

FEATURE



SIMULATION AND VIRTUAL REALITY

A NEW AGE OF TRAINING TECHNOLOGIES

Photo credit: © AIRBUS 2018 - photo JV. REYMONDON



The American futurist, Stanley G. Weinbaum, described virtual reality (VR) decades before the term gained widespread reception, in his short story - Pygmalion's Spectacles. In the story, the main character encountered an elfin professor who had invented a pair of goggles which allowed people to experience "a movie that gives one sight and sound, taste, smell, and touch." Today, Weinbaum's vision has become a reality, with VR beginning to achieve mainstream acceptance and increasingly gaining traction in the consumer and commercial space. *Aerospace Singapore* examines how the aerospace and aviation industry is shaping up to be one of the leading adopters of this technology.

VR systems, along with related technologies such as augmented and mixed reality (AR and MR), are now used in both commercial and military aviation sectors, transforming the way the industry learns and operates.

As one of Asia's leading aerospace hubs, Singapore is well-placed to ride on the wave of emerging VR technologies. With its excellent connectivity and world-class infrastructure, it has become a regional base for aerospace maintenance, repair and overhaul (MRO), regional distribution centres, precision engineering and electronics activities. The promise of high fidelity training systems utilising VR has attracted significant attention from large and small industry players in developing and upskilling manpower more quickly, cheaply and flexibly.

EXPERIENTIAL LEARNING

AR connects the real and digital worlds to produce new environments where physical and virtual objects interact in real time. VR enhances the experience by not only transporting the user to a digital environment that shuts out the real world, but also placing one in virtual locations that would otherwise be hazardous or restricted.

AR and VR systems have proven useful in the context of aerospace maintenance training, which typically requires system downtime, availability of spares or dummy equipment for hands-on practice. The virtual training systems enable learners to hone

procedural drills in maintenance operations within safe boundaries of a synthetic reality.

As virtual characters in an artificial world, learners gain knowledge through life-like demonstrations that depict the execution of standard procedures. They can even practise troubleshooting emergencies using actual hand motions and body postures, which provides a more realistic experience compared to simply flipping through manuals of complex instructions or protocols. Virtual learners are also exposed to fewer risks of injury when handling heavy machinery, especially when they have no prior experience.

The proliferation of VR has expanded the opportunities for simulation training and edutainment, and some Singapore-based firms and institutions are already harnessing these technologies to offer solutions to deliver unique user experiences that engage, educate and inspire.

Leveraging on the flexibility of VR technologies, AviationLearn, a Singapore-based training provider specialising in the aerospace sector, has developed the Multi-Function Training System (MFTS). It is an easily reconfigurable system which, unlike dedicated flight simulators, is designed to support instruction for a wide range of applications or customer-specific requirements including multi-crew aircraft platforms.

The MFTS allows for computer-based training via an integrated learning management system, an active fault simulator, and networked flight training devices integrated with a central instructor operating station. Data generated by attached training devices is tracked and accessed seamlessly by the instructor, who can monitor and evaluate a learner's performance in real-time. Deeper insights into training sessions can also be gained using data analytics tools.

"VR technologies offer mobility, immersion and flexibility," Edwin Ng, AviationLearn's

BELOW:
AviationLearn's Multi-Function Training System (MFTS) is easily configurable to address diverse instructional requirements



Photo credit: AviationLearn

Director, Business Development told *Aerospace Singapore*. "This gives our clients the ability to have training delivered anytime and anywhere, while enabling the level of immersion required to be trained effectively."

"VR systems also allow companies to reach out to learners that they previously might not have been able to train due to geographical or resource limitations," Edwin added. "The flexibility to change the virtual environment and scenarios also provides more versatility and opportunities for learners that were not as readily available in the past."

Aero-engine manufacturer Pratt & Whitney has also invested significant resources into VR training. The aim is to reduce the resources and time required for maintainers to learn how to repair its PurePower Geared Turbofan (GTF) engines. By harnessing VR technology in its customer training programmes, the company enables learners to virtually observe a running engine in motion, so that individual parts can be examined without having to disassemble the entire system.

Pratt & Whitney's approach comprises a VR headset which enables a learner to interact and manipulate animation. One can, for example, observe how a particular engine valve functions and visualise how airflow moves through the engine to cool components. The tool also allows the user to move around – inside and outside the engine – without physically moving, by manipulating a handheld controller to determine which component to explore.

"Currently, Pratt & Whitney's customer training is



Photo credit: Nanyang Polytechnic

done through classroom time and with real engines," said Bruce Hall, General Manager, Customer Training. "Beta-testing has already commenced to determine how VR training tools can be best applied. Our vision is to have a virtual reality component that supplements what we currently have."

NEW AGE TECHNOLOGY FOR THE NEXT-GENERATION

Besides the airlines and aerospace industry, Singapore's schools and higher learning institutes are also offering increasingly diverse and comprehensive programmes to support the region's growing requirements for flight and maintainer training.

Since 2012, Nanyang Polytechnic (NYP) has leveraged

ABOVE:
NYP's 3D Immersive Virtual Reality Centre provides its students with authentic and immersive learning experiences

VR-training technologies to develop the next-generation of aerospace engineers. Its 3D Immersive Virtual Reality Centre boasts custom-designed VR software – the first in an Institute of Higher Learning – created specifically to provide an authentic and immersive experience for its students to improve learning outcomes.

The institute employs EON Reality's four-walled EON Icube system, which is the largest system of its kind in Southeast Asia. The flexibility of the system allows it to be used with 20 VR learning modules developed for the school's aerospace programme.

NYP's VR-training centre also includes VR-ready computers and VR systems, based on the EON Ibench Mobile software. This allows students to be

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trained individually or in small groups and learn skills in a life-sized immersive setting.

“We have been using VR-based education for over five years and have seen very positive results amongst our students in terms of increased attention, understanding, and retention,” said Desmond Tan, NYP’s Deputy Director of Aerospace and Precision Engineering. “By deploying the 4-Wall full-scale Virtual Reality training system, we are able to offer a truly immersive and realistic hands-on virtual learning experiences in which several students can participate at the same time – without the need for large facilities or costly physical equipment.”

HIGH FIDELITY SIMULATION

With over 700 aircraft in service and another 400 in its order books, Airbus has partnered with Singapore Airlines to set up the Airbus Asia Training Centre (AATC). The US\$100 million effort has attracted 45 airline customers since its inauguration at Singapore’s Seletar Aerospace Park in April 2016. The company is predicting that the Asia-Pacific region will lead global demand for new aircraft, with the in-service fleet growing from around 5,600 aircraft today to 14,000 over the next two decades. This will see the active flight crew population employed by airlines in the region increase from over 65,000 to almost 170,000, generating significant demand for flight crew training services.

The 9,250 m² facility offers type rating and recurrent training courses for all in-production Airbus aircraft, and is presently equipped with seven full-flight simulators – two A330, two A350 XWB, one A380 and two A320 systems – operating

RIGHT: Airbus is developing MR and VR technologies that enable its staff to easily review maintenance processes and test new designs via 3D digital models



Photo credit: Airbus Group

around the clock throughout the year. The AATC also plans to install an additional A350 simulator by the end of 2018.

The company is also investigating new training solutions based on MR technologies to complement its simulation systems. It has partnered with Japan Airlines (JAL) and JAL Engineering to develop a prototype MR training application based on Microsoft’s “HoloLens” and immersive headset. This approach provides access to aircraft digital data which can be viewed virtually from any angle to run specific

BELOW: The AATC is equipped with highly realistic full-flight simulators that replicate the capabilities of the company’s aircraft such as the A330 and A350 XWB



Photo credit: Airbus Group

aircraft procedures, enabling users to learn anywhere without the need of the physical aircraft.

“Digital and interactive immersive solutions have a positive effect on competence and skills acquisition,” Xavier De Larboust, Head of Business Development, Airbus Training Services, told *Aerospace Singapore*. “This follows the principle that we remember only 10% of what we read and 90% of what we do ourselves, even in simulation.”

He added, “Looking ahead, we can say that flexibility, interaction and distance-based self-learning tools are the Airbus strategic axis of development. New solutions will increase efficiency through more self-learning, which can be done at the trainee’s own pace and at any place with internet capability”.

Meanwhile, Boeing is predicting the need for more than a million new pilots and maintenance technicians over the next two decades, and is boosting its training capabilities to meet this projected demand. Although it is one of the biggest players in the market, the company has adopted an approach that places less emphasis on volume

by leveraging technology to increase its training throughput.

The Boeing Training and Professional Services campus in Singapore offers comprehensive training for its aircraft types. Equipped with a total of eight full-flight simulators for the 737 Max 8, 737NG, 777-300, 787-8, and 787-9 platforms, it is Boeing's largest simulator centre in Asia-Pacific. The Singapore campus currently serves at least 90 airline customers – including Korean Air and Scoot – which utilise its flight, maintenance and cabin-crew courses.

High fidelity simulation offers "learning by doing" solutions that can reduce the need for ground instructors, and lower overall costs by reducing the practice time on actual aircraft.

PAVING THE WAY AHEAD

However, there is still some work to be done to fully integrate VR technologies into present training operations.

BELOW:
A training session in progress at the Boeing Training and Professional Services campus in Singapore

"One challenge is to fit VR technologies into the current curriculum," AviationLearn's Edwin noted. "As VR technologies are [still relatively] new, not all clients will have a training curriculum that take VR technologies in consideration."

"This is a new opportunity for us as we assist clients to relook at their training curriculum and to revise it to fit in VR technologies effectively in a cost-effective manner," he added.

Likewise, Airbus' Xavier is confident that the industry can exploit the benefits of immersive training, but cautioned that the right approach and support is key to ensuring successful implementation.

"[We must] make sure that the right technology is used for the right training objective. We cannot believe there is a single technology that meets all needs in all conditions," he explained. "As technology evolves very fast, teaching techniques and

instructional curriculum will need to become flexible enough to adapt to this evolution."

"Regulations that drive the training business will need to evolve at the same pace or to become flexible enough to adapt to the fast-evolving technology too," he added.

Moving ahead of current capabilities, leading companies such as the aforementioned firms are investigating the next-generation of virtual simulations. The future of VR could include fully interactive elements and a developed sense of realism in the virtual world through integration of other senses such as touch and smell.

As industry and regulators become more accepting of VR innovations and its capabilities for the mechanics as well as improved efficiency and more effective training, the use of virtual reality in Singapore's aviation and aerospace sectors are poised to take off. 🚀



Photo credit: Boeing

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