Accelerating Innovation in Automotive Design

How real-time 3D and VR are radically transforming the car industry

By Ed Martin

Developing the vehicles of tomorrow

The pace of competition in the automotive industry continues to accelerate. In its 2017 "Car Wars" study, Bank of America Merrill Lynch forecasts an average of 57 new vehicle launches per year in the US market alone from 2018 to 2021. To match this faster pace, automotive OEMs have made big strides in speeding up development timelines from concept to showroom. Nonetheless, competitive and economic pressures are compelling manufacturers to compress ramp-up time even further. Optimizing 20th-century production processes will not be enough to develop the vehicles of tomorrow. Greater ROI is going to require more innovation. Auto manufacturers must not just optimize, but thoroughly transform the way they design, engineer, build, market and deliver mobility.

The ultimate competitive differentiator

At the same time, automakers are constantly working to deliver a better customer experience, the ultimate competitive differentiator for modern cars. Consequently, designers and engineers are under pressure to create high-quality products loaded with the latest comforts, amenities and safety features that buyers have come to consider standard. Next year's model, by definition, has to be better than last year's. And that's the challenge the industry has to reconcile: How do you produce increasingly superior cars on faster timetables and at lower costs?

Lexus LC500 rendered in Unity by Light and Shadows

A complete 3D car model projected into a VR headset lets even remote team members see and comment on updates in real time.

Virtualization use cases

The following are examples of use cases that are becoming more common throughout the automotive workflow.

Interior ergonomics studies
Virtual customer clinics
Collaborative design reviews
Serviceability studies
Augmented driving research
Manufacturing assembly studies
Manufacturing cell layout
AR-based service training

Holodeck VR experience by Lighshape

Design engineers can fully experience and iterate on new designs virtually, long before committing to a physical prototype.

More disruption, new business models

The automotive industry is facing more disruption than at any time since its origin brought on by an exponential increase in product complexity, combined with the rise of entirely new business models and new competitors. For example, consumer-centric "connected cars," advanced driver-assistance systems (ADAS), electric vehicles (EVs), and self-driving/autonomous vehicles are becoming a reality. In addition, the old model of selling "take it or leave it" models from dealership lots is fading, being replaced by highly personalized, made-to-order vehicles, new car-sharing models from automakers, and by disruptive players like Uber and Lyft that will "buy their autonomous pods in bulk from the manufacturers."[2]

Streamlining design and engineering

How can automotive OEMs gain a competitive edge in this dynamic environment? One place to start is the design studio. Few endeavors experience such tension between creativity and pragmatism as the design of a motor vehicle. Creativity requires time, thought and patience. Pragmatism demands that budgets, schedules and exacting engineering requirements are met. This chasm is exacerbated in a market that demands not just a beautiful, functional product but also an enthralling customer experience.

Pain points even with conventional 3D modeling

Without question, technology has done much to simultaneously enhance the creative process while making overall model development more efficient. Yet faced with the competing pressures of quality, cost and time-to-market, conventional 3D modeling and visualization tools are reaching their limits. In the past, these tools were seen as essential to creating vehicle designs, but they don't provide a convenient way for designers, engineers and executives to immerse themselves in a virtual vehicle. Without the ability to "experience" the product during the iterative design process, it's impossible for designers and engineers to know if they're hitting the mark until the end of development.

Creating the "digital twin"

What's needed is a way to bring an immersive "digital twin"[3] of the vehicle to life and create a realistic experience that is accessible to both design specialists and executives. This immersive experience can even be used to collect customer feedback during the design process. Compared to conventional customer clinics, a digital twin enables greater speed, scale and diversity in testing, as well as the ability to collect precise analytics on customer behavior in addition to qualitative responses.

Holodeck VR experience by Lighshape

A complete 3D car model projected into a VR headset lets even remote team members see and comment on updates in real time.

The future of automotive design lies in the ability of design teams and decision makers to visualize their designs instantly, iterate on the fly and collaborate across dispersed geographies.

The technology that makes it possible is here today. A development platform that delivers real-time 3D visualization and virtual reality experiences has the potential to drive down program costs, speed up development time and deliver higher-quality, more fully realized end products. Of equal importance, real-time technology brings 3D data out of design and engineering workstations and into the hands of those who need it, on the devices of their choice. The result is a more agile and flexible design process based upon inclusion and data instead of isolation and guesswork.

Holodeck VR experience by Lighshape

With VR/AR technology, engineering teams can collaborate creatively in 3D space, in a fraction of the time of old-school methods.

Three ways real-time 3D and VR help transform workflows

1. Visualization

It's extremely difficult for designers to communicate and engineers to visualize the full scope of a design on a two-dimensional screen. Conventional design systems also lack the degree of interactivity necessary to convey a sense of how the many features of a car will actually perform before going to prototype. By the time prototype hardware is prepared, fundamental design decisions have already been frozen and can't be revisited.

In contrast, the combination of real-time 3D and virtual reality enables designers to create and refine a fully immersive experience throughout the development process, allowing teams to envision and interact with a finished car at 100% scale, both inside and out. Not only can designers see the vehicle and all its features, but they can also get a sense of what it's actually like to open the doors, adjust the mirrors, turn on the entertainment system, evaluate interior lighting or interact with any other feature in the car. All this can be accomplished at the designer's desk with a standard computer and VR headset, yet with no loss of design integrity. Real-time 3D and VR allow designers to communicate their vision of the user experience (UX) in ways that were not possible before.

2. Iteration

Using conventional systems, every change to the design, whether a major replacement or a minor tweak, takes hours or even days to prepare for design review – with no assurance that the results will be successful. Preparing physical prototypes is even slower, often taking weeks. This doesn't just slow down the process. It stifles innovation and creativity, forcing designers to evaluate the risks and tradeoffs of making a change before they can actually see the results.

Real-time 3D interaction makes that problem go away. Design teams can iterate freely, exploring multiple design alternatives in a single workday, testing ideas and evaluating changes big and small as they are made. Not only does this promise to shorten the design phase, it also allows for a more thorough exploration of concepts within the allotted schedule, which will result in a superior and more competitive end product.

While a real-time design platform can certainly fuel creativity, it also delivers tangible, bottom-line benefits. As CNN noted while reporting on the virtual reality trend in automotive design studios, "designers can come up with designs that are better thought out, which in turn means that they are more likely to be approved (especially if any engineering prerequisites have been met) and may be easier to build. This will ultimately speed up the process and save companies money."[4]
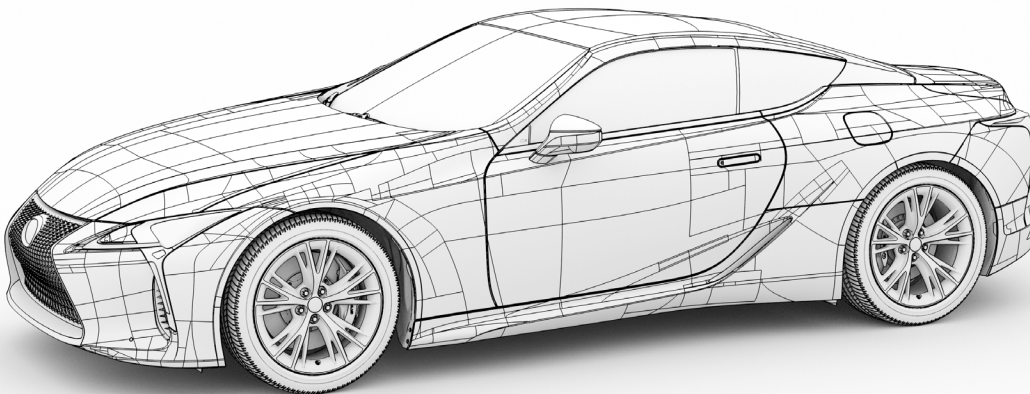
Lexus LC500 rendered in Unity by Light and Shadows

A digital twin lets everyone from design engineers to end customers experience new models in a range of settings, from functional to seductive.

Today's tools give designers and engineers common ground for reviewing each other's work, sharing ideas and collaborating in real time.

Holodeck VR experience by Lighshape

Remote, real-time collaboration accelerates designs and decision-making, while reducing travel and training costs.

3. Collaboration

The reality of today's globalized automotive industry is that development does not take place in a single location. Design and engineering teams are increasingly dispersed across several continents. Sharing design concepts in progress and obtaining feedback by email, conference calls and file-sharing platforms can be quite inefficient while also impeding creativity.

Today's advanced design tools give designers and engineers in disparate locations common ground for reviewing each other's work, sharing ideas and collaborating in real time. New technologies have democratized the design process and created an interactive forum where the best ideas rise to the surface.

Yet collaboration is more than sharing data and working together. It is sharing an experience, which in turn leads to stronger consensus within teams, across domains and geographies. The combination of 3D and virtual reality can foster true collaboration, ensuring that all those involved share the right context and the right data at the same time, with nothing lost in translation.

Moving out of the CAVE

Since virtual reality has become widely commercialized in recent years, manufacturers in many industries have experimented with it in various forms for streamlining engineering and production. As the American Society of Mechanical Engineers (ASME) noted, "Car manufacturers, such as General Motors and Ford, are increasingly using VR to test design plans, tolerances, and safety features in virtual environments to ensure their products are evaluated at a very early phase of the process, thereby reducing the time and costs."[5]

Traditionally, immersive visualization in the automotive, aerospace and other industries has taken the form of the "Cave Automatic Virtual Environment" or CAVE – physical projection spaces that are prohibitively expensive to build and maintain. What is revolutionary about today's technology is that it moves VR out of CAVEs and into user headsets , for an even more immersive and realistic experience, but at a mere fraction of the cost.

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Proven across the industry

Sources

[1]http://wardsauto.com/industry/car-wars-study-forecasts-toyota-have-highest-replacement-rate

[2]http://www.autonews.com/article/20180411/RETAIL/180419932/

[3]https://en.wikipedia.org/wiki/Digital_twin

[4]https://www.cnn.com/style/article/seymour-powell-virtual-reality-car-design/index.html

[5]https://www.asme.org/engineering-topics/articles/manufacturing-design/manufacturing-cars-with-virtual-reality

Real-time 3D and virtual reality development platforms are not a futuristic or unproven concept, nor are they confined to the realm of consumer electronics and entertainment. They are in active use by leading auto manufacturers and their partners throughout the design and engineering ecosystem. In an industry that rewards the ability to think years ahead, forward-looking companies are eager to get a jump on the future and take advantage of technologies with the potential to deliver both a better product and a better ROI.

The race to deliver the "next big thing" in personal vehicles is heating up. Smart technologies, sustainability, connected cars and the trend toward autonomous driving are reshaping the automotive roadmap. In this race, the advantage will go to carmakers who embrace technologies such as virtualization that enable them to turn exciting visions into reality faster, leaving the competition in the rear-view mirror.