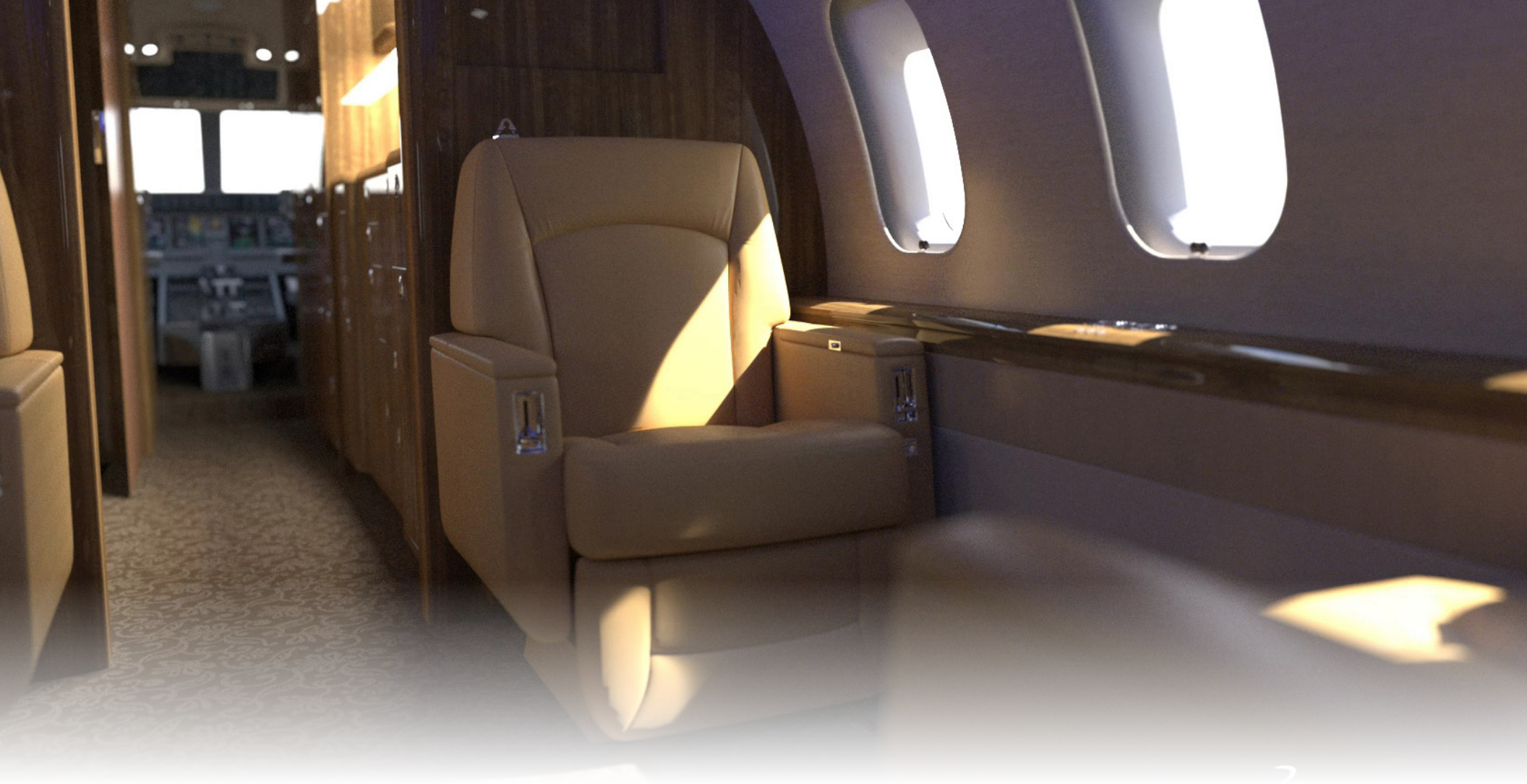

ADVANCED PRODUCT DESIGN FOR INDUSTRY 4.0

PART 4: POST DESIGN — SALES & MARKETING OF MANUFACTURED PRODUCTS

GPU-POWERED WORKFLOWS TO ENHANCE MARKETING ASSET CREATION, THE CUSTOMER PURCHASE EXPERIENCE AND PRODUCTION TRAINING.

NVIDIA

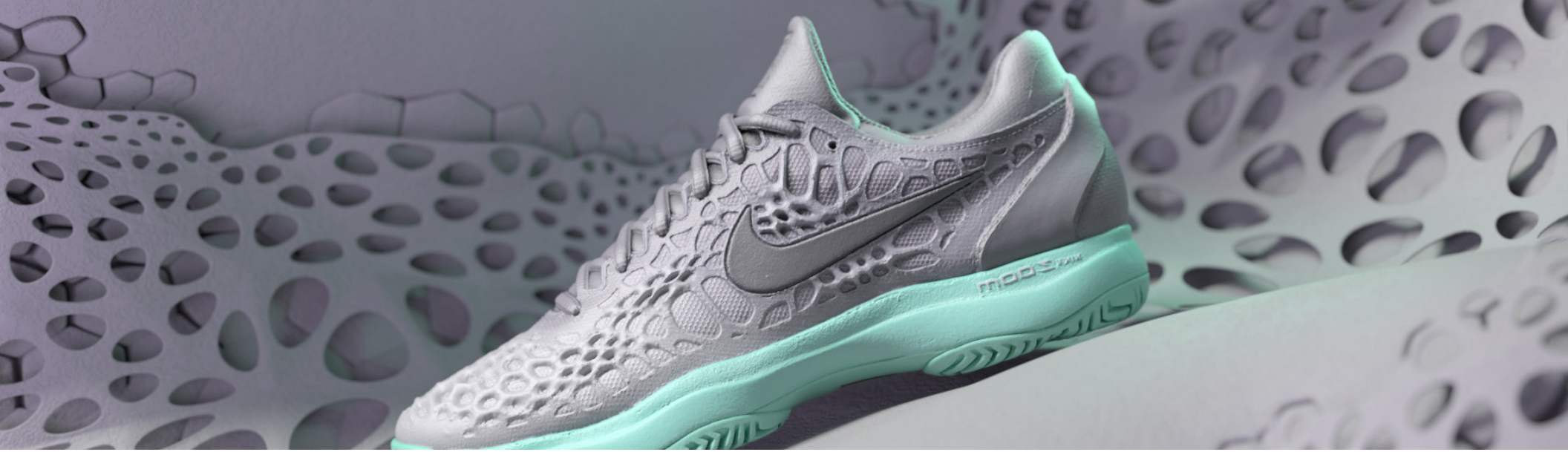

Image courtesy of **Aixsponza**

INTRODUCTION

The world of product development, manufacturing and production is changing. With Industry 4.0 we're on the brink of a new dawn of automation and intelligence, with smart, connected products and the smart factories that produce them.

Autonomous drones capture progress as a new production cell layout is commissioned. Deep Learning-enabled devices with computer vision perform quality checks on the production line and feed back data to continually improve processes. Intelligent, collaborative robots, aware of their environment, work alongside humans to assist with assembly tasks.

Advanced computing devices harvest huge amounts of data from products in the field, to feed design and simulation systems and help ensure that next-generation products learn from those that have gone before.

Virtual reality (VR) presents everyone in the development process with the information they need in a rich, immersive, and collaborative environment. Ultra-powerful workstations are used to design, simulate, and visualize products, production cells, and factories. Then, once manufactured, virtual products or digital twins can be connected via the Internet of Things (IoT) to their real-world manifestations.

At the heart of all these processes is NVIDIA, playing a strategic role in empowering the manufacturing industry to implement Industry 4.0. For the past 20 years, sustained investments in research and development (R&D) have resulted in NVIDIA continually pushing the boundaries of graphics processing unit (GPU) technology. GPUs have, for some time, extended far beyond simply powering computer graphics displays and design software.

Now, a wide range of software and hardware solutions from NVIDIA are enabling manufacturers to develop artificial intelligence (AI) capabilities for industrial collaborative robots and autonomous vehicles in the smart factory. This delivers secure access to data at any time from anywhere on any device, with fully interactive 3D graphics and the compute power required for big data analysis.

In the realm of advanced product design for Industry 4.0, the NVIDIA® Quadro® visual computing platform helps product design teams radically transform the traditional product development process. Utilizing leading-edge technologies like AI, virtual reality (VR), interactive physically based rendering, real-time engineering simulation, and 3D graphics virtualization, they develop the next generation of smart, connected products.

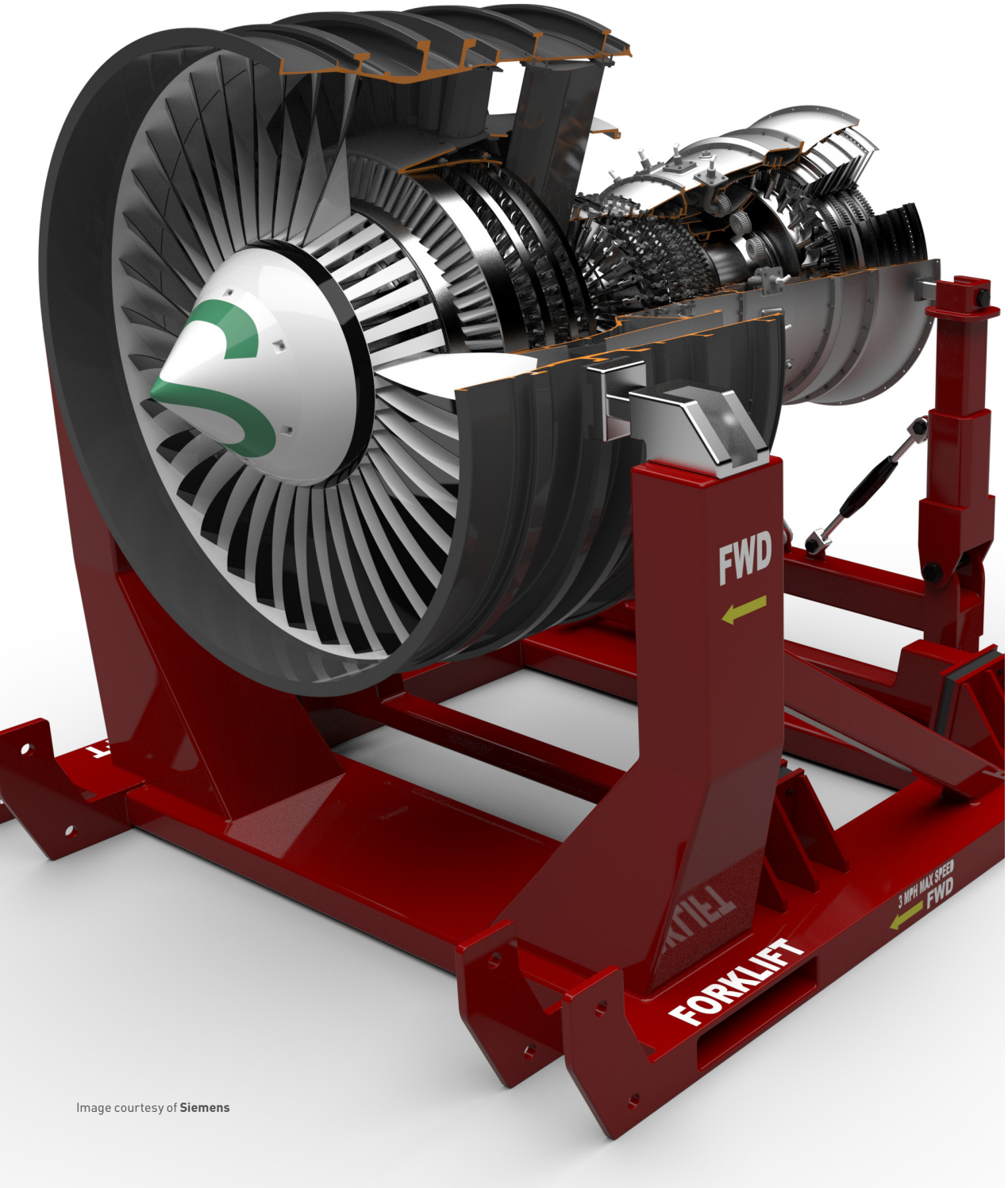

Image courtesy of **Siemens**

REAL-TIME PHOTOREALISM FOR SALES AND MARKETING

The first three parts in this series of e-guides focused on the future of product development. Specifically, they covered the role that systems play in concept design, detailed engineering, visualization for design review and preparation for manufacturing – particularly when combined with today's (and tomorrow's) rapidly advancing visual computing technology.

They examined the use of mobile computing and graphics virtualization for concept capture and ideation, and how modern photorealistic visualization techniques not only make it easier to create such assets and improve their richness, but simplify the distribution of the systems that produce the assets as well.

This final part explores how the same set of technologies is also influencing and enhancing the creation of assets to assist in the sale, marketing, assembly and servicing of products. The sales and marketing process is an excellent place to begin.

Whether a consumer is in the market for a new car, or is a corporate buyer investing in a factory, plant or industrial machinery, today's customer has a very different expectation of how they will interact with potential purchases. A glossy brochure and the word of a salesperson is no longer going to meet expectations. Today's customer expects a rich experience. It's here that new product visualization techniques can deliver significant advantages.

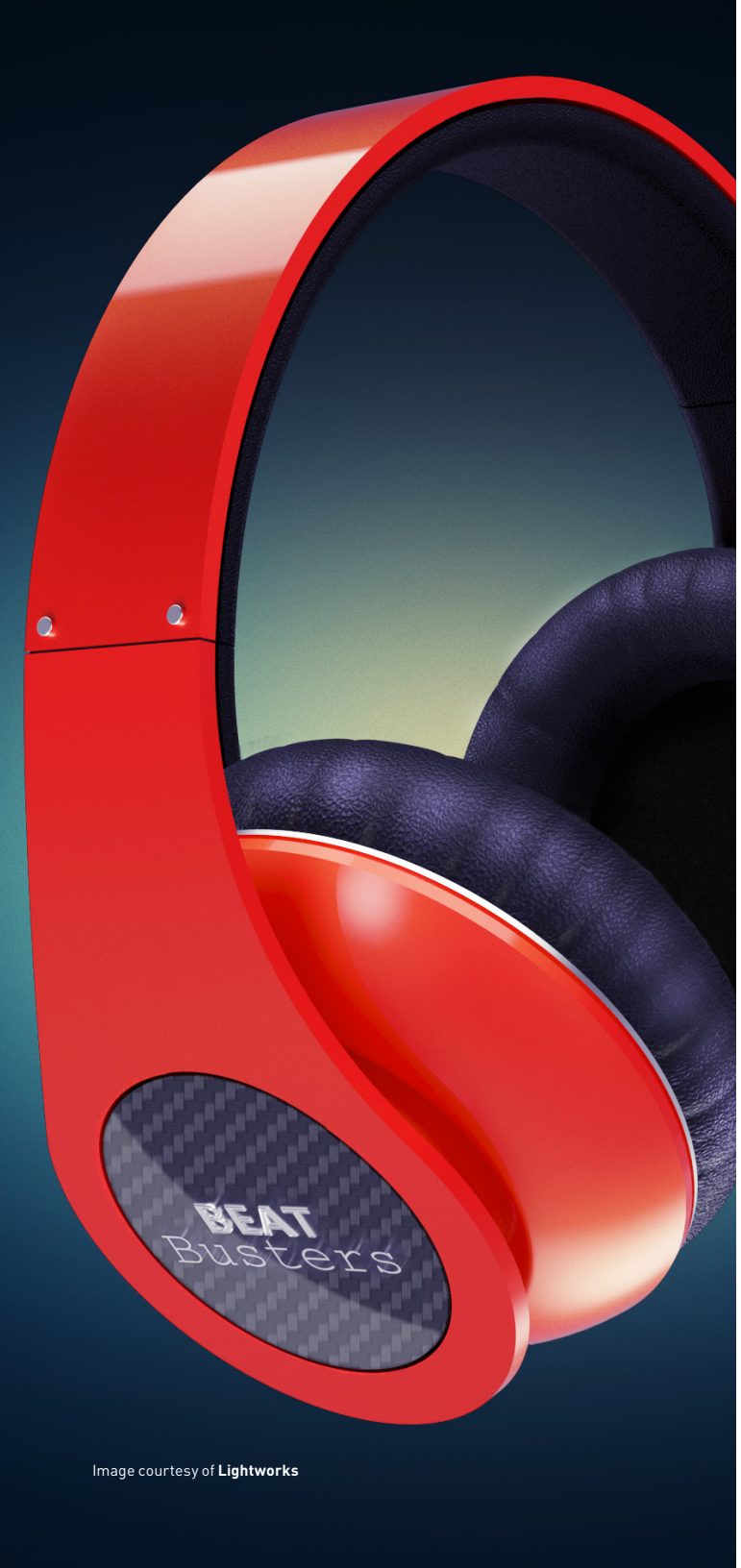

Image courtesy of **Lightworks**

MARKETING COLLATERAL & THE CHALLENGE OF CHOICE

Consumers today have more choices than ever before, both in terms of the number of products available, and in the way those products can be configured with colorways, material options and finishes. The business of offering choices is everywhere, from the traditional markets of automotive and consumer electronics, to the most mundane of products.

For those who generate marketing collateral, this presents a significant challenge that can be addressed with efficient use of photorealistic rendering.

Consider the example of a basic set of headphones. The shape, form and engineering work is done, the product is being tooled up at the factory or contract manufacturer, now it's time to get the promotional materials ready. Not only does this include product packaging, but also point of sale display, advertising, web-pages (for both the vendors' own and distributors'), sponsorship materials – even huge scale materials for buses, buildings and beyond. Now consider that these same materials need to be created for each product variant and there are multiple material options.

Multiple views, multiple product configurations and multiple styling options – it quickly becomes clear that the quantity of visual assets required can quickly get out of hand. Accelerating the generation of these assets offers a solution to the marketing roadblocks.

It's here that physically based rendering (PBR) technology and the systems into which it has been built can truly revolutionize marketing workflows. The ability to quickly set-up scenes, camera views and then switch realistic materials in and out of your scenes is essential, but what really makes a difference is how quickly those assets can be computed.

To generate the most realistic output has always been a computationally intensive process, but the introduction of GPU-based computation can reduce render times of non-trivial jobs from hours to real time.

IMPROVING PROJECT WORKFLOWS THROUGH MORE ACCESSIBLE DATA WITH QUADRO vDWS

As increasing GPU performance has led to improved computation speeds, the use of photorealism to visualize designs with accurate, physically-based renders has become much more widely used. Now, near instant render times on today's virtualized workstations allow everyone involved in the product development process to access not only the data (in terms of images or video) but also the creation, editing and production processes. If the marketing department needs a couple of tweaks to a digital camera angle in a render or to tweak a material setting, they can dive in and do those edits themselves.

For example, NORDAM, a global firm which offers an array of products and services to the aerospace and aviation industries, uses virtual workstations powered by NVIDIA® Quadro® Virtual Data Center Workstation (Quadro vDWS) software to give those in manufacturing and sales access to 3D data.

Management and security are also simplified and enhanced as administrators don't have to maintain and upgrade individual workstations across multiple sites. New workstations can be spawned on demand, as projects dictate or as design teams scale.

At NORDAM, centralizing all storage in the data center instead of issuing individually provisioned laptops enhances security because the data remains under control within the company, eliminating the threat of loss or theft.

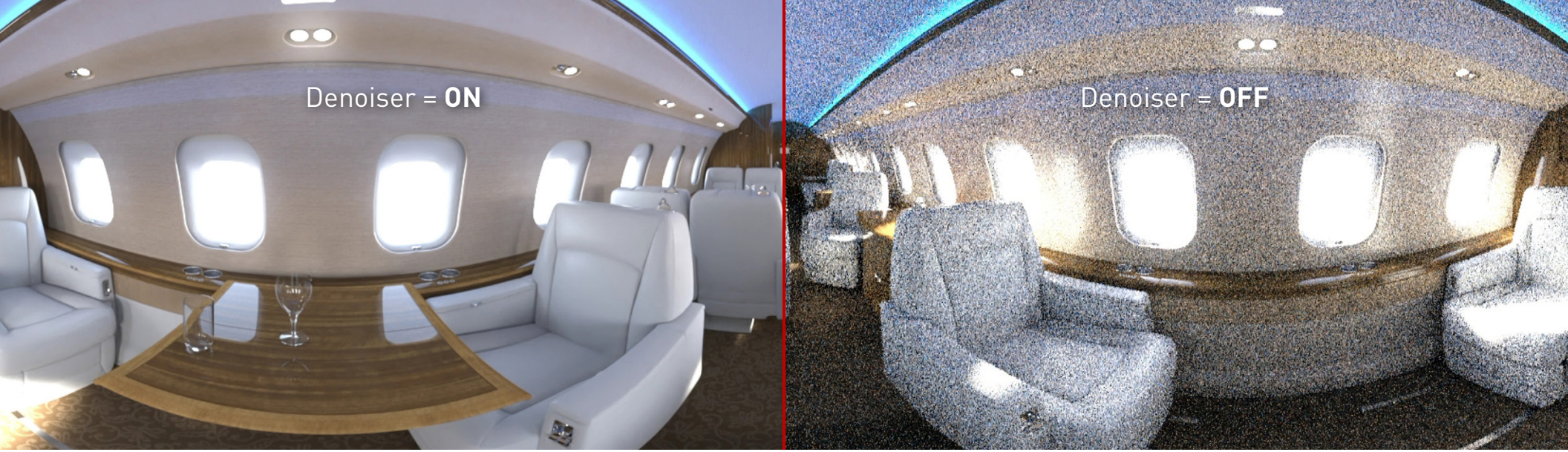

Image courtesy of **SOLIDWORKS Visualize**

Organizations that already take advantage of GPU-powered workstations for design and engineering workflows can now use those resources to efficiently tackle visualization workflows. Those same computational resources can efficiently and effectively be leveraged to run software such as SOLIDWORKS Visualize, CATIA Live Rendering, Lumiscaphe, or Ray Traced Studio inside Siemens NX, or renderers such as Octane and Redshift. GPUs are incredibly fast at ray trace rendering, but photorealistic output can be delivered even quicker by harnessing the power of AI. SOLIDWORKS Visualize and V-Ray NEXT GPU for example feature AI-denoising, which allows scenes to be rendered with far fewer passes and the resulting grainy image refined using deep learning.

AI-powered rendering denoising allows marketing teams to run through many more iterations on-the-fly to quickly narrow down and preview the render before running the final frame renders for collateral creation. Previously, this process was disjointed with teams often taking coffee breaks while waiting for the renders to finish. Now, with near instant feedback, teams can stay in the creative flow and explore many more options in a shorter timescale.

Furthermore, the ability to do this on virtual workstations powered by Quadro vDWS fosters improved collaboration. For example, regional marketing teams can easily customize material as appropriate to their geographic preferences, instantly editing a render and enabling them to bring targeted campaigns to market as quickly as possible. Data is centralized and IP is protected in the data center, while they get a native workstaton-like experience, even on thin clients.

Aixsponza is a company that produces storytelling visuals for complex concepts, using motion graphics, 3D animation, visual effects, and graphic design. The company's requirements are significant, with videos rendered in 4K and print ads at 14K resolution.

"Deadlines are very tight, and we need to begin producing results almost immediately," said Matthias Zabiegly, Lead 3D and VFX Supervisor at Aixsponza. "For example, we need to create test animations in order to review the design and direction. We do all of our rendering in Redshift because it generates final-look results. GPU rendering is absolutely essential to our work."

On a recent project with Nike, Aixsponza decided to replace the four consumer-grade GPUs in its primary workstation with four ultra-high-end NVIDIA Quadro GPUs. "One of my projects saw the Redshift render time per frame drop from eighteen minutes to seven and a half minutes with the Quadro GPUs," continued Zabiegly.

FROM MINUTES TO REAL TIME

Cutting render times in half is impressive but a new generation GPU technology from NVIDIA promises to take rendering to an entirely new level with real-time ray tracing. This will revolutionize design review, as any changes made to the design will be visualized instantly in cinema quality.

To do this, NVIDIA has developed the new Quadro RTX GPU, designed specifically for real-time ray tracing. Quadro RTX includes RT Cores that accelerate ray tracing operations alongside Tensor Cores that use deep learning, a subset of Artificial Intelligence (AI), to reduce the amount of work performed by the GPU to generate photorealistic results. This includes AI-based denoising, which predicts the look of a final image by filling in the spots that the rays haven't yet reached, and deep learning anti-aliasing (DLAA), a technique which trains a neural network to take a lower resolution image and turn it into one that is higher quality.

RTX technology is already gaining traction with software developers. Chaos Group, the developer of V-Ray, has demonstrated the technology in Project Lavina. Meanwhile, Dassault Systèmes has already incorporated AI-based denoising in SOLIDWORKS Visualize and plans to use RTX in SOLIDWORKS Visualize 2020 and in CATIA for rendering with life-like quality materials for design validation. Autodesk has incorporated AI denoising into its VRED visualization system, while Siemens plans to add AI denoising to Siemens NX Ray Traced Studio.

SEE YOUR DREAMS COME TO LIFE

The production of marketing assets using photoreal rendering technology, whether for packaging, advertising or point of sale, is a well-established industry activity. But what has become a growing trend in recent years is the use of the same datasets, techniques and hardware to create much more interactive and immersive experiences.

Rather than flipping through a glossy brochure or using a small-scale configurator on a website, leading manufacturers are using the power of photorealism combined with large scale display or virtual reality, to allow customers to see and interact with the final products. Lower cost and improved capabilities in high resolution, large format display and virtual reality (VR) technology is helping manufacturing organizations explore the potential for richer, more immersive sales environments.

However, the effect of mass customization is a large number of configurations, options and variables – all of which contribute to a workflow bottleneck for organizations interested in taking advantage of such technologists.

Audi os one of the world's leading manufactures of luxury cars, manufacturing more than 50 models, with each available in many different configurations. For example, the Audi Q3 alone can be produced in over 3,000,000 different combinations.

Audi's current VR initiative combines the compute power of high-end NVIDIA Quadro GPUs in their workstations with HTC's Vive VR HMDs. "A customer receives the Audi Code, and eight-digit code representing their unique car configuration," explained Thomas Zuchtriegel, Head of AR/VR Process & Technology at Audi Business Innovation GmbH.

"The dealer inputs selected options on a tablet and generates a 3D visualization of the proposed configuration on a 98" HD screen for initial approval and the 'wow' of seeing their dreams come to life. The dealer then hands the customer a VR headset for an immersive 360-degree experience that feels just like walking around and sitting inside their very own one-of-a-kind luxury automobile," he continued.

Audi began introducing VR showrooms into dealerships in 2016. Today, there are over 1,000 VR deployments in dealerships across the globe.

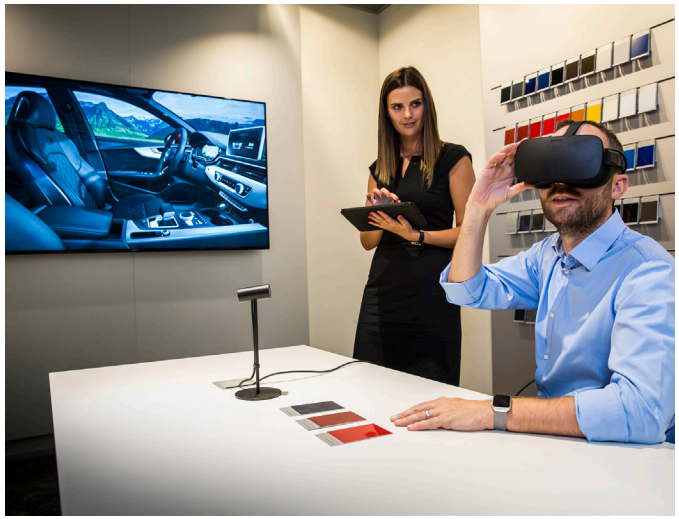

Image courtesy of **Audi**

GETTING HANDS-ON WITH TRAINING

Internal and external training can also be enhanced with Quadro RTX. For example, Bentley Motors uses a mix of rich 3D datasets, powerful graphics compute and immersive display and interaction technology to assist with training its assembly teams.

Installing the seats in a Bentley Motors automobile is a complex, model-specific process, and mistakes can easily damage expensive luxury materials. Bentley needed an efficient way to train assembly colleagues without compromising the excellence of its brand. To accelerate training and improve product assembly efficiency, they turned to OPTIS, a virtual prototyping specialist, to develop a VR-based, highly realistic 3D model of the car combined with real-time physics. To support real-time interactivity, OPTIS coupled imported native CAD data with physics haptic feedback using NVIDIA PhysX.

Modeling an entire factory line, including the robot arm and full 3D model allows Bentley to simulate interactions between the robot arm, seat, and/or car frame as an assembly colleague simulates the installation of the seat using the controllers as if they were their own hands.

Virtual training using VR powered by NVIDIA PhysX running on Quadro GPUs enables Bentley to train assembly colleagues quickly and easily without risking damage to costly materials and components. Training for a new model can begin before the components themselves have been built, thereby ramping up production speed and shortening time to market. This approach also realizes design, material, and process improvements.

According to Mark Harding, Manufacturing Project Leader at Bentley Motors, "The primary use of the VR model was to influence product and process design. The correlation between virtual and real was extremely close."

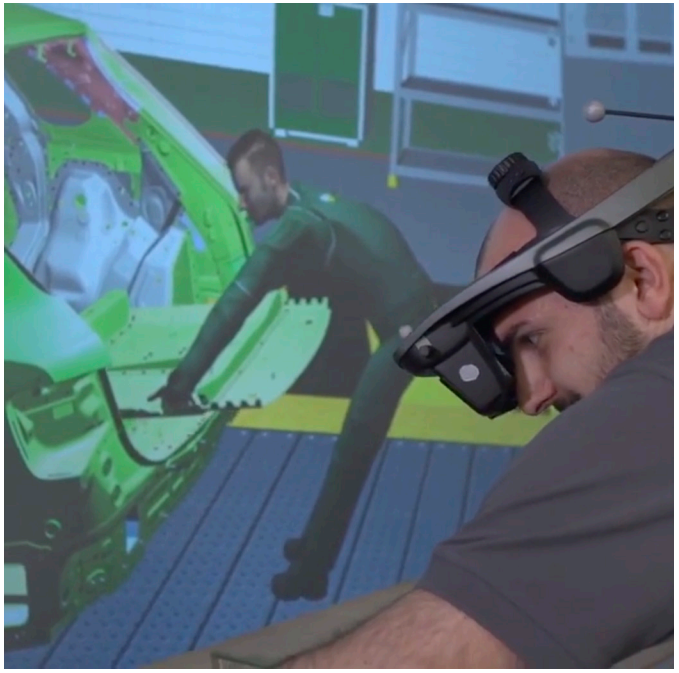

Image courtesy of **Bentley Motors**

IIOT ENABLED FEEDBACK LOOPS INTO DESIGN

While this e-guide series has focused on common advanced product development workflows for Industry 4.0, there is another huge shift coming: Engineering and manufacturing led organizations will be able to capitalize on their smarter, more connected products in the future.

One of the core tenets of Industry 4.0 is the connected, smart nature of products in the field. The combination of low cost, connected sensors, together with edge-based compute capabilities, means that an unprecedented quantity of use and performance metrics can be gathered from products in the field. With careful processing (either at the edge or in a data center), design teams will soon be able to connect this data directly to digital representations of that product, which opens up all manner of possibilities.

Imagine being able to have your products in the field, monitored for extreme use cases, with simulation being run to predict failure modes – then having notifications to both arrange shipment of replacement parts and to schedule the engineering team to fit them. Imagine being able to take that wealth of real-world use data and use it to drive the design of the next generation of products – not based on an idealized set of test cases, but on actual use cases from your customer base.

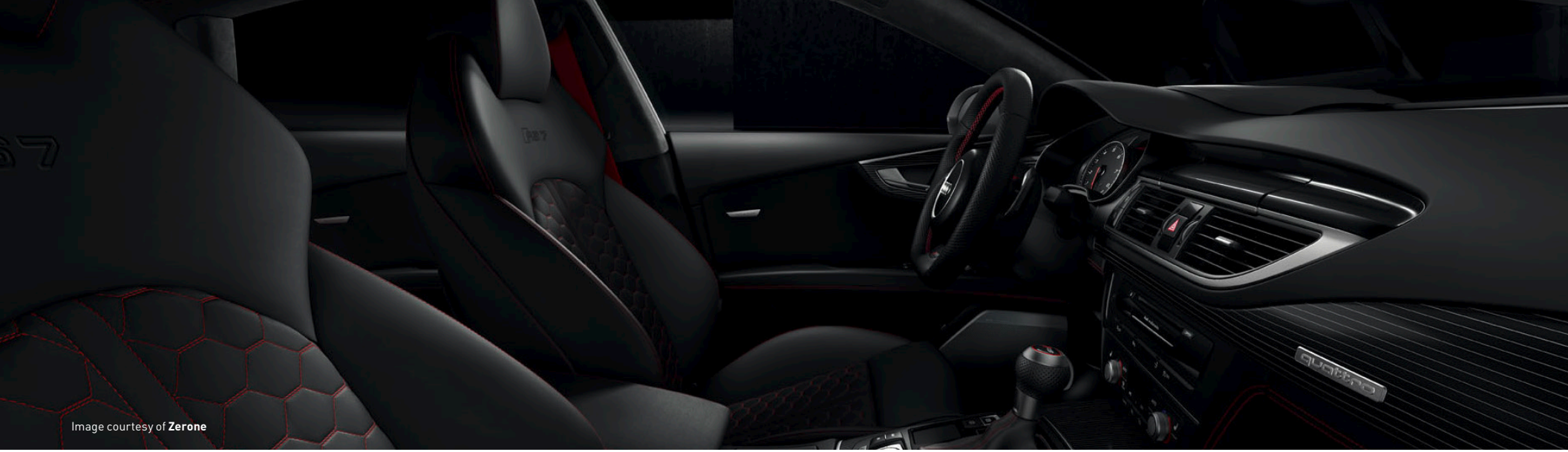

Image courtesy of **Zerone**

CONCLUSION

Today's product development focused organizations are facing more challenges than ever before. Globalized competition is fiercer, time is more compressed, and customers are more demanding. Consumers not only want more choice and more variation in their products, but want them to be more efficient, more cost effective and to perform better.

For many years, standardization and modularization have been the name of the game for engineering. Now, consumers want more customization options – whether it's the smartphone in their pocket, their next motor vehicle or the earth moving equipment for a mine.

The good news is that mass customization is easier across a wide spectrum of processes thanks to highly efficient visual computing methods combined with advanced display technologies. This report has discussed how photorealistic visualization techniques can be used to generate marketing assets more quickly than ever before – an essential upgrade to previous workflows given the need for customization and configuration. It has also explored how those same technologies can be made more widely accessible in an organization through virtualization – sharing not only the assets but also the tools for creation in a secure and centralized manner.

The same techniques and technologies can be used to engage and enchant the customer like never before. Through the use of high-resolution displays, VR HMDs and photorealistic rendering techniques, it's possible to give the customer a true understanding of a virtual product long before it rolls off the production line.

The same approaches and technology can be used to assist in bringing that product to market, to help those on the shop-floor gain a deeper understanding of the process in a richer, more immersive environment.

Advanced visual computing, driven by GPU acceleration is revolutionizing the complex process of product design and development. Soon a more intelligent and efficient set of workflows will help bring new products to market more effectively, and with lower cost than ever before. And most importantly, products that will delight the customer, not just in use but even before the purchase had been made.