COMPANY
Parsons Brinckerhoff

LOCATION
South East Queensland, Australia

SOFTWARE
Autodesk® Infrastructure Map Server
Autodesk® Navisworks® Manage
Autodesk® 3ds Max® Design

Virtual upgrade

Autodesk BIM solutions support spatial information, virtual modeling, and visualization to help deliver a major transportation infrastructure project.

Using Autodesk solutions to link 2D GIS and 3D design and construction data gave the team faster access to current information and faster, better communication of that information. This integrated environment provided significant cost, time and quality savings to Origin Alliance.

— **Mark Patis**
Technical Executive, Design
Parsons Brinckerhoff

3ds Max Design visualization model. Image courtesy of Parsons Brinckerhoff.

Introduction

Eight kilometers of the Ipswich Motorway from Dinmore to Goodna (D2G) in South East Queensland, Australia, has recently been upgraded to increase safety for users, improve transportation efficiency, and reduce congestion. The AUD$1.95 billion project included widening the motorway from four lanes to six, upgrading major interchanges, improving access to rail stations, enhancing facilities for pedestrians and cyclists, and creating new service roads to reduce local traffic on the motorway. The project was delivered by Origin Alliance—a joint venture consisting of Queensland's Department of Transport and Main Roads, Abigroup, Seymour Whyte, Fulton Hogan, SMEC, and Parsons Brinckerhoff. Parsons Brinckerhoff and SMEC jointly prepared the road design. Parsons Brinckerhoff was also contracted for the virtual design and construction/building information modeling (VDC/BIM) and geographic information systems (GIS) services.

The challenge

The upgrade was one of the most complex road infrastructure projects ever undertaken in South East Queensland. In addition to the eight kilometers of rebuilt motorway (see Figure 1), the project included seven kilometers of new service roads, 25 kilometers of shared pedestrian and bicycle paths, the demolition of 15 existing bridges, and the construction of 26 new bridges. Furthermore, the motorway is adjacent to busy rail lines, residential areas, schools, businesses, and shopping centers. And part of the motorway runs over three abandoned coal mines.

Figure 1: Dinmore to Goodna stretch of the motorway. Image courtesy of Origin Alliance.

Precise coordination and construction planning accommodates traffic, minimizes property impacts and utility disruptions, and maintains safety.

"The project was built in a very tight, very busy suburban corridor used by more than 90,000 vehicles every day," explains Mark Patis, Technical Executive, Design at Parsons Brinckerhoff. "We worked around this live traffic and bustling corridor throughout the project." Precise coordination and construction planning was needed to accommodate traffic, minimize property impacts and utility disruptions, and maintain safety for both travelers and the road workers. And clear communication of the project was needed to ease concerns of project stakeholders, affected neighbors, and the commuting public.

VDC/BIM and GIS project scope

The alliance leadership team requested a staggered implementation, with GIS starting first and VDC/BIM second, which resulted in a reduced scope. The GIS service was provided by one team, and the VDC/BIM service was made up of two teams: model integration and visualization.

The GIS service goals were to:

- improve data automation and interoperability
- provide a single point where all D2G staff can obtain the latest information
- improve communication between the discipline teams, which included geotechnical, environmental, safety, quality control, mine rehabilitation, design, construction, community consultation, surveying, planning, and intelligent transportation systems (ITS), as well as public utilities such as telecoms, sewage, and water
- reduce the risk of capturing duplicate data.

The VDC/BIM service goals were:

- multidisciplinary 3D model integration to support decision making in the design, review, and communication process (visualization) using a composite digital model
- support for the construction stage.

The solution

Origin Alliance used Autodesk® solutions to develop a web-based, integrated environment linking 2D GIS data with a schedule (Asta PowerProject) database and 3D design data.

This system enabled faster access of geospatial, design, and construction information to support project planning and reduce project risk. Moreover, the Visualization team reused 3D models in Autodesk® 3ds Max® Design software to generate renderings and animations, helping project stakeholders and the public better visualize the project and understand its impacts on the existing environment and surrounding infrastructure.

The GIS team used Autodesk® Infrastructure Map Server software to present over 300 layers of integrated spatial data, including utility, geotechnical, and environmental maps, as well as CAD-based design information. This web-based mapping service was called OriginMap. Collaboration and knowledge sharing was at the heart of the success of OriginMap (See Figure 2).

This collaboration worked in two ways:

- The GIS team undertook a process to fully understand the workflows of project teams so that project data could be kept current, accurate, and available for all staff.
- OriginMap enabled users to easily collaborate on, create, and share information anytime from any place, and allowed for integration with nonspatial systems.

The project was delivered ahead of schedule and under budget. In June 2010, OriginMap was named one of the project's top three value for money innovations. Over the full life of the project, OriginMap was used more than 72,000 times and produced 17,000 prints, leading to significant time and cost savings.

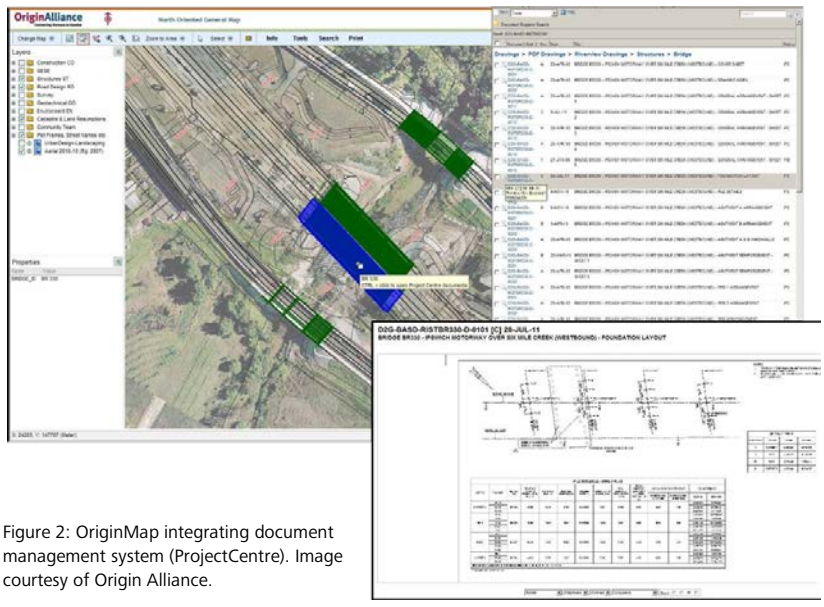

Figure 2: OriginMap integrating document management system (ProjectCentre). Image courtesy of Origin Alliance.

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Origin Alliance delivers ahead of schedule and under budget, and wins three awards.

3D engineering models were continuously updated as new design information became available. The Road Design team used these 3D models for space proofing, line of sight, and constructability analyses, as well as design review and verification. The Model Integration team used Autodesk® Navisworks® Manage software to combine 3D engineering models of the roads, bridges, and other major design elements. In addition, Navisworks was an essential tool for quickly addressing and resolving requests for information (RFIs) during construction.

Improved understanding

In the first years of construction, it was difficult for the local community and commuters to visualize what the upgraded motorway would look like and how it would fit in its real-world setting. "We used a 3ds Max model to generate a series of photorealistic renderings and fly-over and drive-through animations that portrayed how the finished project would look," says Mark Patis.

"As a result, outputs from the 3ds Max model became highly visual and effective media for public engagement, helping to communicate the design, look, and benefits of the motorway to project stakeholders and the wider community." (See image, page 1.) The firm even added aerial photography, landscaping model elements, and other contextual information extracted from GIS to produce photorealistic still images and animations that brought the project to life for viewers.

A flood of information

Massive rainfalls in January 2011 created another, unexpected project hurdle. The project's main site offices and part of the construction site itself was destroyed by flood waters. Once the floodwaters receded, the GIS team quickly created a map of the flood extent. The Model Integration team, using existing 3D models, was able to show a 3D virtual model of the status of the construction in relation to the inundated areas using Navisworks Manage. This 3D virtual model was very useful after the event in helping decision makers confirm remedial actions.

The result

In May 2012, the upgraded and widened motorway was fully opened to traffic, six months ahead of schedule and ten percent under budget—despite the construction challenges and the added impacts of the 2011 floods. "Using Autodesk solutions to link 2D GIS and 3D design and construction data gave the team faster access to current information and faster, better communication of that information'" says Mark Patis. This integrated environment provided significant cost, time, and quality savings to Origin Alliance. During the project, the use of information technologies was advanced to improve the connection between GIS and VDC/BIM.

The above-mentioned achievements contributed to Origin Alliance receiving three awards at the Queensland Spatial Excellence Awards (QSEA) ceremony on 14 September 2012, including:

- Category—Award for Spatial Enablement: Winner
- Category—Award for Innovation: Highly commended
- JM MAC Serisier Award for Overall Excellence (ultimate Queensland overall winner): Winner.

> The Navisworks model also became an effective tool for public engagement, helping to communicate the design of the motorway to the wider community in the Visitor Experience Centre.
>
> **— Mark Patis**
> Technical Executive, Design
> Parsons Brinckerhoff

Figure 3: Navisworks 3D model. Image courtesy of Origin Alliance.

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