

10 February 2019

ATT: ARBS Education and Research Foundation

Subject - Final Report - ARBS Education and Research Funding Agreement:

We hereby submit the final report for the **NEBB Australia virtual reality training project – Phase 2** “The Project”. All four primary objectives were completed, and within a reasonable timeframe given the complex scope and unique nature of this initiative.

Introduction

In September 2018, NEBB Australia with the assistance from Vrtual Pty Ltd embarked on a research and development project to further the understanding of Virtual Reality as a training tool for the Air conditioning, Refrigeration and Building Services Industry.

To steer The Project, the following objectives were set as milestones:

1. R&D - Water balance training module to enhance and extend the capabilities of an existing air balance simulator. Scope included the creation of 3D assets and code, for the creation of an actual VR based water balance training module.
2. R&D - Integration of deployment platform to facilitate the electronic distribution of the new VR water balance training module to individuals and training organisations.
3. R&D - Duct Traverse Module.

Project Summary

Objective 1 – Completed

R&D water balance training module including the creation of 3D assets and code for the complete VR water balance training module

Extensive R&D was completed towards the development of a water balance training simulator. This process required large quantities of development, and user testing hours. Various iterations of the prototype simulator were developed and user tested before establishing the final version of a fully working water balance module.

A large part of the development focussed on re-creating a 'true to life' plant room, immersing the user in an environment much like what they would be used to in the real life version of the job site. Achieving a minimum level of realism is critical to facilitating a fully immersive and convincing experience for the user. This removes any psychological barriers and allows them to focus on the learning objectives presented during the training module. 3D assets such as, air handling units, variable speed drives and hydronic measuring instrumentation were modelled to be true to life as possible.

The images below demonstrate the high quality of the 3D models created to replicate the real world HVAC equipment and instrumentation. Of most importance was the building of an industry leading hydronic manometer instrument, familiar in form and use as its real world counterpart.

Image 1 – Wide angle overview of water balancing training plantroom



Image 2 – Close-up of AHU supply and return pipework showing a virtual STAD balance valve

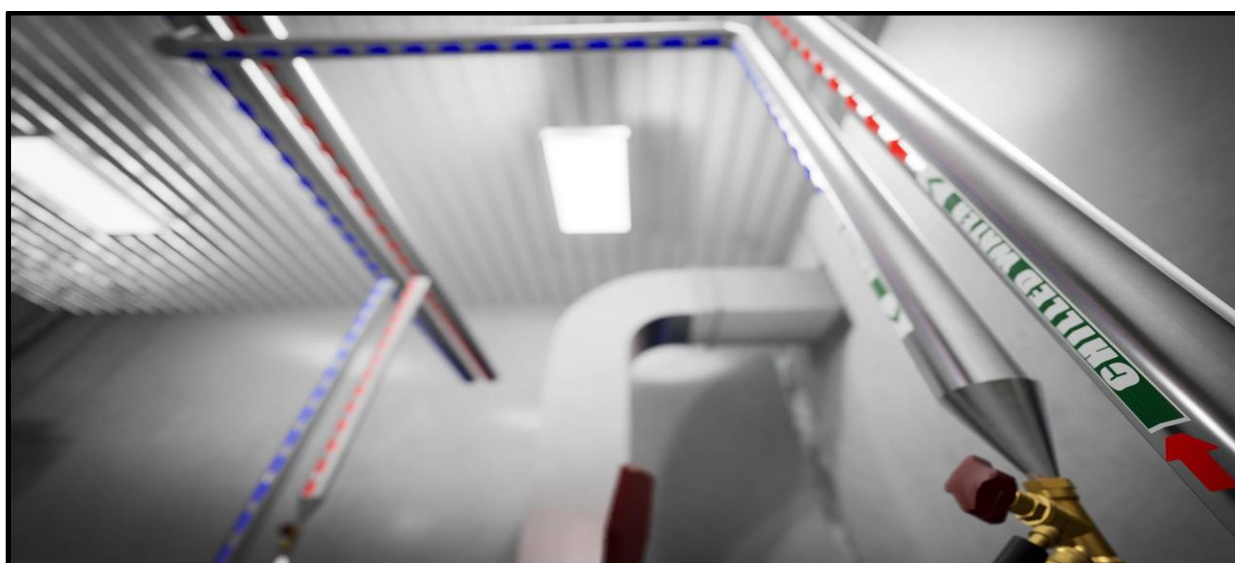


Image 3 – Close-up industry standard IMI-TA hydronic manometer and balance computer



Various industry experts were consulted during the research and development of the back end program code and the developed code accomplishes the task of simulating basic pipework fluid dynamics during the proportional balancing process.

Although there are some areas which we expect will benefit from ongoing improvement and refinement the final training module is world class, a first of its kind and ready for industry adoption as it achieves the primary objective of training effective proportional balance techniques in virtual reality.

Objective 2 – Completed

R&D - Integration of deployment platform to facilitate the electronic distribution of the new VR water balance training module to individuals and training organisations.

Research was conducted into the availability of deployment platforms for Virtual Reality Content. Two high quality providers were identified. **Immerse** based in the United Kingdom and **Innoactive** based in Germany.



www.immerse.io



Innoactive. Hub

www.innoactive.de

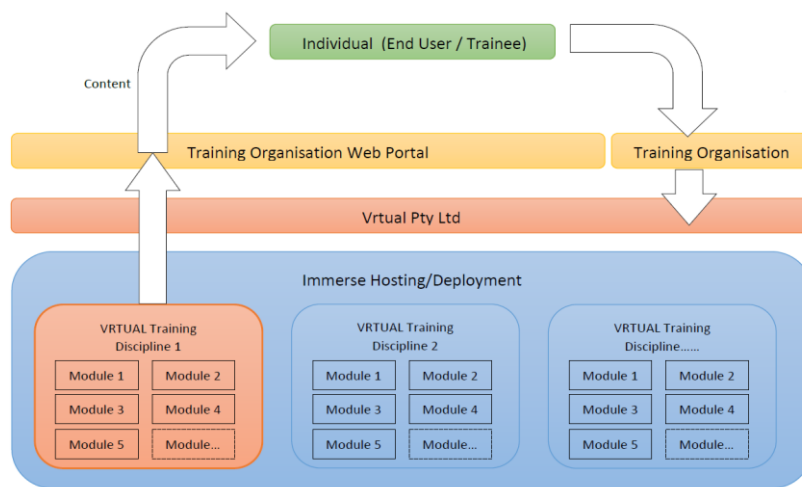
Several online meetings were conducted with representatives from both **Immerse** and **Innoactive**.

Following a thorough review of both supplier offerings, the consensus from the development teams was that **Immerse** offers the most appropriate deployment platform for our needs.

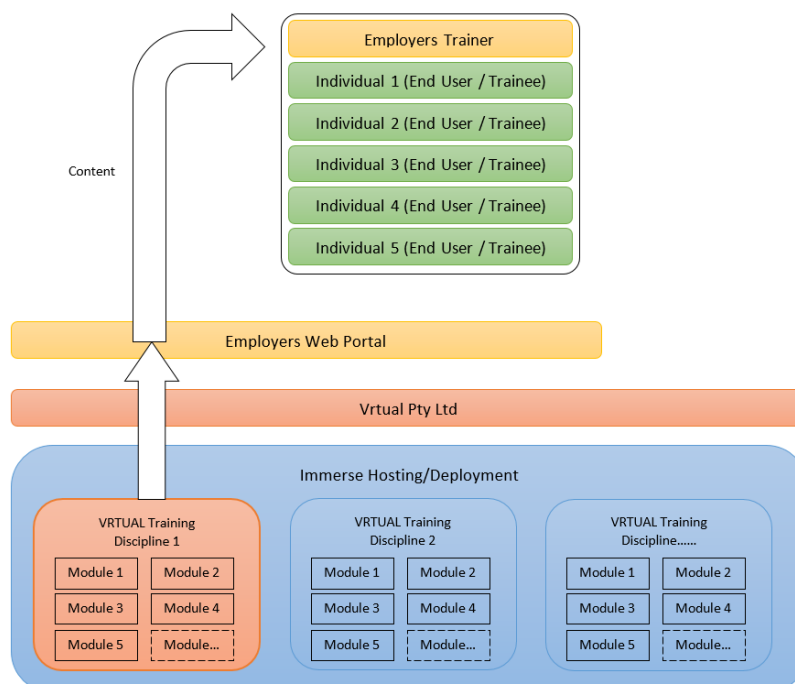
The development team met with the **Immerse** trainers and participated in a real-time training event wherein multiple users from 5 separate geographical locations were able to meet in virtual reality to collaborate and work on the common objective of assembling a virtual satellite dish.

Through this evaluation and research process, the team were able to collect valuable information regarding the software deployment process, content hosting and reporting/analytics capabilities. Following this review a draft deployment model was conceptualised by the Vrtual team and submitted to **Immerse** for review. Six deployment models were proposed in total. **Immerse** confirmed that they have the capabilities to deliver all models proposed.

Flowchart 1 – Example of Training organisation supplied VR training software deployment model



Flowchart 2 – Example of Company supplied VR training software deployment model

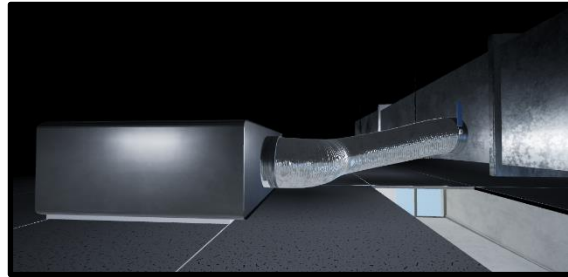
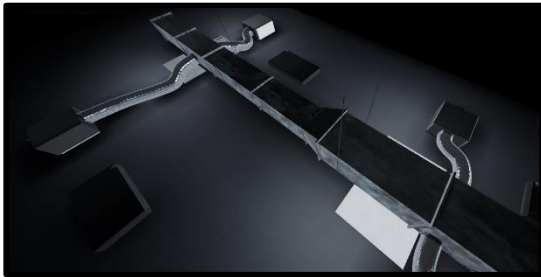


Objective 3 – Completed

R&D - Duct Traverse Module

Research into the development of a future duct traverse module was conducted by Derek OLSEN (NEBB Certified Professional and HVAC specialist). Some prototyping was completed and consultation with industry users heavily affirmed that the delivery of a duct traverse module would be hugely beneficial to the industry.

The current concept is very much in a prototyping and pre-development phase. Derek has previously developed an iPad application which enables the automatic calculation of round or rectangular duct pitot tube insertion points. This base code has been thoroughly tested and the translation to the 3D VR environment has now been confirmed by both Derek and our creative director Joel Hopson.



Metrics and Industry Input

In October 2018 the development team had the opportunity to present early phases of The Project to attendees at the **Danfoss Sales Partner Conference** which included the President of Danfoss Drives, the Head of Sales and Aftermarket Service, the President API Region and the VP Sales and Marketing API Region. 200+ industry experts, engineers and sales managers were in attendance.

A live VR demo was presented to all attendees and intensive user testing conducted through the duration of the conference with approximately 50+ industry experts taking part. The development team were able to collect an extensive amount of valuable feedback to guide the ongoing development of The Project.

In January 2019, NEBB and Vrtual exhibited at the AHR 2019 conference in Atlanta Georgia where both the air balance and water balance modules were demonstrated. NEBB Director Derek Olsen, along with Gabriel Enslin, and Joel Hopson from Vrtual, delivered a presentation on Virtual Reality Training for HVAC which included a live demo of the training modules.



47 people attended the presentation and live demo, representing 39 different companies and individuals from the HVAC and associated industries. The vast majority of which were executives, senior management and product specialists. During question and answer time the development team were able to discuss the benefits of VR training, and gain some deeper insight from the delegates into the local industry training needs and deployment requirements.

As a result of the presentation and live demo, a large number of attendees visited the NEBB exhibitor booth to experience the water balance simulator first hand. Over the course of 3 days approximately 60 attendees participated in user testing and feedback. With 100% of the users (including industry test and balance certified professionals, instrumentation manufacturers and water balancers) indicating an overwhelmingly positive response to the VR training simulator. The main comments made by the users of the system were as follows;

- 1) The high level of virtual environmental realism
- 2) The high level of workflow realism
- 3) Affirmation and agreement that HVAC VR training will have a place in future training curriculums.

Image 4 – Head of Product Development – Dwyer Instruments during user testing



Image 5 – Account manager from IMI-TA Hydronic systems during user demo's.



Image 6 – 2 way product training comparison. (Gabriel) Vrtual and IMI-TA Training Leader



Image 7– 2 way product training comparison. (Joel) Vrtual and IMI-TA Training Leader



Grant Funding was allocated as follows:

Expenditure Type	Amount	Description
Design and development hours	\$16,000	<p>At a discounted rate of \$100/hour we were able to purchase 160 paid hours of dedicated design and development.</p> <p>These hours were distributed amongst the development team for 3D Modelling, design, coding, BETA testing, feedback reporting and upgrade iterations.</p>
Research and Consultation hours	\$4,000	<p>We were able to purchase approximately 40 hours of dedicated research, consultation and stakeholder engagement.</p> <p>These hours were spent on the development of draft deployment models, meetings with industry trainers, testing and commissioning leaders and instrumentation specialists.</p> <p>Hours also include those spent interviewing industry specialists during the AHR expo in Atlanta.</p>
TOTAL:	\$20,000	

Summary

We wish to thank the ARBS foundation for their generous support with this innovative training system.

The Project was completed in a timely fashion and has been deemed a resounding success by all those who have tested and trialled the system. The training content developed during the course of The Project is world class and has been extensively user tested to ensure the effective practical application in preparation for future adoption by the industry.

Endorsement and praise for this project has been received from executive and representatives attached to the following organisations:

- NEBB YPN Young Professionals Network
- NEBB USA & NEBB Australia
- AMCA (Australian Mechanical Contractors Association)
- Danfoss
- Dwyer
- IMI-Hydronics

Should you require any further information then please don't hesitate to contact the undersigned on behalf of Virtual Pty Ltd and NEBB Australia.

Kind Regards,

Gabe Enslin