

Making the CASE for **advanced next-generation automotive technology**

Technology teams are excited by the possibilities of AI but may need expertise as they deal with data silos and a lack of internal expertise.



The future of mobility demands a new level of technological sophistication from automotive manufacturers. To thrive in this era of connected, autonomous, shared, electric (CASE) modernization, automakers must master a diverse range of technologies and embrace innovation to deliver seamless and futuristic driving experiences.

For the automotive industry, this shift demands a wide range of sophisticated technologies to ensure seamless integration of all moving parts. These technologies enable the continuous monitoring of the state of health and behavior of the vehicle, driver, and occupants. Advanced algorithms process high volumes of data with low latency, paving the way for the evolution of software-defined vehicles that deliver an intelligent, responsive driving experience.

Success is critical to meeting competitive realities amid the transformative changes occurring in the automotive industry. This paper examines the challenges manufacturers face, the opportunities artificial intelligence (AI) and automation technologies represent, and the role technology service providers can play in helping automakers meet the moment.

Automotive manufacturing realities

With the fast-paced innovation landscape of the automotive industry, the line between automakers and high-tech companies is blurring.

Automakers are using digital technologies to improve customer experience and create hyperpersonalized products and services and are employing data analytics to optimize business operations and product designs. For instance, some automakers are partnering with high-tech vendors or building their own divisions to create custom code for their vehicles.¹² Others are applying data analytics to predict when parts need to be replaced, analyze driving conditions, and generate crash alerts and other warnings to enable safer driving.

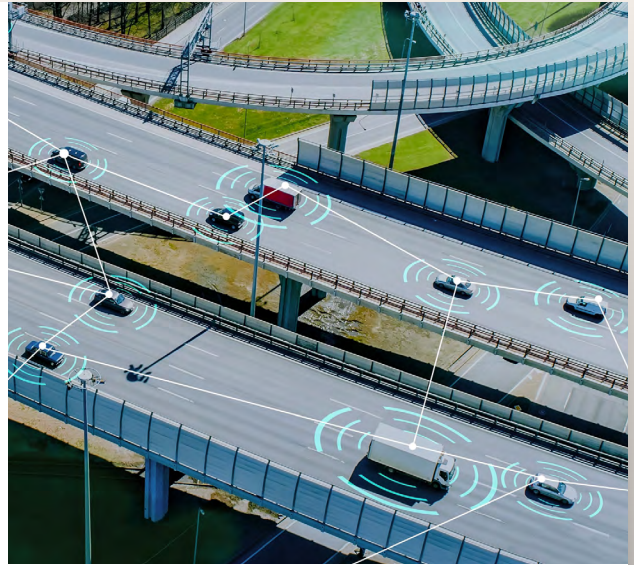
1 “Ford’s high-tech business transformation, fueled by cloud,” CIO.com., January 26, 2024

2 “General Motors Teams Up with Google Cloud on AI Initiatives,” GM.com, August 28, 2023

To develop autonomous driving capabilities, automakers must generate large, diverse artificial data sets to train and test complex algorithms and other solutions. These extensive data sets are essential for refining autonomous driving systems and ensuring their accuracy and reliability. Automakers must develop an environment in which they can integrate data from sensors, cameras, and light detection and ranging (LiDAR) systems to support autonomous driving capabilities. Optimizing batteries for electric vehicles is also critical, forcing automakers to address complexities in battery management systems, thermal control, and power optimization for electric vehicles.

At the same time, automotive manufacturers must maintain compliance with safety and security regulations. That involves ensuring compliance with various functional, safety, and cybersecurity standards for all the electrical and electronic components in modern vehicles. Automakers must conduct extensive testing, including software-in-the-loop, hardware-in-the-loop, and system-level testing.

New business models are driving automakers to shift from traditional vehicle sales to service-based,



user-centric revenue models while enabling seamless shared mobility experiences and enhanced fleet management capabilities. To support this transformation, automakers are implementing flexible software-defined vehicle architectures that allow for dynamic updates and personalization, adapting to fast-evolving CASE-based vehicle technologies.

Another emerging aspect in the industry is health monitoring. As users spend extended hours in a seated position, they maintain continuous attention and prolonged contact with the steering wheel, seats, and other in-vehicle components. This offers the potential for vital-signs monitoring, providing early warnings and detecting chronic illnesses. It could even enable proactive measures when vital-signs variations are detected, improving overall driver and occupant well-being.

The CASE revolution explained

CASE is a framework that outlines requirements for future automotive vehicles.

Connected vehicles can communicate in real time with each other, traffic signals, and other infrastructure required to enable advanced navigation and safety features. Automakers require solutions that provide them with:

- Capabilities to connect vehicles to the cloud, external data sources, and a digital twin for real-time monitoring and predictive maintenance.
- Connected services platforms that can ingest vehicle data and integrate with third-party cloud services to enable remote capabilities such as over the air (OTA) software, configuration updates, and remote diagnostics. These features enhance service experiences, by improving operational efficiency and enabling timely interventions.

- Data-driven insights and predictive diagnostics to enhance vehicle uptime and service efficiency while also enabling hyperpersonalization, instantaneous product discovery, and real-time feedback. This approach not only optimizes vehicle performance but also tailors the user experience, driving continuous improvement.

Autonomous cars can drive themselves with minimal or no human intervention, using sensors, cameras, and AI algorithms. This level of vehicle autonomy requires:

- Large, diverse data sets to train autonomous driving systems.
- Expertise in data integration from sensors, cameras, and LiDAR systems to support autonomous driving development.
- Capabilities in synthetic data generation to supplement real-world training data.

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Automotive

Shared vehicles — in contrast to those owned by individuals — are accessed on demand through a subscription service or a car-sharing platform. This shift toward shared mobility services requires:

- Platforms that cater to different end user personas, such as owners, fleet managers, technicians, and more.
- Solutions that enable seamless shared mobility experiences and fleet management.

Electric vehicles are powered by electricity and contribute to reduced emissions, representing a positive environmental impact. Supporting electric vehicles also means that automakers must understand:

- Complexities of battery management systems, thermal control, and power optimization for electric vehicles.

- End-to-end capabilities in electric vehicle system design, development, testing, and validation.
- Real-time data monitoring and diagnostics for electric power trains.

The components of CASE are driving automakers to rapidly develop new capabilities in areas such as data-driven services, self-driving systems, mobility as a service (MaaS), and electrification to meet evolving consumer and industry demands and keep automakers relevant and competitive.

The road ahead

Automakers embracing CASE should prioritize software development, data analysis, and collaborative partnerships with technology companies.

These steps will help them evolve their manufacturing processes to incorporate new technologies and cater to changing consumer demands.

By focusing on developing electric vehicles with advanced autonomous driving capabilities and creating connected-car ecosystems, automakers can capitalize on the opportunities presented by the CASE revolution in various ways.

- Data collected from connected vehicles will improve end user experiences, optimize traffic flow, and help manufacturers design and develop new services based on real-time insights.
- Autonomous driving systems that include sensor technology, perception algorithms, and decision-making capabilities will be the foundation for innovative self-driving features.
- Software advances could further transform cars into computers on wheels by integrating advanced driver assistance systems (ADAS). Integrating data from sensors, cameras, and LiDAR systems will support the development of robust autonomous driving algorithms.
- Extensive software-in-the-loop, hardware-in-the-loop, and system-level testing will ensure the safety and performance of ADAS and autonomous driving features.
- Battery research and charging infrastructure development will help electric vehicle technology meet the growing demand for sustainability and mobility.
- Connected services platforms can ingest vehicle data and integrate with third-party cloud services to provide data-driven insights and predictive maintenance capabilities, improving vehicle uptime and service efficiency.
- An agile, iterative approach to manufacturing, coupled with close collaboration between automakers and technology partners, will help automakers deliver solutions that are aligned with evolving consumer priorities and safety needs.

Automakers should also look to adapt manufacturing processes that allow for customization and modular design to enable faster production of vehicles with diverse features. Manufacturing processes will need to become more

agile, with shorter production cycles and the ability to scale based on demand. Prioritizing user-centric design, intuitive interfaces, and seamless integration with digital ecosystems will further enhance the driving experience.

AI will also play a pivotal role in automakers' adopting CASE principles across their manufacturing and production environments. AI can help improve manufacturing efficiency, enhance safety, and improve the driver experience. It will also enable automakers to produce higher-quality products and customer experiences at potentially lower costs.

For instance, McKinsey reports that AI-powered machines can detect defects up to 90% more accurately than humans while optimizing assembly lines, reducing human error, and improving production efficiencies.¹ AI applied in automotive manufacturing can provide a more than 20% increase in equipment availability, as much as 25% lower inspection costs, and 10% lower annual maintenance costs, according to McKinsey.² From the production floor to the supply chain, AI may also help reduce forecasting errors

and help automakers cut inventory costs by 20% to 50%, enabling cost savings for automakers.

Partnering for success

Automakers will need to adapt quickly and collaborate closely with the right technology partners. UST, for example, provides expertise in design, engineering, software, and cloud-based services, helping automakers unlock new levels of innovation, efficiency, and customer experience. UST can guide automakers in navigating the CASE transformation and positioning themselves for long-term success in the future of autonomous electric vehicles.

UST's end-to-end automotive technology expertise positions the company to help automakers overcome these complex challenges, transform their manufacturing operations, and stay ahead of the innovation curve. ♦

¹ "Building smarter cars with smarter factories: How AI will change the auto business," McKinsey.com

² Ibid

To learn more about UST Automotive Solutions, **visit our [website](#)**.