V2M

DRIVING INNOVATION:
THE IMPERATIVE FOR AUTOMOTIVE COMPANIES TO EMBRACE AI

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INTRODUCTION & KEY FINDINGS

Welcome to our comprehensive report on the evolving landscape of Artificial Intelligence (AI) in the automotive sector. This report provides an in-depth analysis of the various dimensions of AI implementation and its profound impact on the automotive industry. Divided into five sections, each containing detailed subsections, we explore the current state and future trends of AI technology adoption in the automotive sector. From the maturing landscape of AI technology implementation to the anticipated market growth and the strategic responses of industry players, this report offers valuable insights into the transformative role of AI in shaping the future of automotive technology. Join us as we navigate through the intricate intersection of artificial intelligence and the automotive industry, uncovering key trends, challenges, and opportunities along the way.

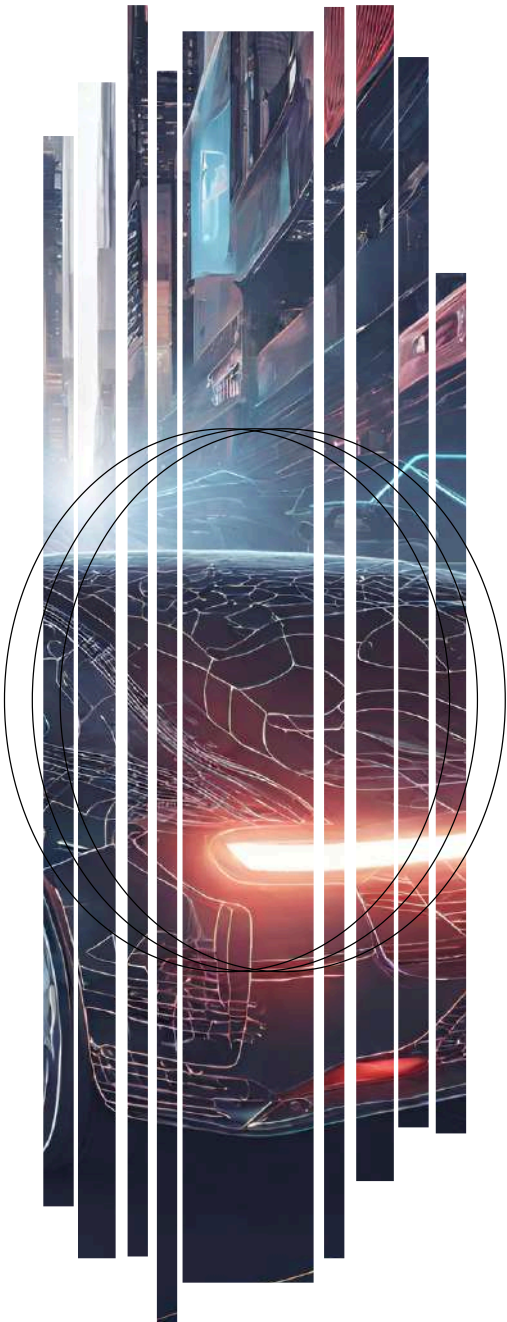## AI Adoption Accelerates: Automotive Sector Embraces New Frontiers

The automotive industry is witnessing a transformative shift as it rapidly embraces artificial intelligence (AI) technology. Once considered a late adopter in the realm of AI adoption, the automotive sector is now emerging as a one of the active sector in integrating AI across various facets of its operations. From optimizing manufacturing processes and streamlining supply chains to enabling autonomous driving capabilities and advanced driver assistance systems, the industry is harnessing the power of AI to drive innovation and efficiency. This key finding underscores the significant potential that lies ahead as automotive companies increasingly leverage AI to navigate the evolving landscape of the automotive industry.

Rapid Growth Projected: AI's Ascendancy in the Automotive Software Market

The automotive software market is poised for substantial growth, with projections indicating an increase from $34 billion in 2020 to a significant Compound Annual Growth Rate (CAGR) of approximately 9% by 2030. While AI's presence in the automotive software sector was limited in 2020, forecasts suggest a transformative 29,2% CAGR trajectory, it is expected on condition that both the Automotive Software and AI in Automotive markets continue their upward trend at the projected CAGR, AI is expected to surpass traditional automotive software by 2033. This key finding highlights the accelerating influence of AI within the automotive software landscape and underscores its potential to reshape the industry in the coming years.

Staying Ahead: Key Players' Imperative to Embrace Emerging Technologies

The automotive landscape is evolving rapidly, with emerging technologies such as AI reshaping industry dynamics. Automotive players must adopt a proactive approach to seek out and integrate these technologies, rather than relying solely on the innovations of competitors. Market expectations for automotive technology are soaring, yet production growth may not align, and pricing sensitivity is on the rise. Therefore, OEMs face a critical imperative to integrate new technologies to maintain market relevance. Failure to do so risks jeopardizing their position in the competitive landscape, as competitors aggressively pursue technological advancements to secure their foothold in the market. This key finding underscores the importance of players embracing emerging technologies to stay ahead in an increasingly competitive automotive industry.

CONTENTS

Artificial Intelligence in the Automotive Sector

We delve into the current landscape and future prospects of AI implementation in the automotive industry. Through a series of subsections, we explore the growing maturity of AI technology adoption, the anticipated market expansion, and the profound impact of AI on various aspects of car design, production, and maintenance. Navigate through the transformative role of artificial intelligence in shaping the future of the automotive sector.

The automotive industry is currently facing a significant technological transformation due to the rapid integration of artificial intelligence (AI), marking a new era of progress and evolution. However, according to FutureBridge's analysis, the maturity of AI technology in automotive industry still in its early phase which categorised between "Beginners" and "New Adopters" group, behindhand other industries like Financial Services, ICT, Retail, and Healthcare.

Exhibit 1. AI Technology Implementation Maturity: Automotive Sector Climbs as AI New Adopters
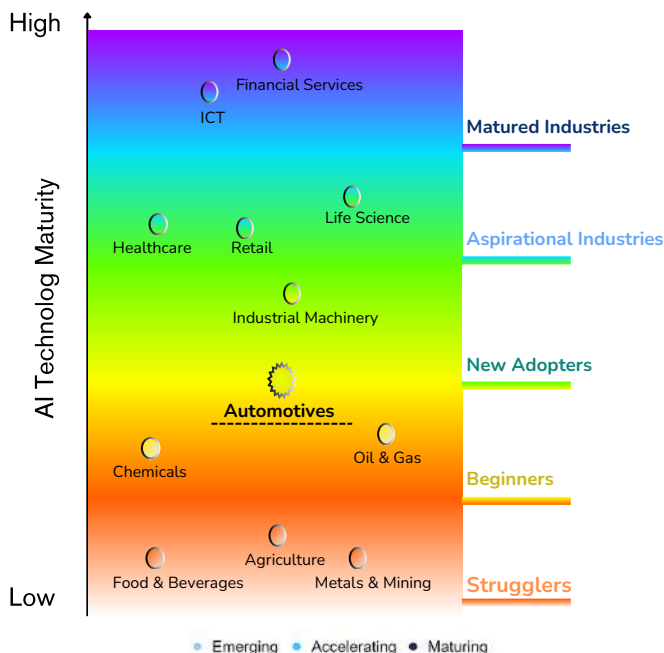
As AI continues to make its way into various aspects of the automotive industry, it is evident that the landscape is shifting towards innovation and efficiency like never before. The potential applications of AI in this sector are vast and promising, ranging from autonomous vehicles and predictive maintenance to enhanced driver assistance systems and personalised in-car experiences.

Despite being categorised between "Beginners" and "New Adopters" in the technological maturity scale, the automotive industry is steadily advancing towards greater integration of AI. Companies are investing in research and development to harness the power of machine learning, deep learning, and natural language processing to drive improvements in safety, performance, and sustainability.
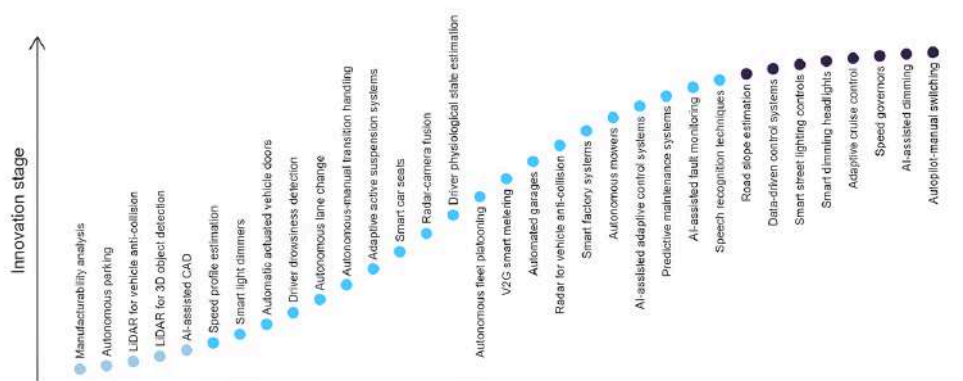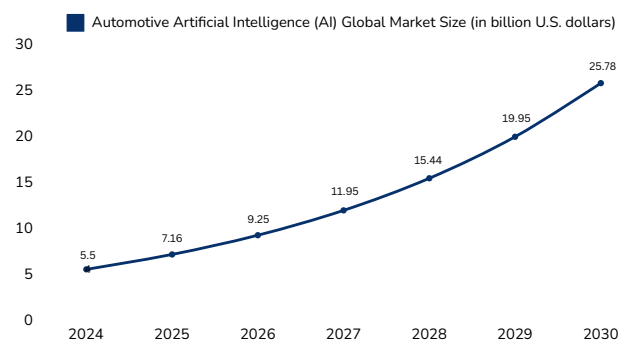
Source: FutureBridge Analysis and Insights.1

Exhibit 2. Automotive AI Technology Market Size is Expected to Grow Significantly

As technology continues to advance, the automotive industry is embracing the power of artificial intelligence (AI) to revolutionise the driving experience. With the Automotive AI Market already surpassing $4.29 billion in 2023, experts predict an impressive growth trajectory ahead. Projections indicate that by 2030, this market is expected to soar to a staggering $25.78 billion, showcasing a remarkable compound annual growth rate (CAGR) of 29.2% from 2024 to 2030. The integration of AI in vehicles is not just a trend; it represents a shift towards smarter, safer, and more efficient driving solutions for the future. From autonomous driving capabilities to enhanced safety features, AI is steering the automotive industry towards a new era of innovation and possibilities.

Source: Next Move Strategy Consulting Report.2

1. futurebridge.com, Article: "Artificial Intelligence Reshaping the Automotive Industry"
2. Move Strategy Consulting, Automotive Artificial Intelligence (AI) Market by Component (Hardware, Software, and Services), by Technology (Machine Learning & Deep Learning, Computer Vision, and Natural Language Processing), and by Application (Semi-Autonomous and Fully Autonomous) – Global Opportunity Analysis and Industry Forecast, 2024–2030

As AI continues to grow and lead the future outlook of the automotive technology, its various applications across the industry are becoming increasingly prominent. From predictive maintenance to autonomous driving systems, AI is revolutionizing how vehicles are designed, produced, and serviced. The growing demand for advanced features and technologies in cars is driving innovation and competition among manufacturers, leading to the rapid adoption of AI-driven solutions.

Increasing Impact: Artificial Intelligence on Car Design and Production

The automotive industry has undergone a significant change with the integration of artificial intelligence (AI) in car design and manufacturing processes, leading to innovation and efficiency improvements.

In 2022, BMW employed AI to analyze decades of crash test data, using machine learning to detect patterns and reduce leg injuries utilizing crash test with 1,000 parameters involving 30,000 components hitting a wall at 60 mph (96.5 km/h) under varied conditions, with on board 1,300 sensors on the car at a sampling rate of 100 Hz per second, 1.4 gigabytes of data per second were generated. The analysis had succeeded significantly shortened the development timeline, saving up to 50 percent of the usual development time. 3
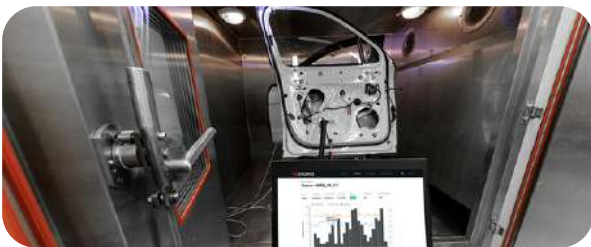
Porsche Digital, the subsidiary of the sports car manufacturer headquartered in Stuttgart, is expanding its product portfolio. The digital assistant 'Sounce' utilizes preemptive detection to address production issues promptly, avoiding faults from turning into costly future repairs.4

Continental, a leader in automotive parts, has innovated with an AI-driven virtual simulation tool. This advanced system is capable of generating 5,000 miles worth of vehicle testing data in just one hour. To put this in perspective, achieving the same results through traditional physical testing methods would typically take over 20 days.5

AI-Driven Efficiency: Enhancing Automotive Supply Chain Streamlining

As the automotive industry continues to evolve, the integration of Artificial Intelligence (AI) has become paramount in optimizing operations. With the pressing challenges posed by labor shortages, AI solutions are proving to be instrumental in boosting efficiency and curbing costs across the supply chain. Original Equipment Manufacturers (OEMs) are at the forefront of this technological revolution, recognizing the potential of AI beyond production processes. By harnessing the power of AI for strategic decision-making in logistics, OEMs are embarking on trials and pilot projects that promise to reshape the future of the automotive supply chain. This innovative approach not only streamlines operations but also paves the way for a more agile and responsive industry that is primed for continued growth and sustainability. The synergy between AI and automotive supply chain sectors holds the key to unlocking new levels of productivity and competitiveness in the market.

BMW and Skoda are the example of OEMs that have integrated AI technology in logistics to improve efficiency. BMW used AI to prevent empty container transportation, expanded AI use in its value chain, and collaborated with NVIDIA to integrate AI into small transport robots.6 Skoda utilized the Optikon AI platform in 2020 to optimize pallet loading for maximum capacity.7

3. monolithai.com, The Future of Engineering Crash Testing With BMW Group | AI for Automotive
4. porsche.com, Press Release: "Porsche Digital develops artificial intelligence for noise detection"
5. continental-automotive.com, Technology Trends -The CAEdge framework as a gamechanger
6. bmwgroup.com, Press Release: "BMW Group is making logistics robots faster and smarter"
7. automotivelogistics.media, Article: "Skoda uses AI application to optimise container usage"

Artificial Intelligence Revolutionizes the Future of Driving Support Systems
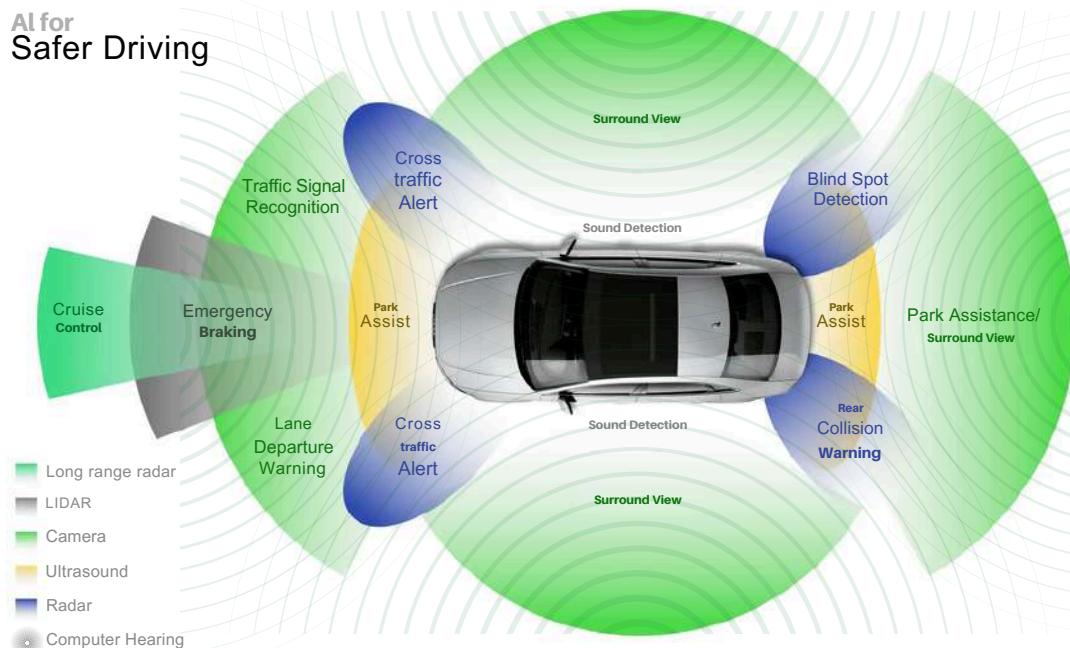
Source: Markovate (edited).7

Artificial Intelligence (AI) has started revolutionizing road safety through advanced driving support systems. These systems integrate cutting-edge sensor technologies such as Computer Hearing, LIDAR, radar, and high-resolution cameras with sophisticated AI algorithms. By analyzing data from diverse sensors, AI enables crucial functionalities like automatic emergency braking, lane-keeping assistance, and adaptive cruise control, ultimately reducing accidents caused by human errors like distraction or misjudgment fostering a safer road environment for all.

With the constant evolution of AI, we can look forward to even more innovative features that will continue to make our roads safer for everyone. The future of road safety is here, thanks to the power of Artificial Intelligence.

Artificial Intelligence is Paving the Way for Advancements in Predictive Maintenance and Malfunction Diagnosis.

Rapid advancements in AI technology are revolutionizing the way predictive malfunction diagnosis is handled within the automotive industry. By harnessing the power of sophisticated algorithms and machine learning, automotive manufacturers are now able to predict potential issues before they escalate, ultimately enhancing safety standards, optimizing maintenance schedules, and fostering a more sustainable approach to vehicle upkeep.

Hyundai Motor Co. asserts that it is the first automaker globally to create technology utilising artificial intelligence (AI) and deep learning to identify and diagnose vehicle issues. Hyundai intends to showcase the acoustic diagnosis system in all of its service centres in Korea, giving local customers the opportunity to see AI scanning vehicles for malfunctions.8

Skoda Auto is currently developing AI-driven diagnostic tools for their vehicles. One of their innovations is the Skoda Sound Analyser, an AI-powered application that identifies issues by analyzing engine sounds. By capturing and converting the vehicle's running noises into a spectrogram, this app visually represents the acoustic signals for accurate diagnosis.9

Ford has introduced an AI-driven predictive maintenance model that utilizes connected vehicle data to anticipate potential vehicle breakdowns. Ford asserts that this model outperforms current diagnostic systems by predicting 22% of failures, typically 10 days before they happen. By leveraging this predictive maintenance solution, Ford has reduced downtime for their commercial vehicle fleets, which play a vital role for various businesses, especially in delivery and logistics industries.10

7. markovate.com, Blog: How AI is Driving Innovation in the Automotive Industry?
8. donga.com, Article: Hyundai develops world's first artificial intelligence auto diagnosis system
9. theengineer.co.uk, News: Skoda app diagnoses faults by listening to engine noise
10. kortical.com, Predict auto failures in advance using connected vehicle data in real time

Investigating the Trends of AI in Automotive Technology

Take a deep dive into the rapidly evolving landscape of artificial intelligence within the automotive sector. From the global outlook of the automotive AI/software market to the expected dominance of AI by 2033, we explore the significance of AI across various domains and its impact on consumer preferences and brand choices. Uncover the pivotal trends shaping the future of AI in automotive technology and their implications for industry players.

The automotive industry is undergoing a profound transformation fuelled by technological advancements and shifting market dynamics. Notably, the global automotive software market is experiencing exponential growth, driven by increasing vehicle connectivity and autonomy. Concurrently, the convergence trend of Electronic Control Units (ECUs) presents new opportunities and challenges for industry players. Additionally, non-traditional companies are entering the AI automotive arena, reshaping industry dynamics. Through new partnership models, collaboration drives innovation and market expansion. In this topic highlight, we delve into these trends, exploring their implications and strategic imperatives for stakeholders within the scope of AI as an inseparable variable influencing the automotive software market growth.

Global Automotive AI/Software Market Outlook

McKinsey, in their report, has forecasted that the value of the Automotive Software market will increase from $34 billion in 2020 with a Compound Annual Growth Rate (CAGR) of around 9% by 2030. Although AI had a slow start with a limited presence in the automotive software sector in early 2020, on conidtion that both the Automotive Software and AI in Automotive markets continue to grow at the same CAGR, AI is projected to have a significant impact on the automotive software market by surpassing it in 2033 and completely dominating the industry by 2037, all within less than 15 years from today, as shown in Exhibit 3 below.

Exhibit 3. Artificial Intelligence Is Expected to Dominates the Automotive Software Market by 2033
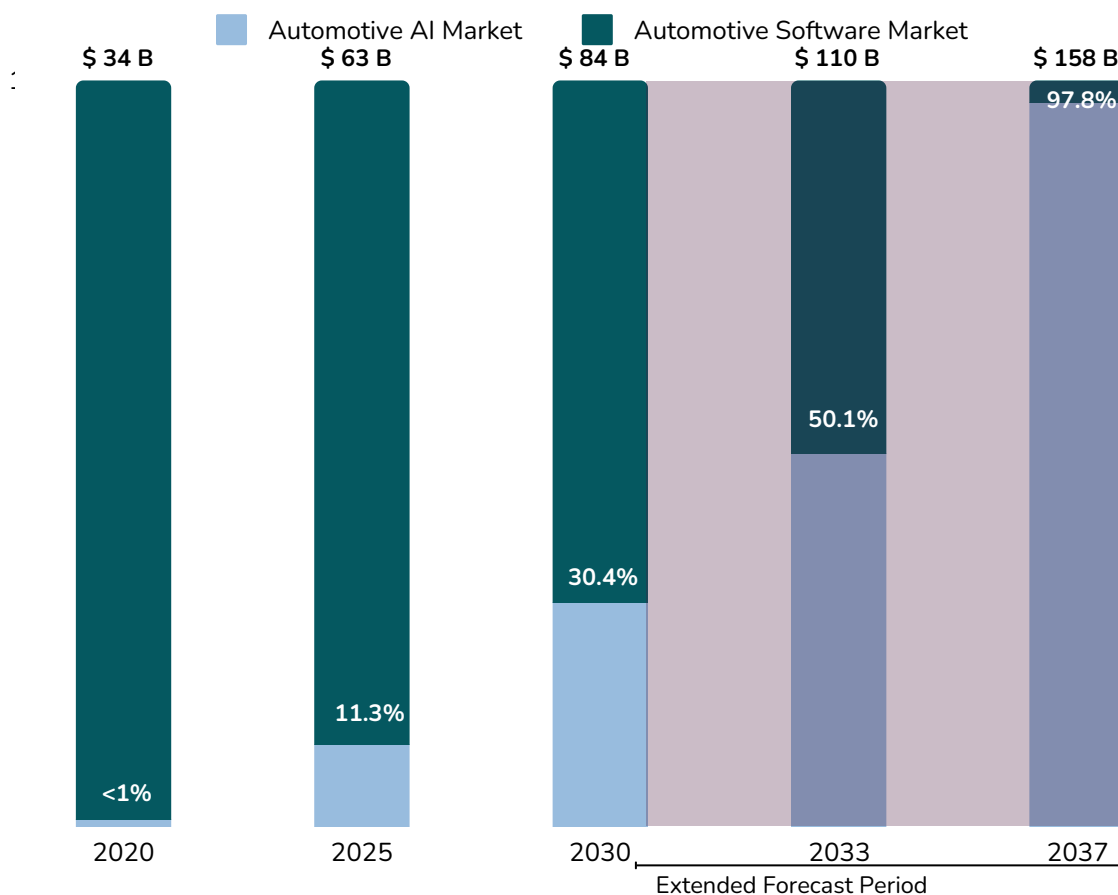
AI's influence on the future of automotive technology is indisputable. To adequately prepare for AI's impact, it is essential to grasp the critical technologies and sectors within the software industry. Automotive technology encompasses a wide array of functionalities, including powertrain, chassis, energy, body, advanced driver assistance systems (ADAS/AD), infotainment, middleware, operating systems (OS), connectivity, security, and connected services. While not all aspects of automotive software development are expected to experience exponential growth, McKinsey's projected 29.9% Compound Annual Growth Rate (CAGR) for the Automotive AI market indicates a promising trajectory in terms of market value. McKinsey's report examines the distribution of automotive software value across various functional domains, shedding light on key insights in this dynamic landscape. In the following Exhibit 4, we adjust the value based on AI's anticipated influence on the automotive software market value, as depicted in Exhibit 3.

Exhibit 4 **AI's Significance Across Future Automotive Software Domains**

The rapid growth of artificial intelligence (AI) in the automotive industry is intricately tied to the trajectory of software and electronic components in the future. Electronic control units (ECUs) and domain control units (DCUs) play a significant role in the growth of the global automotive market due to several factors. Control units are crucial components in modern vehicles, especially with the increasing demand for connected and electric vehicles, as well as the integration of advanced technologies such as autonomous driving systems. Additionally, stringent vehicle safety regulations necessitate the use of advanced ECUs and DCUs to ensure the safety and reliability of modern vehicles.
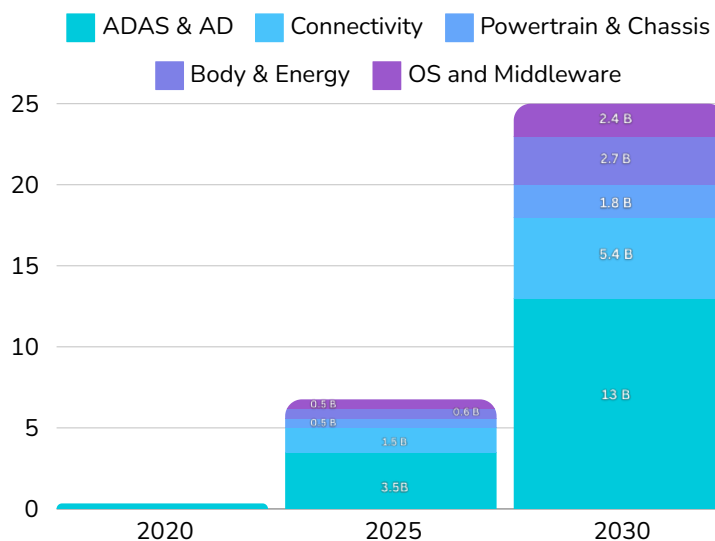
The rise of electrical and electronic components sector is undoubtly linked to the advancement of AI functionalities within vehicles, encompassing critical components such as object detection, sensor fusion, and path planning algorithms essential for autonomous driving (AD) technology. The integration of AI into electrical and electronic components is equally crucial for electric vehicles, as it serves to enhance energy conversion efficiency and bolster the electric vehicle sector as a whole. Nevertheless, with the global automotive market continues to expand, electronic control units (ECUs) and domain control units (DCUs) are poised to claim the largest market share within the automotive software sector. However, as illustrated in Exhibit 5 below, the distribution of advanced domain technologies is anticipated to exhibit varying growth trajectories contingent upon the segmentation of vehicles.

**Exhibit 5.** **USD Allocation per Car: AI Software and Electronic Content Outlook**

11.Mckinsey & Company, Automotive Software And Electronics 2030 Report
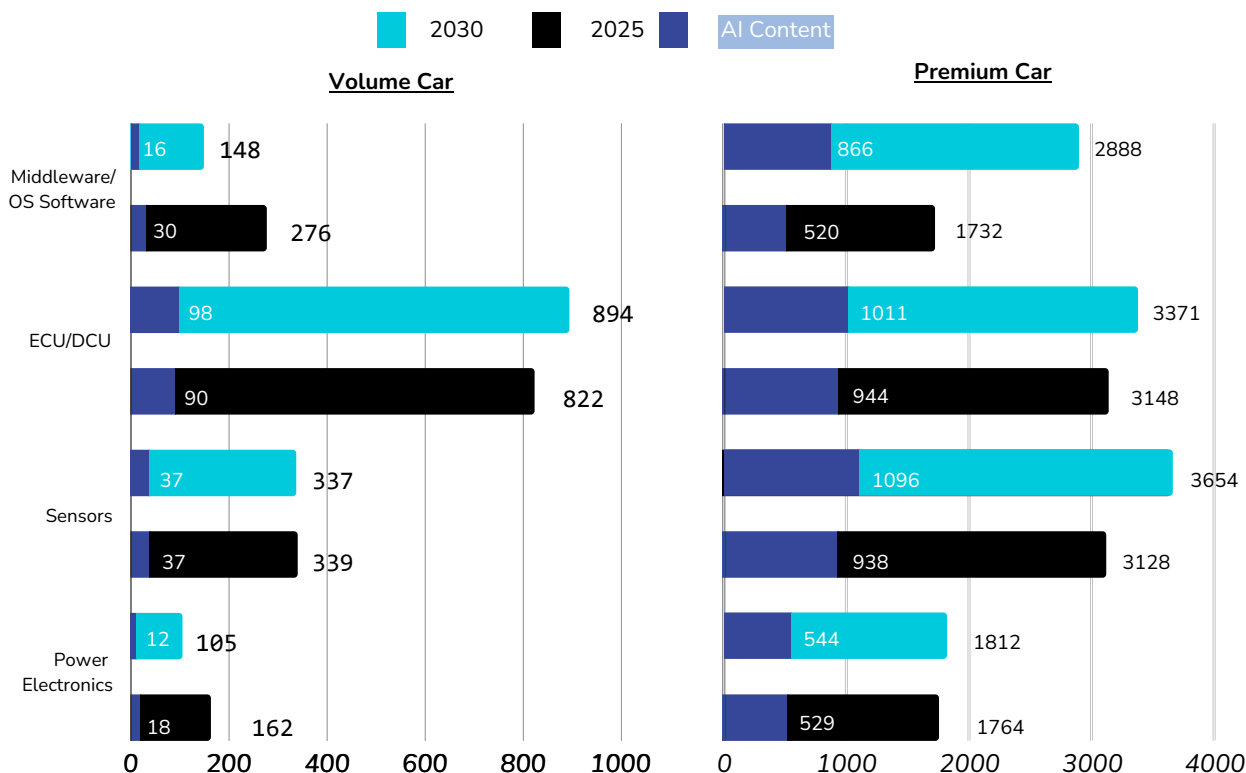
AI Automotive Competition: Aligning with Customer Expectations for Affordability and Market Price Sensitivity

In 2024 and beyond, consumers in the automotive sector are highly aware of the cost and value of vehicles. Affordability remains a crucial factor influencing consumer decisions, as highlighted by findings from a Deloitte study on Exhibit 7. Moreover, in certain markets, there is a resurgence of interest in internal combustion engine (ICE) vehicles due to affordability concerns, underscoring the ongoing importance of this aspect in shaping consumer preferences.

Consumers increasingly seek vehicles that offer high performance, advanced features, and affordability. As the automotive industry advances, manufacturers must find innovative ways to balance cutting-edge technology with cost-effectiveness. This shift in consumer mindset emphasizes the importance for car companies to explore cost-effective solutions without compromising quality and sustainability. By understanding and adapting to this trend, businesses can better meet the evolving needs and preferences of consumers in the competitive automotive market.

Exhibit 6. Preference In choosing ICE Vehicles is Rebounding: Consumer Concerns on Affordability Continue to Weigh Heavily on Forward Intentions
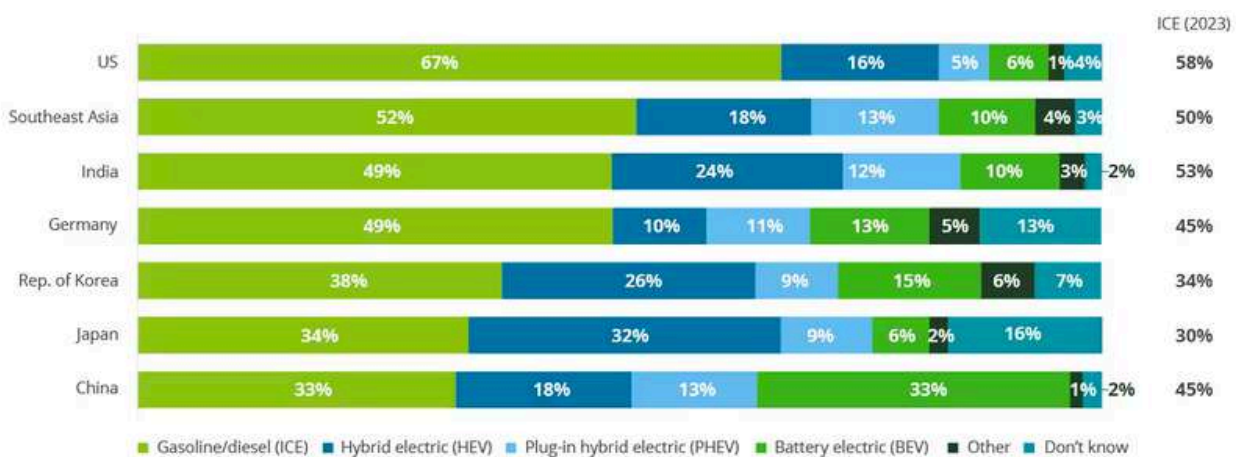
Source: Deloitte Analysis. 12

The resurgence of demand for ICE vehicles underscores the enduring significance of price sensitivity in the automotive industry, with profound implications for customer preferences and the future trajectory of automotive technology, notably artificial intelligence (AI). As the industry progresses towards advanced technologies like autonomous vehicles and AI-driven manufacturing, the demand for AI-enabled features is expected to confront the constraints of cost and affordability. This price sensitivity extends to the future of AI integration in automotive technology, affecting areas such as integration, adoption, and market competition.

- Cost of AI Integration: AI technology demands substantial investment in research, development, and implementation. Automakers, mindful of consumer price sensitivity, must strike a balance between integrating AI-driven technologies and maintaining competitive vehicle prices. Strategies may involve leveraging economies of scale, forging partnerships with technology firms, or streamlining development processes.

- Consumer Adoption: Price sensitivity influences consumer willingness to embrace AI-driven automotive technologies. While consumers value the benefits of safety, convenience, and efficiency offered by AI, they may hesitate due to perceived prohibitive costs. Automakers must devise pricing strategies to make AI-driven technologies more accessible, fostering broader adoption and market penetration.

- Market Competition: Price sensitivity fosters competition among automakers to offer AI-driven technologies at competitive prices, leading to innovation and cost reduction in AI technology. This dynamic drives down prices, making advanced features more affordable and widespread.

12.Deloitte, 2024 Global Automotive Consumer Study Report

Exhibit 7. Most Important Factors Driving the The Choice of Brand for Next Vehicle Purchase

Drivers of brand choice	China	Germany	India	Japan	Rep. of Korea	Southeast Asia	US
Price	32%	**55%**	48%	**58%**	49%	54%	**59%**
Product quality	52%	47%	**65%**	48%	51%	**62%**	57%
Vehicle performance	**53%**	30%	61%	49%	**55%**	57%	52%
Vehicle features	37%	39%	62%	48%	31%	51%	45%
Quality of overall ownership experience	28%	31%	45%	8%	27%	37%	38%
Brand familiarity	36%	39%	43%	21%	25%	32%	34%
Previous service experience	19%	18%	22%	14%	17%	21%	21%
Previous sales experience	10%	27%	15%	10%	5%	13%	17%
Brand image	38%	15%	50%	19%	22%	33%	16%
Availability of battery electric vehicles/hybrid options	33%	13%	36%	22%	25%	24%	14%
Brand advertising	12%	6%	25%	4%	8%	14%	6%
Brand affiliations	14%	5%	21%	5%	7%	12%	5%
Other	0%	2%	0%	2%	1%	0%	1%

■ Most commonly cited

Source: Deloitte Analysis. 12

Furthermore, as AI integration becomes more prevalent in vehicles, it has the potential to revolutionize vehicle maintenance and servicing. With AI, maintenance tasks can be performed more efficiently, predictive maintenance capabilities can be enhanced, and downtime can be reduced. This not only benefits consumers by improving the reliability and longevity of their vehicles but also presents opportunities for service providers to innovate and optimize their offerings in response to changing technological landscapes.

In the context of Porter's Five Forces, the increasing power of customers becomes evident in this scenario. As AI technology enhances the efficiency and reliability of vehicles, consumers gain greater control over their choices. They become more empowered to demand higher quality, advanced features, and competitive prices from automotive manufacturers and service providers. This shift in power dynamics compels businesses to prioritize customer satisfaction and innovation to remain competitive in the market.

In conclusion, the integration of AI into vehicles is expected to have far-reaching impacts on various aspects such as quality, performance, features, security, and compliance. As AI capabilities expand and regulations evolve, ensuring the trustworthy development and use of these technologies become paramount. This necessitates effective talent management and organizational readiness to address technological, governance, and legal challenges. Overall, the increasing power of customers, coupled with the advancements in AI technology, will continue to shape the future of the automotive industry, driving innovation and consumer-centric solutions.

Strategic Adaptation and Industry Response

Here, we explore the emergence of tech companies and startups fueling innovation in automotive technology, the strategic alliances shaping the industry's trajectory, and the collaborative efforts between OEMs and tech companies and startups redefining automotive progress. Join us as we navigate through the evolving landscape of the automotive industry and the dynamic responses of the automotive players to stay ahead in this dynamic environment.

In the fiercely competitive and rapidly progressive landscape of the automotive market, where technology advancements such as AI are paramount, the dynamics between OEMs and tier-1 suppliers are also undergoing a significant transformation. The market demands for innovation is at an unprecedented pace while remaining sensitive to pricing pressures. Consequently, a notable phenomenon has emerged, the relationship between tier-1 suppliers and OEMs are tightening.

In this evolving paradigm, it is the suppliers who wield considerable influence. With technology driving the automotive industry forward, suppliers are no longer merely responding to OEM demands but are actively providing cutting-edge solutions and expertise. This shift in power dynamics has led to a scenario where suppliers hold a more commanding position vis-à-vis OEMs.

Emergence of Startups Fueling Automotive Technology Innovation

As AI plays an increasingly crucial role in the automotive field, manufacturers and suppliers are realising the importance of boosting their AI capabilities to ensure their future sustainability and prosperity. Meanwhile, startups are leveraging their adaptability, creativity, and expertise to offer tailored solutions that align with the ever-evolving technological landscape in the automotive sector.

These startups are swiftly responding to the shifting environment by utilising artificial intelligence to transform various aspects of vehicle advancements such as autonomous driving, predictive maintenance, and personalised driving experiences. By embracing AI technologies, the automotive startups are not only enhancing efficiency and fostering innovation but also shaping the future of transportation in an intelligent and sustainable manner. Below are some of the top AI startup example companies in the automotive sector.

We, V2M Inc., are a startup that has developed a novel AI vehicle diagnostic technology that allows cars to hear the sound of a malfunction and determine what exactly the problem is. The technology, called V2M, uses electroacoustic and sound system technologies to analyse the sounds produced by a car's components and identify potential issues. The main goal of V2M is to increase safety on the roads by providing real-time diagnostic information and predicting potential malfunctions. 13

Luminar Technologies, founded in 2012 by Austin Russell and Jason Eichenholz, specialises in vision-based lidar and machine perception technologies for self-driving cars. Operating in the infrared range for safety, their system uses a single laser to scan images rapidly, detecting objects up to 200 meters away.14

Seeing Machines is an advanced computer vision technology company that designs AI-powered systems to improve transport safety. Their technology spans the critical measurement of where a driver is looking, through to the classification of their cognitive state as it applies to accident risk. The company's AI algorithms, embedded processing, and optics power products that need to deliver reliable real-time understanding of vehicle operators. 15

Charting the Course: Automotive Alliances Between Tech Companies

The automotive industry is witnessing a profound transformation propelled by the convergence of cutting-edge technologies and unprecedented consumer demands. At the forefront of this revolution is the phenomenon of joint ventures between tech company established players, particularly in the realm of artificial intelligence (AI).

By combining the research resources depth of multiple tech companies with, these joint ventures are also poised to redefine the future of mobility, ushering in a new era of automotive technology. Below are a few examples of tech companies' collaboration advancing AI in automotive technology.

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13. V2Minc.com
14 luminartech.com
15. seeingmachines.com

South Korean tech startup BOS Semiconductors has partnered with U.S. artificial intelligence hardware company Tenstorrent to develop semiconductors for use in vehicles and vehicle manufacturing. The goal is to use artificial intelligence to accelerate the processing capabilities of automotive semiconductors. 16

Continental, a German automotive supplier, has partnered with China's edge Artificial Intelligence (AI) company, Horizon Robotics, to set up a joint venture focused on hardware and software integrated solutions for advanced driver assistance systems and autonomous driving. The joint venture, which will be located in Shanghai, will have about 200 employees and aims to accelerate the commercialisation of automotive AI technology.17

Innovating Together: OEMs and Startups Redefine Automotive Progress

In response to fierce competition in the race of automotive technology, car OEMs are increasing their investment into collaboration with startups and tech companies. This strategic move aims to harness the innovation and agility of technology providers amidst rapid technological advancements. By partnering with startups and tech companies, OEMs gain access to specialised expertise and emerging technologies, accelerating their development efforts in areas such as electric vehicles, autonomous driving, and connected car systems. Below are the outlook on how strategic deals are made and examples of OEMs' cooperation with startups.

Exhibit 8. **Auto & Mobility Strategic Deals Greater Than 100 Million USD**
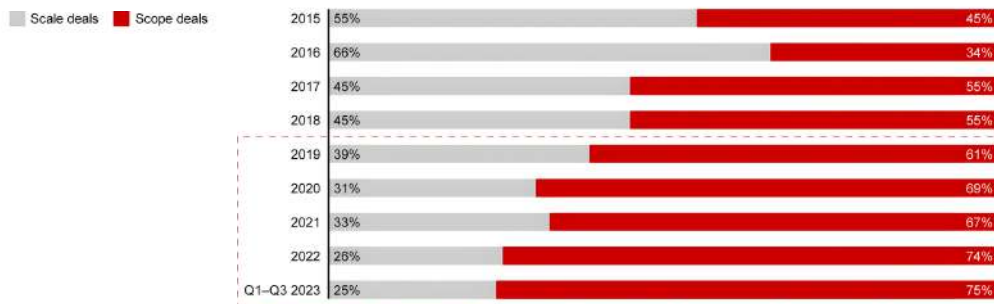
Source: Bain Global M&A Report 2024. 18

General Motors (GM) and Microsoft have invested in and partnered with Cruise, a self-driving technology startup, to develop autonomous AI driving systems for its vehicles. This strategic relationship aims to bring together GM's software and hardware engineering expertise, cloud computing capabilities, manufacturing know-how, and partner ecosystem with Cruise's autonomous vehicle solutions.19

Founded in 2016 and headquartered in Shanghai, Black Sesame Technologies is an AI chip company focused on image processing, perception algorithm, and SOC design. Since its start, Black Sesame has established strategic cooperation with many tier-1 Chinese automobile manufacturers, including SAIC Motor, BYD, and NIO.20

Volvo has partnered with Veoneer, a supplier of automotive safety technology, to develop autonomous driving AI systems for its vehicles. The partnership involves the transfer of Zenuity's operations and people based in Gothenburg, Sweden, and Shanghai, China, to a new stand-alone company wholly owned by Volvo Cars.21

16. cbtnews.com, Article: New partnership to build AI-powered semiconductors for automotive sector
17. en.caam.org.cn, News: "Continental, Horizon Robotics to set up joint venture for commercializing auto AI technology"
18. Bain & Company, Global M&A Report 2024: Gaining an edge in a market reset
19. news.microsoft.com, Cruise and GM team up with Microsoft to commercialize self-driving vehicles
20. bst.ai
21. volvocars.com, Press Release: Volvo Cars and Veoneer complete divide of Zenuity
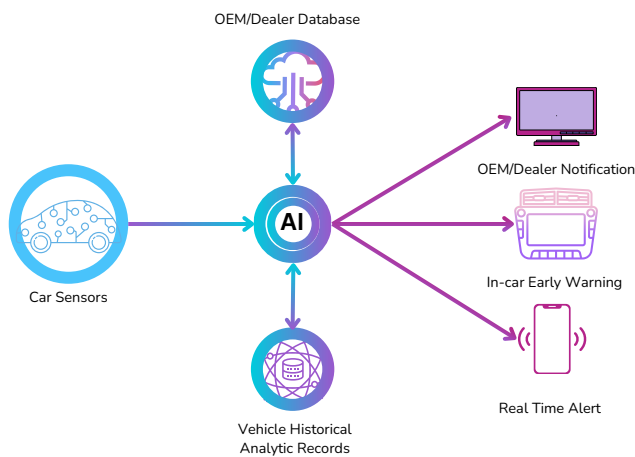
Upcoming Automotive Technology Breakthroughs

This section illuminates future Artificial Intelligence breakthroughs which are predicted to significantly open doors and be pivotal for the automotive technology landscape. We navigate through the intricate landscape of the technological processes, and elucidate the manifold benefits that accrue to stakeholders. We explore the evolution of car architecture, and project the trajectory of automotive sensor and architecture growth amidst anticipated sales evolution. Embark on a journey into the future of automotive technology, where innovation and efficiency converge to shape the automotive landscape of tomorrow.

Innovation within the automotive industry is on the brink of a transformative leap, with a wave of groundbreaking technological advancements poised to revolutionize the way we drive, interact with vehicles, and envision the future of mobility. As automotive manufacturers, tech companies, and startups alike continue to push the boundaries of what's possible, anticipation mounts for the next wave of breakthroughs that will reshape the automotive landscape. In this section, we take a closer look at the anticipated future technological breakthroughs set to propel the automotive industry into a new era of innovation and advancement.

Predictive Maintenance: Revolutionizing Vehicle Service and Reliability

Predictive maintenance is a proactive approach to vehicle maintenance that involves using data analysis techniques to predict when equipment is likely to fail, allowing maintenance to be scheduled at a time that minimises disruption and reduces costs. This approach is also known as condition-based maintenance (CBM) and is in contrast to time-based maintenance, where equipment is maintained regardless of its current condition.

Exhibit 8. **Streamlining Predictive Maintenance: Common Technological Process Flow**

OEM/Dealer Database

Car Sensors

AI

OEM/Dealer Notification

In-car Early Warning

Real Time Alert

Vehicle Historical Analytic Records

Predictive maintenance utilises factory/on-road historical/real-time vehicle sensor data analytics by adaptive machine learning algorithms to anticipate equipment failures and schedule maintenance tasks proactively. By analysing historical/real-time analytics, including various sensor signals such as acoustic signals, engine performance metrics, component temperatures, and wear indicator readings and records, these algorithms identify patterns indicating potential issues adapting to the environment of the vehicle. This proactive approach allows maintenance to be scheduled preemptively, minimising downtime and optimising operational efficiency.

Unlocking Stakeholder Benefits: Automotive AI Predictive Maintenance

In the dynamic automotive landscape, the implementation of predictive maintenance stands as a beacon of innovation, offering a paradigm shift on how vehicle maintenance is approached. It becomes apparent that its proactive strategies offer tangible advantages. Let us explore how predictive maintenance could provide a substantial advantage to the automotive industry.

Car OEM	*Car Dealership*	*Car Owners*
• **Improve Product Quality**	• **Enhanced Customer Satisfaction**	• **Increased Reliability**
• **Enhanced Customer Satisfaction**	• **Differentiation in the Market**	• **Reduced Downtime**
• **Reduced Warranty Costs**	• **Reduced Warranty Claims**	• **Lower Maintenance Costs**
• **Data-Driven Design and Development**	• **Improved Inventory Management**	• **Enhanced Safety**
• **Optimized Supply Chain Management**	• **Optimized Service Department Operations**	• **Extended Vehicle Lifespan**
• **Opportunities for Aftermarket Services**	• **Additional Revenue Streams**	• **Improved Resale Value**
• **Competitive Advantage**		

A single predictive maintenance technology has the potential to benefit multiple stakeholders across the vehicle chain simultaneously. From OEMs to car dealers, car owners, and service providers, it enhances product quality, reduces costs, improves customer satisfaction, and streamlines operations. This technology acts as a unifying force, driving efficiency and reliability throughout the automotive ecosystem.

Leading Players in Automotive Predictive Maintenance Technology

In the rapidly evolving landscape of automotive technology, several notable tech companies have emerged as pioneers in the field of predictive maintenance. These companies are at the forefront of developing innovative solutions that leverage data analytics, machine learning, and IoT technologies to revolutionize how vehicle maintenance is conducted.

Blind spots and imperfect onboard diagnostics with lack of experience leave drivers ill-equipped to accurately dicern unfamiliar car noises or sounds.

- Wheel hub bearings
- Wheels
- Shafts
- Axels
- Ball-joints
- Bushings
- Control arms
- Bottom mudflaps
- Belts
- Tensioners
- Idlers
- Pulleys
- Rotors
- Pumps
- Fasteners
- Springs
- Alternators
- Motor bearings
- Anti-roll bar bushings and links
- Shock absorbers

Our company, V2M Inc., focuses on computer hearing technology on cars applied to predictive diagnostic R&D. We are developing a scoring model that can predict potential malfunctions in vehicles based on the acoustic dynamics of the car. We utilize a technology that uses telematics to gather data from vehicles and analyse it to identify potential issues.

Garrett Motion has developed predictive maintenance software that uses telematics to gather data from commercial vehicle fleets and analyse it to identify potential issues. The system is designed to learn with every route driven by every individual vehicle, giving fleet managers greater ability to make proactive maintenance decisions. 22

Graphen AI has developed an advanced AI Car Doctor system that provides predictive maintenance for the automotive industry. The system is built upon the Graphen Core Ardi AI foundation and is capable of handling voice or text questions and answers, interpreting car symptoms, and providing fix suggestions.23
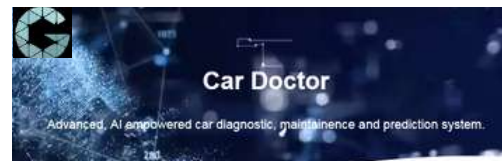
Advancing Car Architecture: Embracing Future Automotive Technologies
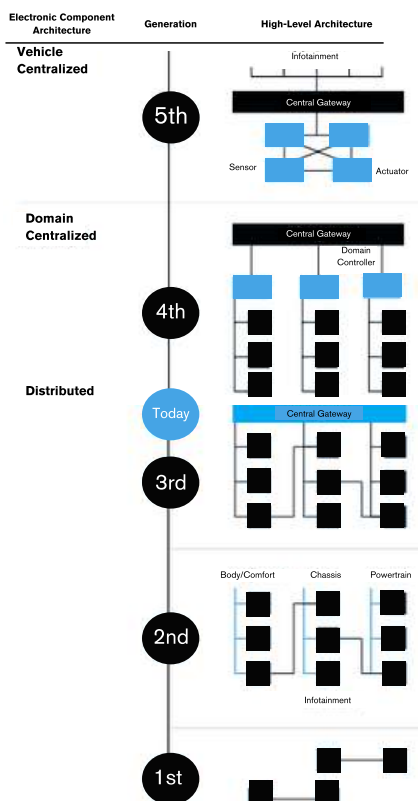
Advancing car architecture is crucial for accommodating future technological advancements in the automotive industry. As AI and other forms of automotive technology become more prevalent, the readiness of car architecture, including ECUs (Electronic Control Units) and DCUs (Domain Control Units), is expected to grow to accommodate these advancements.

The evolution of car architecture progresses from decentralized systems, like those seen in the 3rd generation, with independent ECUs and isolated functions, to more centralized structures in the 4th and 5th generations. Dedicated domain controllers facilitate collaboration and handle complex functions in these later generations. As we move further into the 5th generation, architecture with virtual domains is expected to be utilized, where one control unit manages various functions across domains.

In the current state of development towards the 4th generation, a significant transformation in vehicle architecture is anticipated. This shift moves away from numerous separate ECUs (approximately 100 ECUs for complex vehicles) to a more streamlined approach. The new architecture will feature a few central DCUs, each covering a specific vehicle domain, such as chassis or infotainment. DCUs consolidate non-time-critical functionality from multiple ECUs and centrally process data from various sources, while functions that require local processing, such as data preprocessing and latency-critical I/O operations, are expected to remain local.24

22. garrettmotion.com, Fleet Early Warning System
23. graphen.ai, AI Car Doctor
24. Mckinsey & Company, Automotive Software And Electronics 2030 Report

Further, in the 5th vehicle architecture development, Artificial Intelligence through various algorithms, sensors are concurrently analysed, ensuring a more optimised decision through sensor fusion within the gateway, aiming for more efficient software processing. AI systems can also analyze driving patterns and preferences to tailor assistance and create a more personalised driving experience for each user. This can lead to improved safety, comfort, and overall satisfaction with the vehicle.
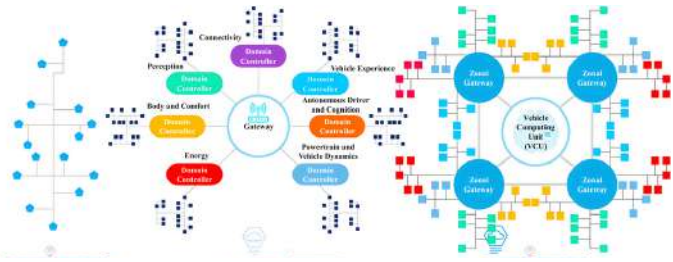

Source: Frontiers. 26

Unlocking Efficiency: The Benefits of Centralized Vehicle Architecture

- **Reduction of hardware and software complexity**. Transitioning to a centralized architecture simplifies both hardware and software by dividing functions efficiently. Moreover, centralized architecture reduces redundant and inefficient communication between individual ECUs, improving overall performance and responsiveness.
- **Reduced hardware cost**. In a centralized architecture, each sensor doesn't necessarily carry its own silo algorithm. Moreover, savings are expected to come not only from the reduction in ECU-related hardware costs, but also from a reduction in secondary costs, e.g., the wiring harness.
- **Better support for latest automotive trends**. Centralized architecture provides a better platform for advanced driver assistance systems (ADAS), over-the-air (OTA) updates, and vehicle connectivity.
- **Improved performance and responsiveness**. Enhanced scalability and easier management of vehicle functions, centralization allows for easier software updates and reduces complexity and maintenance costs.

Transitioning to a centralized architecture offers numerous advantages in the automotive industry and is crucial to support further rapid technological advancement in the future. As automotive OEMs face fierce competition and strive to secure cost efficiency in response to cost-sensitive customer purchasing tendencies, a centralized architecture provides a strategic advantage. Moreover, the pivotal role of AI in driving the shift towards centralized architecture will leverage the process further steps ahead, ensuring that automotive technology remains at the forefront of innovation.

Charting the Course: Projecting Automotive Sensor and Architecture Growth Amid Predicted Sales Evolution

As the automotive industry advances into new technological frontiers, the future of automotive sensors and architecture is expected to experience significant growth to meet market demands. Insights from McKinsey analysis indicate that this shift in automotive sensors and architecture is poised to outpace future car sales.
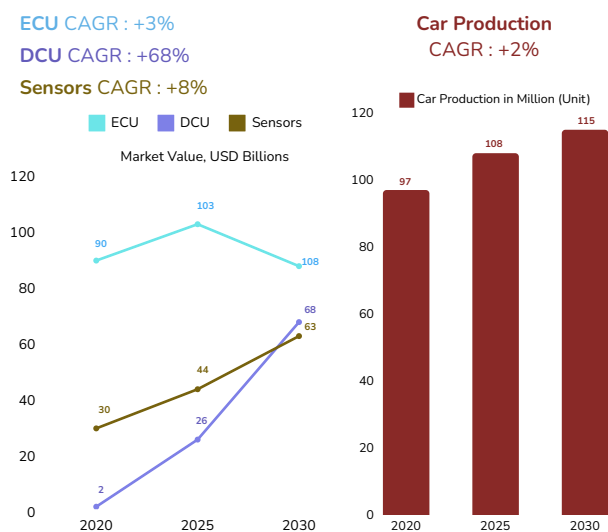
The forecasted trends from 2020 to 2030 reveal intriguing insights into the trajectory of the automotive industry. While car production units are projected to experience a modest 2% compound annual growth rate (CAGR), the sensors market is expected to undergo a substantial 8% CAGR. Similarly, the electronic control unit (ECU) market is anticipated to see a 3% CAGR, albeit with a decline in market value forecasted for 2025. In contrast, the domain control unit (DCU) market is poised for remarkable growth, with a staggering 68% CAGR, signalling a significant shift towards DCUs replacing ECUs. This growth underscores the evidence that the market demands technological advancement and centralisation of vehicle architecture. For automotive OEMs, embracing this shift towards centralised control units is imperative not only for staying relevant in the market but also for meeting the evolving demands of consumers and technological advancements.27

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26. Frontiers in Future Transportation, Article: Automotive Intelligence Embedded in Electric Connected Autonomous and Shared Vehicles Technology for Sustainable Green Mobility
27. Mckinsey & Company, Automotive Software And Electronics 2030 Report

Strategies for Success in the Rapidly Evolving Automotive Technology Landscape

The growing automotive Artificial Intelligence market presents both challenges and opportunities, prompting action from automotive companies and potential newcomers. With changes happening swiftly, it's vital to create a clear strategy to benefit from automotive disruptions instead of being left behind by them. In the next section, we'll detail emerging strategies for different player types and provide guidance on navigating this evolving landscape successfully.

The emerging trends of artificial intelligence in the automotive industry are set to have a significant impact across the board. These trends will not only reshape strategic perspectives and future outlooks but also influence product design and functionality, ultimately affecting end consumers. In the following sections, we'll explore how these trends affect various stakeholders along the automotive value chain, including OEMs, tier-1 and tier-2/component suppliers, startups, tech companies outside the automotive sector, and engineering agencies/3rd-party software developers. We'll discuss areas that require adaptation and provide actionable strategies tailored to each player, helping them navigate the changing landscape effectively.

Automotive OEMs

Mitigate Rising Per-vehicle Hardware-AI Integration Costs

As the costs of hardware and technology IP integration per vehicle are expected to rise significantly, OEMs must seek strategies to reduce these integration costs. This could involve creating economies of scale through partnerships with other OEMs, utilizing supplier components for nondifferentiating components with higher economies of scale, increasing the reusability of technology IP between platforms and models, or simplifying the vehicle architecture.

Create a Cross-Functional Development Organization

By breaking down domain silos within the development organization and centralizing decision-making power for AI and vehicle architecture, OEMs can accelerate time to market for new AI integration definitions and sourcing decisions.

Invest in Research and Development & Foster Partnerships and Collaborations

To stay ahead in the rapidly evolving automotive technology landscape, OEMs should allocate resources to research and development initiatives focused on AI and other emerging technologies. This investment will enable them to innovate and develop cutting-edge solutions that meet evolving customer needs and preferences.

OEMs can leverage partnerships and collaborations with technology companies, startups, and research institutions to access expertise, resources, and innovative solutions in AI and related fields. Collaborative efforts can accelerate technology development, enhance product offerings, and drive competitive advantage in the market.

Enhance Cybersecurity Measures

With the increasing integration of AI and connectivity features in vehicles, cybersecurity becomes a critical concern. OEMs should prioritize cybersecurity measures to safeguard vehicle systems and data from cyber threats and breaches. This includes implementing robust security protocols, encryption mechanisms, and continuous monitoring systems to detect and mitigate potential risks.

Adapt to Regulatory Requirements

As AI technologies become more prevalent in automotive applications, OEMs must ensure compliance with relevant regulations and standards governing safety, privacy, and data protection. Proactively addressing regulatory requirements will not only mitigate legal risks but also build trust and confidence among customers and stakeholders.

Focus on Customer Education and Acceptance

Educating customers about the benefits and capabilities of AI-driven technologies is essential for fostering acceptance and adoption. OEMs should develop comprehensive marketing and communication strategies to highlight the value proposition of AI features, address concerns about privacy and safety, and demonstrate the potential impact on driving experience and convenience. Building customer trust and confidence will be crucial for driving widespread adoption of AI-enabled vehicles.

Tier 1 Suppliers

Collaborate on AI Integration Strategy

Tier-1 suppliers can play a pivotal role by collaborating closely with OEMs to co-create a shared vision for integrating AI into future automotive systems. By actively participating in the definition of AI integration requirements and leveraging their expertise, tier-1 suppliers can contribute to shaping the direction of AI adoption in the automotive industry. Establishing strategic partnerships and engaging in industry ecosystems can further strengthen their position in driving AI integration initiatives.

Develop AI Capabilities and Infrastructure

To capitalize on the growth opportunities presented by AI integration, tier-1 suppliers must invest in building robust AI development and integration capabilities. This requires a concerted effort to attract and retain top talent in AI and software development. Establishing dedicated teams or business units focused on AI development and integration can accelerate the pace of innovation. Additionally, creating an integrated development, integration, and validation framework will enable seamless integration and continuous improvement of AI technologies.

Foster Cross-Functional Collaboration

Breaking down internal silos is essential for tier-1 suppliers to effectively meet the evolving demands of customers and remain competitive in the market. By establishing cross-functional teams and departments, tier-1 suppliers can enhance collaboration and agility in developing cross-domain solutions. This organizational structure enables them to respond more swiftly to customer requirements and market dynamics, driving innovation and differentiation in their offerings.

Invest in Advanced Manufacturing Technologies

To meet the increasing demand for AI-integrated automotive components, tier-1 suppliers should invest in advanced manufacturing technologies. This includes automation, robotics, and additive manufacturing techniques that can improve production efficiency, quality, and scalability. By modernizing their manufacturing processes, tier-1 suppliers can streamline production and deliver AI-enabled solutions more effectively to OEMs and end customers.

Enhance Data Analytics and Security Capabilities

As AI integration becomes more prevalent in automotive systems, tier-1 suppliers must prioritize data analytics and cybersecurity measures. By leveraging data analytics tools and techniques, they can derive actionable insights from vast amounts of data generated by AI-powered systems. Additionally, implementing robust cybersecurity protocols and encryption methods is essential to safeguard sensitive information and protect against cyber threats, ensuring the integrity and security of AI-integrated automotive solutions.

Tier 2 Suppliers

Identify Niche Opportunities

Tier 2 suppliers should proactively identify niche opportunities within the automotive electronics market. By focusing on specific areas where their expertise and capabilities align, such as specialized sensors or components for specific vehicle systems, tier 2 suppliers can differentiate themselves from competitors and avoid commoditization pressures. Once a niche has been identified, tier 2 suppliers should strive to scale their operations within that niche, leveraging their unique strengths to capture market share and drive growth.

Enhance Specialized Software Capabilities

In addition to their hardware offerings, tier 2 suppliers can enhance their value proposition by developing specialized software capabilities. This may involve adding advanced algorithms for functions like functional safety, artificial intelligence, or cybersecurity to their existing products. By integrating software solutions into their offerings, tier 2 suppliers can provide added value to tier 1 suppliers or OEMs, potentially bypassing intermediaries and supplying directly to end customers. This strategic approach enables tier 2 suppliers to strengthen their position in the market and capitalize on emerging opportunities in the automotive industry.

Navigating the Shifting Automotive Landscape: Key Steps for All Players

In addressing the multifaceted challenges posed by the evolving automotive landscape, there exists no universal playbook tailored to each player's unique position within the industry's value chain. Nevertheless, regardless of their specific roles or market positions, all companies must consider a set of strategic actions to effectively maneuver through the transformative effects of advancing automotive technology and the increasing presence of artificial intelligence:

Strengthen AI and Architecture Capabilities and Engage in Early Discussions

Amidst the evolving trends in automotive AI and vehicle architecture, active involvement in early-stage discussions is crucial. By participating in conceptual and design phases, companies can influence the development of technological solutions, shape component integration, and position themselves competitively in the market.

Embrace Experimentation and Agile Practices

Given the absence of definitive solutions for many technological and business challenges, a culture of experimentation is essential. Companies aspiring to excel in emerging technologies, particularly AI integration for ADAS and AD and next-generation services, must adopt a test-and-learn approach. Quick iterations based on experimentation enable rapid learning and adaptation, facilitating innovation and competitiveness.

Continuously Assess Control Points and Adapt to Changing Dynamics

Control points within the technology stack that hold significance today may evolve into commodities tomorrow. To navigate the market successfully, companies must consistently evaluate their control points and adapt to evolving ecosystem dynamics. Vigilant monitoring of ecosystem landscapes allows companies to anticipate disruptions and realign their strategies accordingly.

Forge Strategic Partnerships in Emerging Ecosystems

The increasing complexity of AI, sensors, and software systems in vehicles necessitates collaborative partnerships within the automotive ecosystem. With the growing costs of research and development, particularly in software, collaboration enables shared resources and distributed costs across a broader vehicle base. Deeper integration beyond traditional supplier-purchaser relationships is essential for driving innovation and sustaining competitiveness in the industry's future landscape.

Invest in Talent Development and Retention

Recognize the importance of talent in driving technological advancements and maintaining a competitive edge. Invest in talent development programs, attract top-tier professionals, and cultivate a work environment that promotes continuous learning and growth.

Prioritize Cybersecurity and Data Privacy

With the increasing integration of AI and connectivity features in vehicles, prioritize cybersecurity and data privacy measures. Implement robust security protocols, encryption techniques, and privacy safeguards to protect consumer data and ensure the integrity of vehicle systems.

Embrace Sustainability and Environmental Responsibility

As the automotive industry transitions towards electric and autonomous vehicles, prioritize sustainability initiatives and environmental responsibility. Invest in eco-friendly technologies, reduce carbon emissions throughout the production process, and align corporate strategies with global sustainability goals.

Adapt Supply Chain and Manufacturing Processes

Anticipate changes in supply chain dynamics and manufacturing processes driven by advancements in AI and automation. Embrace digitization, adopt flexible manufacturing systems, and optimize supply chain networks to enhance efficiency, reduce costs, and mitigate supply chain disruptions.

V2M - a Pioneer in Computer Hearing

Spearheading a new AI field which called Computer hearing, V2M creates a solution for on-board diagnostics using sound. The development of V2M can not only effectively find and detect malfunctions while driving, but also predict future breakdowns.
We already made it possible for cars.

OUR SOLUTION

1. Two acoustic sensors collect sound and convert it into a digital signal.

2. The signal is transmitted by wire to the control unit.

3. The control unit converts the signal dinto a sound file.

4. The unique AI-powered software of V2M analyzes the sound file to determine if there's a malfunction on board and, if so, what type of malfunction it is.

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