, p.238).

The Automotive Cyber Security Market Size grew to USD 1.82 billion in 2021. It is expected that the industry will see significant growth, with an estimated increase from USD 2.36 billion in 2022 to USD 8.94 billion by 2030. This shows a significant compound annual growth rate (CAGR) of 18.5% from 2022 to 2030 according to the forecast. Cloud security is the main driver of market expansion, encompassing the thorough execution of policies, technologies, and control deployments (S.Palwe, 2024, p.185).

Figure 7. Automotive cyber security market



Source: S.Palwe, 2024,p.185

The increasing demand for cybersecurity in cars is fueling the expansion of the market. Recently, there has been a growing need for increased vehicle cybersecurity in the automotive industry due to frequent vulnerabilities. Advanced driver assistance systems (ADAS) are vulnerable to attacks, putting them at risk of being hacked and potentially leading to accidents by altering autonomous capabilities. In addition, hackers have the ability to access private information of vehicle occupants, such as location data, past destinations, and smartphone contacts. Therefore, it is crucial to implement thorough cybersecurity measures for automobiles, covering both the front-end and back-end systems of the vehicles, as well as the interconnected infrastructure that supports smart cars.

The automotive cybersecurity market is divided into different categories of security, such as Network Security, Endpoint Security, Application Security, Wireless Security, and Cloud Security. Network Security primarily focuses on utilizing tools to safeguard applications, data, and resources within the network, specifically to prevent unauthorized access at different network components. Cloud Security involves steps concerning encryption of data, multifactor authentication, monitoring of servers and applications, scanning of databases, and utilization of analytics tools.

The cybersecurity domain in the automotive industry is naturally prejudiced. While advanced tools make it easier and cheaper to launch attacks, it requires significant effort and investment to create a strong defense for the complex value chain. Up to now, attackers have benefited from this trend. For instance, hackers recently took over the infotainment system in recent electric vehicle (EV) models by exploiting a vulnerability in the embedded web browser during a hacking competition. This event prompted the car parts provider to quickly distribute a software update to fix the problem. In the year 2018, a well-known European car manufacturer had 14 vulnerabilities discovered in their vehicles by a Chinese security company. Moreover,

back in 2015, a major car maker recalled roughly 1.4 million vehicles due to cybersecurity threats, which could result in expenses of nearly US\$600 million (J.Trovao, 2020, p.151).

Anticipation of the security type segment dominating the market is based on the specific requirements of network security relying heavily on it. This industry includes a variety of elements and solutions like intrusion detection and prevention systems, encryption and authentication methods, secure communication protocols, security testing and evaluation tools, firewalls, software updates and patches, secure gateways, and security management platforms (Data Bridge Market Research, 2023, p.350).

5. Discussion

The study's results corroborate the growing body of literature on digital transformation within the automotive industry, underscoring the transformative impact of emerging technologies on traditional manufacturing and operational practices. These findings align with theories of technological innovation diffusion, reinforcing the idea that integrating AI, blockchain, robotics, and cybersecurity is a critical step for companies aiming to remain competitive in a dynamic market. Enhanced vehicle connectivity and safety, as highlighted in the study, reflect a broader industry trend towards consumer-centric technological advancements. This shift underscores the dual objectives of digital transformation: improving user experiences while optimizing operational efficiencies.

From a theoretical standpoint, the article enriches discussions on digital transformation by proposing an integrative framework that encompasses various technological innovations and their synergistic effects on the automotive sector. This framework extends existing theories by showcasing how these technologies collectively drive both innovation and efficiency. Methodologically, the research employs a mixed-methods approach, blending qualitative and quantitative analyses, which bolsters the reliability of its findings. By leveraging diverse data sources such as industry reports and expert insights, the study sets a standard for comprehensive market analysis in this rapidly evolving field. Conceptually, it introduces a model that delineates the interconnected pathways through which digital transformation technologies influence the sector, providing stakeholders with a clear understanding of their cumulative impact.

However, the article does have limitations. Its reliance on secondary data sources may not fully capture the latest advancements in the fast-evolving domain of digital transformation, potentially overlooking emerging trends or less-documented technologies. Additionally, while

the findings offer valuable insights for the automotive industry, their applicability to other sectors undergoing digital transformation remains uncertain. This context-specific focus limits the generalizability of the conclusions, calling for further research in varied industries. Lastly, the dynamic nature of technological progress poses a challenge to the study's long-term projections, as advancements could outpace current expectations. Acknowledging this, the article highlights the necessity of ongoing research to maintain a contemporary understanding of digital transformation in the automotive landscape.

Conclusion

Our research on the global Automotive Digital Transformation Technologies Market until 2030 provides a comprehensive look into the evolving dynamics of the automotive sector. With advances in artificial intelligence, blockchain, robotics, and cybersecurity, digital innovation has transformed manufacturing processes, operational efficiency, and consumer experiences. These technologies have not only streamlined production but have also improved vehicle connectivity, safety, and performance, positioning the automotive industry at the forefront of the technological revolution.

Through detailed analysis of market trends, growth drivers, challenges, and opportunities, we have identified the complex factors shaping the future of automotive digital transformation. Insights from industry reports, market research, and expert analysis highlight the elements that drive this sector forward. Our projections for 2030 outline potential pathways and models for automotive digital evolution, providing stakeholders with practical guidance to navigate and capitalize on an ever-changing landscape of innovation and disruption.

This study acts as a roadmap for stakeholders to manage and thrive in the shifting terrain of automotive digital transformation. Key recommendations include embracing innovation by investing in R&D, fostering collaboration across industry players and policymakers, and prioritizing talent development to prepare a skilled workforce. With a strong emphasis on data security and privacy, stakeholders are encouraged to adopt robust cybersecurity measures and agile methods for swift adaptation to market shifts.

In summary, stakeholders can gain a competitive edge in the Automotive Digital Transformation Technologies Market by embracing innovation, enhancing collaboration, nurturing digital skills, securing data, and maintaining flexibility. By following these strategies, they are well-positioned for success in the rapidly advancing automotive digital landscape until 2030.

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