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Automotive software and electrical/electronic architecture: Implications for OEMs

Companies must navigate issues around strategy and technology, processes, and organization to keep up as software and electrical/electronic architecture grow more important to mobility.

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April 2019

Decades in the making, the digital car is right around the corner. Where hardware—in the forms of stronger engines, silkier transmissions, and smoother suspensions—once ruled, software is becoming the industry's core enabler. Today, software is driving most of the key automotive breakthroughs in autonomous driving, connectivity, electrification, and smart mobility (ACES) and thus increasingly becoming a differentiating factor. It is also attracting investors: private investments in companies that develop technology for connected and autonomous vehicles totaled more than $9.5 billion through the third quarter of 2018.[1]

As a result, automotive OEMs face several challenges associated with software, from building a profoundly different electrical/electronic (E/E) architecture to adopting the processes and best practices to support efficient software development (Exhibit 1).

The stakes are high for automakers, since a lack of critical software capabilities represents a vital risk (perhaps best exemplified by the rising prevalence of start-of-production (SOP) delays and budget overruns). Even more troubling, software issues can lead to massive recalls and—in the case of hacking attacks—potential casualties.

OEMs must deal with the exponential increase in software content while attempting to reach software-development speeds typical of digital-native companies. They also must change their operating models to develop hardware and complex software side by side. Beyond these tactical issues, automakers need to focus on strategic topics like where to play along the technology stack and how to identify their unique value propositions in the software domain.

After working closely with OEMs and other players in the automotive industry and conducting extensive interviews with technology experts, we believe OEMs need to rethink their approach to software and E/E architecture. Success will depend on how well they navigate expected changes in software and electronics across three dimensions: strategy and technology, processes, and the organization.

Strategy and technology

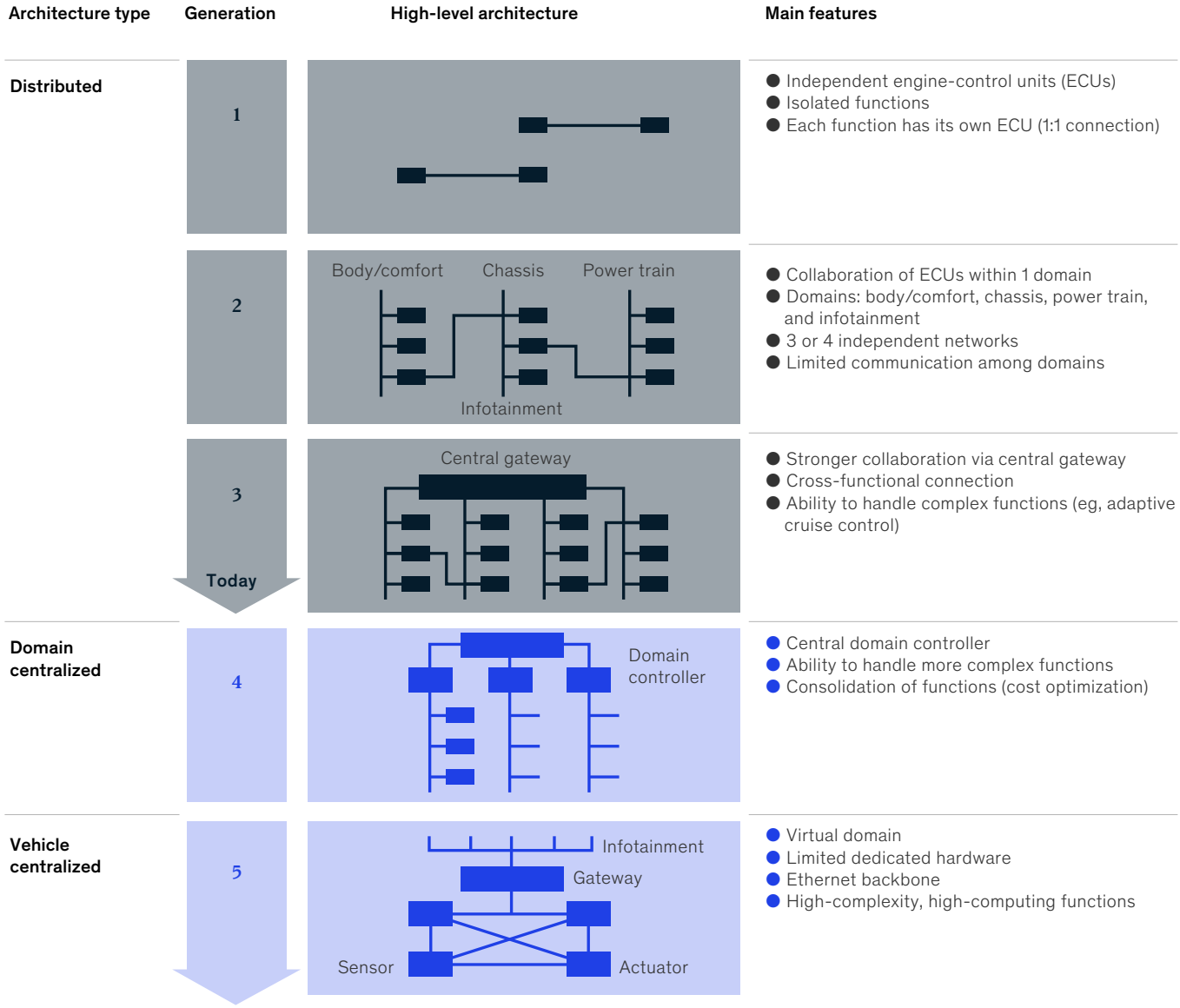
While the industry often relies on a standard of tightly integrated hardware and software architecture, the approach does pose several challenges. Among the biggest concerns are increased complexity, reduced flexibility,

As we approach the next inflection point, cars will become productive data centers and, ultimately, components of a larger mobility network.

[1] Sarah Gardner, "Autonomous-car tech investment skyrockets on SoftBank deals," Bloomberg, August 1, 2018, bloomberg.com.

Exhibit 1

Electrical/electronic architecture is evolving toward a centralized setup.



Source: McKinsey analysis

and often-unavoidable vendor lock in, which can limit flexibility.

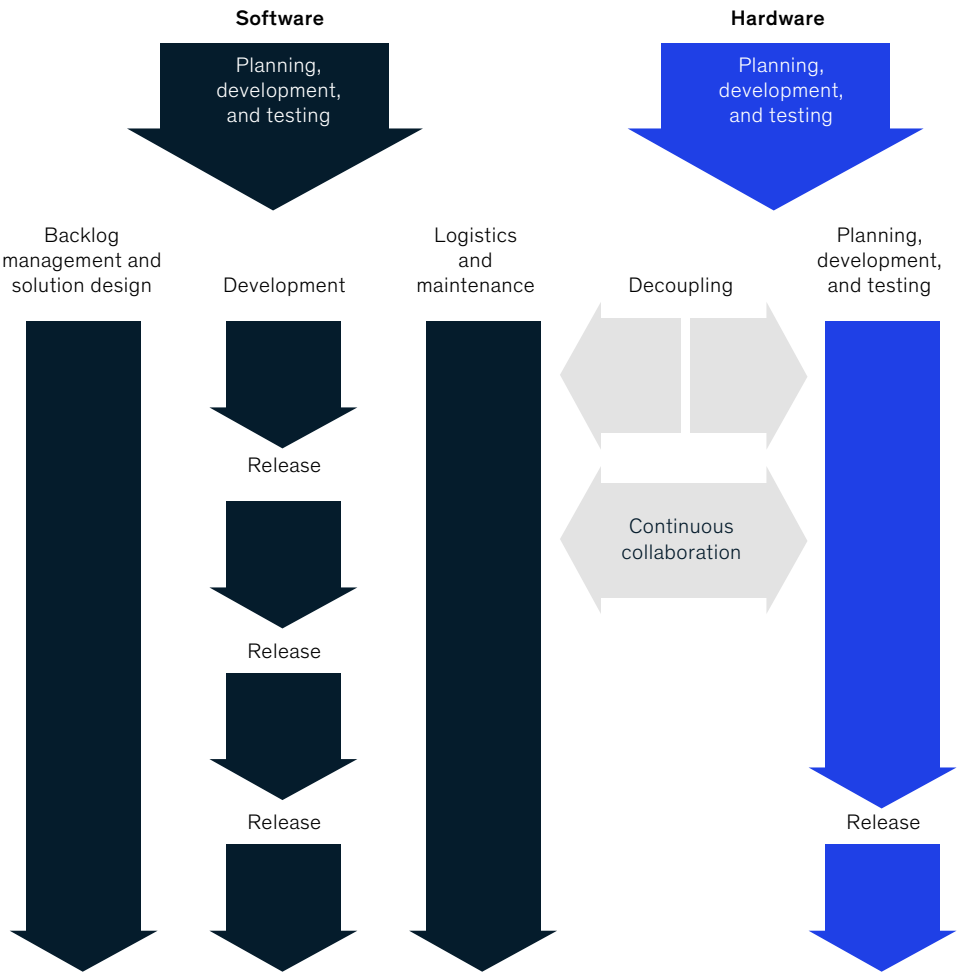
In response, automakers can adopt several important measures. On the process side, they can pursue a more dynamic software-cycle plan that involves frequent releases decoupled from rigid, distant vehicle-platform SOP dates (Exhibit 2). In practice, an OEM can implement this approach by coordinating separate backlogs and road maps, intensifying the use of testing and software-deployment automation, and restructuring

Exhibit 2

Decoupling hardware- and software-development cycles enables OEMs to develop software faster and deploy it more frequently.

Synchronized hardware- and software-development cycles …

… must be decoupled to enable faster development, more frequent releases, and improved collaboration among teams



Source: McKinsey analysis

agreements with vendors. With regard to architecture, players can decouple software from hardware by using a strong middleware layer that abstracts hardware capabilities and makes them available to functions and services through standardized application programming interfaces (APIs).

In an automotive world increasingly driven by digital user experience (UX) instead of horsepower, OEMs must significantly increase their ability to deliver quality software and shift their sources of differentiation actively. At the same time, they need to maintain clarity regarding the specific value they seek, both along the value chain and across functional domains.

Achieving this mix of objectives will require a systematic process that can deliver the following three dimensions of value:

— *Control points.* These elements are essential ingredients for capturing value and should serve as starting points for determining where to focus and which unique assets to exploit.

— *Technology stack.* OEMs must ensure they have enough value add and capabilities in several crucial areas, including the digital user interface, UX, middleware, and vehicle APIs, to secure overall value-creation ownership.

— *Domains.* The priority of a player's value contributions will depend on brand positioning, the market segment involved, and existing OEM capabilities. Several archetypes—focusing on premium infotainment and connectivity experience, for example, or being a highly cost-efficient volume manufacturer—are feasible.

Processes

Moving to a software-centered footing with a new E/E architecture will require major changes in some parts of an automaker's business. Procurement, for example, is one process that OEMs must thoroughly restructure to accelerate hardware and software decoupling. Procurement will also require significant changes to enable the adoption of a total-cost-of-ownership perspective on software.

OEMs should follow a series of best practices in software procurement, beginning with an assessment of which software and apps will have strategic importance in the future, how their requirements will likely evolve, and which sourcing models are the most appropriate in each instance. In fact, in the short term, software and apps are the most relevant areas for the new sourcing strategy. Both areas must begin to treat the cost allocation for software separately from hardware and incorporate a complete-life-cycle perspective on software. Additionally, automakers should establish with suppliers new cooperation models that focus on strategic partnerships instead of multisourcing.

OEMs should also seek to translate the excellence in production they have mastered into operational excellence along the entire product life cycle. Our research shows that for OEMs and tier-one suppliers to support the same number of development programs in 2030 as they do today, they must more than double their currently available resources. Industry players have a variety of options for closing this gap, including increasing their own head counts, buying software players, partnering, and setting up joint ventures. Several OEMs have already established partnerships among themselves or with technology companies to accelerate development in key areas, such as autonomous driving. Notable examples include the partnership of BMW with Baidu, Ford with Volkswagen, and Honda Motor with GM. The need to expand and pool programming capacity reflects the expected increased digitization of most components in automotive-vehicle platforms during the next decade.

Automakers can achieve operations excellence by pursuing targeted actions across all phases of the product life cycle. First, in the concept phase, they should streamline requirements management, take steps to increase diagnostic efficiency, and automate testing. Second, from the detailed design phase to the SOP, they can create effective mechanisms for software logistics and over-the-air updates. Third, OEMs should establish a solid operational foundation by increasing performance-management efficiency and optimizing core operational excellence in software development across large parts of the life cycle.

Organization

Most automaker organizations lack the wherewithal to handle the digital implications arising from the ACES trend. Challenges range from little or no executive-level responsibility for software to the underrepresentation of software engineers and designers.

Several areas are clear targets for optimization. For instance, OEMs need to speed up decision making on software issues. They can also clarify the ownership of software, the company's electronics

strategy, and associated budgets. At this point, however, no one-size-fits-all approach exists.

While there are some common archetypes for how to anchor the IT/software-development unit in the organization, the right setup should be chosen by the OEM based on its priorities—which can include factors such as clarity of responsibilities, reduction of interfaces, and speed of decision making. Even more important, since different organizational functions (including R&D, procurement, production, sales, and aftermarket) can have conflicting requirements and life cycles for software, a dedicated effort must be made to harmonize them and thus ensure a seamless UX and an efficient development process. Generally, automotive companies lag behind those from other sectors in adopting modern organization models, with fewer than 35 percent of them running large-scale agility efforts, according to a 2017 McKinsey survey.[2] However, there are positive examples of such transformations among OEMs. Daimler, for example, has embraced a swarm organization, and Volvo Cars underwent a large-scale agile transformation.

While silver bullets may be in short supply, digital natives have many best practices that OEMs can borrow. For example, increased data transparency can catalyze collaboration efforts. Likewise, investing heavily in actions to close culture gaps and harmonize ways of working throughout the organization via sustained change management can support automakers in their quest to become software powerhouses.

While automakers must achieve a variety of key success factors in their transformations into E/E and software-focused organizations, attracting and retaining the right talent are probably the most crucial of all of them.

We have identified five approaches OEMs must master to succeed in their search for the right talent:

— Automakers should shape a workforce-development strategy that incorporates the expected shift in required skills due to industry-wide trends as well as their own aspirations for capturing value.

— Digital talent is highly concentrated, especially for specific skills in areas like autonomous-driving algorithms. Consequently, OEMs must maintain a presence in digital-talent hot spots to compete for top talent.

— OEMs must fight aggressively for top digital talent. That often means adjusting their employer-branding strategies to attract talented programmers and developing distinctive, targeted, real employee value propositions that extend beyond the offers of a comfortable salary and company car.

— For both new and existing employees, automakers must offer attractive development plans (including training programs), with a lifelong-learning philosophy in mind. Likewise, they must adjust career paths to accommodate new skill requirements.

— In a sector undergoing probably the biggest changes in its history, change management remains a crucial discipline. A solid program focused on producing mind-set shifts and supported by a compelling change story, role modeling, change-supporting processes, and capability building can help rally the troops and persuade the entire organization to get behind the required change.

As the automotive industry struggles to accommodate the disruptive ACES trends, many organizations are already taking serious steps to capture the opportunities these trends offer.

[2] "How to create an agile organization," October 2017, McKinsey.com.

However, most are discovering they lack critical software skills and future-proof E/E architectures. In the emerging software-centered automotive world, OEMs need effective ways to decouple hardware from software on both the technical and process levels. They must define and defend the target value they seek and pursue operational excellence while selectively optimizing their organizations. Most important, they need to invest heavily in identifying, attracting, and retaining critical digital talent to maintain a successful footing in a rapidly changing industry.

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