# VR and immersive environments for oil and gas exploration

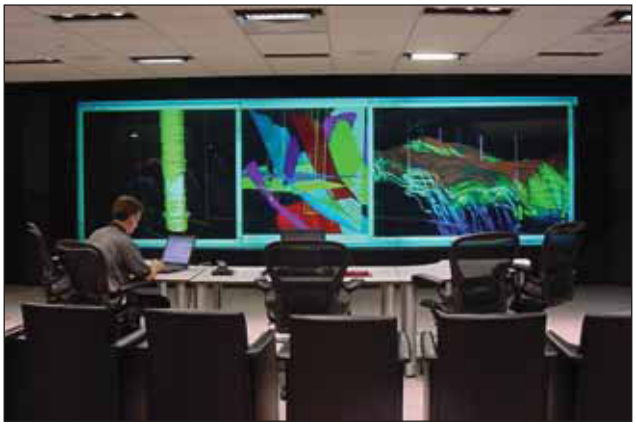
**Do you know what today's immersive environments can provide to assist data analysis and interpretation? Wim Maes[1] and Ken Hunter[2] of Barco Presentation & Simulation offer this guide to what you can expect.**

Virtual Reality (VR) technology has exploded into a range of visualization tools that can be used by geoscientists, engineers, and other asset teams to enhance and speed up oil and gas exploration, drilling, and production. New emerging VR systems can be tailored into fit-for-purpose solutions offering operational integration for all asset teams from the rig to the office, and from office to office.

A reasonable expectation is that a large-scale visualization capability reduces project costs and field errors by 5-10%. Return on investment is typically agreed to be less than one year. VR and immersive environments combine advanced technology with social interaction to analyze complex problems and to take quick and accurate decisions. Very powerful, their applications range from large-scale 3D collaborative viewing rooms over relocatable and portable environments, to fully immersive spaces completely surrounding the interpreters with their data.

These large-screen visual display systems show large amounts of data - typically 2.5 to over 4 Mega pixels - on large flat or curved screens at the same time. They allow multi-disciplinary teams of up to 20 viewers to effectively visualize and evaluate geophysical data for oil and gas E&P in 3D. Applications by the world's leading oil and gas companies include real-time visualization, analysis, and decision-making of seismic data, complex reservoir models, well logs, and geologic cross sections. Most systems are tailored to meet specific needs with the screen size, the depth of the system, and number and type of projectors customized to provide the optimum display solution. As a standard they offer stereoscopic visualization and include interactive whiteboards and integrated videoconferencing systems.

Large presentation environments usually carry a high price tag, but are reported to provide maximum return on investment. Many of the world's leading oil and gas companies use them in their headquarters and in important subsidiaries all over the world. Recent new high-resolution three-chip LCD projectors deliver 1920 x 1080 pixels enabling the building of a stereoscopic large screen display using only two projectors. As most advanced network centric concepts even include a built-in powerful upgradeable display server, all information available in the company can be retrieved via the network and displayed in multiple windows on the large VR workroom screen. These windows with mono or stereo content from the network or from diverse external sources (video or data) can be freely positioned and scaled. Teleconferencing windows can be added and several locations can be visually linked for efficient collaboration.



*Large-scale, 3D collaborative viewing rooms for interpreting geophysical data*

*Freely position and scale windows in mono or stereo with up to four external video or data sources can be displayed.*

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*When large facilities are more than fully booked, easy to transport Barco TRACE allows more asset teams to work with stereoscopic visualization. Adding units allows for wider field of view and use of multi-channels.*

Frequently used content can be saved on the projector's hard disk and retrieved on demand.

Easy intuitive operation through the familiar Windows XP desktop interface enables all team members to access all sources and to control all content by simply using the wireless mouse and keyboard. By adding optical tracking and mouse emulation technology, the VR workroom allows direct, wireless interaction with the data.

Connecting several network centric VR workrooms to an existing network enables companies to visually link multiple off- and onshore facilities, saving expensive traveling time and increasing business efficiency. All information can be shared from a remote location on one large canvas. Such direct access to all information and collaborative viewing on a large canvas makes for accurate analysis and fast decision-making. The networked VR workrooms themselves can be centrally managed to ensure optimal use of the investment.

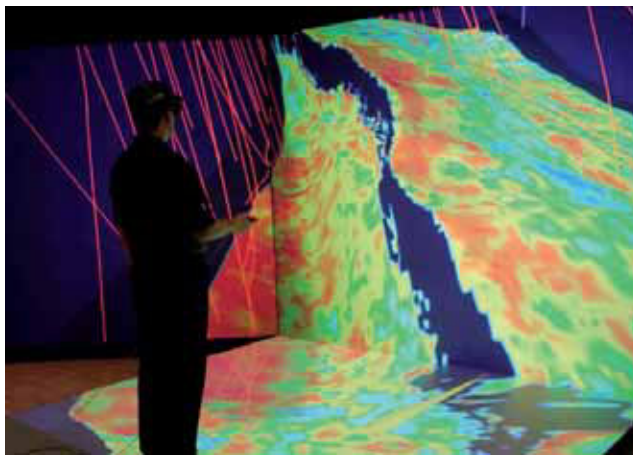
## Portable environments

Today's systems can be scalable plug-and-play stand alone units - often equipped for active stereo viewing - or larger, easy to set up configurations offering incorporated passive stereo projection. Stand alone units, such as Barco's TRACE system, offer active stereoscopic viewing in a compact design that easily fits through a normal door opening, eliminating room modifications or build-out. Juxtaposing multiple units allows users to change the configuration from mono to multi-channel, adapting the field of view to the requirements of the application. Active stereoscopic viewing gives excellent depth perception, but this comes at a cost in light efficiency. Reaching the brightness for viewing in normal light conditions requires the use of high brightness DLP projectors, delivering data at double the refresh rate to produce the stereo images. By offering asset teams the stereoscopic viewing of large amounts of data, stand alone displays can deliver the functionality of a high-end visualization room without the high investment.

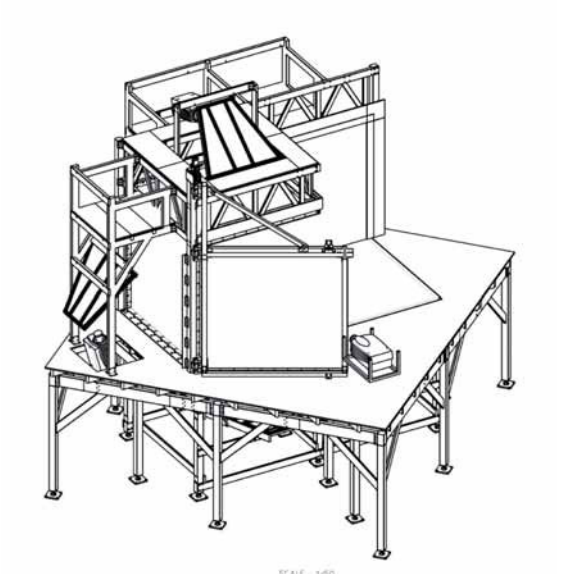
Transportable solutions equipped for passive stereoscopic viewing tend to be larger, as they have to incorporate two projectors: one to display the left eye picture, and a second projector to display the right eye picture. Such modular set-ups also incorporate front surface mirrors to fold the light path to reduce the footprint of the system. When equipped with an active-to-passive stereo conversion unit, the transportable system also accepts computer sources delivering active stereo signals. As this system is meant to travel from one application site to another, a sturdy mechanical structure in which both factory prealigned projectors are mounted will considerably reduce setup time at each relocation. For a good stereoscopic result, the polarization of the stereo glasses should perfectly match the polarization of the projector and preferably be from the same brand. As analysis of data requires the movement of the viewer's head, circular polarization is imperative to maintain stereo separation and depth viewing from all angles.

## Virtual cube

Typical brandings for this technology include CAVE, I-Space, and Holospace. In these environments, analysts are com-



*With the MoVE installed at the Unversity of Calgary (Canada) 3D virtual reality lab, a programmable touch panel allows for straightforward, accurate, and fast motorized positioning for flat, L-shaped, 450, and cubic immersive space configurations. The projection is driven by three active stereo Barco Galaxy 3-chip DLP projectors, delivering high-resolution images on the three 3 m x 2.4 m screen modules. A fourth projector covers the floor. A tracking system tracks the entire central floor of the environment in all of the system's multiple configurations. Photo courtesy University of Calgary, Canada.*



*Design of the '4-in-one' multi-segment virtual environment at the Centre of Advanced European Studies and Research in Bonn, Germany. The four configuration types are: a 2-segment m wide stereoscopic CADWall; a 4-segment L-Shape or Holobench, by adding two floor segments; a 5-segment cubic-wide stereoscopic environment by adding a side-wall; and a 5-sided immersive I-Space room-like environment for highest immersion. Illustration: courtesy Barco.*

pletely surrounded by virtual imagery inside a cube that has at least three sides and as many as six sides. Most of these applications are to be found in universities and research centres, where the virtual environment is often used for a range of disciplines, not just earth sciences but medical training and surgery simulation, molecular modelling, etc. On offer is large-scale stereoscopic viewing for researchers working in teams with their colleagues from industry and other disciplines. Depending on resolution, brightness and size required, CRT, LCD or DLP projection is used with active or passive stereo separation. Thanks to the rear-projection of the images and the flawless image continuity in the corners, the illusion of a complete sense of presence in the virtual environment is created. As several users can immerse themselves in the same virtual environment at the same time, a wide viewing angle of the screen is very important. The floor screen must be solid to support several people, yet thin enough to prevent doubled images from the projector underneath. When a small footprint is needed, front-coated mirrors are used to fold the light path of the rear projection. A safety door mechanism automatically opens the door when an emergency button is pushed. The immersion is enhanced through carefully positioned tracking devices that make the computer change the images' perspective according to head and body movements.

## Multi-purpose virtual environment

Barco's MoVE (Motorized multi-purpose Virtual Environment) is an example of how today's technology can provide a variety of room configurations that can accommodate a small to large number of viewers. The unit is typically configured with rear-projected screens on three walls and the floor and, as such, meets a wide range of visualization needs. In one application the University of Calgary's Centre for Innovative Technology (CCIT) uses the system with three pre-programmed configurations. In the flat position (180°), it provides an impressive auditorium screen for presentation purposes. The 45° wing configuration can accommodate approximately 20 viewers in a partially immersive theatre. The completely enclosed configuration offers the closest thing to complete immersion and enables collaborative research with multi-disciplinary teams of up to five people.