The *software-driven* mobility era

Beyond vehicles

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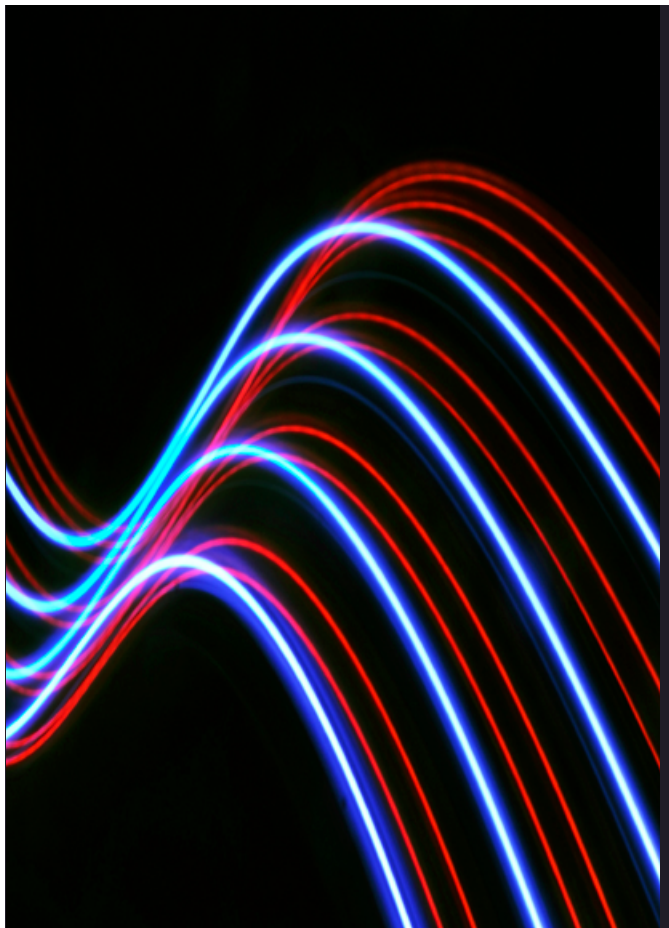

Defining software-driven mobility (SDM)

By SDM, we mean the full realization of opportunities provided by software for automotive products and services, and the means to achieve it. It is expected to deliver, on one hand, significantly enhanced mobility experiences and value for customers and users, and on the other hand, much better control of the overall complexity of vehicles and across the value chain.

SDM focuses on:

- **Setting the foundation of a "software platform,"** that defines all products and services. This includes Software-Defined Vehicles (SDVs), all in-vehicle software, digital user services for mobility and all related backend systems (incl. those ensuring safety, cybersecurity and compliance)
- **Streamlining "software delivery"** to craft the products and services. It relies on a "software engineering framework" i.e., an integrated and industrialized set of processes, methods, and tools to design, build, operate, and maintain, with a specific focus on testing, quality, and performance.
- **Accelerating to transform into a "software company."** It covers the transition of business strategy, execution of change management, and addresses culture and talent.

Our definition of SDM, as used in this study, extends to any software related to vehicles and mobility product and services, but excludes other types of software systems such as manufacturing and supply chain, finance, or marketing.

Executive summary

Software is powering a shift to holistic mobility solutions

The automotive industry is undergoing a transformation in which software is emerging as a strategic imperative. Consumer expectations of seamlessly connected and continuously evolving digital experiences are accelerating this evolution. In parallel, digital-native organizations are disrupting the market by tapping into revenue streams from software-defined products and services.

Traditional automotive players are under immense pressure to adopt a more software-centric approach across the entire value chain. This positions software as a core enabler of innovation, agility, and long-term competitiveness.

Our survey of automotive organizations reveals:

- 92% of automotive organizations believe that every automotive organization will evolve into a software company to support software-defined vehicles (SDV) and mobility services.
- Around nine in 10 (87%) organizations agree that software will be the single biggest source of competitive advantage over the next five years.
- 81% believe that software-defined products and services, not just physical vehicles, will become the core value proposition.
- 61% report that their software-defined strategy will impact all or most (over 50%) of their brands within the next five years.
- Over eight in 10 (83%) organizations identify the creation of a unified software platform as a key component of their software-driven mobility strategy.
- 80% emphasize the importance of establishing dedicated software units to accelerate the development of software-enabled features and services.
- We expect the trend toward building sovereign software capabilities to gain momentum, with 94% of organizations agreeing, reflecting a strategic shift toward control and resilience in software development.
- As many as 80% report cost reduction benefits from their software initiatives, or expect them soon.

Executive summary

While ambitions are strong, realizing the full potential of software-driven mobility (SDM) will require organizational transformation at global enterprise level

The transformation to SDM is not just a technological shift; it demands a fundamental change in strategy, operating model, and organizational practices of the company. The transformation should involve multiple corporate functions such as sales, product strategy, engineering, and corporate IT. Our research reveals that only 14% of organizations have successfully scaled an SDM use case, and fewer than half have progressed to scalable initiatives.

Traditional automotive players continue to rely on legacy vehicle architectures, where software remains tightly coupled with hardware components. Transitioning to a decoupled architecture enables faster innovation, improved scalability, and extends onboard capabilities by seamlessly integrating with a connected offboard ecosystem. However, our survey shows that only one in 10 organizations has achieved this, while 27% are currently running pilots.

Many traditional OEMs face challenges not simply due to the complexity of adopting new technologies, but because the transformation into software-driven mobility requires a deeper shift in mindset. This evolution presents a powerful opportunity to rethink and modernize the underlying structures, behaviors, and cultural practices that have long guided their operations. Recognizing that technology is just one part of a broader strategic and organizational transformation is key to unlocking

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long-term success. Therefore, adopting an SDM strategy demands an overhaul of the operating model. According to our survey:

86%	of organizations believe an SDM strategy will impact their organization and operating models.
80%	anticipate a change in tools.
73%	expect significant shifts in their methods and processes.
91%	foresee an impact on skillset.

In addition to structural changes, organizations face a range of challenges in software engineering, compliance, safety, cybersecurity, leadership, and talent acquisition:

92%	report conflicting requirements and siloed operations across business functions.
91%	cite difficulties in ensuring supplier products meet safety and cybersecurity regulations.
86%	acknowledge the absence of a centralized unit for enterprise-wide software development planning.
94%	struggle to source talent due to intense competition from both automotive and non-automotive sectors.

Executive summary

Digital natives, including Chinese players, are rapidly redefining the SDM landscape, and other legacy automakers must act now to avoid falling behind

Chinese as well as global digital-native automakers have emerged as innovation leaders by positioning software as a core product. Their success is driven by a collaborative, standardized, and user-centric approach that accelerates development cycles and fosters ecosystem integration. This user-first, software-first mindset serves as a compelling model for legacy original equipment manufacturers (OEMs) seeking to remain competitive in the software-defined vehicle (SDV) era.

Executive summary

The industry is accelerating toward a software-first future

Automakers are shifting from traditional decentralized vehicle architectures toward architectures following a chip-to-cloud approach that supports high data-processing power, faster transmission, low latency, real-time responsiveness, and increased hardware demands. Our survey indicates that automotive players are adopting a phased transition toward software-defined and data- and AI-augmented architectures over the next five to 10 years.

Modern vehicles and mobility services require frequent software updates to deliver new features and enhance user experience, which are key drivers of purchase decisions and brand loyalty. According to our survey, by 2030, 66% of vehicles are expected to support full over-the-air (FOTA) updates, up from 28% today.

Over 75% of automotive organizations believe that integrating AI into software development, in-vehicle functions, and mobility services will reshape the automotive value chain. Furthermore, 85% report that AI is a core component of automotive software features and functions.

With software now at the core of vehicle systems, safety and cybersecurity have become top design priorities. Nine in 10 organizations in our survey already deploy or plan to deploy within five years FOTA patches for cyber risks. Around 80% of organizations report being well prepared to secure in-vehicle systems, and nearly 75% now center their cybersecurity strategies on AI-driven threat detection.

Executive summary

Strategic partnerships and ecosystem collaboration are accelerating the shift to SDM

Ecosystems are needed to navigate the transformation to SDM. Many organizations are forming strategic alliances. About 40% already partner with hyperscalers for operating system (OS), cloud, and data capabilities (while retaining control over brand-defining areas).

Organizations are also restructuring their supply chains for geopolitical resilience, with 84% exploring new sourcing markets including India, Vietnam, and Eastern Europe. They are also safeguarding core innovation, with nearly 70% ramping up in-house development, particularly for critical systems such as powertrain and advanced driver assistance systems (ADAS).

To accelerate and capitalize on their SDM journeys, organizations should:

- **Set the foundation of a software platform for products and services. This includes:**
  - **Establishing a unified software and electronics platform:** OEMs must transition from fragmented legacy systems to a unified software and electronics platform. This includes consolidating electronic control units (ECUs) into centralized architectures, adopting or contributing to commercially available or open-source OS and middleware, exposing stable application programming interfaces (APIs) for internal coordination as well as integration with third-party services and external ecosystems, and embedding OTA capabilities. A

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dedicated model-based systems engineering (MBSE) framework will also ensure consistent integration of legacy and future ECUs, enabling faster development and reducing system complexity.

- **Building uncompromising cyber, safety, and compliance resilience:** Cybersecurity and compliance must be embedded from design through deployment. OEMs should implement continuous vulnerability scanning. Automakers should monitor regulations for updates and IP and code should be secured and protected.
- **Enhance customer and user experience (CX/UX):** OEMs should prioritize software driven personalization, using vehicle and user data for tailored services, enhancing hardware longevity, integrating AI to enhance user experience and support advanced features like ADAS and autonomous driving, and supporting third-party apps through standardized APIs and sandbox environments.

- **Streamline industry-grade software delivery, which incorporates:**
  - **Adopting cloud-native DevSecOps across the vehicle and services lifecycle:** OEMs should embrace cloud-native DevSecOps to integrate development, security, and operations across vehicle and cloud environments. By implementing continuous integration/continuous delivery (CI/CD) pipelines, embedding safety and cybersecurity checks, and using digital twins, virtual testing, organizations can accelerate software delivery, ensure compliance, and maintain quality, while reducing reliance on physical prototypes and enabling continuous validation across the vehicle lifecycle. OEMs must also adopt a new form of variant management, tightly integrated with DevSecOps workflows that can handle increasing complexity. Underpinning this transformation should be a robust software engineering framework, a structured foundation that aligns tools, processes, and governance across the vehicle lifecycle.

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In addition, companies can use Gen AI tools to create comprehensive test suites, and identify high-risk areas in the codebase. It enables data continuity across the entire vehicle lifecycle, boosts productivity and software quality and reduces time-to-market.

- **Build a unified data foundation for AI-enhanced vehicle development and accelerating time-to-market:** Automotive companies must transform their operations to fully leverage AI in vehicle design and faster market delivery. This includes building a unified, secure data foundation and adopting modular, hardware-agnostic software architectures for scalable AI deployment. Traditional development pipelines should shift to agile, DevSecOps models powered by digital twins and cloud computing. Crucially, a culture of continuous learning, where real-world vehicle data feeds back into AI refinement, ensures ongoing improvement and responsiveness to user needs.

- **Orchestrate an open, multiparty ecosystem:** To accelerate SDV adoption, OEMs should collaborate with hyperscalers, chipmakers, and open-source foundations to establish shared standards. Embracing open communication protocols, defining IP-sharing rules, and co-developing foundational software will reduce complexity, enhance interoperability, and foster industry-wide innovation.

Executive summary

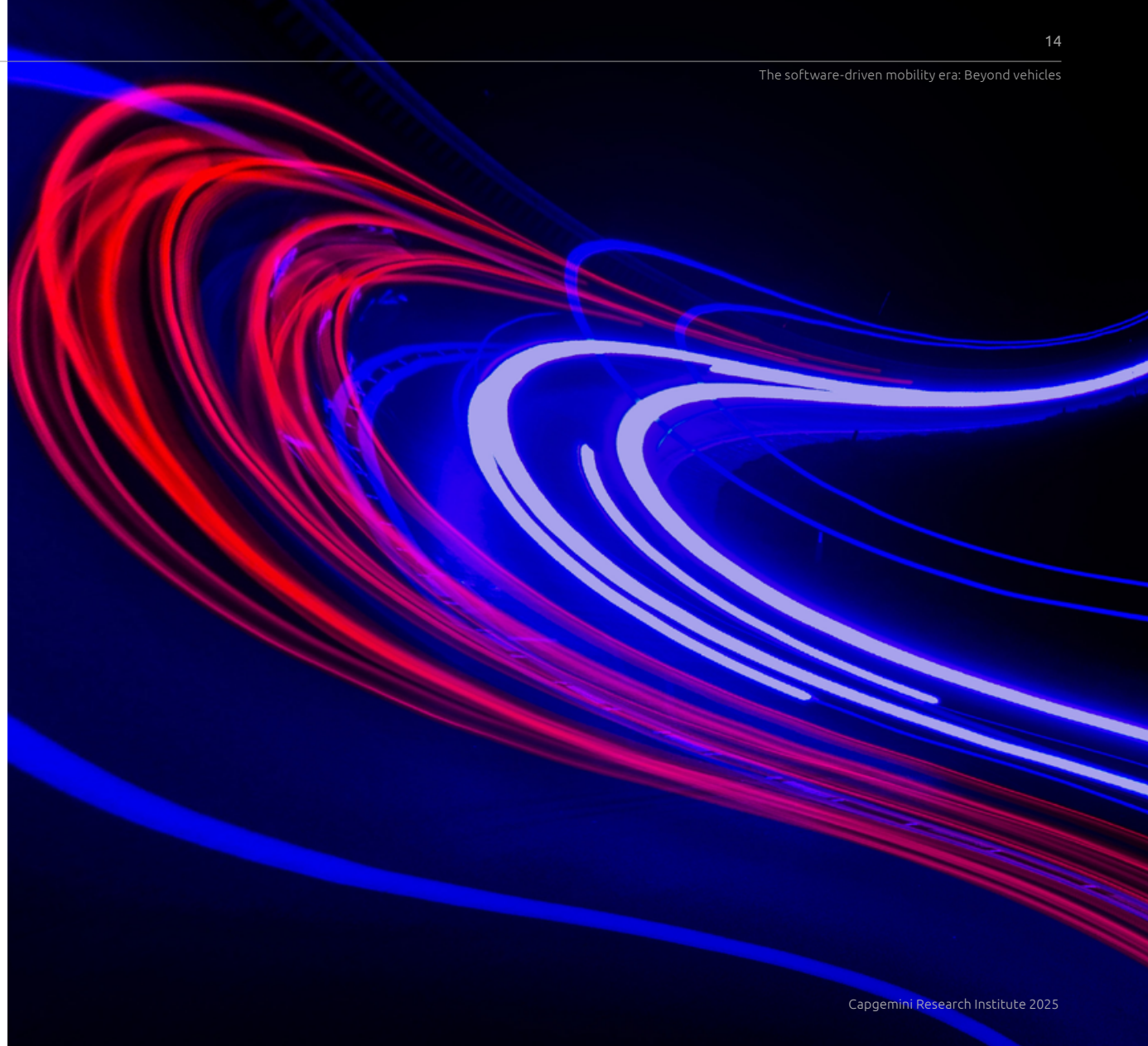
- **Accelerate to transform into a software company:** A transformation program at the global organizational level focused on becoming software-centric will impact the entire organization and must be considered as an opportunity for positive change. All functions of the enterprise must be involved in the transformation, under the responsibility of the CEO. Sales, quality, engineering, manufacturing, and IT functions must actively participate in and contribute to the software-centric, organization-wide transformation to ensure its success. Further, this transformation comprises:

  - **Creating profitable data- and service-centric business models:** OEMs must monetize software and data through subscriptions, and mobility services. By defining clear pricing models, building data marketplaces, launching mobility-as-a-service (MaaS) platforms, and enabling direct digital commerce, they can generate recurring revenue and deepen customer engagement.

  - **Future-proofing talent and fostering a software-driven culture:** OEMs must upskill legacy talent in software, AI, and cloud technologies through hands-on, integrated training programs. Teams need to be restructured around agile, product-centric models that emphasize ownership of outcomes and rapid iteration. Similarly, building global talent pipelines via flexible work arrangements and recruiting for mindset adaptability are essential to building resilient, innovation-ready teams.

- **Strengthen software sovereignty and supply chain resilience:** To mitigate geopolitical and vendor risks, OEMs must own critical software assets such as embedded systems, AI models, and connectivity platforms, adopt modular architectures, and carefully track the dependency to third-party technologies. Combined with strong supplier risk management, this approach ensures operational continuity and strategic independence.

Jean-Marie Lapeyre, EVP and CTIO, Automotive Industry at Capgemini, summarizes, ***"The automotive industry is shifting from mechanical engineering to software-driven innovation. While most organizations see software as key to future competitiveness, legacy systems and fragmented architectures still impede progress. Delivering agile, secure, and compliant software at scale demands a rethink of organizational models, tools, and talent. Companies that treat software as central to their business, standardize common functions, and retain control over differentiators can unlock new revenue and long-term resilience."***



"The automotive industry is shifting from mechanical engineering to software-driven innovation. While most organizations see software as key to future competitiveness, legacy systems and fragmented architectures still impede progress. Delivering agile, secure, and compliant software at scale demands a rethink of organizational models, tools, and talent. Companies that treat software as central to their business, standardize common functions, and retain control over differentiators can unlock new revenue and long-term resilience."

Jean-Marie Lapeyre
EVP and CTIO, Automotive Industry,
Capgemini

Who should read this report and why?

The report is important reading for automotive executives – specifically, chief technology officers, chief software officers, chief digital officers, and product strategy leads. As the industry transitions to software-centric design, decision-makers must understand the technology and the ecosystemic mindset, competitive dynamics, and long-term business implications. This report provides critical insights into what the SDM transformation brings and takes – from the definition of vehicle architectures to the emergence of new business models and competitive paradigms.

Additionally, suppliers and automotive software innovators – including heads of digital product and services, cybersecurity leads, and software engineering managers – will benefit from this research. The report pinpoints where budgets are shifting, which partnerships move the needle, and how newcomers are setting the pace. In short, anyone whose job depends on turning SDM rhetoric into a profitable, compliant, and cyber-safe reality will find a benchmark and roadmap here.

This report is based on the findings of a comprehensive survey of 600 automotive executives from 200 long-established organizations, including OEMs, suppliers, mobility service providers, and digital natives, with annual revenue of $1 billion across 12 countries in Asia–Pacific, Europe, and North America, and in-depth interviews with selected executives. See the research methodology at the end of the report for more details on the organizations surveyed.

Glossary

- **ADAS** – Advanced driver assistance systems; assisted parking and driving functions like collision warning
- **ALM** – Application Lifecycle Management
- **E/E** – Electrical and electronic
- **EEA** – Electrical and electronic architecture
- **ECU** – Electronic-control unit which is an embedded electronic device controlling the operation of vehicle sensors, actuators, or functions (for example: operation and performance of the engine)
- **EV** – Electric Vehicle
- **FOTA** – Full Over-The-Air updates
- **HPC** – High-Performance Computing
- **OEM** – Original Equipment Manufacturer
- **OSS** – Open-Source Software
- **OTA** – Over-the-air updates; wireless updates post sales
- **PLM** – Product Lifecycle Management
- **Mobility ecosystem** – The totality of entities across (and sometimes beyond) the global mobility industry, working together to help move people, goods, or any combination of these, and with the connections between them enabled by software.
- **Software-driven transformation (SDT)** – The change that the industry and individual companies need to undergo to fully realize SDM, including the strategy, skills, culture, and so on, that are required
- **Software-defined vehicles (SDVs)** – Vehicles for which most of the capabilities previously delivered by electronic hardware are implemented in software, providing the ability to continuously evolve, integrate with a wider mobility ecosystem, and better manage complexity

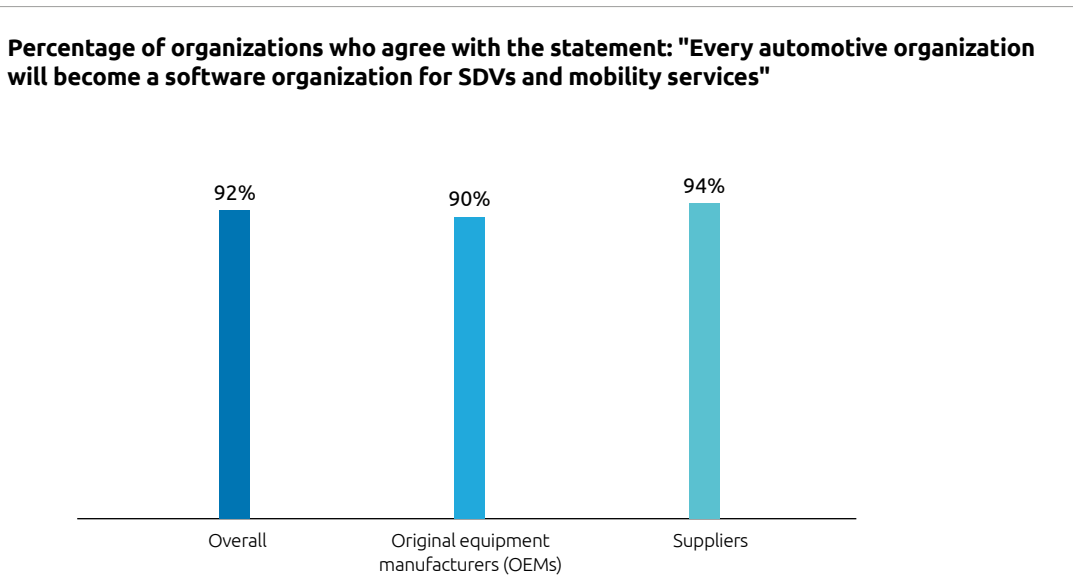
01 The expanding impact of software-driven mobility

The auto industry is aligned on the transformative role of software

The automotive sector is moving beyond software-defined vehicles (SDVs) to a broader vision of software-driven mobility (SDM). This shift marks a transition from simply embedding software in vehicles to redefining the entire mobility ecosystem through software.

Around nine out of 10 automotive organizations globally (92%) in our survey believe that every auto organization will evolve to support SDVs and mobility services. This sentiment is consistent across all surveyed automotive subsectors (see Figure 1).

Figure 1.
Nine out of 10 automotive organizations believe that every automotive organization will evolve into a software organization



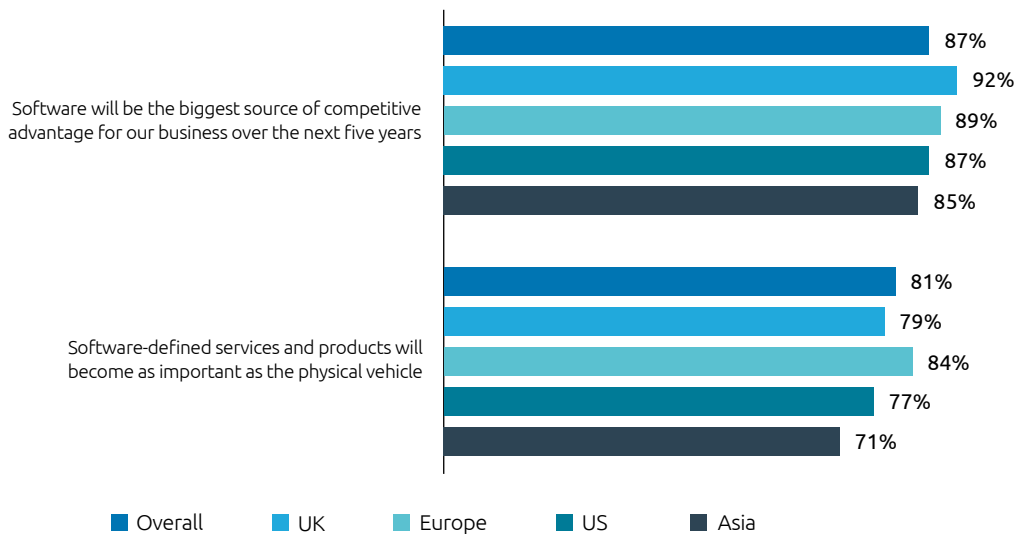
Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 overall automotive organizations, N = 100 Original equipment manufacturers (OEMs), N = 88 suppliers.

Rising software and technology complexity driven by digital-native software-embedded organizations is disrupting the automotive market. Traditional players are under tremendous pressure to evolve their product-centric business models to deliver mobility solutions aligned with users' expectations.

Recognizing this shift, traditional automotive companies are beginning to embrace and prioritize a "software-first" approach to remain competitive. Automakers that embrace a service- and software-first approach can position themselves to lead the industry transformation by unlocking new growth opportunities. Our survey highlights that 87% of organizations globally agree that software will be the biggest source of competitive advantage over the next five years, rising to 90% in the UK and Europe (see Figure 2).

Figure 2.

More than four in five organizations in the UK and Europe consider software the biggest source of competitive advantage over the next five years



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 overall automotive organizations, with N = 30 automotive organizations from the US; N = 24 automotive organizations from the UK; N = 70 automotive organizations from Europe; and N = 76 automotive organizations from Asia.

Similarly, eight in 10 automotive organizations (81%) in our survey believe that software-defined services and products will become as important as the physical vehicle – a belief shared by 79% of automotive OEMs and 85% of suppliers.

Automotive organizations worldwide are building in-house software capabilities, restructuring operations to prioritize software, and forming strategic partnerships with tech organizations, hyperscalers, and startups.

Notable examples include:

- Ford restructured its business divisions to create Ford Model e, a separate unit offering services such as interior digital experiences and OTA updates for internal combustion engine (ICE) products.[1]

- Continental Group is set to rebrand its automotive division as Aumovio by September 2025, in alignment with its focus on SDVs and advanced electronic solutions for global OEMs.[2]

- In 2021, Renault Group launched Mobilize, a next-generation automotive brand dedicated to advancing shared, electric, and connected mobility solutions.[3] Jean-Christophe Labarre, Director, Mobility Services at Mobilize, Renault Group, says, "When we launched Mobilize Beyond Automotive, our goal was clear: we didn't want to be just another carmaker. We envisioned a software-first company where services drive the strategy, and vehicles simply support the experience. That's why we say, 'Beyond Automotive,' because the real innovation lies in the digital platforms we build around mobility."

- Mercedes-Benz has partnered with Microsoft to enhance its in-car experience, integrating AI-powered features like the ChatGPT-based "Hey Mercedes,"[4] Microsoft Teams, and Intune into its new MB.OS. The company also plans to bring Microsoft 365 Copilot to vehicles soon.[5]

Software-defined products and services, including mobility services, are expected to become significant revenue contributors for OEMs. According to our survey, their share of OEMs' total revenue is projected to double, contributing to nearly 60% by 2035 (see Figure 3). Similarly, for Tier-1 automotive suppliers, revenue share from software-defined products and services is expected to rise from 18% currently to 35% by 2035.

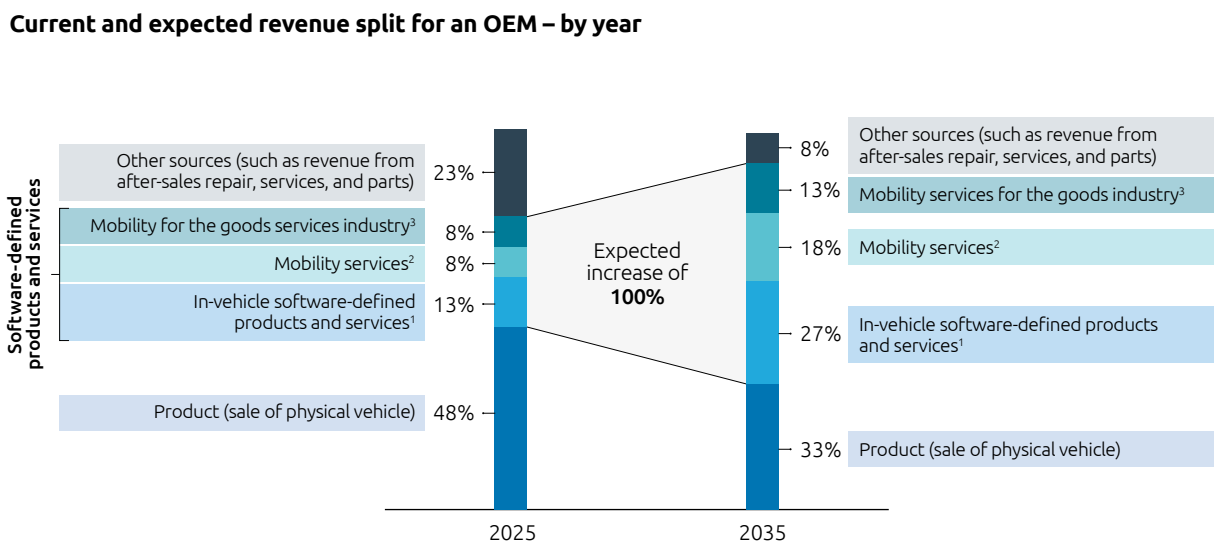
Auto organizations are setting long-term targets to boost their software-driven revenue. Software-based products and services are anticipated to generate more revenue over the lifespan of a vehicle than the initial sale. Yves Caseau, Group Chief Digital and Information Officer, Michelin, elaborates on their strategy, ***"We've made three strategic moves to align with the rise of software-defined vehicles: first, selling digital tire models ahead of the physical product; second, embedding our tire expertise into vehicle software such as Anti-lock Braking Systems (ABS) and predictive maintenance; and third, exploring app store integrations to deliver driver-centric services. It's about transforming our deep physical know-how into digital value."***

Ford anticipates a tenfold increase in revenue from its in-car software services over the next few years. CEO Jim Farley emphasizes the significance of this growth: ***"This will be the fastest-growing revenue stream at Ford. And unlike our traditional vehicle business, the margins here are enormous."***[6]

Renault Group plans to increase software's share of their vehicles' lifetime profit to 40% by 2030, up from 10% currently.[7] Similarly, in December 2021, Stellantis announced its expectation to generate €20 billion in incremental annual revenue by 2030 through software-enabled product offerings and subscription services.[8] Similarly, Tesla has launched its paid autonomous car service.[9]

Consumers expect more flexible and usage-based payment models for automotive services, such as pay-per-mile insurance, rather than fixed subscriptions. While service-based revenue streams are growing, affordability challenges persist, highlighting the need for more value-driven

Figure 3.
The share of OEMs' revenues from software-defined products and services is expected to double over the next decade



Note: 1. In-vehicle software-defined products and services include products and services such as connectivity, function on demand (one-time payment to unlock new features), infotainment, etc.
2. Mobility services enabled by SDVs, specifically ridesharing, car-sharing, subscription-based models, navigation systems, parking lot locators, integrated payment systems for ride/car-sharing, real-time journey planning, and MaaS platforms.
3. Mobility services for the goods industry include fleet management, delivery services, lifecycle management.

Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 65 automotive OEMs.

strategies. For instance, in the United States, average monthly car payment for a new car is over $700. Similarly, the share of revenue from physical vehicle sales and after-sales services including repairs and parts is projected to decline over the next decade. This trend is likely driven by evolving fleet and vehicle ownership models, declining product margins, as well as the growing adoption of EVs, which typically require less maintenance and fewer repairs than traditional internal combustion engine (ICE) vehicles.

In the passenger car segment, software is positioned as a strategic differentiator and revenue generator, offering competitive advantage through enhanced customer experience. While the commercial vehicle sector views software as a necessity to manage operational complexity and cost pressures for truck OEMs, fleet operators, and logistics providers, driven by goals such as ROI improvement, cost reduction, and service continuity through data-driven fleet services.[10]

Therefore, nearly every automotive organization is striving to evolve into software-first organization. However, their progress will largely depend on two critical factors: (i) the level of investment in building robust software capabilities, and (ii) speed of digitalization of the business.

Software is becoming integral organization-wide

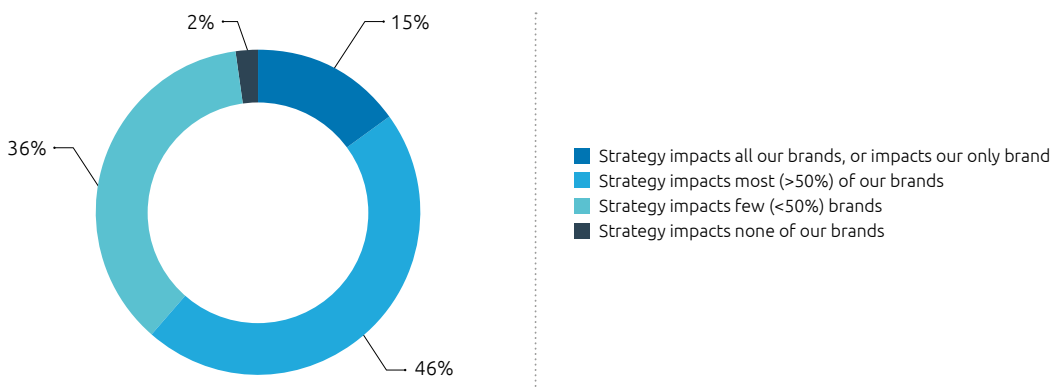
The software transformation of automakers impacts every function. Manufacturers are embedding software in their brand identities, transforming vehicles into dynamic, evolving platforms. In our survey, six out of 10 automotive organizations stated that their software-defined strategies will impact all or most (over 50%) of their brands within the next five years (see Figure 4). Ford, for instance, has been developing a new, cost-effective EV platform with a central digital OS for the past two years, to support new sedans, SUVs, and small pickups.[11]

81%

Percentage of automotive organizations that believe that software-defined services and products will become as important as the physical vehicle

Figure 4.
Six out of 10 organizations stated that their software-defined strategies will impact all or most (over half) of their brands within the next five years

The expected share of brands impacted by their organizations' software-driven mobility strategies in the next five years



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 85 automotive organizations.

Delivering differentiating features and services continues to be a top priority for automakers. According to our survey, 83% of automotive organizations identified the creation of a single software platform to run all customer-related functions, controls, and services as a key component of their SDM strategies. A unified software platform will boost automakers' efficiency by standardizing development across models and ECUs, while a common API accelerates the rollout of new vehicle and mobility applications and services. Dr. Luc Julia, Chief Scientific Officer, Renault Group, adds, ***"A shared platform across all brands would be the smartest move, allowing you to pick and choose software modules based on the features you want. While we're already seeing this kind of modularity at the hardware level, the software side still has a long way to go. In the context of SDVs, that kind of flexibility should be the ultimate goal."*** Several automakers are already building or deploying such platforms:

- Mercedes-Benz has introduced MB.OS, its proprietary OS designed to deliver a luxury digital CX via advanced automation.[12]

- BMW has launched Operating System 9 (iDrive 9), emphasizing UX and connected services. This system supports OTA updates, an integrated app store, subscription-based features, and smart data analytics.[13]

In parallel, 80% of organizations also emphasize the importance of establishing dedicated software units to accelerate the development of software-enabled features and services. For example, Renault Group has created a dedicated software development subsidiary, Ampere Software Technology.[14] Similarly, Hyundai Motor Group has launched its software brand, Pleos, featuring a proprietary vehicle operating system (VOS), next-gen infotainment, an open development platform, and strategic partnerships to expand the in-vehicle app ecosystem.[15] Yves Caseau of Michelin remarks, ***"While we're embedding digital skills into existing teams, we're also building dedicated software units. Some initiatives, like digital tire twins, may even evolve into standalone businesses. It's about balancing integration with autonomy to remain agile in the software-driven landscape."***

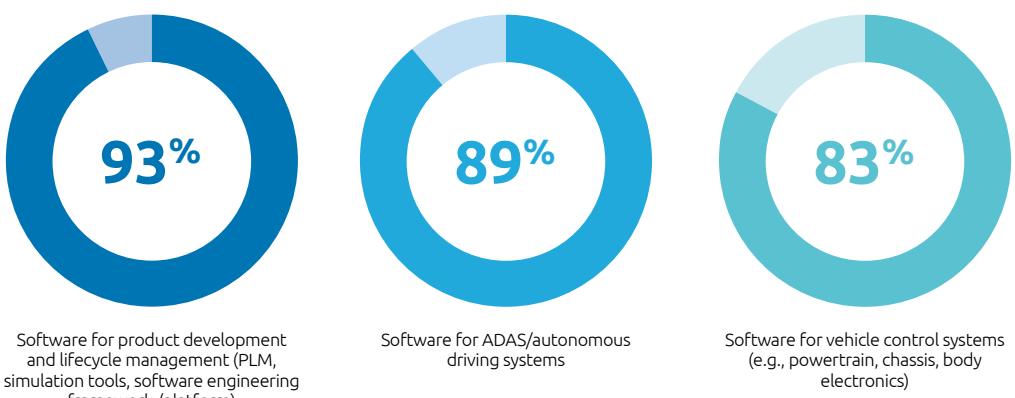
Additionally, demand for modern vehicles is increasing the complexity of product development. Traditional players now find that agility, scalability, and user-centric innovation are essential to managing this complexity and mitigating risks such as technology obsolescence, integration challenge, and delivery uncertainty. In our survey, nine out of 10 automotive organizations rank software for product development and lifecycle management (including product lifecycle management (PLM), application lifecycle management (ALM) simulation tools, and software engineering frameworks/platforms) as a key domain for their organizations (see Figure 5).

This focus will enable standardization and simplification of vehicle architectures, implement continuous development practices, and employ advanced engineering technologies, while accelerating production speed. Mercedes-Benz, for example, uses digital twins to reduce coordination by 50% and double the speed of assembly hall conversions.[16] General Motors (GM)[17] and German multinational auto parts manufacturer Continental[18] also employ digital twin.

Similarly, the rise of autonomous vehicles is increasing demand for advanced safety features. Our survey indicates that 89% of organizations see software for ADAS and autonomous driving systems as essential.

Figure 5.
Software for product development and Life Cycle Management (LCM), ADAS/autonomous driving systems, and vehicle control systems remain the top three key software domains

Percentage of automotive organizations ranking the top three key software domains of their organization



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.

OEMs plan to accelerate development and implementation, either in-house or through partnerships. As per our survey, nearly half will collaborate with hyperscalers, software tech companies, or semiconductor firms, while one-third intend to develop autonomous systems internally over the next five years. For ADAS systems, 53% will seek external collaborators, and one-fifth will build these internally. Additionally, 83% of organizations indicate software for vehicle control systems as key.

83%

Percentage of organizations that identified the creation of a single software platform to run all customer-related functions, controls, and services as a key component of their SDM strategies

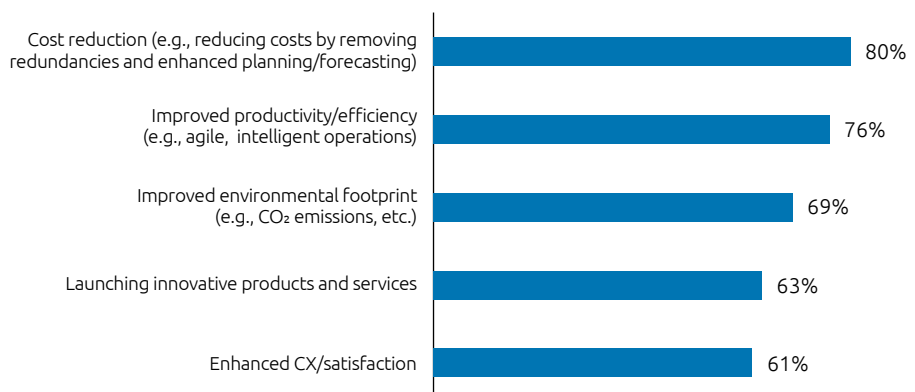
SDM is already delivering substantial benefits to automotive stakeholders

According to our survey, 80% of automotive organizations have experienced or expect to realize cost-reduction benefits. More than three-quarters report improved productivity and efficiency. Additionally, most automotive organizations highlight improvements in environmental footprint (69%), and the ability to launch innovative products and services (63%) (see Figure 6). While software is often pursued for cost reduction and operational efficiency, its true value lies in creating competitive advantage and enhancing customer experience. In fact, 61% of organizations in our survey have already experienced or expect to realize improved customer satisfaction through software initiatives. To fully unlock this potential, customer satisfaction must be established as a key performance indicator (KPI) across software programs.

A director at a Japanese automotive firm says, ***"The benefits of software in the automotive industry vary by initiative, but at a high level, it's about either unlocking new revenue streams or reducing operational costs through enhanced digital experiences, connected services, or smarter vehicle systems."***

Figure 6.
Most automotive organizations have realized or expect to realize savings and efficiencies

Percentage of automotive organizations highlighting benefits/advantages realized or expected through SDM



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N=200 automotive organizations.

"We've made three strategic moves to align with the rise of software-defined vehicles: first, selling digital tire models ahead of the physical product; second, embedding our tire expertise into vehicle software such as Anti-lock Braking Systems (ABS) and predictive maintenance; and third, exploring app store integrations to deliver driver-centric services. It's about transforming our deep physical know-how into digital value."

Yves Caseau
Group Chief Digital and Information Officer,
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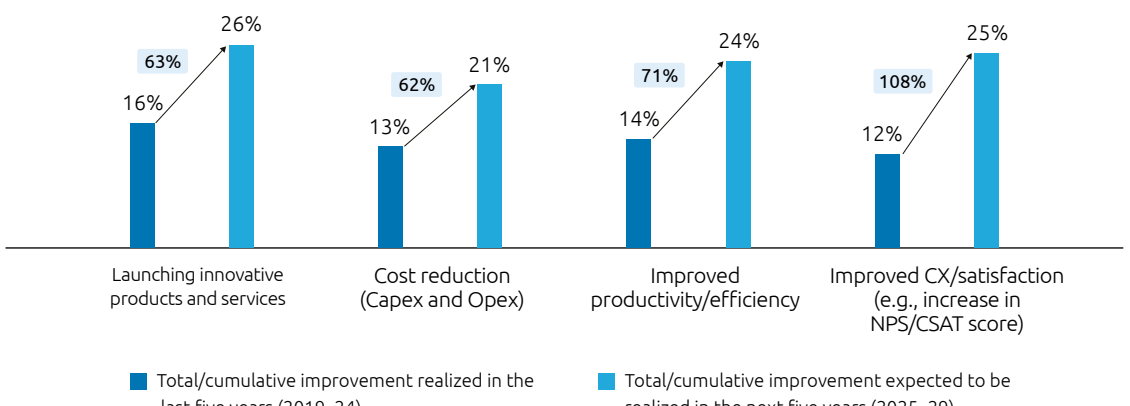
As illustrated in Figure 7, automotive organizations have achieved an average cost reduction of 13% and productivity/efficiency improvements of 14% over the past five years. These figures are expected to reach 21% and 24%, respectively, by 2029, representing increases of 62% and 71%. Likewise, advancements in launching innovative products and services are projected to grow by 63%, reaching 26% in the next five years. Improvements in CX and satisfaction are also forecasted to increase the highest by 108% during this time frame.

Around one-third (32%) of automotive organizations surveyed have benefited from their SDM strategy for over three years. Meanwhile, most (66%) anticipate benefits within three to five years. According to our survey, seven in 10 (69%) report that benefits align with investment levels.

Figure 7.
SDM strategy is anticipated to bring significant benefits

Average percentage improvement realized or expected to be realized by automotive players



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.

Sovereignty and security to the fore

Global automotive players have benefited from cost competitiveness through globalization. However, ongoing geopolitical uncertainties and the global trade and tariff war between China and Western countries are significantly impacting automotive organizations' operations and market access.

Additionally, foreign-made connected vehicles are raising concerns around digital sovereignty and, by extension, national security. For instance, from 2027, the US will ban the sale of connected vehicle software from China and Russia on national security grounds.

In our survey, 94% of automotive organizations agree that the movement to build sovereign software capabilities will continue to grow; this ambition is closely tied to the adoption of open standards and open-source ecosystems. Similarly, 81% believe that these capabilities will boost innovation.

This underscores the need to strengthen the domestic ecosystem through strategic partnerships, collaborations, and alliances to build the necessary capabilities. US and European governments are carving out distinct digital models to mitigate strategic dependencies. For instance, the European Commission has launched the European Connected and Autonomous Vehicle Alliance, bringing together automotive stakeholders to develop next-gen vehicles, shared software, and digital hardware within Europe. The Commission will enhance the regulatory framework, supported by €1 billion in joint public-private investments over 2025–27 through the Horizon Europe program.[20] As Figure 8 shows, 69% of automotive organizations surveyed indicate they would invest in developing in-house software components in response to changes in trade policies and tariffs, while 67% plan to increase their reliance on domestic suppliers.

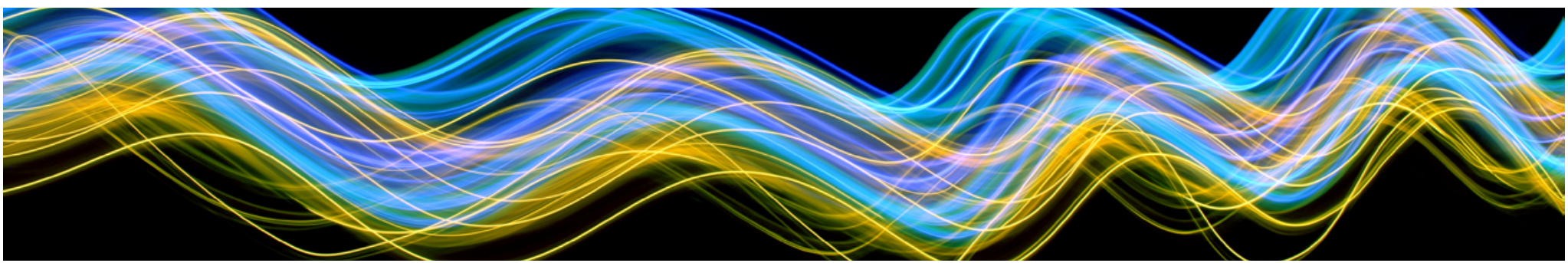
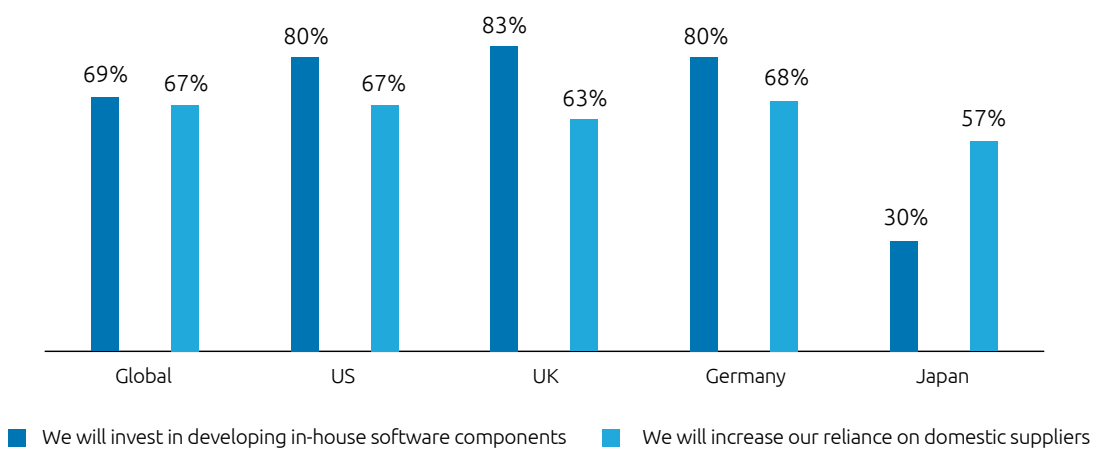


Figure 8.
More than 80% of organizations in the US, UK, and Germany will focus on developing secure in-house software capabilities

Percentage of organizations that agree with the statements below



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 170 global automotive organizations; N = 30 from the US, N =24 from the UK; N = 25 from Germany; N = 23 from Japan.

According to our survey, 63% of automotive organizations say, despite the cost, they are investing in an end-to-end domestic automotive software supply chain to reduce reliance on China.

To enhance supply chain resilience and reduce dependency on external sources for critical components such as semiconductors, the European Commission, through its European Chips Act, is advocating for the development of an open ecosystem and reliable semiconductor supply for automotive software and hardware.[21]

69%

Percentage of organizations that plan to invest in developing in-house software components

"A shared platform across all brands would be the smartest move, allowing you to pick and choose software modules based on the features you want. While we're already seeing this kind of modularity at the hardware level, the software side still has a long way to go. In the context of SDVs, that kind of flexibility should be the ultimate goal."

Dr. Luc Julia
Chief Scientific Officer,
Renault Group

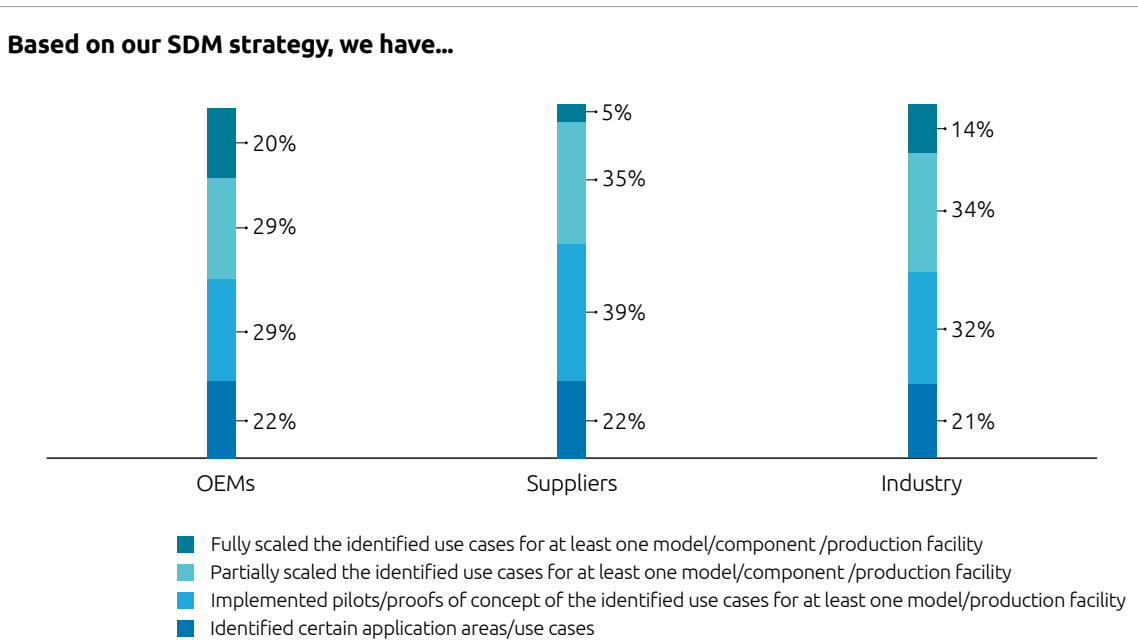
02 SDM demands an organizational overhaul

Less than half have scaled their SDM initiatives

Despite aspirations, our research found that only 34% have partially scaled at least one use case, while a mere 14% have reached full-scale deployment. Among OEMs, one in five has fully scaled an SDM use case (see Figure 9).

Multiple issues are stalling progress. Mercedes-Benz's DRIVE PILOT, the first SAE Level 3 automated driving system approved for use in the US, is currently available only on the S-Class and EQS Sedan models.[22] Tesla was forced to recall around 694,000 vehicles over an issue with the tire pressure monitoring system (TPMS).[23]

Figure 9.
Around one in five OEMs has fully scaled their SDM use cases



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations, 100 OEMs, and 88 suppliers.

Only a minority have decoupled the hardware and software architectures

Organizations must decouple their hardware and software architectures, but among the traditional OEMs we surveyed, we found that only around one in 10 has done so to date, while another 27% are running pilots. Legacy vehicles have real-time functions scattered across scores of ECUs. Abstracting these into a few upgradeable programs demands complete electronic and electrical (E/E) redesign. Secondly, safety rules (ISO 26262, UNECE R155/156) mandate that every software change be trace-linked to hardware, resulting in independent release cadences that entail months of paperwork. Integration between ALM and PLM systems remains a significant challenge, further complicating traceability and coordination. Additionally, the lack of cloud-native CI/CD pipelines in many organizations, and the culture of writing procurement contracts for five-year hardware cycles, rather than for weekly software updates, also contributes to thwarting this goal.

NIO introduced digital architecture in its flagship model, ET9, which supports a decoupled, layered approach to computing and communications. This enables independent iterations across hardware, OS, algorithms, and applications.[24]

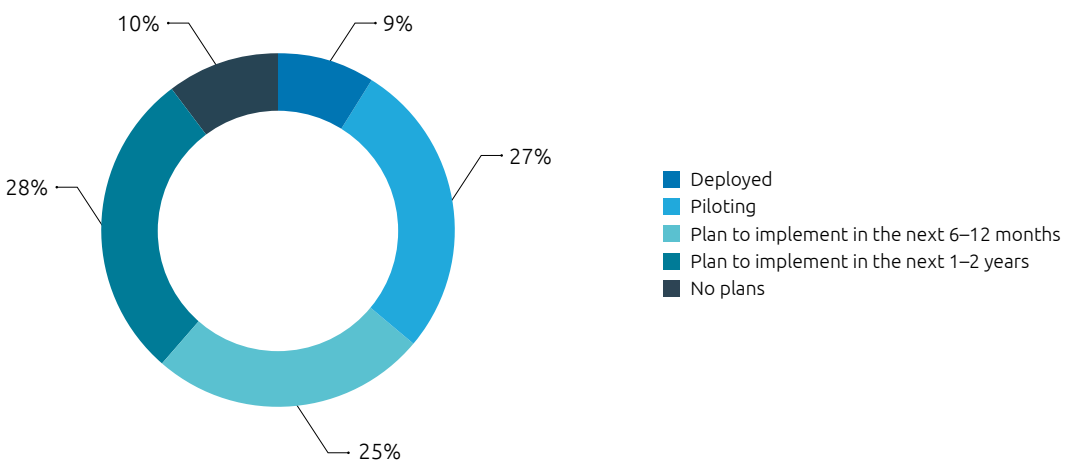
BMW is launching a new "digital nervous system" for all its drivetrain variants and vehicle segments, initially in its Neue Klasse models. Four high-performance computers called "Superbrains" consolidate the computing power for automated driving, infotainment, driving dynamics, and other basic functions such as climate control. BMW hopes that this architecture will allow them to decouple vehicle from software development. ***"Future BMW models will remain digitally up-to-date via OTA upgrades and will receive updates even from the next and subsequent vehicle generations,"*** says Frank Weber, Board Member for Development at BMW AG.[25]

9%

Percentage of organizations that have decoupled their hardware and software architectures, at some scale

Figure 10.
One in 10 automotive organizations has decoupled hardware and software architectures and development cycles for their fleet

Have you or do you plan to decouple integrated hardware and software architectures and development cycles?



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 88 automotive OEM organizations.
*Deployed means that the organizations have moved beyond pilots.

Industry will need an overhaul

Realizing this ambitious goal will require a revision of the operating model (as mentioned by 86% of organizations), tools (highlighted by 80%), and methods or processes (73%). Nine in 10 also believe new skillsets will be needed. Karin Pennemann, Vice President, Marketing & Strategy, Cross-Domain Computing Solutions, Bosch, says, ***"The transition from a hardware-centric to a software-driven paradigm necessitates a strong emphasis on training and empowering our associates with the requisite skills and a mindset geared towards agility and transformation. This isn't merely about recruiting new talent; it's crucially about upskilling our existing workforce and decentralizing decision-making authority to those with direct expertise."***

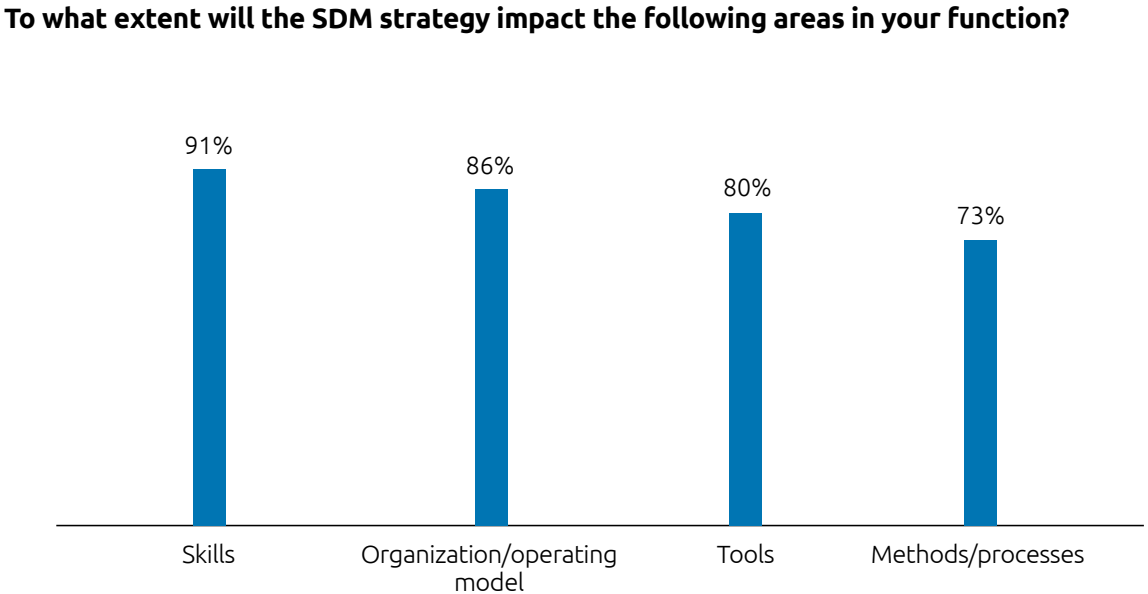
Turning a car into a digitally updatable product starts with people: alongside drivetrain and chassis specialists, organizations need software and cloud engineering experts, data scientists, and cybersecurity analysts. But cross-functional platform squads and 24/7 security operations centers won't slot neatly into the old sub-system silos, as they need their own budgets, roadmaps, and decision-making

rights.

A new toolkit will also be a necessity. A safety-certified CI/CD pipeline, digital twins that operate in the cloud, and automated test farms – all of these must fit inside a cohesive process. In short, making cars behave like software products requires a full-stack rethink of skills, structure, tools, and day-to-day methods.

As a part of its vision to accelerate SDV transformation, the Hyundai Group plans to develop a shared hardware and software platform for vehicles to significantly reduce the time required for all mass-production processes, including planning, design, and manufacturing. Further, the Group's internally developed Connected Car Operating System (ccOS) is expected to maximize hardware performance through extremely high computing power. Hyundai is also building a new data platform that can combine and process data generated throughout the vehicle's entire lifecycle.[26]

Figure 11.
A significant majority agree that SDM is going to impact their talent and operating model, besides tools and methods



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 196 automotive organizations.

Several challenges hinder transformation

The shift to software-driven mobility fundamentally disrupts the core of how automotive organizations are structured and operate, and Figure 12 shows the top challenges that organizations face.

92%

Percentage of organizations that rank "different organizational functions having conflicting requirements and working in silos" among their top two challenges in progressing towards software-driven mobility

Conflicting functions and engineering framework misalignment

Most legacy OEMs are still organized around a waterfall/V-cycle development model, with R&D segmented by functional components such as powertrain, chassis, infotainment, etc. However, the software demands a different paradigm in terms of agile development, cross functional collaboration, platform thinking, and real-time data feedback loops. Many traditional actors still lack these capabilities and are in the early stages of this realization. They may acknowledge the need for change, but few have internalized the scale of transformation required, or launched the kind of change management programs necessary to support it. Volkswagen delayed the market launches of the Porsche Macan Electric and the Audi Q6 e-tron by more than a year owing to software development issues. More delays are anticipated for its electric vehicles (EVs), including its ID.4 successor and a new Porsche electric sports utility vehicle (SUV).[27] Ballooning costs and delays forced Ford to abandon its fully networked vehicle project to build next-gen electrical architecture.[28]

Safety and cybersecurity compliance challenges

Two major challenges that organizations contend with are the desynchronization of hardware and software lifecycles and regulatory compliance pressures. Once organizations have cleared the hurdle of mismatched hardware and software cycles, they must address regulations. The United Nations Economic Commission for Europe (UNECE) World Forum for Harmonization of Vehicle Regulations mandates that vehicles must stay secure by design, and also introduces a legal basis for OTA/FOTA updates to on-board vehicle software.[29]

Absence of centralized software excellence structures

Segmenting vehicle systems into separate functional components worked well when their interactions were fixed, predictable, and relatively simple. In that setup, optimizing each subsystem individually led to an overall optimized vehicle. But today, interactions between components are far

more frequent, constantly evolving with each software update, and often extend beyond the vehicle itself. In this environment, keeping engineering teams siloed, where each function is making decisions independently, is no longer effective. Tesla was able to consolidate their engineering organization, enabling its engineers to work together on projects.[30] General Motors also consolidated distinct software functions, such as software, digital and IT, and digital business, all under one organization.[31]

Organizational silos, lack of centralized software leadership, and slow decision-making are impeding the move to a consistent software strategy. Historically, OEMs prioritized vehicle-level optimization, allowing each silo to choose its own solutions, which led to inconsistency across programs. The current shift is toward an "inversion of priorities," where standardized software platforms take precedence even if it limits individual vehicle optimization to enable scalable, consistent mobility services.

Talent acquisition costs and industry competition

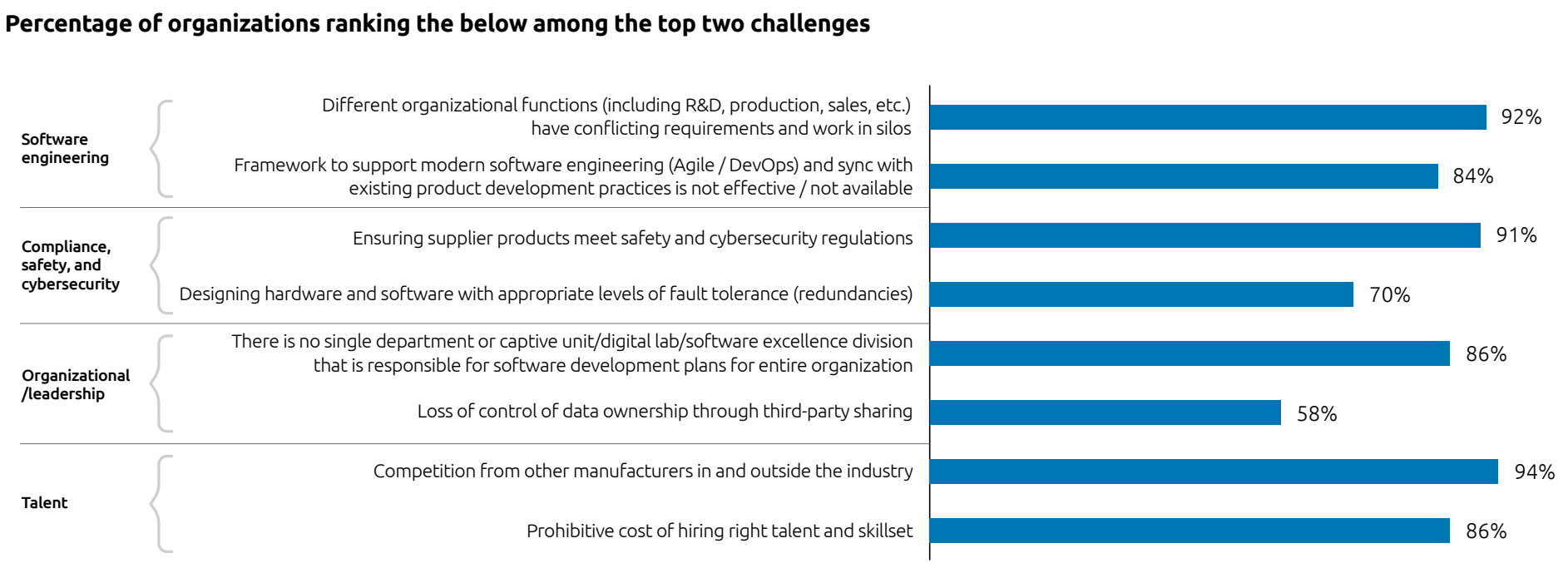
Finally, our research also highlights the challenge of talent. Today's software engineers have a broader range of choices. People who can combine traditional automotive engineering with modern software skills, such as those juggling functional safety, and Kubernetes and machine-learning (ML) pipelines, are in high demand across industries – not just by tech companies focused on cars, but also by cloud providers and fintech firms. This shift makes it critical for OEMs to become attractive employers by offering compelling career paths, fostering a software-first culture, and investing in talent retention. Sourcing the right talent is now more competitive and expensive. Automotive organizations must take significant steps to compete. To accelerate its development of EVs and SDM, GM hired an additional 8,000 technical staff.[32]

Jean-Pierre Dumoulin, formerly with Stellantis, highlights another critical challenge, ***"Legacy OEMs are struggling with the software transformation, not just because of technology, but due to deeply rooted cultural and structural barriers. Their mechanical engineering heritage often clashes with the agile, collaborative nature of software development. To truly build software-defined vehicles, they must evolve into software-driven companies, revamping everything from purchasing to manufacturing."***

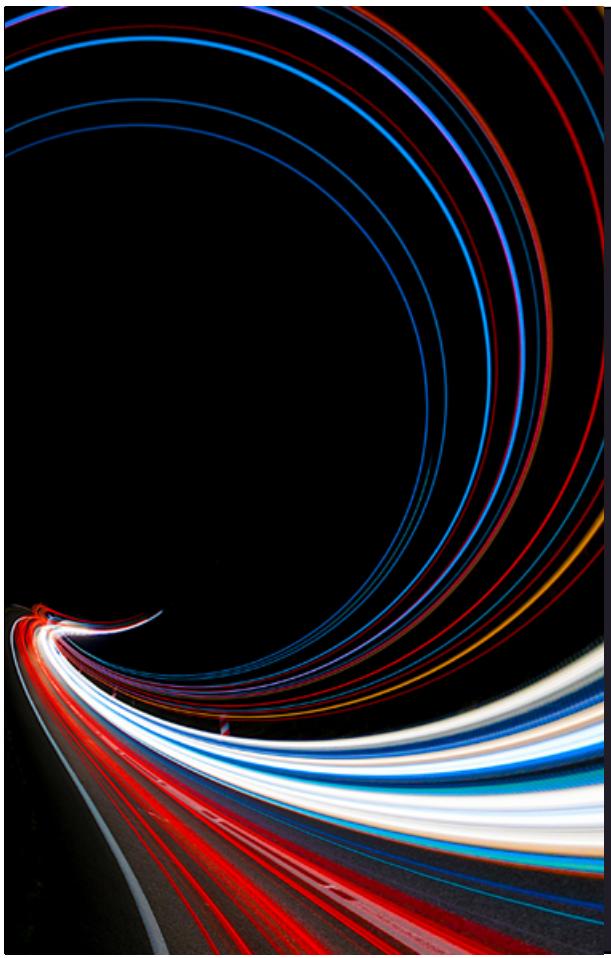
94%

Percentage of organizations that rank "prohibitive cost of hiring right talent and skillset" among their top two challenges in progressing towards software-driven mobility

Figure 12.
SDM progress faces many hurdles



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.



Digital mobility innovation by Chinese and global digital natives

Customers' willingness to pay, readiness, and acceptance of new technologies vary by age of customer base and region. Faster adoption in some markets enables OEMs to accelerate innovation and deployment. At the same time, organizations with deeply integrated digital technologies are increasingly disrupting the automotive industry through rapid innovation. Additionally, Chinese automotive organizations have also evolved from budget brands to innovation leaders at a remarkable speed. These companies are moving with a start-up-like speed but at an industrial scale. Their approach emphasizes standardization of hardware and software, rapid development cycles, and centralized architecture. They combine consumer-centric design with deeply localized user interfaces, making the in-car experiences more engaging and relevant.

Strategic learnings from Chinese and global digital native automakers for legacy OEMs:

- **Prioritizing customer-centricity:** Beijing-based Chinese EV startup Li Auto exemplifies customer-centricity in vehicle development by placing user experience (UX) at the core of its strategy. The company offers an intelligent cockpit experience featuring a five-screen, three-dimensional interactive interface.[33] Its proprietary AI system, Mind GPT, powers adaptive features across its vehicles, including Face ID and family accounts, and provides personalized navigation, entertainment, and comfort settings.[34]

- **Shifting to centralized architectures:** With digital-first DNAs, these organizations are demonstrating the advantages of centralized electronic architectures, consolidating multiple ECUs into powerful vehicle-level computers. This reduces wiring complexity, enables real-time cross-domain coordination, and leverages the speed of development in virtual environments, accelerating prototyping, validation, and deployment of new features. Volkswagen's partnership with XPENG exemplifies this.[35] Rivian has transitioned to a zonal electrical architecture, reducing wiring by 1.6 miles and consolidating ECUs into powerful centralized controllers within just two years, simplifying manufacturing and enhancing scalability.[36] Similarly, Tesla uses a centralized HPC that manages nearly all vehicle functions, enabling rapid software updates and deep system integration.[37]

- **Treating software as a core product – without doing it all alone:** Chinese automakers such as NIO, XPENG, and BYD and companies like Tesla and Rivian treat software as central, enabling FOTA updates of performance and safety functions, rather than relying on dealership visits. A compelling example is XPENG's rollout of its City Navigation Guided Pilot (City NGP) in Beijing, which offers advanced driver assistance in complex urban environments. With each update, the system refines its ability to handle lane changes, bypass obstacles, and follow traffic patterns – gaining the equivalent of a year's driving experience every three months.[38]

- **Standardizing and collaborating for common functions while controlling differentiators:** While many players vertically integrate to gain control of software, China's ecosystem thrives on collaboration and standardization. The result is a hybrid model, vertical integration for differentiation, and collaboration for scale and speed. BYD exemplifies this dual approach. On one hand, it develops critical software components in-house, including battery management systems (BMS), vehicle control units (VCUs), infotainment platforms, and ADAS.[39] On the other hand, it actively partners with players like Huawei[40] and NVIDIA[41] to advance the development of SDVs equipped with intelligent features. Annie Xie, responsible for the product management for the IDVP (intelligent digital vehicle platform), Huawei, comments, ***"We support multiple collaboration models in EEA architecture planning and design. Some OEMs opt for our full-stack solution, which bundles hardware, OS, and applications. Others prefer a joint innovation model, where we provide reference designs and core modules (include hardware module and OS, middleware, etc.), and they build their own software on top."***

- **Differentiating by building in-house autonomous driving platforms:** These organizations are investing massively in proprietary ADAS and autonomous-driving capabilities. BYD's newly launched "God's Eye" driving assistance system showcases its commitment to in-house innovation. The system uses BYD's self-developed intelligent driving chip and algorithms, and incorporates computer platforms from other suppliers, including NVIDIA and Horizon Robotics.[42] BYD has integrated this system across its product range, including entry-level models.[43] Similarly, Tesla is also developing its proprietary Full Self-Driving (FSD) system, which continuously evolves through real-world data and AI-driven updates.[44]

- **Accelerating software development through rapid iterations:** Digital automotive brands often employ short iteration loops, continuous deployment, and direct consumer feedback to evolve products faster than legacy OEMs. By using agile methodologies, XPENG has dramatically accelerated its development and deployment cycles, to one version iteration every two days and a full OTA experience upgrade every two weeks. In the 70 days since its global debut on May 20th, 2025, Tianji XOS has undergone five major updates and over 35 version iterations.[45] With fewer external dependencies, these automakers can bring new features and models to market in months, rather than years.

These organizations are not just building cars – rather, they're building ecosystems. Their success is rooted in a holistic strategy that fuses software, hardware, and UX into a unified product-and-services vision. Legacy OEMs must embrace software as a strategic asset, standardize on non-differentiating functions, and prioritize mobility customers' overall needs as the key driver of strategy.

Many global legacy OEMs have already begun adopting the "in China, for China" approach by collaborating with Chinese players to leverage their strengths and remain competitive. By tapping into China's advanced software-defined vehicle (SDV) ecosystems and rapid pace of development, these OEMs have accelerated innovation and reduced time-to-market. Notable examples include the BMW Group's collaboration with Momenta, a Chinese ADAS technology provider, to co-develop advanced driver assistance systems specifically for BMW's China portfolio,[46] and Volkswagen's partnership with XPENG to jointly develop smart electric vehicles,[47] both illustrating how traditional automakers are integrating with local digital ecosystems to stay ahead.

The Chinese market is also being transformed by supplier-led innovation. Automotive suppliers such as Desay SV,[48] ECARX,[49] and Huawei[50] are playing a pivotal role in the SDM transformation. Their intelligent cabin/driving solutions, ranging from domain controllers to immersive UX platforms, are empowering OEMs to deliver highly differentiated and engaging in-car experiences.

03 Preparing for a software-first future

The automotive industry is moving toward software-driven solutions

Decades-old traditional vehicle architecture with statically integrated ECUs and software functions could handle the pre-defined features that are hard to update in conventional vehicles. However, with connected, more autonomous vehicles, and sophisticated mobility services relying on even more complex sets of electronic systems and sensors, greater responsiveness and data-processing power are required.

In our survey, among the traditional OEMs that are in the process of decoupling their hardware and software architectures, around seven in 10 automotive executives report continued use of legacy, distributed architectures, relying on independent ECUs for each function, with minimal cross-domain communication and software tightly coupled to hardware. Automakers are adopting a phased approach to gradually transform their E/E architecture into a more centralized, software-driven model that is both scalable and upgradable:

- 43% of executives plan to adopt centralized architectures with high performance computing units (HPC) within three to five years.
- 53% aim to evolve further toward software-driven and fully data- and AI-augmented architecture in five to ten years frame (see Figure 13b).

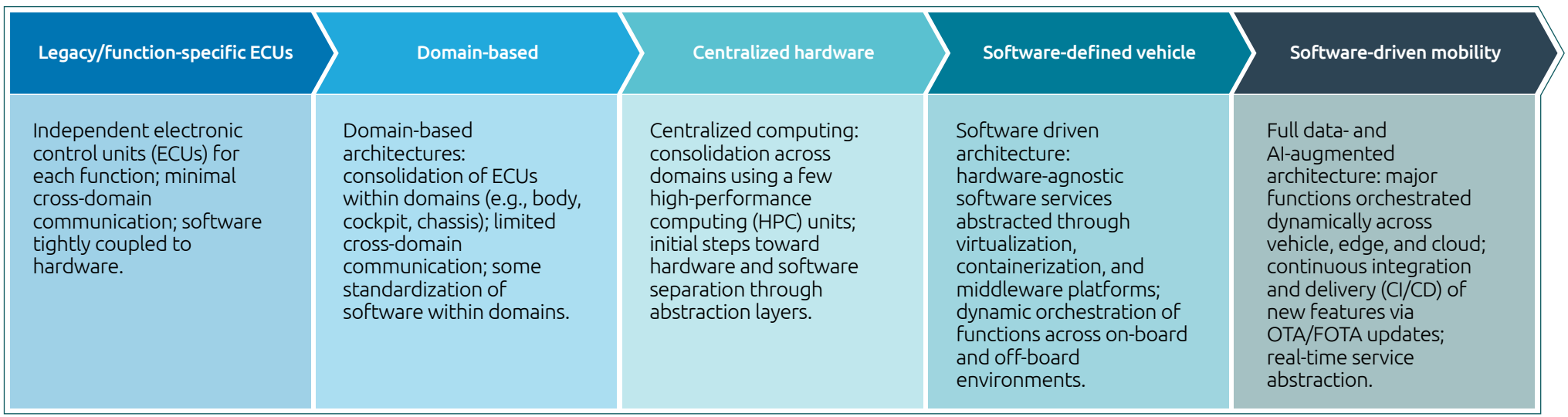
43%

Percentage of executives that plan to adopt centralized architectures with high performance computing units (HPC) within three to five years

53%

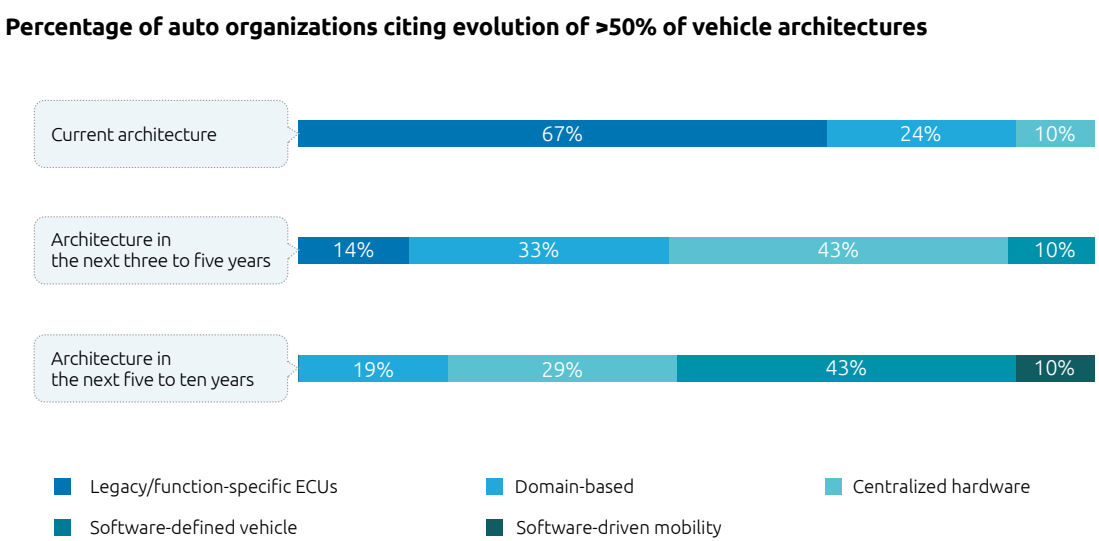
Percentage of executives that aim to evolve further toward software-driven and fully data- and AI-augmented architecture in five to ten years

Figure 13a.
Evolution of vehicle and mobility solutions architecture



Source: Capgemini Research Institute, Software-driven mobility research analysis.

Figure 13b.
Automakers are steadily transitioning from a function- and domain-based architecture to a more centralized and software-driven architecture



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 21 automotive executives from organizations that are in the process of decoupling (i.e., separating their previously tightly integrated hardware and software architectures and development cycles).

Early movers, including Tesla[51] and Chinese EV OEM NIO, have pioneered centralized HPC architectures with full-stack software approaches and FOTA capabilities. NIO recently introduced comprehensive digital architecture that includes a computing platform, sensors, communication systems, power systems, software, toolchains, and cloud and data integration.[52]

Traditional OEMs are introducing centralized, cloud-augmented, software-driven architectures for their next-gen vehicles. This enables diagnostics and maintenance, facilitates FOTA software updates, and simplifies feature enhancements. For instance, BMW Group employs advanced zone-based software that reduces wiring complexity and supports continuous development.

Tier-1 suppliers are also advancing toward centralized vehicle architectures. For example, Bosch is developing new E/E systems to manage complex future vehicle systems.[53]

Automakers aspire to deliver a UX like that of smartphones, in terms of intuitive access to systems and applications. The new E/E architecture helps manufacturers reduce total cost of ownership (TCO) by saving on wiring harnesses, development, and production.

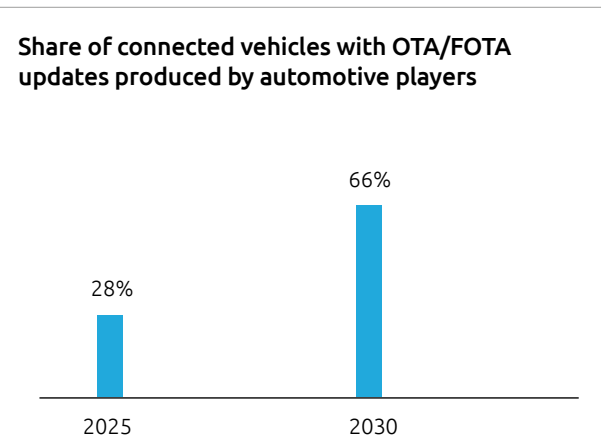
More connected, more updatable

For OEMs, the ability to upgrade and enhance vehicle features, beyond infotainment, through FOTA is both a technical and a dynamic, strategic necessity that redefines the customer relationship. Digital-native companies like Tesla have long leveraged FOTA to deliver innovative features; in 2024, for example, Tesla introduced an update enabling Apple Watch integration to unlock vehicles, open the trunk, check charge status, and control interior climate.[54] Traditional OEMs are now accelerating efforts to catch up.

- According to our survey, automotive OEMs anticipate 66% of their total vehicles will connect with OTA updates, a significant increase from the current 28% (see Figure 14). While 100% coverage is not feasible due to legacy vehicles that lack connectivity and cannot be retrofitted for OTA, nearly all vehicles currently in production support some level of OTA functionality. For example, BMW delivers OTA updates to over 10 million vehicles across all brands, model series, and drive types. These updates span comfort, safety, infotainment, powertrain, and driver assistance systems, demonstrating the broad impact of a robust OTA strategy.[55]

- Mercedes-Benz recently rolled out a major OTA update including ChatGPT integration to over two million vehicles, enhancing infotainment capabilities and improving overall driving experience.[56] A VP at a multinational automotive firm mentions, ***"While nearly all new models support OTA, older vehicles lack the necessary hardware, and retrofitting takes time. The ramp-up begins with high-end models and gradually expands across the fleet. However, infrastructure gaps such as uneven 5G coverage and cybersecurity requirements continue to slow progress. As older vehicles are phased out, fleet penetration is expected to accelerate."***

Figure 14.
Automotive OEMs expect that two-thirds of their fleet will connect with OTA/FOTA updates by 2030

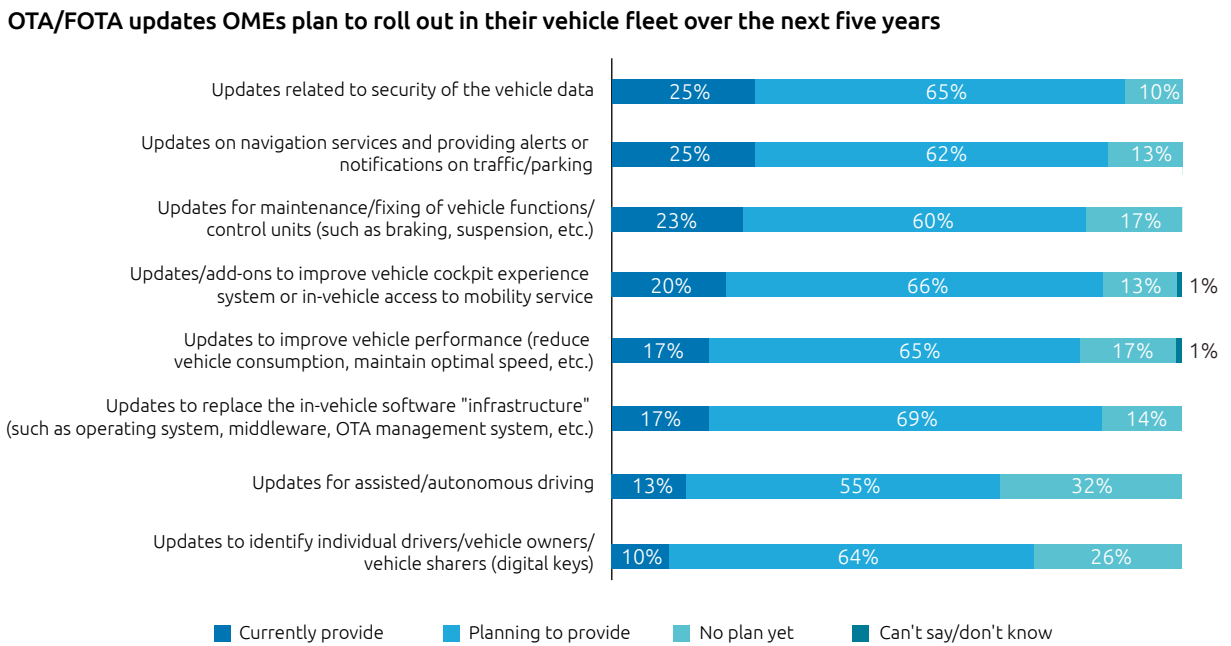


Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 100 automotive OEMs.

Our survey indicates that only about one-quarter of OEMs currently provide updates for key features such as vehicle data security, navigation services, cockpit experience improvements, performance enhancements, and in-vehicle software infrastructure replacements. Only 25% of OEMs currently offer OTA/FOTA updates for vehicle data security and navigation services. However, most plan to implement OTA/FOTA updates over the next five years (see Figure 15). Among the various features that organizations plan to roll out, in-vehicle software updates and vehicle interface and mobility access improvements rank the highest.

OTA/FOTA updates have two key dimensions: the technical ability to deliver updates remotely, and the organizational control over developing and approving the software being deployed. While many OEMs can transmit updates, they struggle with managing different types of software, ranging from minor feature tweaks to critical safety updates. These updates often follow different development lifecycles, and ensuring that vehicles remain tested and compliant after updates is a complex challenge that's frequently underestimated.

Figure 15.
Significant number of OEMs are planning to deploy OTA/FOTA updates within five years



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 100 automotive OEM organizations.

"When we launched Mobilize Beyond Automotive, our goal was clear: we didn't want to be just another carmaker. We envisioned a software-first company where services drive the strategy, and vehicles simply support the experience. That's why we say, 'Beyond Automotive,' because the real innovation lies in the digital platforms we build around mobility."

Jean-Christophe Labarre
Director, Mobility Services at Mobilize,
Renault Group

The ability to deliver ongoing improvements can significantly influence purchasing decisions and brand loyalty. Moreover, our survey highlights that organizations believe that, on average, buyers are willing to spend an additional 3.7% on vehicles equipped with connected features and services.

The automotive industry continues to make progress toward the development of fully autonomous vehicles. However, realizing this vision remains a long-term and ambitious goal that will require sustained innovation, regulatory alignment, and significant technological breakthroughs. Over the next five years, Level 3 and 4 autonomy is expected to become significantly more common. Our survey also reveals that automotive players expect around 23% of their fleets to feature advanced autonomy (Level 3/4) within the next five years, up from 11% currently.

Stellantis, for instance, has recently announced its first in-house-developed automated driving system, providing "Hands-Free and Eyes-Off" (SAE Level 3) functionality.[57] Similarly, BMW has integrated Level 2 and Level 3 features into its new BMW 7 Series from August 2024.[58]

OTA/FOTA updates are often implemented out of necessity but underutilized, unlike Tesla which uses them quite frequently to launch MVP vehicles and continuously enhance customer experience. OTA/FOTA enables feature upgrades post-purchase, potentially increasing resale value and reducing technology costs. In the commercial vehicle sector, FOTA is crucial for maximizing uptime and minimizing expensive workshop visits or recalls. It facilitates remote diagnostics, predictive maintenance, and fleet-wide updates,[59] thereby making it a strategic mechanism for delivering long-term value beyond just software deployment.

AI is an embedded reality

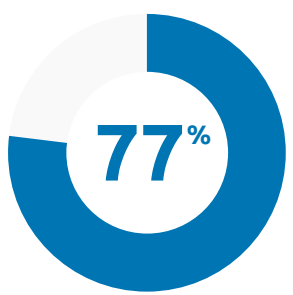
By reducing costs, boosting productivity and efficiency, and enhancing product quality, AI is propelling the industry into a new era of innovation. Our survey highlights that more than three-quarters of automotive organizations believe successful integration of AI into software development, in-vehicle functions, and mobility services will offer competitive advantage (see Figure 16).

85%

Percentage of organizations that report that AI is increasingly becoming an integral part of automotive software, embedded directly into software features and functions

Figure 16.
Most automotive organizations see AI integration in software, vehicles, and mobility as offering a competitive edge

Percentage of organizations who agree with the statement



Organizations that effectively integrate AI into software development, in-vehicle functions, and mobility services will gain a competitive advantage

Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.

"AI fundamentally enables scalability within our platform. Through modular architecture and cutting-edge technology, we achieve seamless scaling without the need for constant hardware overhauls. Ultimately, it boils down to optimizing the largest possible code for the smallest device footprint."

Fedra Ribeiro
EVP, Sales, Cross-Domain Computing Solutions, Bosch

In our survey, 85% of automotive organizations report that AI is increasingly becoming an integral part of automotive software, embedded directly into software features and functions. Fedra Ribeiro, EVP, Sales, Cross-Domain Computing Solutions, Bosch, adds, ***"AI fundamentally enables scalability within our platform. Through modular architecture and cutting-edge technology, we achieve seamless scaling without the need for constant hardware overhauls. Ultimately, it boils down to optimizing the largest possible code for the smallest device footprint."***

Most (86%) surveyed organizations view integration of AI for ADAS and autonomous driving capabilities as extremely significant in their organization's software-driven Highlighting the role of synthetic data in AI

applications, Dr. Luc Julia from the Renault Group says, *"Synthetic data plays a crucial role in simulation, whether it's crash testing or replicating rare road scenarios. Since we can't crash cars endlessly or recreate every possible situation on a test track, we rely on AI-powered simulations to train systems like ADAS. The real challenge, however, lies in accessing real-world data. Due to GDPR and restrictive contracts, using actual vehicle data is often not an option, making synthetic data not just helpful, but essential."* Additionally, 74% consider AI's role in cybersecurity (e.g., detecting threats in vehicle data) critical. Davide Montosi, Director, Software & Electronics Technology, Aston Martin, summarizes, *"In my personal view, there's no playbook anymore. Every process in vehicle development is being reshaped, especially by AI. To stay ahead, we must rethink, and rebuild everything we thought we knew well."*

"In my personal view, there's no playbook anymore. Every process in vehicle development is being reshaped, especially by AI. To stay ahead, we must rethink, and rebuild everything we thought we knew well."

Davide Montosi
Director, Software & Electronics Technology,
Aston Martin

AI in automotive: Enhancing in-vehicle intelligence and accelerating time-to-market

The examples below illustrate the potential of AI to transform diverse segments across the automotive value chain.

Areas	Use cases	Examples
Vehicle design	• Generative design • Simulation and testing to optimize safety and performance	• Volkswagen's AI Lab, a global AI competence center and incubator, develops early-stage AI prototypes.[60] • BMW Group uses AI to simulate crashes and aerodynamic performance early in design.[61]
Vehicle software development and testing	• Creating requirement specifications and test cases • OTA management ▪ Feature update preparation and automation ▪ Intelligent scheduling and rollout ▪ Predictive update validation	• Volkswagen is relying on Copilot within Codebeamer, an ALM platform from PTC, to enable its engineers to create new requirement specifications and test cases using specific data and business context. This AI assistance improves overall quality by reducing duplication, and ensures compliance with existing engineering standards.[62] • XPENG uses AI to process vehicle and cloud data, enabling rapid algorithm updates and continuous enhancement of autonomous driving features via OTA.[63]
Operations	• Automation and robotics • Predictive maintenancee • Quality control • Energy optimization • Human-robot collaboration • Autonomous manufacturing	Mercedes-Benz uses ChatGPT to optimize production data analysis and quality management.[64] It also uses AI to monitor relevant sub-processes in the pilot testing, leading to 20% energy savings.[65] • Toyota improves efficiency of its manufacturing operations through its in-house-developed AI platform. [66] • Hyundai Motor Group will deploy Atlas humanoid robots and develop a physical AI ecosystem at its various manufacturing and logistics bases in the US and around the world.[67] • Tesla also has plans to develop 10,000 humanoid Optimus robots in 2025 to tackle industrial automation, logistics, and consumer services.[68]

Areas	Use cases	Examples
Supply chain	• Inventory management • Supply chain optimization • Autonomous logistics and routing	• Toyota has implemented AI-driven predictive models to streamline inventory management across its multiple production sites.[69] • Renault uses AI to prevent shipping disruptions by suggesting real-time workarounds. This helped cut expedited parts deliveries, unfinished vehicles, and production downtime by 50%, saving €260 million in inventory.[70]
Connected car experience	• ADAS • Autonomous driving	• Starting in 2027, Nissan will integrate self-learning AI into its ProPILOT driver-assist system (ADAS) to enhance collision avoidance and adaptability.[71] • Volvo has established Zenseact, a dedicated AI and software organization, to enhance its ADAS and self-driving capabilities.[72] • GM uses AI to develop autonomous driving systems, enhance vehicle hardware, and create AI-powered in-cabin experiences.[73]
Customer experience	• Personalization • Infotainment • Smart navigation • Voice assistants • Driver monitoring • Predictive service alerts • AI-powered virtual assistants	• Stellantis' STLA SmartCockpit platform utilizes AI and multi-modal interfaces (voice, touch, gesture, glance) to provide navigation and entertainment services within the vehicle. [74] • GM has developed an in-car ChatGPT assistant to help drivers solve real-time vehicle issues. It can offer instructions for tasks such as changing tires, explaining vehicle alerts, and scheduling maintenance visits.[75] • Toyota uses connected vehicle data to develop ML predictive maintenance models for components such as batteries, brakes, tires, and for oil changes. These models notify customers of maintenance needs, ensuring reliable mobility experiences.[76]
Cybersecurity	• Threat detection and response	• Ford Trucks uses a software platform with AI-powered cybersecurity detection to protect its connected commercial vehicle fleet.[77]

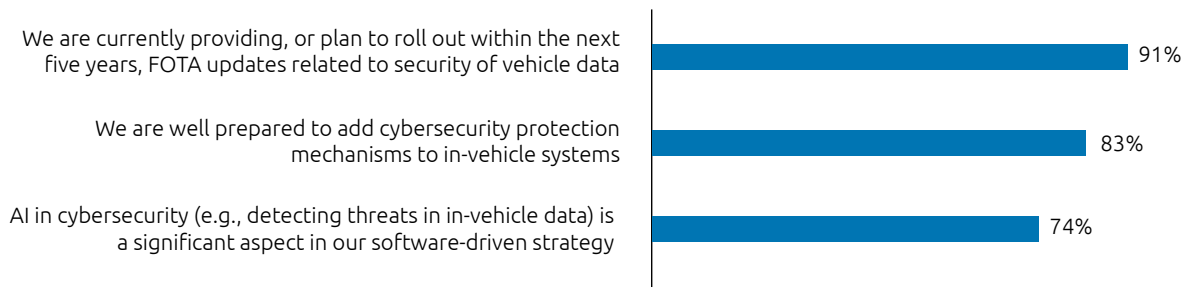
Cybersecurity and safety remain top priority

Rapid digitization of vehicles has expanded the attack surface, so addressing software vulnerabilities urgently is now essential. Exploitation can lead not only to data theft, but to vehicle hijacking or manipulation of safety systems.

Nine out of 10 organizations in our research already push FOTA patches to combat cyber-risk, or will do so in the next five years. Tesla had to recall more than two million vehicles due to a font size on its instrument panel being too small, which made the lights hard to read and thereby increased the risk of a crash. Tesla fixed the issue with an FOTA update.[78]

Around eight in 10 organizations say they are "well prepared" to reinforce in-vehicle systems, while the United Nations Economic Commission for Europe (UNECE) WP.29 framework, specifically regulations R155/156, require OEMs to provide safe and secure software updates, with a focus on enhancing cybersecurity and software update management in modern vehicles. The industry is relying on AI to deliver security.

Figure 17.
FOTA-and AI-driven cybersecurity are key strategies for large majority



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 112, 200, and 200 automotive organizations, respectively.

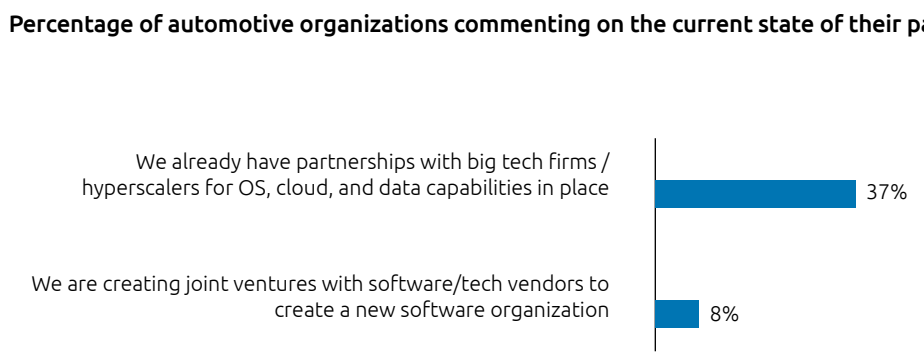
04 Partnerships and ecosystems are driving SDM

Automotive organizations have realized that they cannot master every part of this transformation on their own. So, they are partnering with allies in certain areas while maintaining a tight grip where it matters to their brand. For instance, roughly two in five organizations in our research already lean on big tech or hyperscalers for OS, cloud, and data capabilities. BMW is using AWS to help innovate new features for its next generation of Neue Klasse vehicles. Along with Qualcomm, the BMW Group is developing the next generation of the Automated Driving Stack, which is based on the Snapdragon Ride system-on-chip (SoC) and computer vision stack from Qualcomm.[79] Renault Group expanded its existing partnership with Google to develop platforms and services for future SDVs. This collaboration will include in-vehicle software to help enable the SDV platform, as well as cloud software to enable a digital twin.[80] Georges Massing, VP, MB.OS, automated driving, and integration electric/electronic, Mercedes-Benz, explains their reasoning behind partnerships, ***"We begin by analyzing our architecture to pinpoint our strengths and identify any gaps. This helps us decide whether to partner, co-develop, or handle things in-house. It's all about choosing the right fit – whether that's teaming up with NVIDIA for computing power or Google for scalable data – always with the product experience as our guiding focus."***

Joint ventures (JVs) are a route to realizing the SDM ambition. Volkswagen Group and Rivian have formed a joint venture to co-develop next-gen electrical architecture and software for future EVs, including subcompact cars, aiming to cut development costs and accelerate tech deployment.[81]

Sony and Honda pooled resources to form Sony Honda Mobility, which plans to launch Afeela EVs with next-gen software.[82] Only 8% of organizations have sealed such deals to date, but another third aims to follow within three years.

Figure 18.
Nearly two in five automotive organizations have partnerships in place with big tech/ hyperscalers



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.

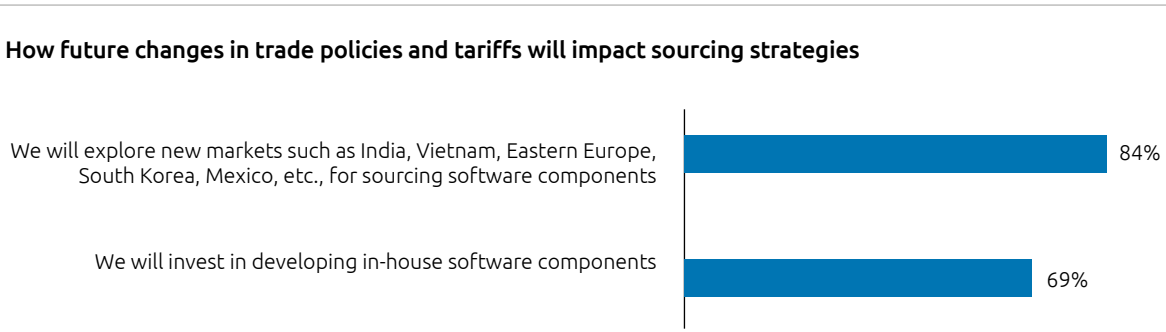
The industry has also realized that teaming up with their peers on non-differentiating aspects, such as safety stacks, tools, and middleware, is beneficial, allowing them to compete where it matters. Such collaboration for open platforms such as Autoware[83] fosters shared innovation, accelerates development, and helps establish unified standards across the automotive industry. At the same time, it allows them to redirect their budgets to proprietary innovations in UX, competitive differentiation, and integration. Eclipse SDV and SOAFEE also align on APIs and middleware to cut duplication.

Organizations are also rewiring supply chains for geopolitical resilience. Concerns about rising tariffs could prompt up to 84% of organizations surveyed to scout suppliers in new markets such as India, Vietnam, and Eastern Europe. In 2024, ZF invested $200 million in Monterrey, Mexico to create a technology center with corporate hubs, a manufacturing plant, and an R&D center focused on technologies for electric and autonomous mobility.[84]

Finally, relying on external partners does not mean handing over strategic assets. Nearly 70% of the organizations say they are doubling down on in-house development. This is particularly helpful for selective components within the areas where software defines differentiation. Mercedes-Benz built its MB.OS as a proprietary OS, integrating its own software with NVIDIA's DRIVE platform; [85] MB.OS is designed and developed in-house which allows the organization to retain full control over the customer relationship, ensure data privacy, and offer its customers a differentiated experience through the integration of all car functions. Georges from Mercedes-Benz adds, ***"When we began our SDV journey, the first question was: what's important? The answer was clear, customer experience. That focus led us to take control of key experiences like building our own HMI and voice systems, always considering unique market needs and content, and it continues to guide everything we do, right up to MB.OS."***

Figure 19.

Automotive players favor expansion into new software markets to mitigate risks from potential trade policy or tariff changes



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 170 automotive organizations.

Automotive organizations have traditionally viewed software, especially domains like ADAS, as proprietary differentiators. But with limited budgets and rising complexity, this approach is unsustainable and necessitates the shift toward collaborative ecosystems. A shared software architecture across ecosystem partners can serve as a foundation for innovation, allowing OEMs to focus their resources on brand-defining features, mitigating budgetary constraints, and also accelerating time-to-market and enhancing interoperability.

Michael Tenschert, Automotive Industry Lead and Head of "Cloud & Custom Applications" Center of Excellence, Capgemini, remarks, ***"Software-driven mobility is about rethinking the way mobility is designed, delivered, and experienced. The organizations that thrive will be those that treat software as a living ecosystem, where platforms evolve continuously, partnerships fuel innovation, and talent works across disciplines to anticipate and shape customer needs."***

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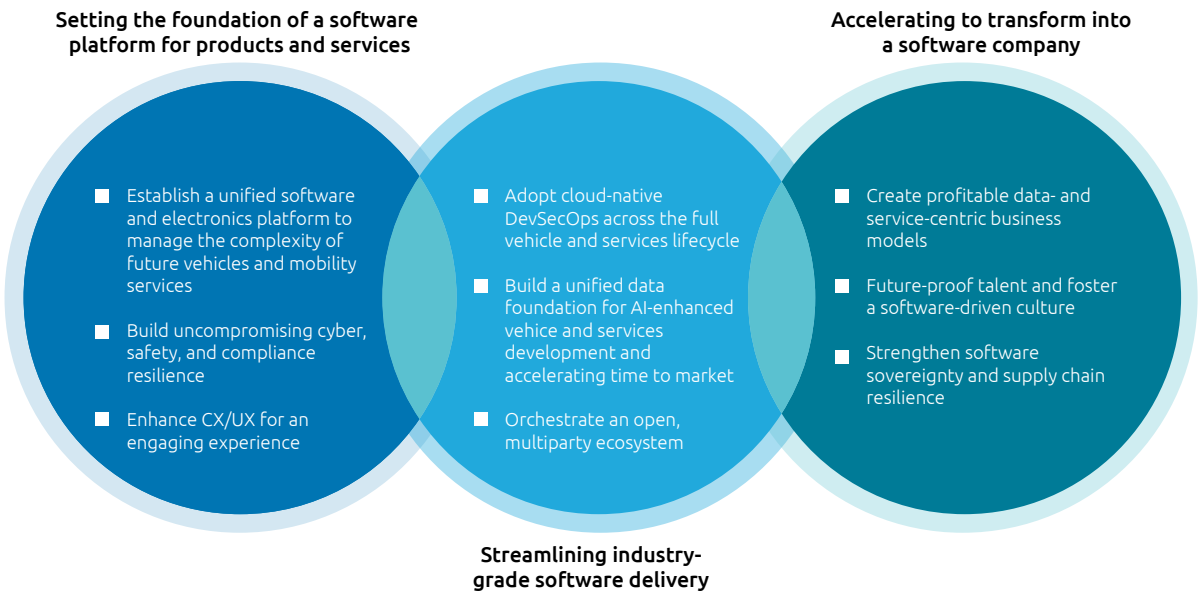
Automotive Industry Lead and Head of "Cloud & Custom Applications" Center of Excellence, Capgemini

05 How the automotive industry can forge a software-first future

As the automotive industry transitions to software-driven mobility, OEMs must address the challenge of maintaining products over extended lifecycles. This shift requires organizations to manage both legacy systems and future architectures in parallel, ensuring continued support for vehicles already on the road while enabling rapid innovation. Sustaining this balance is a core competency for OEMs, as it directly impacts customer trust and long-term brand value. Based on our survey, interviews, and experience, we propose the recommendations below for organizations to become software-ready organizations.

Figure 20.
Key recommendations for organizations to become software-ready organizations



Source: Capgemini Research Institute, Software-driven mobility research analysis.

Set the foundation of a "software platform for products and services"

Establish a unified software and electronics platform to manage the complexity of future vehicles and mobility services

OEMs are under mounting pressure to accelerate innovation and deliver continuous updates and cross-domain coordination. In contrast, software-native organizations have set new benchmarks for agility, scalability, and user-centric innovation. OEMs must integrate software and hardware development through a common digital thread and unified platform to reduce system complexity. This transformation delivers significantly higher value as OEMs progress beyond Level 4 (SDV) maturity as shown in Fig 13a. Our survey highlights that 58% of executives view centralized E/E architecture with unified software stacks across domains as key to SDM. Many OEMs are already moving in this direction.

"Building next-generation vehicles requires a precise coordination of multiple development paths for onboard and offboard developments. The potential for improvement today is huge and promising. It means embedding continuous development, validation, simulation, and automation into every stage of development so that software evolves with the same pace and reliability customers expect from consumer tech."

Eric Dalla Vecchia
VP for Automotive, and Global Lead for Software-Driven Transformation, Capgemini

"Standardized software stacks and abstractions are no longer optional in this industry. They form the shared foundation that allows automakers to scale innovation without duplicating effort. True differentiation comes not from reinventing the basics, but from focusing energy on customer-facing features, while the common layers enable speed, security, and interoperability across brands."

Jayashree Ravichandran,
Vice President, Automotive Software,
Capgemini

To compete for the future of mobility, OEMs must evolve their software platform artefacts through the following key actions:

- **Consolidating electronics into a centralized architecture:** Fewer, more powerful units can enable OEMs with real-time, cross-domain coordination, reducing hardware redundancy and supporting secure, high-speed data communication and virtualization.

  Similarly, OEMs need to adopt modular and open architecture. Designing vehicle software platforms with modularity and open standards such as Eclipse SDV and SOAFEE allows for flexible integration of components from multiple suppliers, reducing single points of failure. The European Commission's Vehicle of the Future initiative exemplifies this approach by promoting collaboration among manufacturers and suppliers.[86]

- **Adopting unified software stacks and abstractions (including vehicle OS and middleware):** Building a standardized, shared software infrastructure, by using or contributing to commercially available and open-source solutions, is a key step toward creating a strong foundation across vehicle platforms. This foundation is essential for future vehicle architecture. This infrastructure will enable scalability, interoperability, and continuous innovation. Its value lies in standardization at scale, making it a shared, non-differentiating layer across the industry. Therefore, automotive players should focus on collaborative development through partnerships, open-source initiatives, and cross-industry alliances. Differentiation efforts are better focused on customer-facing capabilities, where user experience and brand value are most visible. Volkswagen's CARIAD exemplifies this approach by deploying a unified cloud software platform across Audi, Porsche, SEAT, Škoda, and Volkswagen, streamlining backend systems and enabling advanced app development for next-gen vehicles.[87] Jayashree Ravichandran, VP, Automotive Software, Capgemini, reflects, ***"Standardized software stacks and abstractions are no longer optional in this industry. They form the shared foundation that allows automakers to scale innovation without duplicating effort. True differentiation comes not from reinventing the basics, but from focusing energy on customer-facing features, while the common layers enable speed, security, and interoperability across brands."***

- **Exposing stable onboard and offboard APIs and SDKs:** Creating stable, backward-compatible APIs and software development kits (SDKs) for both internal teams and external partners creates a more agile, collaborative, and scalable software development environment. This strategy supports the broader shift toward CI/CD and other agile methodologies. Automotive players have started creating application programming interfaces (APIs) specifically for internal teams and third parties. Tesla for instance is officially opening its API for third-party fleet management, allowing vehicle owners to control access while enabling external developers to innovate, opening new revenue streams and enhancing CX.[88]

- **Embedding seamless OTA/FOTA upgrade capabilities:** OTA/FOTA upgrade capability future-proofs fleets and enables immediate updates to retain competitiveness. Integrating OTA/FOTA functionality enhances customer satisfaction, reduces recall-related costs, and opens up post-sale revenue opportunities. BMW demonstrates the power of this strategy by delivering OTA updates to over 10 million vehicles across brands, model series, and drive types.[89]

Critically, this transition must be supported by a dedicated model-based systems engineering (MBSE) framework. MBSE enables structured modeling, validation, and traceability across hardware and software domains, ensuring architectural coherence and reducing integration risks. It serves as a foundational discipline to align legacy systems with future-ready platforms, accelerating development while maintaining system integrity. By adopting this unified platform strategy, OEMs can streamline development, enhance vehicle intelligence, and remain competitive with agile, software-native disruptors.

Build uncompromising cyber, safety, and compliance resilience

The SDV is a rolling data center: complex, connected, and increasingly autonomous. Consequently, the attack surface for cyber threats and regulatory scrutiny has expanded. Automotive manufacturers can no longer treat cybersecurity, safety, and compliance as reactive or isolated functions, but must design them into the vehicle architecture. At the same time, international safety regulations and compliance frameworks such as UNECE R155/R156 and ISO 26262 are evolving to address the growing complexity of digital mobility.

- **Implement continuous vulnerability scanning and coordinated disclosure programs spanning vehicle, cloud, and mobile apps:** Securing vehicles is no longer limited to static perimeter defenses. It requires continuous scanning and threat assessment across all digital touchpoints. BMW includes measures such as secure boot processes, certificate-based communication, and runtime security features. BMW also ensures complete traceability of every software component, enabling engineers to identify and address vulnerabilities quickly, strengthening public trust in the brand.[90]

- **Industrialize compliance with UNECE R155/R156, ISO 21434, ISO 26262, and emerging AI-safety regulations through automated documentation and audit trails:** Standards such as UNECE R155 and R156 mandate cybersecurity management systems (CSMS) and software update management systems (SUMS), requiring automotive manufacturers to track, audit, and document software risks throughout a vehicle's lifespan. Consistent and frequent testing via automated security controls and test sequences is essential. Ford is implementing a cybersecurity management system (CSMS) to comply with UNECE R155/R156 and ISO 21434, that uses automated processes for traceability and audit-ready documentation across vehicle systems. Their strategy integrates cybersecurity into both in-vehicle and off-board systems for end-to-end compliance.[91] Emerging AI safety regulations are increasingly relevant as more vehicles incorporate computer vision, autonomous navigation, and ML.

- **Embed hardware "roots of trust":** Cyber resilience starts at the silicon level. Embedding hardware roots of trust ensures that a system can verify the integrity and authenticity of its software before execution. Secure boot processes, powered by cryptographic signatures, prevent malicious code from being uploaded during system startup.

- **Strengthening supplier risk management:** Automotive organizations should regularly assess their software suppliers' financial health, cybersecurity posture, and compliance with worldwide standards.

Enhance CX/UX for an engaging and differentiating experience

Using software to filter and harness data to enhance CX will be a key value proposition, whether that be through virtual assistants or by enhancing software offerings like ADAS.

- **Use vehicle and user data to offer tailored services, and enhance hardware longevity through software optimization:** OEMs need to focus on using vehicle data to optimize software in ways that extend the lifetime of hardware components. This approach improves reliability and user satisfaction while also fostering brand loyalty. Additionally, according to our survey, 84% of organizations provide or plan to provide OTA maintenance capabilities, enabling continuous improvements and updates that support this strategy.

- **Use AI to enhance in-vehicle experiences:** Integrating AI into the vehicle will enhance UX, and its maturity will be a key purchase consideration. A meaningful 70% of organizations surveyed state that AI for enhancing in-vehicle experience is a significant component of their software-driven strategy. BMW's Intelligent Personal Assistant[92] retains users' preferences (e.g., driving routes or music) and can provide vehicle/driving information on voice command. AI can also enhance auxiliary features such as ADAS and autonomous driving capabilities, which 86% of organizations surveyed said is extremely significant to their software-driven strategies.

- **Support third-party app integration through standardized APIs in a sandbox environment:** Standardized APIs can seamlessly integrate third parties into the software experience. Smartcar[93] is one such API; it is compatible with many car brands and supplies useful information to mobility-service providers. Furthermore, integrating these apps into a sandbox environment preserves privacy and security.

Streamline industry-grade "software delivery"

Adopt cloud-native DevSecOps across the vehicle and services lifecycle

As the automotive industry advances toward a more connected, autonomous future, organizations must treat software not just as a component of the vehicles they develop, but as their foundational layer. To support this, adopting a cloud-native DevSecOps approach is essential, as it integrates development, security, and operations seamlessly across both vehicle and cloud environments. Through a cloud-native DevSecOps approach that embeds security and functional safety checks directly into the development pipeline, organizations can proactively identify and mitigate vulnerabilities, reducing the risk of costly recalls and enhancing vehicle safety.

To manage software complexity and security, automotive organizations should:

- **Set up end-to-end CI/CD pipelines:** As a first step, OEMs should adopt a comprehensive software engineering framework encompassing the processes, methods, and tools of modern software development alongside the underlying platforms. This foundation enables the implementation of robust CI/CD pipelines that support seamless development, testing, and deployment of software updates across embedded systems. Automated processes reduce manual errors, improve software quality, and deliver new features to customers reliably and at high frequency. BMW has implemented a modern DevOps platform to manage CI/CD pipelines for embedded systems development of the next generation of ECUs.[94]

- **Use digital twins and virtualization to accelerate validation and reduce reliance on physician testing:** OEMs should prioritize virtualization such as virtual hardware-in-the-loop (vHiL) and virtual broadnet environments to

enable automated, shift-left validation. HiL testing should be reserved for final approvals only. Similarly, digital twins allow developers to simulate and test software in a controlled environment. This approach can reduce validation timelines from around four years to under 24 months, supported by tools like Microsoft's SDV toolchain for digital twins and CI/CD pipeline management.[95] Eric Dalla Vecchia, VP for Automotive, and Global Lead for Software-Driven Transformation, Capgemini, asserts, ***"Building next-generation vehicles requires a precise coordination of multiple development paths for onboard and offboard developments. The potential for improvement today is huge and promising. It means embedding continuous development, validation, simulation, and automation into every stage of development so that software evolves with the same pace and reliability customers expect from consumer tech."***

- **Adopt advanced variant management:** OEMs must also adopt a new form of variant management that can handle increasing complexity. This should be tightly integrated with DevSecOps workflows to enable continuous validation and efficient lifecycle management of software variants across platforms and regions.

- **Use Gen AI to accelerate software engineering and automate test case creation:** Developers can use Gen AI tools to create comprehensive test suites, and identify high-risk areas in the codebase. It enables data continuity across the entire vehicle lifecycle – from defining requirements, to generating the right epics and user stories, to optimizing the creation and execution of test cases. This boosts productivity and software quality and reduces time-to-market. For example, BMW Group has developed a Gen AI assistant to empower DevOps teams to streamline their infrastructure optimization efforts.[96]

Build a unified data foundation for AI-enhanced vehicle development and accelerating time-to-market

Automotive companies need a structural shift in how they operate in order to truly harness AI's potential in shaping in-vehicle experiences and in accelerating time-to-market.

To leverage AI for in-vehicle design, development, and testing, organizations need to build a robust, unified data foundation. This includes consolidating data from sensors, infotainment, telematics, and the cloud into a standardized, secure framework. Without this, AI models will be limited by incomplete or inconsistent inputs. They must also adopt modular, hardware-agnostic software architectures so AI features can be deployed, updated, and scaled without being tied to specific chipsets or ECUs. This agility allows AI-enabled

"We begin by analyzing our architecture to pinpoint our strengths and identify any gaps. This helps us decide whether to partner, co-develop, or handle things in-house. It's all about choosing the right fit – whether that's teaming up with NVIDIA for computing power or Google for scalable data – always with the product experience as our guiding focus."

Georges Massing
VP, MB.OS, automated driving, and integration electric/electronic, Mercedes-Benz

functions, be it for safety, personalization, or autonomy, to evolve in step with customer expectations and regulatory demands.

When it comes to time-to-market, leveraging AI effectively requires organizations to rethink their development pipeline. Traditional waterfall processes are too slow for the speed of AI iteration. Automotive organizations need to embed AI into an agile, DevSecOps environment, where design, simulation, testing, and compliance checks happen in parallel, powered by digital twins and cloud-based compute.

More importantly, AI integration must be backed by a culture of continuous learning. Feedback from deployed vehicles, including performance data, customer usage patterns, and safety insights, should flow directly into model retraining and feature refinement. This closed-loop system turns every vehicle in the field into part of the R&D ecosystem, ensuring that AI not only launches faster but improves faster.

Orchestrate an open, multiparty ecosystem

Post-development standards must be developed and enforced to ensure software is compatible with multiple systems. Organizations recognize the importance of this: our survey indicates that an average of 9% of software budget is allocated to shared software initiatives (such as SOAFEE, Eclipse SDV), building strategic alliances, and initiatives. Fedra Ribeiro from Bosch mentions, ***"Our approach involves contributing to open-source initiatives where industry-wide scale benefits everyone, while simultaneously safeguarding what makes us unique. It's a balance between fostering ecosystem growth and preserving our differentiating value."***

- **Align with leading hyperscalers, tech partners, chipmakers, integrators and open-source foundations (such as SOAFEE, Eclipse SDV):** OEMs must view adherence and creation of standards as paramount. The foundations should involve stakeholders (e.g., chipmakers, cloud technology providers) from across the value chain. Open sourcing can help foster a rich developmental ecosystem. Foundations such as SOAFEE aim to deliver a cloud-native architecture enhanced for automotive applications by collaborating with various industry experts. Automotive Grade Linux (AGL) is a similar open-source project that collaborates with leading Japanese organizations to develop Linux-based software platforms.

- **Adopt open communication and data standards (V2X, COVESA):** Vehicles increasingly interact with on-road objects, other vehicles, and pedestrians to facilitate autonomous or assisted driving features. Within this context, not least from a safety perspective, vehicles must follow a common data and communication standard. COVESA, an alliance of OEMs, suppliers, and technology providers, aims to establish such standards for seamless data transfer and interoperability.

- **Set clear IP and revenue-sharing rules to protect proprietary assets:** Protecting IP to safeguard differentiating assets is essential to preserving competitive advantage. However, organizations must

"The transition from a hardware-centric to a software-driven paradigm necessitates a strong emphasis on training and empowering our associates with the requisite skills and a mindset geared towards agility and transformation. This isn't merely about recruiting new talent; it's crucially about upskilling our existing workforce and decentralizing decision-making authority to those with direct expertise."

Karin Pennemann,
Vice President, Marketing & Strategy,
Cross-Domain Computing Solutions,
Bosch

recognize the utility, under certain circumstances, of foregoing IP rights to facilitate collaborative effort. For instance, lower-level software infrastructure will be used by all brands, making it suitable for collaborative development and distribution. Resource allocation can be channeled to develop proprietary branded software, with which customers interact directly and that offers brand differentiation and competitive advantage.

- **Adopting modular and open architecture:** Designing vehicle software platforms with modularity and open standards such as SOAFEE allows for flexible integration of components from multiple suppliers, reducing single points of failure. The European Commission's Vehicle of the Future initiative exemplifies this approach by promoting collaboration among manufacturers and suppliers.[97]

The VP for SDV at an automotive supplier summarizes, ***"Software-defined vehicles are too complex for anyone to go it alone. The real strength lies in knowing when to build, when to integrate, and when to partner. The failures we have seen weren't technical, they came from thinking you could outpace the ecosystem alone."***

Accelerate to transform into a "software company"

Create profitable data- and service-centric business models

Enabling the vehicle portfolio to support the mobility service opens up a new market as part of a sprawling, sustainable service-based ecosystem.

Additionally, OEMs can continue to engage with customers through post-sales offerings by offering upgrades or add-ons, including subscription offerings, providing recurring revenue. Customer preferences for subscriptions vary across markets. For instance, customers in China are more willing to pay for subscriptions. The central locus spearheading all these monetization initiatives is a robust application of user and vehicular data.

- **Define clear value propositions and pricing tiers:** Organizations can offer a variety of supplementary value-added features. Tesla's Acceleration Boost package enhances acceleration in exchange for a one-time payment.[98] Our survey also revealed that 68% of organizations expect to offer content-related subscription services within five years. BMW, for example, offers a subscription-based High Beam Assistant[99]that switches between low and high beam automatically, based on driving conditions.

- **Monetize vehicle and user data for insurers, energy providers, etc.:** With data protection and privacy laws at the forefront, data collected by automotive OEMs can be fed into related areas, such as insurance. Daimler Buses provides vehicle data to telematics and depot management system providers and to the charging station network.[100]

- **Launch mobility-service platforms (MaaS, fleet, subscription) to capture downstream revenue:** OEMs can generate recurring and service-led revenue beyond initial sales. There is strong institutional and government support for mobility-based services that reduce environmental footprint. The EU prioritizes a green mobility strategy to encourage the growth of such

platforms, which many OEMs have already built. Hyundai offers a car subscription service through Mocean, which operates in the UK, with plans for European expansion.[101, 102] Our survey indicates that organizations expect 10% of global revenue to come from mobility services by 2030.

- **Build direct digital commerce channels that allow customers to try out software:** Platforms for direct digital commerce can keep customers engaged and informed of new industry developments, as well as offering an efficient automated trial and sales platform. Hyundai's Bluelink app offers post-sales features on a trial basis as well as subscription bundles for customer convenience.

Future-proof talent and foster a software-driven culture

The increasing complexity of SDVs requires a workforce fluent in software, AI, and cloud-based technologies. Traditional OEMs often operate with legacy skillsets and rigid structures that cannot keep pace with market evolution.

A notable example of a more forward-looking approach is Egypt's collaboration with DXC Luxoft, which led to the launch of the Middle East and Africa's first certified android automotive training program.[103] This initiative highlights national investment in localized and specialized software talent. Organizations must focus on the following strategic pillars:

- **Upskill legacy mechanical and electrical engineers in software, AI, and cloud disciplines:** Many engineers have previously had limited exposure to modern software, AI, and cloud-based technologies. To bridge this gap, organizations should design upskilling programs that integrate hands-on training to develop software skills to enhance technical capabilities. Toyota launched its Software Academy to upskill talent in AI and software development.[104]

- **Adopt agile, product- and service-oriented team structures:** Traditional organizational structures often follow a "waterfall" model with siloed teams and long development cycles. This model is ill-suited to software development, which requires rapid iteration, continuous feedback, and cross-functional collaboration. Automotive organizations must transition to agile methodologies. Agile transformation also promotes accountability and autonomy. Instead of managing inputs (e.g., hours worked), teams "own" outcomes, such as delivering OTA updates or improving driver-assistance features.

- **Secure global talent pipelines through flexible work arrangements targeting strategic campuses and acquisitions:** Automotive organizations must look beyond traditional hiring hubs to tap into diverse and scalable talent pools. Flexible work models, including remote roles and hybrid setups, can expand access to high-caliber software engineers across geographies.

- **Assemble the right team:** Beyond skills and structure, having the right mindset and cultural alignment is critical. Recruiting individuals who are not only proficient in software but also capable of thriving in fast-paced, iterative environments is key.

The future of mobility hinges not just on technological advancement, but on the people who drive it. Upskilling legacy talent, embracing agile structures, globalizing recruitment, and fostering a collaborative, inclusive culture are foundational steps toward future-proofing the automotive workforce. As the industry transitions from hardware-defined to SDVs, and from products to "products and services," organizations that prioritize talent transformation will be better positioned to lead in innovation, safety, and CX.

Strengthen software sovereignty and supply chain resilience

With rising geopolitical tensions, market uncertainties, and ongoing global trade and tariff challenges, the automotive supply chain is increasingly vulnerable. Ramakrishnan Ramanathan, Vice President, Born Electric Vehicle and New Mobility, Renault Group, remarks, ***"With regulations taking effect across the US and Europe, we've adopted a pan-European open software development approach, guided by a clear requirement matrix. This framework helps us decide what to build, buy, or borrow, ensuring our software remains compliant, secure, and future-ready."*** In this context, software sovereignty has emerged as a strategic imperative to ensure that an organization is not entirely dependent on software it cannot access or control, especially during critical situations such as system failures, vendor insolvency, or abrupt policy changes in foreign jurisdictions.

To mitigate these risks, automotive organizations must reduce their strategic dependencies on foreign software ecosystems:

- **Strategically balance ownership, control, and collaboration across software components:** While developing and maintaining software in-house, organizations gain full control over quality, customization, scalability, and data governance, enabling faster innovation and agility. OEMs should prioritize owning and staffing internal teams for software that is both mission/business-critical and differentiating, such as proprietary vehicle OS or ADAS algorithms. Leading OEMs such as Hyundai Motor Group,[105] Mercedez-Benz,[106] and Volkswagen Group[107] have already developed their own proprietary vehicle OS. While doing this, OEMs should collaborate on non-differentiating components such as middleware, basic connectivity stacks, or standard interfaces to reduce duplication, accelerate development, and foster ecosystem-wide compatibility.

  Legacy systems and end-of-life products, where differentiation and strategic value are low, can be outsourced with a focus on economic performance.

  This balanced, layered approach allows organizations to focus internal resources on areas that truly drive competitive advantage.

- **Implement code escrow agreements or open-source strategies:** To safeguard mission-critical systems such as ADAS, and digital twin platforms, organizations should implement code escrow agreements or adopt open-source alternatives. Code escrow agreements involve a trusted third-party agent holding the source code of critical software, with predefined conditions for its release such as vendor insolvency or acquisition, ensuring continuity and compliance with safety and regulatory standards such as ISO 26262 and UNECE WP.29. Alternatively, open-source software can offer transparency, community-driven support, and long-term maintainability, allowing internal teams to evolve the software independently while reducing vendor lock-in.

- **Harness OSS:** OSS allows organizations to use publicly available source code that can be reviewed, modified, and maintained by internal teams or the broader developer community. This fosters rapid prototyping and integration. Participation in open-source communities also promotes shared standards, interoperability, and collective problem-solving. To maximize the value of OSS, automotive players must invest in internal governance, security vetting, and compliance processes. Tesla, for example, has built its OS using a customized stack of open-source components, to stay ahead of the competition while ensuring the performance, security, and flexibility its customers expect. [108]

Conclusion

The automotive industry's center of gravity has shifted from metal to code. Most organizations are still learning to walk on this new terrain. Almost every respondent sees software eclipsing hardware as the main competitive lever, but the gap is still wide between vision and rollout. Barely one organization in seven has moved a software-driven use case from pilot to full production, with legacy architectures muddying the waters.

That tension explains why respondents single out organization, tools, methods, and skills as the areas in flux. Organizations can't deliver fortnightly OTA drops with a structure designed for model-year releases, nor can they hit UNECE cyber mandates with a patchwork of siloed ECUs. The next five years will be decisive. Centralized compute is moving to production; AI is sliding from showroom demos into safety-critical code paths; and FOTA compliance is imperative. Organizations that treat these shifts as an add-on risk locking themselves out of future revenue pools, including subscriptions, data services, and autonomy upgrades. Our research shows that this dynamic is already shaping board-level discussion.

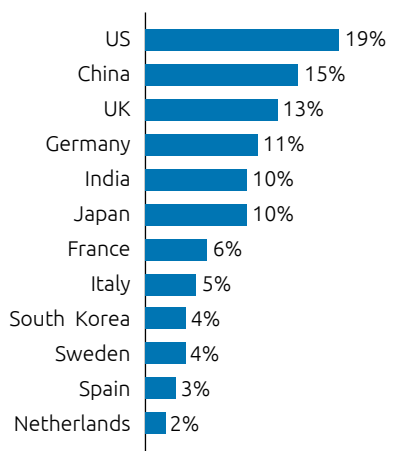
In short, software-driven mobility is no longer a horizon strategy. It is the OS of the business itself. The winners will be those who align practices, talent, platforms, and partners with that reality.

Research methodology

In June 2025, we conducted a survey of 600 executives from 200 long-established automotive organizations, with no more than four respondents from each organization. These executives represented organizations across four segments: original equipment manufacturers (OEMs), suppliers, mobility service providers, and digital natives from countries across North America, Europe, and APAC.

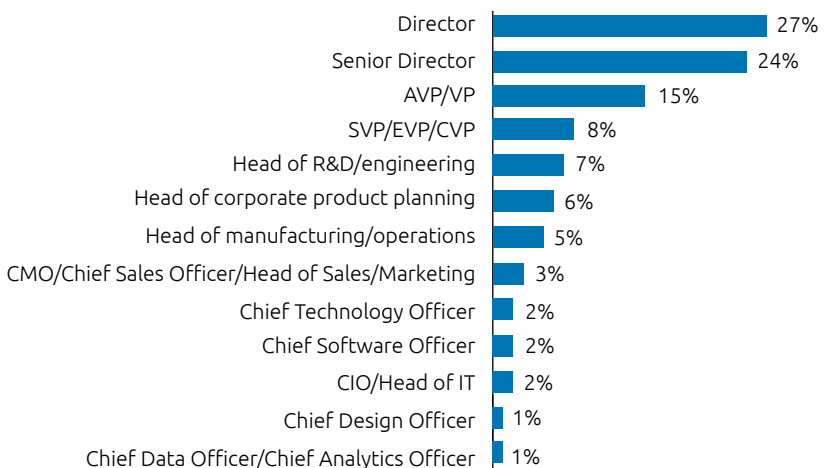
The surveys were complemented by eighteen interviews with industry experts. The distribution of survey respondents is provided in the following figure:

Executives by location



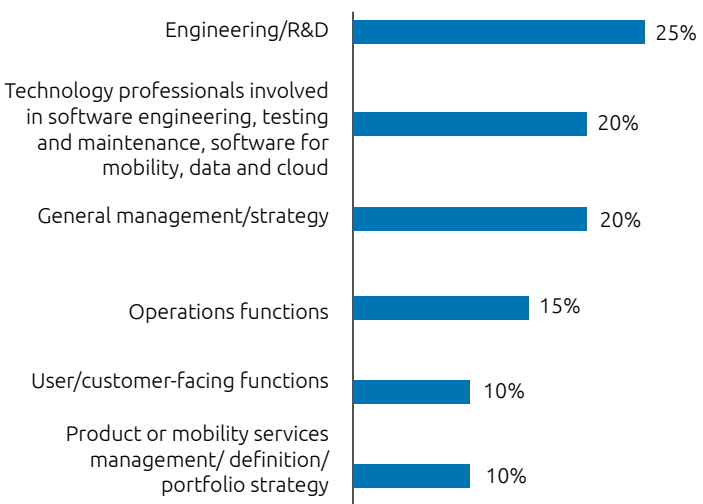
Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 600 executives from 200 automotive organizations.

Executives by job title/role



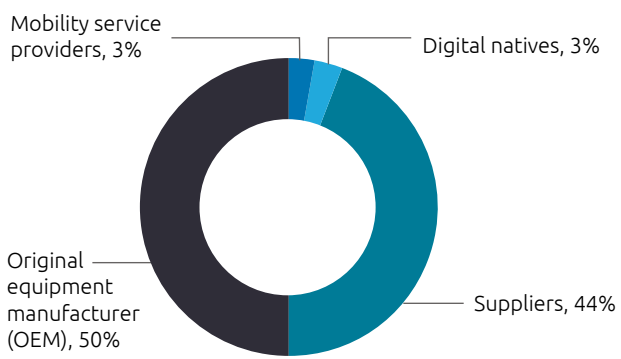
Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 600 executives from 200 automotive organizations.

Executives by function

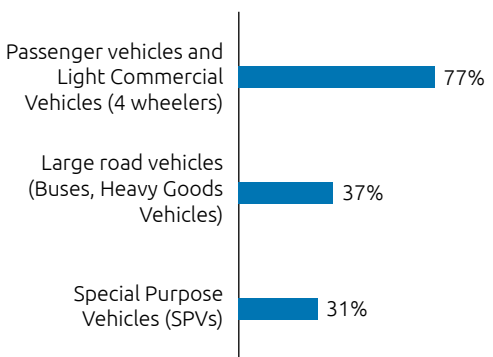


Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 600 executives from 200 automotive organizations.

Organizations by type

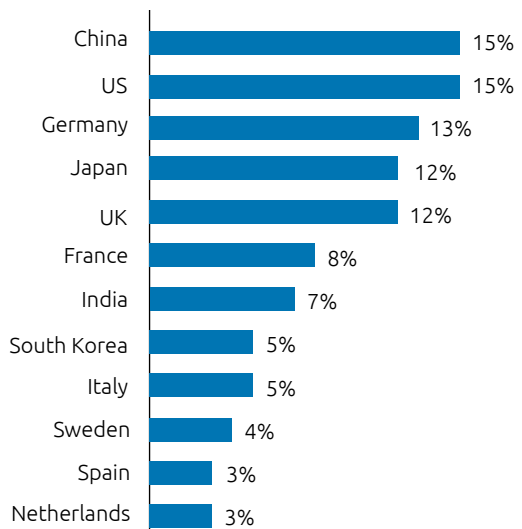


OEMs by type



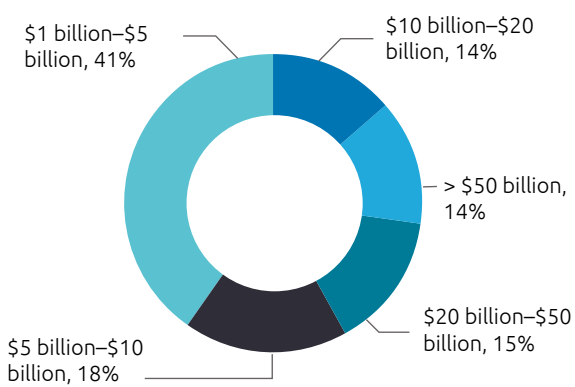
Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations, 100 OEMs.

Organizations by location of headquarters



Source: Capgemini Research Institute, Software-driven mobility survey, June 2025, N = 200 automotive organizations.

Organizations by annual revenues



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Capgemini's proven approach to SDM transformation

As this report has shown, transformation to SDM presents automakers with substantial and diverse challenges. Yet this transformation must happen at speed, not incrementally, if traditional OEMs are to overtake digital natives in the race to satisfy consumer expectations about seamlessly connected, continuously evolving digital experiences.

Capgemini's Software-Driven Mobility offer empowers your automotive company both to overcome the challenges and to accelerate the transformation. The offer is already helping leading automakers position themselves for continued success in a software-first future.

Our SDM approach is structured around three enablers that facilitate custom software development across all environments – software for vehicles, software for digital services, and software for enterprise. It also enables the organization to make best use of existing software and services, whether in-house or third-party.

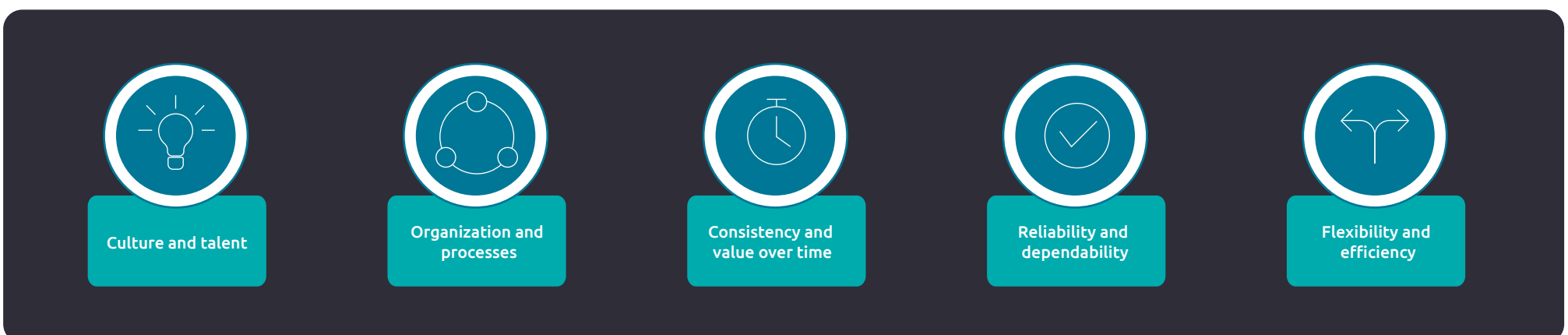
Accelerating transformation into a **software company**	Laying the foundations for a **software platform**	Streamlining industry-grade **software delivery**
Defining a **software strategy** leveraging core capabilities and prioritizing investments	Establishing end-to-end **architecture standards** for product and services	Creating a streamlined **software factory** [processes | methods | tools]
Addressing **talent and culture** through a reskill, upskill, and change management program	Ensuring **software compliance** to regulations, standards, and contractual terms	Shaping an innovative **testing strategy** focused on end-user experience
Driving the software **transformation and execution** of the value model	Setting up and running a **cybersecurity program** [define | protect | defend]	Setting up and running **efficient testing** across all environments

As experts in both system integration and custom software creation, Capgemini is uniquely positioned to support clients in their transformation to SDM. Our software experience and assets span design, development, and testing for enterprise, digital, industrial, and vehicle.

In addition, Capgemini is:

- An experienced service partner that fully understands the business transformation from products to services associated with SDM.
- A specialist in the convergence of software and business skills and practices across products, services, and enterprise – a convergence that is vital for SDM.
- A leader in mobilizing global software talents at scale to fill any gaps in clients' SDM capabilities.

With our help, clients are achieving excellence in five areas that are key to SDM success – areas where historic practices have tended to limit flexibility and the ability to innovate and scale.



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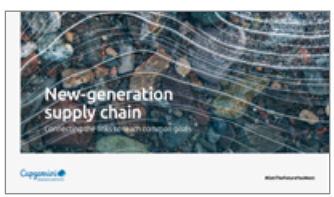
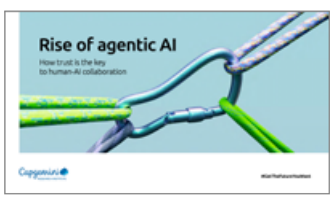
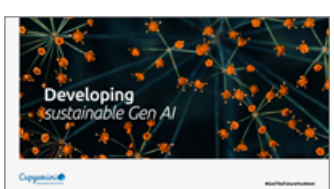


New-generation supply chain

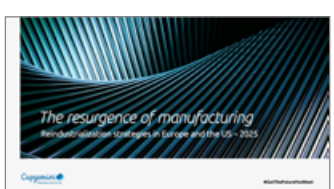


Rise of agentic AI

The battery revolution



Developing sustainable Gen AI



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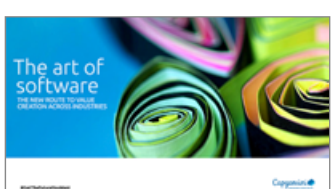
Gen AI in software



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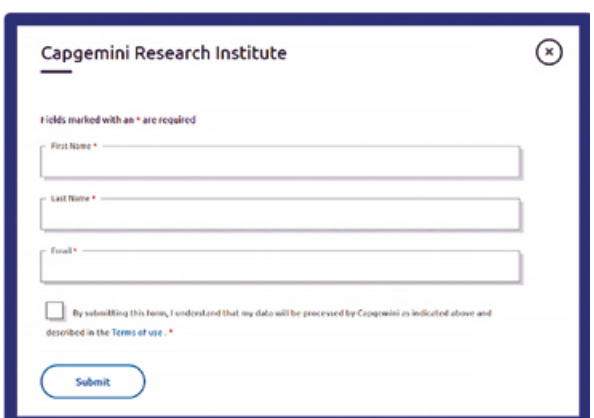

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About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 350,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, generative AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2024 global revenues of €22.1 billion.

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