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Northrop Grumman VR Technology Tools Case Study: Leaders in Applying Virtual Reality

This enterprise case study focuses on how Northrop Grumman leverages Virtual Reality in the design and testing of its products.

Northrop Grumman Corporation is an American multinational aerospace and defense technology company headquartered in Los Angeles, California, with annual revenues exceeding \$37 billion – that puts them at #101 on the 2022 *Fortune* 500 list. In 1994, Northrop Corporation acquired Grumman Aerospace resulting in the creation of the Northrop Grumman Corporation, although the firm's history goes well beyond the original two companies founded by Jack Northrop in 1939 and Leroy Grumman in 1929. Today's Northrop Grumman is a result of the integration of over 20 pioneering companies from across the aerospace, technology, and defense industries.

The firm is one of the world's largest weapons manufacturers and military technology providers, with approximately 95,000 employees globally with more than 550 facilities in all 50 U.S. states and in more than 25 countries around the world. Northrop Grumman consists of four business sectors: Aeronautics Systems, Defense Systems, Mission Systems, and Space Systems. Its products include military aircraft and unmanned aerial vehicles; military vessels; missiles and missile defense systems; autocannons, chain guns and munitions; satellites & space; information technology; electronic sensor and systems; and rocket launch systems.

Northrop Grumman's many accomplishments include its pioneering work on the Apollo space program, the lunar module that landed a man on the moon, the B-2 stealth bomber that it maintains for the US Air Force, and the latest drone technology.

When designing satellites or the interior of spacecrafts, creating prototypes is crucial to help engineers evaluate and improve their designs. It is not feasible, however, to test these designs in outer space. That is why Northrop Grumman turned to 3D Virtual Reality (VR), which facilitates their engineers to bring outer space closer to home by seeing their designs in action prior to putting them into production.

Using VR tools for space flight is relatively new. In the early days, NASA engineers and technicians scrutinized design details using two-dimensional drawings and calculation sheets. That evolved into utilizing Computer-aided design or CAD models that led to full-size physical mock-ups built from wood or metal. But CAD designs are limited by the 2D screen. To overcome this constraint, engineers now create 3D CAD renderings that in minutes get converted for VR viewing, put on the VR headset, and examine a full-scale model in extraordinary detail. Because headsets are lightweight and work wirelessly, engineers have the flexibility and freedom to walk entirely around, for example, a spacecraft or a piece of military hardware, examining it inside and out. And because VR renders details so precise and realistic, engineers can view design details to include the threads on bolts, the twists in wires and the embossed identification labels on various components.

Here are 3 examples of how Northrop Grumman is currently leveraging VR technology.

- This first example highlights Northrop Grumman 'Digital Shadow testbed,' which is a digital replica or 'digital twin' of their CRJ-700 test aircraft. By creating a digital twin of the aircraft, Northrop Grumman can evaluate mission systems virtually and rapidly collect valuable systems data needed to drive

enhancements. For example, Northrop Grumman can test digital representations of fighter radars on the aircraft in the Digital Shadow testbed, while collecting valuable performance data to enhance radar design. Northrop Grumman can also create scenarios and sensor combinations beyond the physical-testbed limitations, thus increasing the breadth and scale of experimentation while reducing timeline, flight test costs, and risk.

- This second example explains how Northrop Grumman applied VR techniques to help design a new intermediate class rocket in response to questions raised by their customers. One of those questions had to do with batteries that have to be replaced in the rocket just before launch while the rocket is still on the launch pad. The batteries weigh 25 pounds each, and the design requires they be installed or removed through a small access door. During the design review, an engineer simulated the battery installation in the VR environment using a 25-pound dumbbell. The VR design review quickly showed engineers and customers that the currently planned battery access panel was placed in an awkward location making it difficult to perform the battery exchange. The VR simulated environment helped engineers redesign a battery ‘hanger system’ to allow for easy swapping out of the batteries while on the launch pad.
- This third example references Northrop Grumman’s Virtual Reality lab located in Dulles, Virginia, where engineers leverage VR technology by slipping on a VR headset to test the feasibility of procedures such as operating a robotic arm or cleaning the module in a zero-gravity environment. This helps evaluate and improve engineering designs, which then get created into 3D-printed mock-ups.

Northrop Grumman’s VR technology programs have delivered many benefits to the firm, for example:

- Design engineers can evaluate and improve engineering designs and answer questions with increased speed and agility.
- The use of a digital twin reduces the time to test and deploy new designs from years to hours.
- VR design and testing also improves real-time outcomes on the battlefield, where agile and networked warfighters can adapt to changing adversary tactics, techniques, and technologies.

Northrop Grumman knows that leveraging VR and other ‘virtual world’ technologies requires putting stakes in the ground today, then keeping up to date on the latest technologies and incorporating these technologies into their current and future virtual world efforts. That may help to explain why Northrop Grumman created the internal position of ‘Principal Investigator for XR Technologies.’ I am curious to learn how Northrop Grumman will apply Apple’s Vision Pro to their future virtual world efforts.

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