Case Study

**Project: RM900 Ballast Cleaner
Virtual Reality Training**

Client: Network Rail

Date commissioned: June 2020

Background

Weighing in at 341 tonnes and with 21 axles each, Network Rail's £50m ballast cleaners are large, complex, expensive machines. Operator training relied upon manuals, mentors, and locations that were governed by plant availability, with the ever-present risk of accidental damage.

High operational demand for the cleaners limited the number and duration of training courses, restricting the extent to which trainees could fully familiarise themselves with the ballast cleaners. But new operators were needed.

Throughout the COVID 19 Lockdown, we collaborated remotely with Network Rail to design, trial, and implement a new virtual reality training environment. The project made use of the latest gaming technology, which we tailored to create an immersive user experience.

Deliverables

Network Rail's requirements were for:

- A 100% safe, user -friendly experience

- An immersive, realistic, and fully interactive training environment, representative in layout to the actual equipment, with authentic operational functionality, procedures, and responses

- A training environment that accurately simulated a wide range of operational scenarios

- A clear, comprehensive, and standardised set of instructions to accompany the training experience

- Greater flexibility in terms of training availability, duration, locations, and trainee engagement

- Real-time technical support, interpretive assistance, and feedback

Benefits

Safe, structured, training that embeds familiarity with every aspect of operation and allows time for extended hands-on practice

- Cost effective - avoids removing expensive equipment from operational duties and eliminates the associated risk of accidental damage

- Flexible – Deployable through either a full (headset and joystick-enabled) virtual reality experience, or a simpler desktop mode (with the virtual controls using a standard mouse and keyboard interface)

- Achieves levels of user engagement that operations manuals cannot match

- Eliminates inconsistent training styles and avoids misinterpretation of manuals

- Mentors can easily observe trainees as they learn, allowing bad habits to be corrected

- Common issues and problems can be simulated to help prepare operators

- Emergency and failure scenarios can be simulated in with zero risk to personnel or equipment

The key issues

Training opportunities, and locations were governed by plant availability. With a price tag in the region of £50m per unit, operational availability of the plant often took precedence over training. The ever-present risk of accidental damage was also a factor that severely limited the extent to which trainees could fully familiarise themselves with the ballast cleaners.

In addition to limited plant availability, the training relied on complex user and training manuals, supported by mentors, who each had their own slightly different ways of working. The constant need to cross reference between the paper copies and the equipment, along with non-standard mentor guidance introduced the risk of confusion and error.

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Challenges and Solutions

This was the first project that we completed entirely remotely, due to COVID 19 restrictions. We created collaborative online workspaces, and regular web meetings with Network Rail helped us successfully maintain the agreed programme.

Understanding the operating philosophies, control systems and risks associated with something as complex as a 341-tonne ballast cleaner was another challenge. The existing user and training manuals were not always easy to follow. Our team had a steep learning curve but collaborated with experienced Network Rail operators to gain the necessary level of technical understanding, so our solution achieved the desired authenticity and accuracy. This approach also helped us to define which reference material and processes were required to address the slightly different cabin and control layouts of the multiple models of ballast cleaner that Network Rail operated.

With much of the existing training delivered verbally by a mentor, differing terminologies had developed, which did not necessarily reflect that used in the manuals. A series of clarifying conversations helped us to standardise terminology and agree a correct step-by-step procedure that everyone was happy to implement.

Our close collaboration with various stakeholders enabled us to develop a training program that takes the user through the entire plant start-up process, and accurately simulates every step of operation, all the way through to shut down.

Next there was the issue of course delivery. It was important that trainees should be focused as much as possible on learning to operate the ballast cleaner, rather than wasting too much time learning to work the simulator controls.

The interface was designed to be as simple and intuitive as possible, and the peripherals were chosen for their ease of use and reliability. We set up the control joysticks, pedals, and a virtual reality headset in a way that enables the end user to operate the training system easily, without the need for additional technical training. And all the peripherals are hard-wired to prevent any accidental external connection issues, or interference.

The interactive 3D virtual environment that we created faithfully replicates each of the ballast cleaner's buttons, screens, and switches. The twin joysticks and foot pedal controls are similar to those found in the operator's cabin, creating a sense of familiarity for the user before they've even set foot inside a ballast cleaner.

Finally, Network Rail wanted greater flexibility in terms of training availability, duration, locations, and trainee engagement. In response, we developed two modes for complete flexibility:

- In virtual reality mode the user is fitted with an Oculus Quest 2 virtual reality headset and has joystick and pedal controls. This provides a fully immersive experience, enabling users to develop a more intimate familiarity with the simulated environment. This mode is suited to initial training sessions at centrally based facilities.

- In desktop mode, the user interacts with the virtual controls using a standard mouse and keyboard interface. This mode is fully deployable to a wide variety of locations and can be augmented by peripherals such as joysticks and pedals. This mode is suited to remote training and extended user familiarisation.

Network Rail have been so impressed with the system and its' functionality that they have since commissioned D2 Digital Technology to help them develop other types of immersive virtual training systems at their depots.