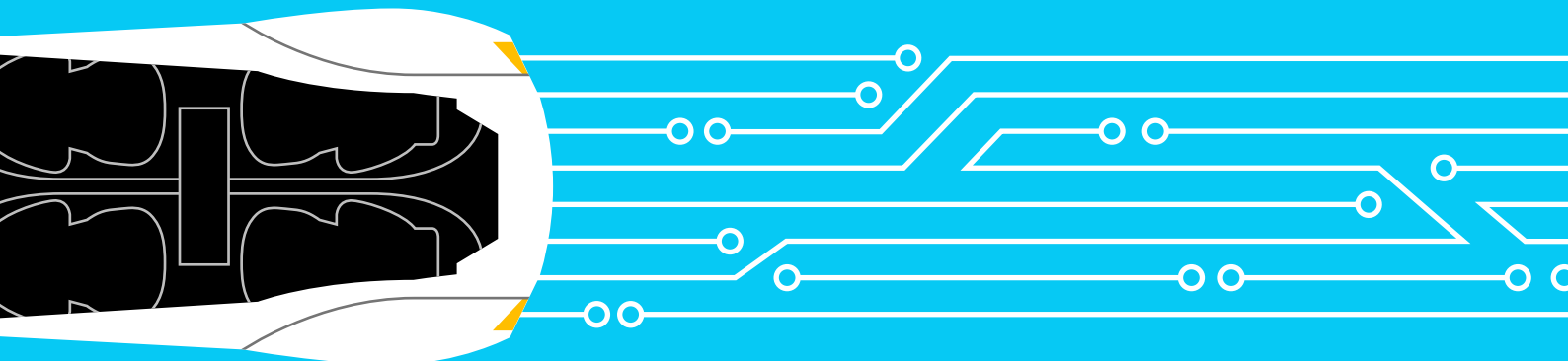
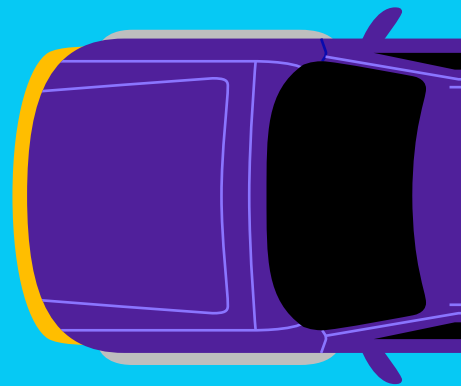


DEBUGGING THE CAR HARDWARE AND SOFTWARE DISCONNECT

Helping product developers meld
software with hardware



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Software and electronics have dominated cars for the past decade. To stay competitive, automakers must do more than cling to product development's hardware-centered past.

Electronic systems and software form a significant part of a car's systems today, up from about 20 percent in the past. Now, trends in connectivity, autonomous vehicles, shared mobility, and electrification (CASE) have led the industry into a new development space that is beyond the comfort zones of many incumbents. These traditional companies need to reinvent themselves in a new environment and ecosystem to develop the vehicles of the future. The mandate is disrupting the entire value chain, compelling many automakers and tier-1 suppliers to work with unfamiliar new partners.

This new "software plus hardware" construct affects everything from the way customers buy and use cars to the shape of the value chain that produces them to the automakers' role within the automotive business system. In turn, these game changers are creating a major shift in design processes, work methodologies and interactions across the product development and industrialization cycles, and in vehicle launch phases. They create more complexity by multiplying process cycles and stakeholder interfaces; all in shorter periods of time.

Product developers thus need to achieve an integrated, hybrid cycle that accommodates hardware and software development. They also need external support and benchmarking, since many top management teams remain unsure the new approach will create the quality products customers demand. Given these complications, automakers need to blend hardware and software development cycles using agile and traditional methods to minimize production risk. Four suggested focus areas include requirements, validation, stage gates and the organization.

MEETING TOUGHER REQUIREMENT SPECIFICATIONS

The way automakers define and manage product requirements continues to evolve significantly across the value chain, both internally and among suppliers. Projects once simply set requirement specifications at the system level — something everyone involved readily understood. Now, projects feature more embedded elements and must cover far-flung systems that "talk" to each other. Non-incumbent suppliers now provide sub-systems, presenting automakers with two new sets of difficulties. The first consists of writing highly detailed requirements because some vendor systems are "black boxes." The second involves anticipating the requirements for all the interfaces that communicate between systems.

In some cases, technology is blurring the lines between systems. In the past, the requirements for the steering and braking systems were straightforward. Now, as these systems become digitized and integrated with autonomous driving technologies and others, specifying their requirements becomes more complex. Many automakers lack experience in dealing with these levels of complexity.

To overcome this hurdle, car companies must detail their requirement specifications at the software performance level as opposed to the functional performance level. That requires a new structure that can expose the requirement necessities as early as possible in the development process. In turn, this typically mandates new links within the organization to integrate the right people and identify needed relationships as soon as possible.

AUTOMATING THE VALIDATION PROCESS

With more interfaces to consider, integrating full systems with sub-systems becomes a greater challenge, which increases the complexity of test validation. Originally a simple “go/no-go” process with basic specifications, automakers now need good validation levels for every element of the car and its environment. That means checking whether codes or code levels are functioning or not, which often requires new methodologies like rapid prototype software validation using analog devices. Since suppliers own some parts of this process, car makers must define good control levels to validate the right integration within the subsystems. That means more steps in the process, more elements to integrate, and more levels within the requirements. Furthermore, the validation criteria must then pass from one step to the next.

To minimize risks, automakers must check the compatibility and interfaces of each sub-system before integrating it. They should run a risk assessment to help identify missing requirements or customer inputs across systems. They need to create a robust validation timeline and schedule between base software and features, then between features and subsystems, and finally between subsystems and full integration. Automakers must also establish clear software capabilities based on the defined requirements and develop visualization tools and methods to prove out software functionalities.

ADAPTING STAGE GATES FOR SOFTWARE

Overall product development timing continues to shrink each year. The growing importance of software development within this shrinking cycle is expanding the number of interfaces between hardware and software, generating more interaction loops and validation issues within a constantly diminishing time allocation. With more time and effort devoted to software, automakers have less to spend on the hardware and electrical/electronic development stages, given the scarce resources available.

Likewise, new diversified suppliers continue to join the global process, with some unprepared for automotive requirements. Simultaneously, automakers are asking their traditional suppliers to do more in terms of requirements and validation process steps.

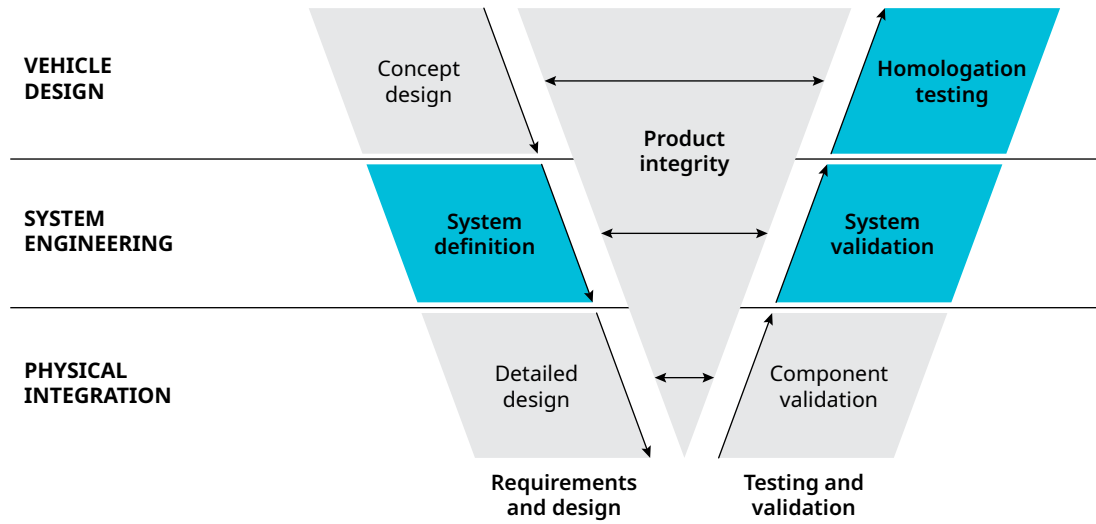
To adapt their stage gate processes to current product development realities, automakers must reinforce the robustness of existing gates by introducing new criteria for passing validation steps. Most must also add new gates during the design and validation phases to make sure everything is progressing according to plan. For example, parallel software gates should feed into the overall process gate. Early on, such modifications will enable hardware/software requirement integration. Later in the process, the intense new software focus will affect the entire validation review system.

RETOOLING THE ORGANIZATION

As the digital revolution drives more software (and hardware) into the vehicle platform, the product development process needs to involve more departments and players. All those new interfaces create more complexity, which requires new communication channels. Ideally, all R&D product value chain teams should have the ability to communicate seamlessly on an end-to-end basis.

To complete this connection, automakers need systems engineering teams. Creating designs that offer strong customer value requires the coordination and aligned performance of multiple systems. Building an organization with requirements for focused systems and a robust validation approach can deliver higher-level quality and performance at the final homologation stage. As represented in Exhibit 1, the systems engineering structure operates between vehicle design and physical integration, linking sub-systems to the final product. The effective development of this structure and organization (with sufficient strength in embedded software development strategies) enhances the chance for success.

Exhibit 1: Organizational structure impact on the V-Cycle



● Organizational structure to reinforce

Source: Oliver Wyman analysis

As the digital age transforms the automotive vehicle platform, companies need to address four key elements of their product development process: requirements, validation, stage gates and the organization. Other industries like gaming and aviation have already undergone this transformation, offering proven solutions automakers can embrace. By building this robust foundation, automakers can meld their hardware and software development processes into an effective, repeatable system.

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