DIVERCITY
virtual reality applications for the construction industry

The challenge

Although it is the EU's largest industrial sector, the construction industry is highly fragmented. It involves large numbers of companies, many of them SMEs, who come together in short lived alliances to work on individual construction projects.

The project teams need to exchange and discuss information about building designs at frequent intervals during a project but existing ways of sharing such information can lead to misunderstandings about what the various team members expect form each other. Three important stages, where such misunderstandings can lead to costly mistakes, are:

- Client Briefing, which involves detailed discussion of the clients requirements and the architect's proposed solutions
- Design Review, which requires detailed input from multi-disciplinary teams of architects, engineers and designers
- Construction, which involves many contractors and specialist sub-contractors in implementing the agreed design

There could be significant improvements in efficiency at each of these stages, if the various players were able to interact with a three-dimensional model of the proposed building, explore 'what-if' questions and agree the actions needed to deliver the optimum solution to the customer's requirements. Virtual Reality techniques should be able to make this possible.

The technical solution

The IST project DIVERCITY[1] (www.e-divercity.com) set out to develop virtual reality tools that could support each of these stages of a construction project. The project has produced a modular suite of virtual reality workspaces that can be used individually or as part of an integrated environment to support construction projects. The project's tools are based on open standards or standards that are widely accepted in the construction industry.

The Client Briefing module provides a virtual workspace that will enhance communication between client and designer during the early stages of the design process. It uses an informal interactive environment to capture the clients requirements and develop 3D sketches, which capture the abstract concepts of the design, such as space and the relationship between spaces. The sketches can be annotated with specific requirements. The workspace allows the design to be visualised as a 3D model, which the clients can explore and suggest modifications that will make the design meet their requirements more effectively.

Three modules support the Design Review stage of the project . An acoustic module allows designers to interact with the CAD model, change the materials used for the various component (walls, floors etc) and then listen to a simulation of the acoustic environment inside any part of the building. This allows any user, not just experts in acoustics, to evaluate the various design options. A thermal module allows designers to make similar interactive changes to materials in order to optimise the thermal efficiency of the design or meet specific client requirements on cost or pollution. Finally a lighting simulation module allows designers to explore various lighting scenarios in order to obtain the required look and feel in different areas of the building.

The Construction Phase is supported by a workspace for rehearsing, evaluating, and optimising the planning of the construction schedule. It tests the "constructability" of a building by assessing the spatial and temporal implications of a proposed schedule and highlighting potential conflicts that

[1] DIVERCITY is led by the UK company 'Construct IT for Business' and includes partners from Denmark, Finland, France, Italy and the UK. The project started in January 2000 and is due to run for 30 months. More detailed information about the project, along with demonstrations of the tools that it developed, can be found on its website http://www.e-divercity.com

would be costly to resolve at an advanced stage of construction. The workspace has two modules. A Visual Product Chronology module generates a four dimensional model that shows how the building, or a part of it, will look at any stage of its construction. During progress meetings this model can be used to demonstrate future steps in a way that can be understood by everyone, and highlight potential constructability problems. A second module addresses site planning and offers site planners/managers a tool for improving the efficiency and safety of the site. They can use it to visualise various possible site layouts. It will then help them to identify hazard zones within a proposed layout and evalauate whether that layout provides sufficient accessibility and visibility for the various activities. This will result in an optimised site layout that takes account of both safety and cost.

The results

Requirements capture and testing of the prototype workspaces were carried out with user groups involving consortium members, a subcontractor and a number of industrial users. These trials confirmed that the prototypes met the original requirements and the project is continuing to evaluate their effectiveness.

In parallel with this, DIVERCITY also made the prototype tools available to members of the construction industry on a consultancy basis. The project website http://www.e-divercity.com offers detailed descriptions of each of the tools, along with video clips demonstrating their use and contact information for companies that would like to use them. The system is available as a complete package, as individual modules, or as combinations of modules. For example, customers may want to know how the building will ‘look and feel’. The acoustic and lighting simulation modules could produce highly effective models to show how the finished building will appear to its users and, hopefully, convince the customers that they are spending their money wisely.

Conclusions

DIVERCITY has developed a modular package of ‘virtual reality’ tools to improve communications between the various large and small companies involved in a major construction project. These allow the various players involved in each phase of the project to work with 3D models of the proposed building and explore ‘what-if’ questions about the details of the design or construction.

The project consortium is currently offering the prototype tools to construction industry companies on a consultancy basis. This will allow the tools to be evaluated by a much larger group of users and support the development of fully commercial products based on the prototypes.