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Mapping the future of R&D in the automotive supply chain

Automakers need to speed up R&D efforts to meet demand for EVs, autonomous vehicles and connected cars. They also need to develop new models to fit marketing niches and consumer

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demands that change much more quickly - in the process affecting what their suppliers need to supply and how quickly. So, what IT tools are OEMs and suppliers using to support and manage the rapidly changing R&D processes? By Andrew Williams

Cloud-based IT systems, as well as augmented and virtual reality technologies are changing the way engineers, designers and researchers in OEMs and suppliers work through the automotive supply chain on future products and services.

As Mike Quinn, Principal at the Boston Consulting Group (BCG), explains, electronic components currently account for around 35% of a car's total material costs - a share that is expected to increase to more than 50% by 2030, as automakers 'spend close to half of their engineering budgets on electronics R&D development.'

In an effort to keep pace with the knowledge and expertise required for such fundamental changes OEMs around the world are also adopting hardware-in-the-loop, model-in-the-loop, and software-in-the-loop products and techniques to design and verify autonomous driving.

A popular example of such a product is NVIDIA Drive, which Quinn describes as a product offering that 'integrates a scalable hardware platform with full-stack software and a simulation environment to test vehicle prior to deployment.'

"One of the more interesting examples is from Tesla. Many of their vehicles in the field have their autonomous driving algorithms running in the background while the driver is in control. The decisions that the driver made are compared to what the algorithm would have made - and are then processed off-line with any differences flagged," he says.

"An analyst can then determine which manoeuvre was more correct - the driver or the algorithm - and use those decisions to train the algorithm," he adds.

When it comes to supply chain R&D processes, Ruud Vossebeld, Director of Business Development at INFORM, agrees that both OEMs and suppliers are likely to use a range of CAD-CAM tools specifically designed for EVs or autonomous vehicles, such as the self-driving cars software produced by Nvidia.

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According to Quinn, OEMs are now not only adjusting their validation methodology to be 'more models and systems based,' but also changing how they are organized to support autonomous technologies. To expand on this point, he reveals that BCG has published an article, Building the Digital Car Company of the Future, which discusses four 'archetypes' of a digital organisation.

"Many OEMs are starting to fall into the 'Pacemaker' archetype as they setup organizations dedicated to the software development, simulation, and ownership of the AV customer interaction model," he says.

Elsewhere, Alan Baum, Chief Automotive Analyst at Baum and Associates, highlights the fact that, along the automotive supply chain, simulation exercises are now commonly being carried out 'in concert with brute force testing' - with the 'former being done in order to make the latter more useful.'

Augmented and Virtual Reality

In addition to software-based approaches, many companies in the automotive supply chain now also use augmented reality (AR) and virtual reality (VR) as part of their R&D and design processes.

According to Tuong Nguyen, Senior Principal Analyst at Gartner, a useful way for stakeholders throughout the automotive supply chain to think of AR and VR is as 'interface technologies' - in a way that is perhaps similar to 'how the mouse or keyboard is the interface for PCs and touch is the interface for smart phones and tablets.'

"AR and VR are, and will be, the way that engineers, designers, researchers, or even consumers like you and I interact with the physical and digital world around us," he says.

As far as the supply chain is concerned, Nguyen also observes that AR is a tool to augment worker capabilities by providing them with 'relevant, interesting and actionable information to help them with the task at hand.'

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"AR in the enterprise is currently best suited for heavy industry and deskless workers with hands-busy tasks. However, there are a broad number of use cases here, but it boils down to saving cost optimization, cycle time reductions, and improving safety," he says.

"As such, for deskbound workers, there are benefits as well, but I see these coming to fruition a little further down the road. As a visualization tool, engineers, designers and researchers can benefit from seeing their designs in three dimensional space - compared to the current method of shoe-horning 3D images onto a 2D screen," he adds.

In a similar way, Nguyen points out that the use of VR for training and decision making in 'high-cost, high-risk or high-insurance type situations' is becoming more common.

"Like AR, VR can also be used for prototyping in certain situations where it would be faster and more cost effective than using a physical model," he adds.

Quinn agrees that virtual prototyping has become 'core' to forward model vehicle designs to 'allow faster upfront iteration cycles when refining a vehicle concept.'

He also points out that advanced OEMs have developed virtual simulation environments to digitally create a life size virtual reality vehicle that 'allows users to interact with the interior and exterior of the vehicle.'

In such situations, he explains that VR technology is directly integrated with their product lifecycle management (PLM) system to auto-generate the digital rendering from the actual CAD data - and the system is able to 'accurately simulate not only the vehicle itself but also key attributes, such as reflections caused by different lighting conditions.'

"This allows designers and engineers to rapidly adjust the vehicle concept, leadership to quickly make informed decisions, and customers to provide early input. Digital twins allow the manufacturing process to be evaluated for efficiency, ergonomics and so on - and adjusted to drive smoother launches downstream," he says.

Alongside new technologies like AR and VR, Quinn also highlights the fact that OEMs are increasingly adopting low fidelity physical prototypes in an 'agile' environment in an effort to immerse their teams in 'really understanding how a customer would ultimately experience the vehicle.'

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"As you think about the supply chain, OEMs are also looking at how to adopt technologies like block chain technology to enable, for example, higher fidelity component tracking end-to-end throughout their supply chain," he says.

"OEMs are more heavily leveraging over-the-air updates to release new features and experiences after the sale - for example Tesla changing the vehicle ride height on the Model S to address a potential recall. OEMs can then use data from the vehicle to better inform their product validation approaches. For example, OEMs can start to tailor 'door slam' durability tests based on actual customer usage patterns instead of potentially over-testing based on internal heuristics," he adds.

AI Technologies

When it comes to assessing the ongoing impact of evolving AI technologies, particularly in changing engineering and development processes throughout the automotive supply chain, Baum argues that the impact will be relatively slight - and predicts 'a continuation of current trends' in an effort to 'try to reduce costs by using simulation.'

In contrast, Vossebeld highlights the fact that software such as that created by Nvidia is capable of 'very fast computer processing with 3D visualization' - and he is convinced that some AI use cases exist that 'can speed up the development process further.'

Quinn agrees that AI technology is likely to prove very useful for ongoing vehicle development processes. In his view, it could also help to reduced warranty costs - largely because, based on usage patterns, OEMs will be 'able to predict when parts will need to be replaced before they fail.'

"The driver can be notified in advance and the replacement parts can be at the closest dealership waiting for them," he says.

Quinn also predicts that AI could prove useful in a large number of other areas - ranging from predictive maintenance to minimize downtime and costs, right-sizing for customers and specifications, tailor products to real-life usage, determining sufficient quality levels to improve project performance and reducing overruns and delays to prioritization and resource allocation, project performance monitoring, reduction in lead times and costs, the reuse of components and

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simulation to reduce testing and product costs.

Moreover, he reveals that an increasing number of OEMs are now coupling the adoption of generative design with additive manufacturing techniques to design and manufacture parts that are 'both lighter weight and stronger than any engineer could achieve manually.'

"AI could also help OEMs to leverage social, economic, and technological inputs in order to identify leading indicators relating to how consumer preferences are changing - in the process equipping them with the ability to better tailor products to meet future needs despite longer development cycles," he adds.

(Join the discussions with CIOs and supply chain executives, about how AI, VR and other technologies will impact the supply chain at the 2019 Supply Chain Conference this March 19-21 in Atlanta, Georgia)