XML3DRepo
The Future of Experiential Design and Stakeholder Engagement on the Web
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http://www.driversofchange.com/make/tools/future-tools/

Topics covered
• Review of the current tools, design software and techniques used in the industry (artist drawings, photorealistic renderings, virtual worlds, CollaborativeMap, 3D annotations)
• Understanding of several primary technologies: Quest3D, XML3D, 3D Repo, Android, CollaborativeMap
• The opportunities offered by the new developments in virtual environments on the web such as XML3DRepo
• Vision of the future tools and the benefits they would provide

Intended audience
• Planners and designers for works that require public inquiry or consultation including roads, rails and energy infrastructure
• General audience interested in urban design, CAD modelling and Web3D
Arup

- Global multi-disciplinary architectural and engineering services firm
- Founded in 1946 in London
- Famous since its work on the Sydney Opera House
- Over 10,000 employees in 37 countries

Arup is a multi-disciplinary engineering firm with global reach. Based on our experiences from real-life projects this workshop outlines how the new developments in digital world shape the radical change in design innovation at the global scale. The opportunities presented by the latest developments in virtual technology offer great improvements for stakeholder engagement and define the possibilities for future experiential design in areas as broad as master planning and even public works of art to be facilitated over the Internet.
The vision presented here explains how the novel digital environments can drive and enhance the adoption of change and the perception of virtual design and innovation. This shall stimulate evolution of future tools and processes based around the emergence of Web3D technologies.

Foresight, Innovation & Incubation

“We envisage a future where every project stakeholder will be able to explore and comment on proposals freely, intuitively and from their own point of view.”

• Driving adoption of radical change and innovation
• In search of real-time 2.0
This design inception process is used to represent different aspects of our vision for the future interactive online tools. It details the sequence of steps that follow a project inception. The “review” quadrant represents a face-to-face discussion with a client. Arup’s role is to stimulate and harness client’s expertise and ideas about the project and the overall desired results to be obtained. In the future, each iteration should explore several distinct proposals to speed up the process and lower the number of required reviews.
Communicating ideas in the right way for the right audience is not an easy task. In general, 2D engineering drawings are suitable for engineers, but not for general public and fund holding stakeholders. Artistic impressions are not quantitatively accurate hence lose the trust of the viewers, while photorealistic renderings are not necessarily desirable either as they might give false ideas about the final appearance of a project. On the other hand, a problem with pre-recorded fixed path fly-through visualizations is that they offer guided tour from a single perspective, mostly that of a CEO. However, people prefer to explore the scheme freely from their own point of view.

In the photograph on the left, a member of the general public listens to an auralisation showing the effectiveness of the proposed motorway sound barriers.
Suppliers of the existing BEM software have their own vision for applications of their products. These, however, do not necessarily fulfil the needs of the built environment design and engagement. Most of the software originates from the automotive and aerospace industries, yet their processes significantly differ from those required in urban planning. For instance, the built environment clients usually deal with an extremely wide range of stakeholders and communities that are all affected by the new proposals. What is more, these do not manage their own supply chain, hence have to communicate with various audiences at each project stage.

### BEM vs. Automotive/Aerospace

- **BEM** == Built Environment Modeling
- **Wide range of stakeholders and communities**
- **BEM designers**
  - Do not manage the supply chain
  - Present to different audiences at each project stage
Our aim is to move beyond the existing component-based software and harness the emerging digital tools to involve clients and other stakeholders in the design process itself. This shall give people a chance to experience and understand the proposals at their own time and convenience.
CollaborativeMap is a user friendly online tool that gathers spatially located input from stakeholders and the community developed by the Arup Australia office. Comments from the users appear in real-time making engagement with others interactive while the outputs can be migrated to a GIS environment for analysis and reporting at a later stage.
Comments are placed as an overlay on top of 2D Google maps such that they correspond to physical locations over the building site. Users can select from different categories related to various aspects of the construction and express their opinions and concerns.
3D environments already allow several aspects of physical design to be presented virtually. This includes holistic design, testing, documentation and optimisation of various stages of projects with better understanding from the people who commission and fund the constructions to those who use it.
By relying on game engines such as Quest3D, Arup can already deliver immersive navigable 3D environments that allow the users to experience the proposals in terms of the visual and functional aspects using false color renderings. Based on information supplied from GIS databases and physical analysis, these 3D visualizations provide multidisciplinary representations of the proposed developments.
This Zero Carbon City in China depicts results of seven accurately simulated disciplines: daylight factor (façade surfaces), air movement, architectural massing, landscape design, sound, people and vehicle movement. Using false colour renderings, the model provides accurate representation of the data and allows users to freely navigate the space and observe the effects on the environment. Unfortunately, most people did not understand what the colors represent, unlike in a photorealistic rendering.
Admiralty Station virtual testing of the quality of signage and the overall experience on the ground by ordinary commuters. During the usability testing, the team identified 235 potential problems with the 970 signs. As a result, 145 signs were altered virtually what amounts to a significant cost saving for the client compared to a post-production relocation in real world.
By providing intuitive interactive tools, end-users are able to familiarise themselves with the environment quickly. In this case, a youngster is able to place virtual signs in 3D space effectively without any aid from the engineer, her father.
3D Repo™ is a non-linear revision control framework built around a domain specific database, a.k.a. 3D repository. The role of the repository is to store 3D assets and to provide interfaces and conventions to add, modify and extract delta changes on them. By supporting standard web-accessible front-ends, it enables connections to modeling packages via intermediary tools, or simply to a viewer that visualizes selected revision from the DB. Conflict resolution is achieved via a unique visual 3D Diff tool which highlights incompatible edits and offers quick merge suggestions. Furthermore, the framework supports retrieval of any full or partial revision that can be exported as a new 3D file.

3D Repo

• Open source version control framework
• For engineers to
  – Track changes over time
  – Collaborate
• For project stakeholders and general public to
  – Preview proposals
  – Comment on them
3D Repo app is a light-weight open source client that enables you to view, share and annotate 3D models stored in the 3D Repo cloud anywhere on the go. Connect to a remote repository to visualize and annotate virtual designs and their individual revisions during the development and review stages of your project.

http://3drepo.org/download
XML3D is an extension to HTML5 that embeds scene graph directly into the web pages. Using this technology, it is also possible to devise frameworks for annotations on top of 3D models.
The site of King’s Cross in London is the Grade 1 listed building, designed by Lewis Cubitt in 1852. It is being restored and expanded in partnership with English Heritage in order to create 8 million square feet of offices, retail and housing space. Fitted solar panels will cover 2,500m^2 and provide 10% of the station’s energy needs.
Rendering of the final model of the King’s Cross station is over 3M polygons in 2.5GB assets spread across nearly 600 files. The model was not only used for promotional materials but also for validating the placement of virtual CCTV cameras and several usability studies.
Way finding user study evaluates the speed of navigating around the station. The hotter the color the faster the virtual walking. Hence, cold areas demonstrate places where the signage could be significantly improved in order to increase the flow of passengers through the station.
Challenges on the Web

3D Data
- Massive datasets
- Limited bandwidth

Hardware
- Various specs (screen res, ...)
- Impossible to test on all

Interaction
- 3D navigation for general public
- Touch input

Feedback
- Virtual annotations
- Game-like scenarios
XML3DRepo, our latest middleware that joins XML3D and 3D Repo using a REST architecture enables us to load the entire King’s Cross Station model in a web browser. Model courtesy of Network Rail.
Inside view of the Western Concourse which is part of the whole King’s Cross 3D model.
To make the most of the client’s aspirations and ideas, we need to empower them and the engineers with tools and techniques that would provide intuitive representation of the data and relevant parameters and let them simultaneously explore multitude of solutions at once.

Our Vision

1. Client and designer decide key factors
2. Designer selects a solution from a DB of possibilities
3. System calculates results for the factors
4. Each new solution is published as
   - 3D visualization
   - Table of quantitative data
   - ...

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The new tools have to enable clients quickly and easily explore the relative merits of the proposed designs. In addition, the process has to be fast and provide multiple concurrent solutions that can be evaluated simultaneously and in relative terms to each other.

**Required Toolset**

- Client-centric visualizations
- Inter-related experiential designs
- Game-like experiments and scenarios
- Virtual collaboration with real-time avatars
- On-site augmented reality
More information about the topics presented in this workshop can be found in the booklets published by the Foresight, Innovation & Incubation group at Arup:
http://www.driversofchange.com/make/tools/future-tools/