WIND™

Keeping Pace with the Software-Driven Car

How Automakers Can Better Control Software, the User Experience, and Profitability as the Rate of Change Continues to Accelerate

WHEN IT MATTERS, IT RUNS ON WIND RIVER

EXECUTIVE SUMMARY

Automakers are still coming to terms with the fact that a "car," in the eyes of consumers, is no longer defined by its physical properties and capabilities. In many ways, the automobile is evolving into a software-driven mobility service, defined by the experience it delivers while taking passengers from point A to point B. That experience is largely defined by software—from dashboard instruments and GPS systems to in-vehicle infotainment (IVI). And consumer demands and expectations about this software-driven experience continue to change at an ever-increasing pace.

Forward-looking original equipment manufacturers (OEMs) now face a difficult challenge: how to stay ahead. What will be required to fully control and "own" the software in order to evolve it quickly enough to keep up with changing consumer lifestyles, market demands, and competitive innovations?

This article summarizes four key requirements for staying ahead of the curve—and maintaining profitability—in an era of unprecedented change for the automotive industry. It's a software strategy that enables the preservation of existing automotive business to deliver new, high-quality experiences throughout the vehicle's lifecycle. We call it the "ACRU" software model: abstract, consolidate, reuse, and update.

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AUTOMAKERS: IT'S TIME TO OWN THE CONSUMER EXPERIENCE

For consumers, the rapid evolution of software has opened up a whole new world of innovative in-vehicle experiences. From GPS and other telematics applications to entertainment, content streaming, predictive services, messaging, notification services, and more, the automobile has become a delivery mechanism for mobile, software-driven experiences.

For many automakers, however, entry into this new software-dominated world comes with some trepidation. At the very least, it represents a major disruption to traditional business models. For some, the disruption is potentially catastrophic—particularly for those who can't adapt quickly, who can't find a way to better control and own the consumer's digital experience.

Recent analyst reports help quantify the threat—and the opportunity—for OEMs. According to the 2017 Strategy & Digital Auto Report from PwC, "the future of mobility is a $2.2 trillion opportunity, but it will halve today's players' share of the profits." More specifically, the report says OEMs in the U.S. and E.U. will see their share of industry profits cut in half, from 85% in today's model to 40%–43% by 2030.

A new report from Boston Consulting Group (BCG) sheds additional light on the situation: In effect, OEMs face a double whammy in the years ahead because margins will decline while growth areas will require new investments. The net effect, the report says, is that total profits will decline 1.1% from 2017 to 2025, while CAPEX as a percentage of revenue will increase 1.2%. That small percentage translates into huge dollars for OEMs, and a sea change in the way OEMs will do business moving forward.

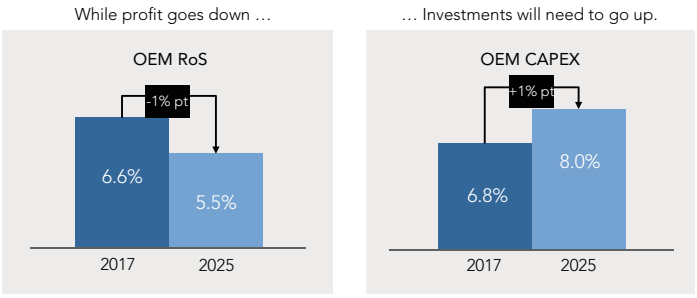

Figure 1. The Boston Consulting Group forecast for OEM profitability through 2025

Equally troubling, most of the projected market growth is coming from areas in which OEMs traditionaly have limited expertise: software, connectivity, and mobility. According to the BCG report, total car sales volume will stall by 2025 as self-driving, on-demand models emerge, bringing decades of growth to an end, and the largest emerging profit pools are in data and connectivity and on-demand mobility services.

WHAT DOES A SMARTER OEM BUSINESS MODEL LOOK LIKE?

Software has emerged as the common control point for the three top trends impacting the auto industry—connectivity, electrification, and the rise of autonomous vehicles—and that means there is no longer any question that software must become the central element of the OEM business model. OEMs will need to heavily leverage software in order to present new value to consumers.

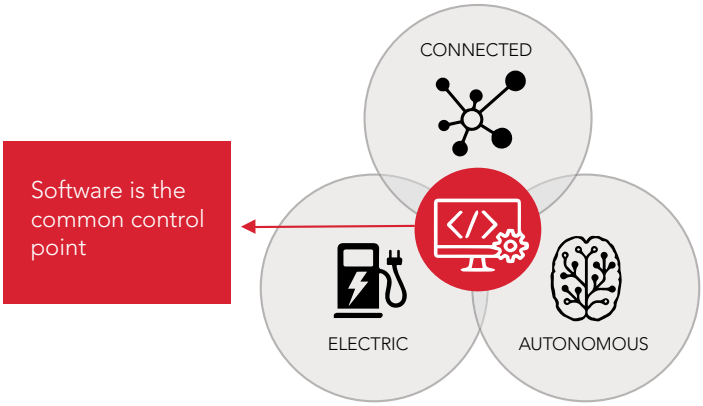

Figure 2. Software is emerging as the dominant point of commonality in trends impacting the auto industry

The question is how.

The answer involves taking ownership of software to deliver superior in-vehicle experiences. OEMs will need to begin seeing the car as a deployment platform for new software innovations. This translates to:

- Becoming faster and more innovative in creating software-driven services that deliver great experiences
- Introducing more nimble and secure ways to update software so consumers have constant, anytime/anywhere access to the latest features and versions, without inconvenience or disruption
- Implementing software that has minimal hardware dependencies, such that software and hardware can be introduced and updated independently

- Developing and deploying software that doesn't require additional hardware, thereby removing cost, weight, power consumption, and complexity
- Finding new ways to increase scalability, lower costs, and reduce time frames between releases

Simply put, OEMs must prioritize owning their software strategy and the consumer experience above all else—and be able to manage this process over the entire lifecycle of the vehicle, from ideation to end of life.

However, owning the software does not necessarily mean that you need a 1,000-person software team that can outperform the best and brightest developers from Silicon Valley. It means thinking about the implementation of software in a way that lets you fully control the inputs and the outputs. And the way to do that is by focusing on four core capabilities: the ability to abstract, consolidate, reuse, and update, or ACRU.

ACRU: FOUR REQUIREMENTS FOR FUTURE PROFITABILITY

Step one in the ACRU model is both to recognize that consumer demand for better digital experiences in the vehicle will continue in an upward spiral and to start preparing a software strategy based on that assumption.

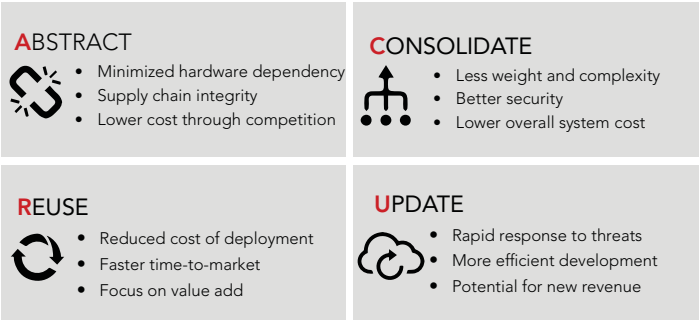

Figure 3. The ACRU model outlines four capabilities needed by OEMs to meet consumers' in-vehicle software expectations

Two key trends are impacting consumer expectations: First, technology is advancing at a ridiculously fast pace, meaning consumers have come to expect instant gratification and outstanding entertainment from their in-vehicle services and devices. That trend shows no signs of abatement.

Second, the ownership model for vehicles is about to change radically, from individual ownership to fleet-based ownership and shared ownership, all involving autonomous vehicles. By 2030, according to the PwC report, up to 37% of kilometers traveled will be done by shared and autonomous vehicles. And that means the in-vehicle experience will matter even more, because more and more "drivers" will become "passengers" with nothing left to distract them from their devices and apps.

At the same time, OEMs will have to support the vehicles of tomorrow in much the same way they support the vehicles of today. For example, if a new BMW is sold with a five-year, 50,000-mile warranty, the OEM needs to update and upgrade all of the technology within that vehicle not just during that initial five-year period but for 10 years beyond that. So the question becomes: How do you keep up with consumer expectations and keep upgrading old technology without constantly adding cost, weight, power consumption, and complexity that eats away at your profits?

The ACRU model addresses these trends and considerations fully but from very different perspectives.

Abstract

The A in ACRU refers to abstraction, which calls for minimizing hardware and software dependencies. This primarily applies to hardware, because it's a conventional piece of the bill of material. The hardware elements that impact the consumer experience can drive up the cost structure significantly, so it's important to get maximum use and value out of that hardware. To do that, a level of abstraction is needed. Abstraction can also maintain supply chain integrity. For example, when software is abstracted away from the hardware and no longer directly dependent on it, OEMs can create an environment in which competitive parties bid for the same piece of hardware business, whether it be at the ECU level or the algorithm level, keeping total costs down.

The Wind River® approach to delivering these advantages borrows a concept from the telecommunications and networking industry: multilayered decoupling. This starts with "silicon flexibility"—enabling integrated circuits from multiple suppliers to support the same software architecture. The next layer builds a secure and reliable framework to act as the foundational core. By having a framework that serves as a backbone for building multiple variants, it

is possible to bring in new software algorithms and applications, whether they're from software vendors, from an OEM, or from a Tier 1 supplier. Either way, you can bring it into the development environment faster and do it in a way that's more predictable, because you have a solid backbone that provides strength and integrity as the system evolves.

Furthermore, the Wind River approach abstracts the development process. In the telco business, for example, you often see an abstracted, virtualized compute environment that can move from one data center to the next seamlessly. In the automotive industry, a capability like that would be similar to being able to shut down the assembly of a C-class car in one factory and bring it up seamlessly in the next factory. If auto OEMs can bring this capability to the development side of the business, they can recreate the entire software stack, simulate their hardware, simulate their use cases and inputs and outputs, and dramatically reduce development time and cost. They can even start debugging before deploying the software to new vehicles. This would translate to dramatically improved time-to-market, cost efficiencies, and scale.

Consolidate

Key benefits and outcomes from consolidation include less weight, less power consumption, and less complexity in delivering innovative new services. OEMs have added more ECUs inside the car as they create new capabilities and types of experiences, and that's a linear and extremely costly way of approaching the development of next-generation vehicles. As OEMs move into a world that expects richer and more complex digital technologies and higher fuel economy, the potential power drain and additional materials weight that come along with those innovations become excessive. OEMs need to make sure that they are consolidating the compute workloads within the car as much as possible.

Many automakers and Tier 1 suppliers are already working on consolidation platforms, but there is more that can be done. There's a tremendous amount of horsepower in modern compute platforms, and much of it goes unused. Wind River sees an opportunity to do in automotive what we've already done in the aerospace and the defense industries; we can bring more compute power into multi-core hardware environments and then run both noncritical and critical systems side by side, taking advantage of technologies such as hypervisors or virtualization that provide time and space partitioning.

A level of determinism is required to bring advanced driver-assistance systems (ADAS) features into vehicles, and that part is difficult. But with proper determism and time-and-space partitioning, it is possible to update hardware independently from the middleware and the application layer, and these layers can all operate on different time cycles and lifecycles. That means that you can accelerate your development cycle and your deployment while reducing the cost and the complexity inside the actual hardware inside of the vehicle system.

This same concept can also be applied to take ECU consolidation to a whole new level. OEMs can consolidate more workloads on fewer pieces of silicon, since the vehicle systems have been partitioned, and they have the security of knowing that a breach in one compute domain will not have an impact the adjacent domains. This translates to direct savings in cost and accelerates time-to-market.

Reuse

In the same way that the auto industry has learned to reuse platforms from one vehicle to the next, OEMs can now reuse software and hardware architectures. For example, a software system in a single-vehicle environment can scale across multiple brands and multiple price classes. This way, OEMs get to market faster and can focus their investments where they add the most value, instead of on infrastructure pieces that the industry can't ultimately monetize.

When Wind River talks about reuse, what we mean is that OEMs can start to reuse the core elements of their software, that framework in the middle, and then customize the applications that live on top, such as ADAS or IVI systems.

If you consider a conventional vehicle system, every time an OEM has to iterate the software for that vehicle, or for another vehicle or another price line, it requires another significant investment. But if OEMs have a software framework that provides the baseline for a 50% reuse rate, they can achieve, over multiple vehicles, scaled economies and savings in both OPEX and the bill of material. We've been working on this concept for several years, and we've been able to validate it in production environments with proven results.

Update

No matter which software architecture OEMs are using, it has to be updatable, because software is a living thing. Additionally, the consumer experience is always evolving. As new apps and mobile

capabilities appear on the market and consumers want access to them, new threats emerge every day and must be responded to quickly and effectively. Developers must constantly be ready to deliver new innovations and updates to consumers as quickly as possible. If OEMs can accelerate their ability to continuously maintain and update the system, then they can continue to drive new value and new ways to monetize.

The way many technology companies address the update issue is to offer over-the-air (OTA) updates to software. They add new applications and refresh the operating system OTA. This is difficult in the auto industry because there's such a mix of critical and noncritical functionality; there are multiple security, safety, and compliance issues; and there is currently no framework that accommodates OTA updates for multiple interrelated services. In fact, many automakers today are hesitant to allow OTA updates for anything beyond adding a radio app.

At Wind River, we recognize that OTA is only one piece of the solution and that broader thinking is required to address the overall challenge. That's why we advocate looking at the management of the entire software lifecycle, not just OTA.

When you consider that the average vehicle is developed for 200,000+ equivalent customer miles, that means there is a primary, secondary, and maybe even a tertiary opportunity for that vehicle to generate value that we can push back to the OEM, while also creating new value and experiences for the consumer. An average consumer today owns their vehicle for nine to 10 years and drives 10,000 to 15,000 miles a year. That means that we have an opportunity to recreate the experience in the same vehicle multiple times over.

So if you look at software lifecycle management in its entirety, it begins at the ideation phase. From the moment OEMs start thinking of the new experiences and new value they want to put into the vehicle, they can use digital deployment and start modeling in a cloud environment rather than in the earthbound environment. They can explore those concepts in prototyped vehicles rather than real vehicles. Every time they want to make a change, they can manage the software in real time while the vehicle is deployed. This can save time on road testing and development and keep the development cycle moving more rapidly. It also enables OEMs to reduce the overall cost structure. OEMs can also monitor and maintain that vehicle and its software all the way through end of life.

Additionally, imagine the benefits that would come from gathering all the data from a vehicle near the end of its life and using it to inform the next series of ideations. This kind of thinking enables automakers to truly differentiate themselves and add a new value proposition going forward.

In summary, software lifecycle management offers OEMs huge benefits in four categories. It provides greater security. It grants OEMs a higher level of efficiency. It gives OEMs transparency into the vehicle and the vehicle's performance. And it enables OEMs to create new streams of revenue and new experiences for the consumer. Simply put, robust software lifecycle management enables conventional automotive players to compete with new tech players—and win.

LEARN HOW TO EXTRACT NEW VALUE FROM SOFTWARE

Transitioning into a new software-driven business model focused on the consumer experience is both a daunting challenge and an enormous opportunity for auto OEMs. The purpose of this article is to present core concepts and spark further discussion.

We encourage you to learn more about the Wind River approach to keeping pace with the evolution of the software-driven car, and to learn about Wind River Helix™ Chassis solutions. We provide software products, frameworks, tools, and services to facilitate the automotive industry's profitable transition to the architectures of the future. Let us show you how to generate new economic advantages by implementing the ACRU model. Visit www.windriver.com/auto to learn more.