VR Solutions for Health, Safety and Environment

By Ilya Simonov
CROC VR Director
5 block 1, Volochaevskaya St., 111033, Moscow, Russia
infoVR@croc.ru

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Employee safety and health are top-priority tasks at any industrial enterprise. According to the International Labour Organization, approximately 2.3 million people worldwide die every year as a result of workplace accidents or occupational diseases, which number is equal to large city population.

Accidents and work incapacity lead to equipment idle time and downtime, company's financial losses and tarnished reputation.

Yet too often, accidents and deaths are caused by employee errors, proving that conventional occupational safety trainings are no longer sufficient. Studies show that classroom training and retraining are much less effective than hands-on drills. According to NTL Institute, trainings always result in a partial retention only. Most effective exercise involves both challenging tasks and deep trainee immersion in a production process, i.e. training in real-life facilities.

Enterprises always find it difficult to maintain a variety of training benches and unfeasible to train staff in a real-life facility, and cannot accept any risk of equipment damage. Moreover, while real-life facilities are upgraded from time to time, training center equipment often falls behind.

These problems can be solved with training simulators, which visualize technological processes using VR and 3D technology. In addition, VR makes training as effective as that in real life.
VR training is a must when it is hard or impossible to simulate an emergency in real life, such as a high-voltage plant operation or fire.

VR trainings also help learn how a certain employee will respond and act in an extraordinary situation. For instance, you can run emergency scenarios in any sequence or even in parallel to make a trainee choose what to do to address the emergency.

These technologies are most demanded in the energy and similar industries where human errors may lead to occupational injuries and even more heavy consequences. CROC VR is a business unit of IT company CROC and immersive technology specialist that has already deployed VR solutions at SIBUR, Mosoblgaz, and other industry leaders. These solutions contribute to industrial risk management during the transition to Industry 4.0 and HSE employee trainings at manufacturing companies.

CROC offers two VR-based HSE options: development of either VR courses or a comprehensive VR architecture to be further integrated with enterprise production processes.

VR courses
A VR course is a platform-specific virtual reality app inspired by an emergency response plan and training methodology developed by customer's training center specialists.

Through such courses, employees can obtain knowledge, learn rules, and have their skills checked in a computer simulation, with the results provided to their superiors. Written regulations are thus visualized to facilitate knowledge retention and reinforcement through practice.

Computer simulation and VR technology enable hazard response and emergency drills, including fire or power line accident, since the technology can reconstruct nearly any situation. You can either simulate potential hazardous situations for prevention purposes or reconstruct actual accidents as part of “lessons learned”.

HSE breach in computer simulation triggers extra visual effects, such as explosion and body fragments with blood splatters here and there. All this impacts employee's psychoemotional state and adds some caution and alertness to their actions. VR courses help you identify and eliminate the root cause to prevent such accident or emergency in the future. VR training also helps assess how fast and proper employee's actions are. Employees are given some time to prevent emergency progress.

Although CROC has an HSE expert on staff, such a course can be developed only if a customer provides its training materials, regulations and methodologies along with its specialist supervising the project and submitting the required information.

To keep facility and enterprise details in secret, CROC develops a training and then teaches customer’s IT specialists so that they could maintain, update and improve VR content without third-party contractors.

VR course delivery formats
There are various VR course delivery formats, each addressing certain tasks and having its own strengths and weaknesses.

A VR solution may be tailored to various platforms: 3D ready PC, VR glasses and HMDs, industry-class VR systems, and multiuser VR devices, differing by immersion depth, mobility support, and graphics quality.

Thus, mobile 3D and AR apps for tablets can be used for self-learning anywhere, anytime, with mobility being a key advantage of this delivery format. In this case, a training course is a “pocket-size” tutorial for daily use, with a medium immersion depth and material perception, since text material is supported by 3D visualization and infographics driving better retention.

However, graphic quality is rather poor because of technical limitations of devices in use.

Trainings delivered through PCs, portable computers, and laptops have medium immersion depth and mobility, but the best possible graphics quality. Today, it is the most popular format used at enterprise training centers.

And, on top of this, two more VR technologies come into play:
- VR glasses with mobile device (mobile VR)
- VR systems (fixed VR) consisting of a HMD, joysticks, spatial positioning systems, and high-performance workstations (VR Ready laptops or powerful PCs) capable of high-quality content displaying

Each of these delivery formats has its own advantages and shortcomings. Thus, mobile VR ensures deep immersion (peripheral vision is not distracted by anything) and high mobility (a trainee only needs a smartphone while compact glasses can be easily carried in a briefcase, backpack, or medium-size bag).

Thus, instructors and specialists can deliver onsite demonstrations or conduct trainings anywhere anytime.

In this delivery format, graphics quality will be above average and limited by hardware performance.

VR glasses do not allow trainee to move within a virtual space, i.e. a trainee has a 360° view of the content from a single point. Movement is only possible from point to point and controlled using eye tracking or joystick (on some devices).

In turn, HMDs ensure very deep immersion, which directly relies upon the best graphics quality and the possibility to move across and interact with some 9 sq. m virtual space, using joysticks and various functions.

This delivery format features medium mobility, since the unit itself has rather small footprint and equipment is not very bulky or heavy, but installation and setup require some time and certain skills. This tool is ideal for classrooms in enterprise training centers.

CROC also offers a multiuser solution for collective training. This delivery format ensures maximum immersion, since trainees can see avatars of each other, communicate and act cohesively in a virtual world. This solution can hardly be called mobile, since it is rather difficult and time-consuming to configure. Such projects give customers ready-to-use occupational safety VR training focused on specific industrial hazards.

VR solution architecture

VR architecture provides an interactive experience available to all organization units and branches subject to role-based access, which means fewer expenses on content development. A single VR solution architecture is created for integration with business processes, flexible scenario configuration, and collective remote access.

Such an architecture can be integrated into an enterprise Learning Management System providing end-to-end visibility of each employee skills and knowledge. The system allows managers to assign trainings (including VR-based) to employees who, in turn, receive notifications, enter trainings into their schedules and receive training materials.

Those who requested such a training for an employee can also access LMS and see detailed progress statistics. Thus, a customer gets unbiased data on every specialist and makes a decision on whether to issue a work permit for such employee or demand retraining.

When investing into VR course development, a customer wants to get source data – CAD plans, 3D models, objects, textures, interactions, scenes, assemblies, and ready-to-use courses – in a reproducible format to further re-use them when necessary. The customer can also easily find this data in the Object Library (a structured storage of accumulated ready-to-use materials) using a navigation map attached. Thus, a company can continuously add new materials to the library and use accumulated stuff without need for re-development engagements.

When used as a scenario builder, a unified VR engine with additional modules helps optimize costs and create simple VR courses from scratch using visual tools and pre-developed objects only.

This is the best choice when a customer realizes the need in VR technologies (especially during energy industry digitalization), but cannot clearly define where and how to use these technologies and even what finished product to expect.

As part of Customer Development at this stage, customers can ask for the detection of bottlenecks, like the most frequent equipment operation staff errors. [4] Our specialists leverage their findings to generate an analytical report and develop a roadmap for VR implementation at an enterprise.

Keywords
Virtual reality, virtual reality training, VR courses, HSE, occupational safety, and industrial safety

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Biography

Ilya Simonov is an expert in development and integration of virtual and augmented reality solutions. A manager of integrated development projects based on immersive technologies (VR, AR, XR). Coordinates development team activities with 14 qualified engineers and project management teams. Responsible for their continuous professional development. Builds partnerships with leading developers and manufacturers of the industry. Under his leadership, the team of the Virtual Reality Center successfully implemented projects for the companies in GCC, including Saudi Aramco, STC, Sharjah Government, and for multiple industrial customers (including oil and gas, energy and petro chemistry industries) in Russia: SIBUR Holding, Roskosmos, Gazprom Neft, Rosatom, Delaval, Mosoblgaz, etc.