



Forbes
INSIGHTS

Next-Gen, Plus One:

The Software-Centric
Future Of The Auto
Industry

IN ASSOCIATION WITH

WINDRVR

Table Of Contents

3 Introduction

4 SECTION I
From Chrome And Glass To Silicon
And Code: Software-Centric Practices

9 SECTION II
How Industry Leaders Think
About Transformative Change

12 SECTION III
Initiatives That Matter

15 Conclusion

Introduction

Automotive leaders are turning to software-centric thinking and design to transform their businesses and shape industry innovation.

This mindset is increasingly infused across a vehicle's five-stage life cycle—design, development, manufacturing, deployment and ongoing operations—to mold an exciting future for the automotive space.

While dozens of departments and disciplines are deepening focus on software as key to value generation, tangible success depends on understanding how,

when and where software-centric thinking and practices can power the industry's next chapter.

This Forbes Insights report, prepared in partnership with Wind River, explores the thinking of 200 software design and development business leaders in the automotive industry.



From Chrome And Glass To Silicon And Code: Software-Centric Practices

For generations, the automotive industry was synonymous with innovations in heavy manufacturing practices, from assembly lines to quality-focused engineering to reusable vehicle platforms.

Leaders now see the industry's future as defined not by factory machines, but by software that can be deployed and updated at build, in the showroom and in a customer's garage.

"The things that change the automobile experience are going to be software," says Avijit Sinha, chief product officer at Wind River. "There will always be the need for the metal-benders and seat-suppliers, but anybody else in the value chain is a ripe candidate to be disrupted. And so software-driven change is what we'll see playing out in the automotive industry."

Nearly four in ten respondents said their organizations had taken at least some concrete steps to embrace a software-centric business model today and not a single automotive leader ruled it out entirely. This reflects the reality that organizations seek durable strategies to become more productive, and that many of those efficiencies have already been wrung out of the physical manufacturing process.

"Certainly, less than half now have actually made a move," says Shelly Van Dyke, vice president of automotive strategy at NXP, an automotive chip supplier. "But you can see where investments are going: into software-based reorganizations and into [answering] the complex equations of how to simplify, refine and offer more features quickly...through software."

Even more telling is that one-third of respondents said they've entered planning and strategy phases around software-centric practices with the intention of running experiments and exploring more opportunities. When asked to look five-to-ten years ahead, that welled-up readiness translates into action: 84% saw their businesses becoming software-centric by making at least some core changes to their practices in the near future, with 14% of the remainder reaching the planning-and-strategy phase.



A SNAPSHOT

Companies will increasingly compete on software-reconfigurable features versus physical design

Most leaders say their organization will be software-centric within 10 years

Early benefits of software-centric practices are qualitative, with more concrete gains expected within five years

FIGURE 1.

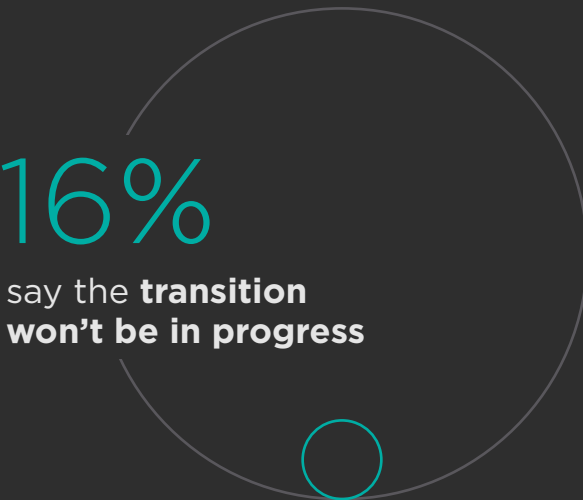
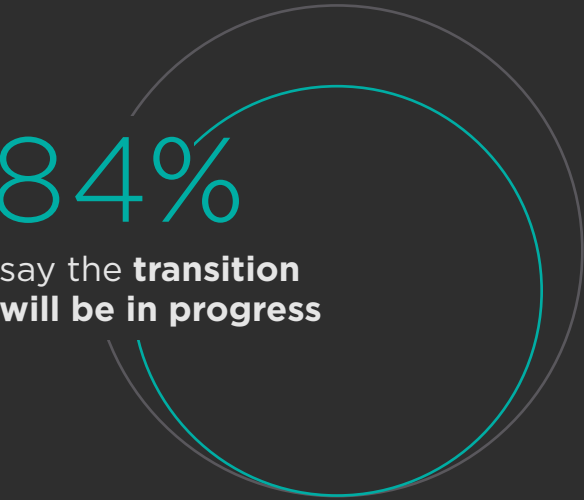
Are Leaders Adopting Software-Centric Business Models?



*Totals vary due to rounding

FIGURE 2.

Where Will Organizations Be In 5 To 10 Years?



7% Your organization has fully adopted a software-centric business model.

14% You've had planning and strategy conversations about software-centric business models as you intend to run experiments or further explore opportunities.

22% Software-centric business models could be the most predominant business practices for your organization going forward based on what you've learned from experiments and use cases.

2% There have been minor conversations about software-centric business models in your organization but no real plans or experiments yet.

33% A software-centric business model is becoming mainstream in the organization's business practices.

0% You've heard of the idea behind software-centric business models but haven't really investigated it extensively to have an opinion.

23% Some core changes in the organization's business practices have occurred to transition to a software-centric business model for products and services.

0% You've heard of the idea behind software-centric business models and it wouldn't be appealing to your organization.

*Totals vary due to rounding

Those already working along software-centric lines at the industry's highest tier endorse the shift. Brian Kursar, chief technology officer and chief digital officer of Toyota Motor North America, says his company's six-year journey included the creation of software-focused Toyota Connected to provide a focal point for the broader company's transformation. "When you invest in in-house software talent you control your own destiny. You're able to bring in customer feedback and create feedback loops, driving new features and new value," says Kursar, who also serves as CTO of Toyota Connected.

Respondents were asked to rank the magnitude of change their organizations will see with the adoption of a software-centric business model.

Over the near-term, leaders expect that benefits would be in more qualitative areas, like resource agility and talent. At five years and beyond, leaders shifted their predictions to improvements in areas like opex and revenue.

Van Dyke says this is consistent with broader tech-driven returns on investment. "In semiconductors, we can offer more technology every few years for essentially the same price—that's Moore's Law," she says. "And the more we have software-centric design, the more you can increase re-use, and that makes vehicles easier to manufacture and should ultimately reduce the individual [research and development] costs of producing a full new vehicle."



FIGURE 3.

The Top 3 Benefits Leaders Expect From Software-Centricity

Over The Next 5 Years:

- 1. Improved resource agility
- 1. Increased ability to attract and retain talent (tie)
- 3. Improved internal team skill set

5+ Years From Now:

- 1. Improved operational expenditures
- 2. Increased revenue
- 2. Increased capacity to innovate (tie)

*Respondents allocated 100 points across 11 areas of potential impact

“

There will always be the need for the metal-benders and seat-suppliers, but anybody else in the value chain is a ripe candidate to be disrupted. Software-driven change is what we'll see playing out in the automotive industry.”

AVIJIT SINHA

CHIEF PRODUCT OFFICER,
WIND RIVER



How Industry Leaders Think About Transformative Change

Automotive leaders disagree about the scope of changes today, but are near-unanimous in saying rebirth is just around the bend.

Disruptive change often bubbles up from smaller, nimbler companies, but in the automotive industry, it appears to filter down from the top tiers. Respondents from smaller organizations (fewer than 5,000 employees) were less likely than enterprise-scale (5,000+ employees) to say their organizations had already started software-centric transformation today and were less likely to expect that outcome in the future.

“Larger players have capital and scale, and they feel pressure from the ecosystem, from customers and even from governments to transform,” Sinha says. “Smaller players in the value chain are more skeptical because they’ve seen enough examples where bigger players tried to dive headfirst into transformation, but failed.”

The survey results don’t mirror that top-down bias when it comes to organizational hierarchy, however. Respondents outside the C-suite were more likely to say their organization is transitioning to a software-centric business model, and more likely to see software-centricity in its future.

Top leadership may be wary of hype cycles and moderate their expectations for software centricity after several automakers have shaken up their executive offices in recent years, says Sinha. “The C-suite feels a little burnt, they’re being more cautious. But the employee base is changing. Those coming in [to lower-level leadership] want to work with modern tools and they’re more optimistic about the power of software and data analytics and AI.”

When asked about the magnitude of software-centric change expected in their organization across the five life cycle phases, respondents were clear on two points:

- They were nearly unanimous that dramatic change across all five phases is at most five years away.
- More respondents see changes in the later lifecycle phases (those closer to the consumer), both today and in the future.



A SNAPSHOT

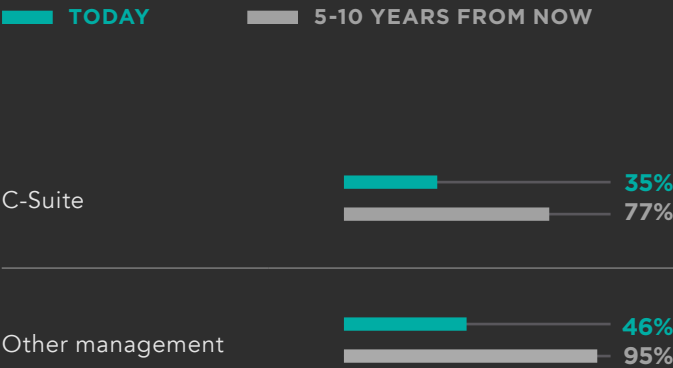
Larger companies appear to be more invested in software-centric practices

Top executives are more skeptical of software than line management

Respondents are almost unanimous: By 2033, every phase of auto production will be completely transformed by software

FIGURE 4.

The C-Suite And Line Management Differ On Transformation



**Percent of respondents who see their organization using a software-centric business model by making at least some core changes to their business practices to full adoption.*



This reflects the larger industry trend that cars are evolving from transportation platforms with fixed features to much more sophisticated hubs for transportation, entertainment and engagement.

“Consumers today have encountered what it means to be software-defined, and the personalization that comes with it,” Van Dyke says. “That mindset is going to move over to vehicles—looking for what enhances your life in the car, so that the time you spend commuting or taking road trips is richer.”

This shift will radically challenge current practices around vehicle deployment (distribution and ready-for-sale processes) as well as operation (the post-sale ownership experience including maintenance). “In the software-centric world, a car isn’t a one-and-done purchase. Customers get new features and new fixes, and we get new opportunities for engaging customers,” Kursar says.



FIGURE 5.

When Will Transformative Change Arrive In Each Production Phase?

	Within the next 5 years	5-10 years	Over 10 years
Design	51%	90%	93%
Development	57%	91%	96%
Manufacturing	65%	94%	99%
Deployment	66%	98%	99%
Operation	76%	98%	100%

**Percent of respondents who selected a 6-10 on a 10-point scale (1-No changes to 10-Transformative changes).*

Initiatives That Matter

Where are automotive leaders investing for the next five years?

To identify potential investments for auto leaders, the survey presented a list of eleven initiatives affecting each life cycle phase. Respondents selected the top four that will matter most to their organizations over the next five years.

DESIGN

For purposes of this research, we define “design” as the way an organization thinks about how its vehicles are created, from its materials to safety features. This includes personalization, manufacturing methods, computing resources, subscription services and vehicle-to-vehicle communications.

Priorities for the next 5 years:

1. Planning for the monetization of vehicle data through improved efficiency, cost reduction and optimizations (e.g., preventative repair)
2. Planning to monetize vehicle data through consented sale of consumer usage information to advertising and related industries
3. Planning for capabilities in all models, but they will be standard in premium models and could be “turned on” in less premium lines after sale to the consumer
4. Addressing hardware complexity and life cycle costs by shifting focus to software defined capabilities (e.g., hardware abstraction, mixed-criticality partitioning)

DEVELOPMENT

This refers to implementation of the vehicle, including experimentation, testing, validation and everything necessary to get it onto the production line.

Priorities for the next 5 years:

1. Improving capabilities for co-developing software and services that can be leveraged and supported across legacy and next-gen architectures
2. Researching and/or developing new battery chemistry for improved energy density, efficiency and reduction in constraints of raw materials
3. Focusing on investments in cross-organizational collaboration especially across software teams to increase cooperation, reuse of code and reduce redundant efforts
4. Deploying configurable, app-based, updatable and user-profile driven software platform with modern user telemetry and tracking capabilities

MANUFACTURING

This phase involves the physical production and final integration of the vehicle’s hardware and software to prepare it for distribution.

Priorities for the next 5 years:



A SNAPSHOT

AI and machine learning are key priorities in vehicle manufacturing, deployment and operation

Investments in the design phase prioritize revenue/margin opportunities

Supporting both legacy and next-generation vehicles is top-of-mind in the development stage

1. Creating a sensor network and coordinating operations using private 5G solutions that can provide enhanced broadband, high reliability, low latency and large-scale communication capabilities
2. Deploying AI/ML manufacturing solutions to improve defect detection, optimization and correction in real-time vs. post-processing
3. Developing vision-based (e.g., camera) and/or radio-based (e.g., RFID) technologies for intelligent detection, identification and classification of humans or objects
4. Incorporating simulation and digital twins in production-level assembly, integration and testing to reduce costs and speed up time-to-market

DEPLOYMENT

This phase involves distribution and pre-sale processes, including post-manufacturing updates to hardware and software and selling the vehicle to the end customer.

Priorities for the next 5 years:

1. Allowing vehicle customizations as late as possible to improve customer delivery time on customized vehicles and reduce manufactured inventory
2. Use analytics and AI/ML tools to determine vehicle build configurations and options to be distributed to

geographies where a specific vehicle build will sell most quickly

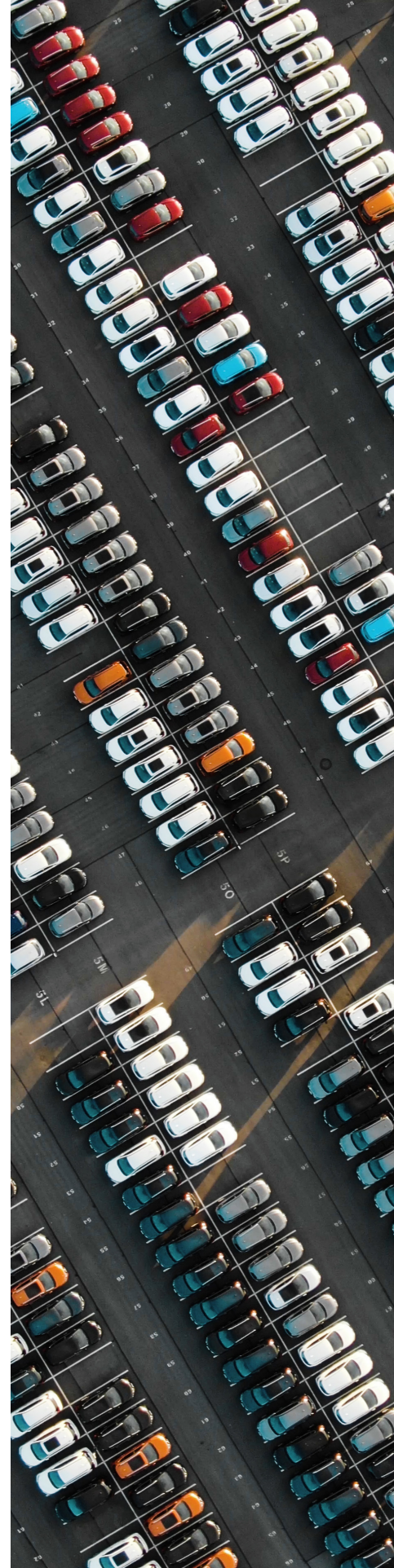
3. Providing a more transparent purchasing experience for buyers by removing the ability for dealerships to add “markups” on MSRP
4. Dynamically configure vehicles in real-time when sold

OPERATION

This is the end customer’s ownership and management experience, including data collection which can be fed back into the design phase or used to improve servicing and warranty processing.

Priorities for the next 5 years:

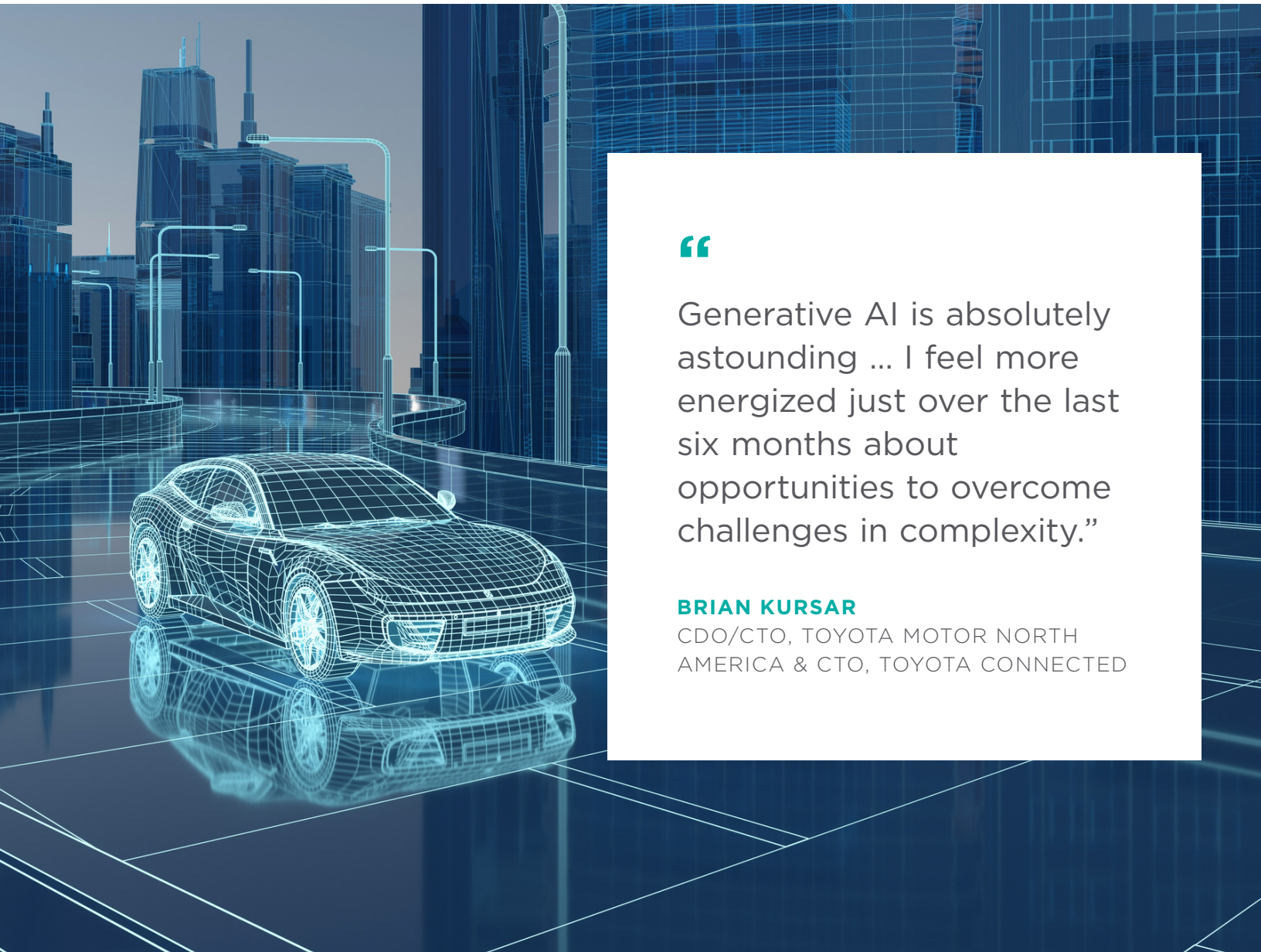
1. Configuring intelligent data filters and AI/ML at the edge with the ability to target specific vehicles to support business goals and optimize for high costs
2. Continuously optimizing vehicles to provide an improved driving, efficiency and ownership experience based on analytics collected from vehicle
3. Supporting education and training for software-driven vehicle architecture including the support of a low-tech user-base
4. Offering fleet management monitoring and services to commercial, professional and fleet customers



Toyota's Kursar strongly echoes the high placement of AI investments across multiple phases. "Generative AI is absolutely astounding. We've validated the numbers, we've used [it] for code creation and saw [a] 40% improvement in productivity. With this force multiplier, I feel more energized just over the last six months about opportunities to overcome challenges in complexity."

NXP's Van Dyke encourages leaders to ensure that software-centric investments aren't solely internal. Instead, she advises

creating a global network of contributors from a variety of disciplines, much as smartphone app stores did more than a decade ago. "If we can really tap into the broader global software application developer community, we'll have even more ideas over the next ten years that we didn't realize we needed."



“

Generative AI is absolutely astounding ... I feel more energized just over the last six months about opportunities to overcome challenges in complexity.”

BRIAN KURSAR

CDO/CTO, TOYOTA MOTOR NORTH AMERICA & CTO, TOYOTA CONNECTED

Conclusion

The near-universal support for software-centricity as early as 2028 may come as a surprise.

Previous generations moved more cautiously. In the face of massive global shifts around transportation, renewable energy and consumer experience, and the changes already brought on by early EV pioneers, today's leaders say they're prepared for the faster pace.

"There's proof it can be done—in the manner you produce a car, reconfigure factories to source alternate silicon and change software on the car and change assembly lines using software," Sinha says. "And that is why some were able to react to changing macroeconomic conditions and to Covid and come out unscathed—while other automakers got tremendously disrupted by semiconductor shortages, supply chain issues and battery availability."

There could still be infrastructure challenges, such as unanticipated setbacks in electrification programs or other macroeconomic or supply-side shocks. And as our results show, not everyone's equally geared for change. But pivoting to a software-oriented mindset means being open to new programming even if they challenge ingrained assumptions. And that, for the majority of the industry that hasn't yet

made a strategic move into software, could be the most important first step.

"I think the more an organization has tech debt, the longer and more difficult the transformation will be," Kursar says. "But I think investing now in software engineering talent helps educate business leaders about what's possible."

JASON COMPTON

Report Author



A SNAPSHOT

Friction from legacy practices can create headwinds

Commitment to software can combat those challenges

Covid 19-related manufacturing shocks and nimble workarounds provide helpful models for the future

An aerial photograph of a two-lane asphalt road that curves through a dense, lush green forest. The road has a double yellow line in the center and white lines on the edges. A dark-colored car is visible on the road, moving away from the viewer. The forest is composed of tall, thin evergreen trees, and the overall scene is bathed in soft, natural light.

“

Consumers today have encountered what it means to be software-defined, and the personalization that comes with it.

[They're] looking for what enhances your life in the car, so that the time you spend commuting or taking road trips is richer.”

SHELLY VAN DYKE

VICE PRESIDENT OF AUTOMOTIVE
STRATEGY, NXP

Methodology

Forbes Insights surveyed 200 U.S. automotive OEM executives across organizations of at least 250 employees.

Respondents included C-suite leaders, business decision makers and technical decision makers with involvement in system-wide or system-specific software decisions.

