VR/AR ASSOCIATION

VR/AR WHITE PAPER

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VIRTUAL REALITY (VR) AND AUGMENTED REALITY (AR) BEST PRACTICES FOR THE AEROSPACE INDUSTRY

AUTHORS

Dr. Alethea Duhon
Co-Chair

Samuel Trevino
Co-Chair

CONTRIBUTORS

DiSTI
Future Visual
Kris Kolo, VRARA

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About

The Aerospace Committee of the VR/AR Association serves as a resource to promote the application of VR/AR technology as a solution to a number of traditional problems in aerospace. The committee enables the sharing of best practices and information on VR/AR related applications in the aerospace industry as well as curate industry relevant case studies. Furthermore, the committee shapes and recommends best practices for the scaling of VR/AR applications across aerospace.

Image Source: VE Studio by DiSTI

Introduction

This publication is part of an ongoing discussion on the wide-ranging applications of VR/AR technologies in the broader Aerospace framework. These case studies are intended to assist in understanding the challenges faced by these companies, the impact of adopting these technologies as solutions, and the recommended best practices for VR, AR, MR applications in the aerospace industry.

We encourage continuous industry feedback to keep this a living document. As a committee, we intend to update this material as needed.

Edith Montecinos, Development Engineer - VMT Team, Demonstrates The Bell 412 Classroom Trainer

Image Source: DiSTI

Foreword

The bar for operational excellence has moved up. Virtual work-place training and augmented overlays serving as a medium to present teams and people with important information are commonplace. In aerospace, it's a race among common players, new disruptors, and players in other verticals to lead the charge; who can use new tools to eliminate old problems. And how far can we, should we, go with this technology? Analyze, develop, test, repeat. Get a developer with a vision, or a visionary with a developer, and the previous limit is 50,000 feet below you. But you're not alone at that altitude.

We still have rules, and reliable processes, virtual and augmented reality support existing operations, not scrap them. What's so special is the immediate and continuous impact these tools have to accelerate the learning/training process and lower fixed and variable costs. These tools empower employees to create content libraries of reusable training making visualizing data possible. Because of this, errors are caught earlier; defects are reduced. Tests are more thorough. Pilots and technicians are prepared for more extreme scenarios. Every aspect of developing and operating a manned or unmanned aircraft has some story of how they've improved using these tools.

Experience-based training. Soak on that. What is experienced-based training? It used to align with creating simulations that involved as real of a scenario as an under-funded training program could provide. Now, it's using VR to practice starting an aircraft 50 times (in every temperature, night, day, backward, forward, at every airport) before you before you ever see a physical aircraft. It's validating and practicing work instructions to connect a wing to an aircraft within the time manufacturing engineers estimated without needing hardware to train. It's taking your client (who happens to be on the other side of the world) into a virtual world to visualize what your product fully integrated and operating well for them means. The contributors to this document speak this type of success based upon the tools they're creating for us. People using their products, and products like theirs, know so much more, learn and innovate so much quicker, identify root causes earlier, increase product reliability, and position their organizations to support technological art that is Industry 4.0.

This isn't a blip on the productivity radar that will level off as soon as the gimmick is over. This isn't the 30-day app. This is some variant of The Matrix happening right before our eyes. Quite literally. Right now, experienced workers are adding augmented reality overlays to processes and procedures (visual cues to notes, cautions, and warnings, for example) and uploading these sessions to a learning management system ready to deploy the knowledge globally. The IoT of manufacturing and production identifies when someone hasn't performed a task recently offers proficiency training, publications, checklists, and SME support within their field of view the day before the task is likely to be completed.

There is some information that we know, but still so much we don't know. How far will this go? Where does the virtual line stop, and the physical line stay? What we do know is this technology is spreading quickly because it's so effective. Teams are diving deep and using more tools to get to hyper-performing organizations in every vertical.

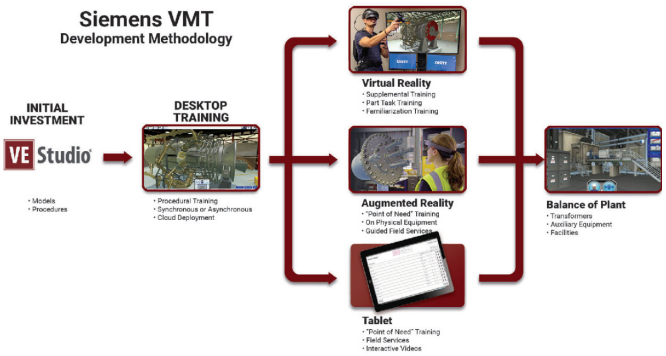
Thank you to the contributors within this document. They are a joy to watch, let alone work alongside.

Sam Trevino
VRARA Co-Chair, Aerospace

Case Study 1

How Siemens Digitalized Maintenance Training for its Global Workforce (DiSTI)

Training field service engineers to service power equipment is a highly complex and lengthy process. Historically, all new technician training was done via a combination of classroom training and hands-on training at one of Siemens' global training facilities. According to Kevin Carpenter who is the Director-Global Operations Training Network at Siemens, "The process to train a field service engineer is complex and time consuming. It requires a combination of theoretical courses combined with immediate hands-on practice with instructors in the training centers as well as on the job site so that engineers can perform the tasks required. We need to distribute training, however, the biggest challenge we are faced with is the need to conduct the training in the facilities where physical equipment is installed. The sheer cost of the equipment and its maintenance makes it difficult to distribute training using traditional training methods."



CHALLENGE:

- Reduce travel and logistical costs for training
- Offer asynchronous training for global workforce
- Create new interactive training methods for the next generation of employees

IMPACT:

- Increased student throughput
- Improved training efficiency and student efficacy -greater than 66% reduction in classroom training time; initial assessment scores of 93% on average
- Proven reduction in training costs
- New training business model

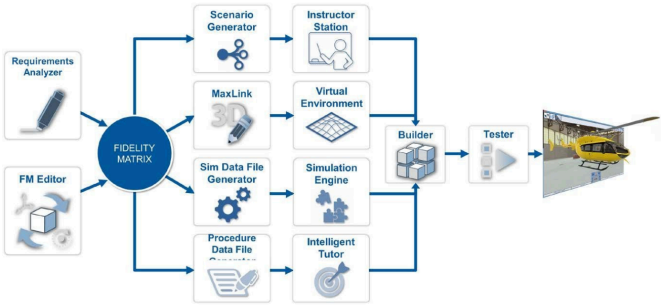
SOLUTION:

- VE StudioTM virtual training development platform
- DiSTI Professional Services
- Desktop, Virtual, Augmented Reality applications
- Amazon AppStream for enterprise deployment

Case Study 2

How the Chilean Air Force Developed A Virtual Maintenance Training Solution for their Fleet of Bell 412 Helicopters (DiSTI)

Maintenance training for the Chilean Air Force's fleet of Bell 412 helicopters previously involved a combination of classroom based training combined with hands on training using physical helicopter equipment. As Chile's Air Force modernizes, this model has proven to be difficult to keep updated due to the high costs of the physical hardware and the inconveniences associated with the airframe being out of service during the training. In addition the incoming technicians are expecting more modern forms of digital education. After an extensive evaluation of various methodologies and commercial off the shelf technologies, Fuerza Aérea de Chile (FACH) decided to create their own virtual maintenance training (VMT) solution with VE Studio from DiSTI as their development platform.



VE Studio's Patented Process and Tools

CHALLENGE:

- Reduce training costs with virtual technology
- Improve skills of maintenance technicians
- Implement virtual technology within 12 months
- Develop in-house using commercial technology

IMPACT:

- Shortened project length from 18 months to 9
- Cut costs through less use of physical hardware
- Certified training development team for VE Studio
- Improve maintenance technician competency

SOLUTION:

- VE Studio Virtual Training Development Platform
- VE Studio training and certification program
- DiSTI Professional Services

Case Study 3

The Value of AR Training Devices to Primary Flight Training

"Research has shown aviators trained with the help of 3D environments were able to maintain better situational awareness and improve skill performance, long term memory, retention and recall ability."

-Lori Brown, Associate Professor, Western Michigan University

CHALLENGE:

1. Overall pilot, and instructor pilot shortages
2. Training devices at 100 pct; instructors at 100 pct –retention issues
3. High cost to deliver training
   - All training in aircraft (no FFS)
   - Program washouts: "Could have retained student if we could have afforded more reps" (aircraft and instructor)

IMPACT:

1. Positive training tool for "economical" reps – can accelerate learning
2. Mixed Reality Flights allows cost effective visual upgrade to existing investment

SOLUTION:

1. **Complete VR**
   - Controls only through HOTAS
   - Positive results in two classes of Pilot Training Next
   - Some concern about negative training of incorrect muscle memory (eg, landing gear lever)
   - Some concern about VR discomfort/sickness in complete VR world
2. **VR with Hand tracking**
   - Controls in virtual world (Avatar hands/fingers)
   - Hand/finger tracking improving
   - Similar concern about VR discomfort/sickness
3. **AR/MR with camera pass through (eg, VITAL MRF)**
   - Camera view of physical reality (hands, controls, instrument panel) suffer resolution loss
   - Depth perception limitations with single camera
   - Positive muscle memory (see and activate)
   - Better tolerance of VR discomfort/sickness
4. **AR Visual System upgrade to existing CPT/UDT/FFS**

Case Study 4

The Use of Immersive Technologies in Aviation Training (International Air Transport Association with RampVR powered by Future Visual)

"The most effective way to learn is through experience. In live operations, it's very difficult to show people what can go wrong and how you can mitigate. Everything is smooth when operations are running, in a very safe way. You don't have the chance to show them what can go wrong.... In the virtual environment, you can replicate error issues that we know exist in the industry and you can do it several times without affecting any real operations, or any real equipment."

-Dimitrios Sanos, Senior Product Manager, Airport, Fuel & Ground Operations Training and Publications

CHALLENGE:

1. IATA was faced with the challenge of how to train employees effectively if they are unable to experience working in real life situations and learn on site.
2. IATA's established training programme provided trainees with extensive classroom based learning, mixed with shadowing experienced staff.
    - Although this gave trainees a thorough theoretical grounding, it could not give them a real sense of the airside space they would be working in, including the impact that adrenaline, fear and things "going wrong" may have on their reactions and decision-making skills.

IMPACT:

1. Training using VR provides a faster route to competency; where crews can experience a greater breadth of scenarios resulting in better trained people at a reduced cost.
2. Crew can train without risk of damage and practice multiple times without tying up expensive equipment.

SOLUTION:

1. Virtual reality was selected as the technology to replicate real-life, high-risk scenarios in which people can learn safely.
    - Participants are placed in numerous scenarios to address operational issues, such as foreign object debris and marshalling aircraft.
    - In the case of the marshalling module, trainees can use the VR controllers to perform the correct hand signals used on the tarmac. Using a neural network trained to understand these gestures, users can signal to aircraft in VR and have the aircraft react as it would at the airport, enabling a new level of immersion in the training scenario.
2. The training is integrated into IATA's training programme, complementing classroom based learning and it is fully compliant with IATA standards, as set out in the Airport Handling Manual (AHM) and IATA Ground Operations Manual (IGOM).
    - It has built-in metrics to monitor and track each trainee's performance which is fed into their overall training records.

Best Practices

These case studies highlighted the use of immersive technologies to enable and improve training in the various aerospace fields. The committee evaluated each case study and pulled from our collective expertise to offer up these best practices for consideration.

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1. Consider the real world
Importance of understanding your physical environment to develop a training program.

2. Focus on creating the experience instead of the lesson
Albeit a training program, it is important to understand and define the experience that the users will be undergoing.

3. Don't overcomplicate it.

4. Engage users up-front

5. Importance of technology collaboration
Work with technology providers to learn faster and to collaborate for creating new industry solutions.

We invite you to learn more by participating in our Aerospace Committee.
Learn more at: **thevrara.com/industry-committees**