Research

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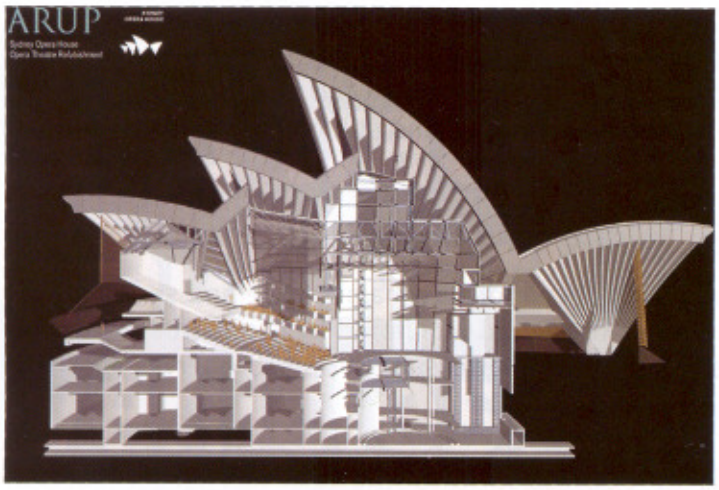
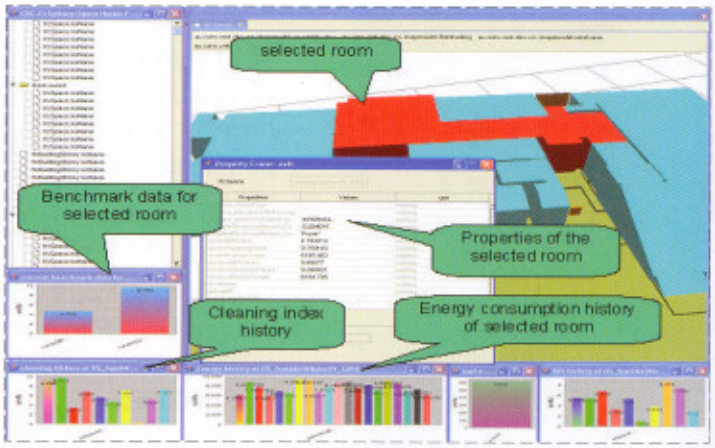
Modelling the Sydney Opera House



A three-dimensional (3D), computer-aided design (CAD) example of the visual component of digital modelling at Sydney Opera House – presented as a sectional side elevation. Courtesy: ARUP & Johnson Pilton Walker JPW. Copyright: Sydney Opera House.



This section of Sydney Opera House shows a foyer in view. On display is data on the properties of this space, such as the cleaning index, energy consumption and Building Presentation Index (BPI). The model can be developed to support connection to historical data, which would enable performance of these properties to be monitored over a period of time. Copyright: CRC for Construction Innovation.

Over the past two years, the Cooperative Research Centre for Construction Innovation has collaborated with Australia's facilities management (FM) leaders in a project that will help bring the Sydney Opera House, into the digital age.

The Sydney Opera House FM Exemplar project involved investigating and highlighting FM practice, using one of Australia's most unique buildings as a model. One component of this research was the development of a rich digital model of a section of the Sydney Opera House.

The Sydney Opera House was designed and constructed well before the advent of today's 3D computer-aided design (CAD) systems. Therefore the main source of information about the building exists in paper form. The building is now 30 years old and one of the busiest performing arts centres in the world. A functional upgrade is approaching which will require accurate information for new developments and operations.

Benefits of a building information model

The use of 2D drawings limits the ability to coordinate, share reliable data or support multi-disciplinary role activities.

A means of sharing building information data is required, so building proposals can be integrated and coordinated, and information about the whole life of the building, energy, cost, operations and other data can be understood and managed.

The industry has historically focused on its own role in the development cycle of a building, with the outcome that information cannot be shared for different tasks. At the completion of construction, the building's users are left with a pile of marked up drawings. Facility managers need data to maintain their assets and strategically manage the building usage.

Digital modelling technology enables the development of a building information model (BIM). BIM is a database for built facilities – an integrated digital description of a building and its site comprising objects, described by accurate 3D geometry, with attributes that define the detail of the building part or element, and relationships between objects.

Such a model is called a "rich" model because all objects in it have properties and relationships and can be derived by simulations or calculations using the model data. An example is the ability to perform automated code checking to confirm compliance with a building standard, or to undertake a thermal load calculation.

The integrated FM model brings into one central location all the built facility data building - structure, engineering services and fabric. However there is the potential to store a wide range of assets and FM data that support operation, maintenance and strategic functions.

The Sydney Opera House FM Exemplar project

Clearly there are many benefits for management to incorporate information about the Sydney Opera House into a consistent, single data source. Intelligent modelling of a building enables the reuse and extension of data.

The Sydney Opera House FM Exemplar project was undertaken by a Construction Innovation project team comprising the Facilities Management Association of Australia, Transfield Services, Rider Hunt, Woods Bagot, Sydney Opera House, Brisbane City Council, Queensland Department of Public Works, CSIRO, the University of Sydney and

Queensland University of Technology. The project was developed as part of the Federal Government's FM Action Agenda.

One of the components of the FM exemplar project was to look at the usefulness of a digital model as applied to the Sydney Opera House for FM purposes. Other components of the project included procurement services and benchmarking data.

This work utilised a digital model of the Sydney Opera House to demonstrate the ability of using a digital model as a rich data source of FM information from various information sources.

In a traditional FM object-based system, the interface supports multiple views of the data – graphical and textual – but always from a single model. The digital model of a section of the Sydney Opera House offers a visual representation of the building and its component elements in CAD and provides comprehensive property data for each element, and can integrate geographical information system (GIS) information.

The model enables the collection of data from disparate software systems, hard copy, and new model-based systems through the use of open exchange standard.

The model can incorporate huge amounts of servicing, maintenance and costing information. It includes all information about objects within a building, such as lifts, ventilation and fire systems, and the relationship between them in a single repository – ensuring consistent, accurate and up-to-date access.

Broader benefits to industry

But digital modelling also offers real benefits to the broader construction industry, not just facility management.

A digital model can provide coordinated, consistent and computable information about the design of a facility (infrastructure or building) that yields reliable digital representations. This can be used for design and fabrication decision-making, production of high quality construction documents, performance predictions (including safety and sustainability), cost-estimating and construction planning, and, eventually, for managing and operating the facility.

It allows different disciplines – the property developer, the structural engineer, the architect, the cost planner, the constructor and facility manager – to link into a single, distributed digital model.

Currently we have a situation where 25-30% of the construction cost is caused by the splitting up of processes and poor communication. Before a building is handed over to the owner organisation, the same information can be re-entered, on average, seven times in different systems. And the same information is re-created several times in different software.

Construction Innovation is working closely with its stakeholders and key industry players to develop an integrated digital solutions research program which aims to address some of these inefficiencies.

For more information on the Sydney Opera House FM Exemplar project, go to www.construction-innovation.info. For more information on integrated digital solutions in the building and construction industries, contact Peter Scuderi, Construction Innovation, on (07) 3138 9291, or email p.scuderi@construction-innovation.info.