UNMANNED AERIAL VEHICLES MOVE TO THE NEXT LEVEL

The telecommunications industry has embraced the use of drones beyond site survey data collection, and is using them to inspect and monitor infrastructure.

Communications tower inspections typically require the site to be shut down and the tower climbed by an expert rigging team. If the tower is non-climbable, an elevated work platform must be used to allow close-up inspection of the antennas and equipment. Capturing imagery and other information with drones enables significant cost savings, eliminates the safety risks of tower climbs, and reduces the time required to assess tower conditions.

“ProjectWise made it possible to quickly coordinate among the stakeholders, providing telecommunications operators with immediate access to up-to-date information and a huge amount of data, and provides the documentation base to support continuous asset management”

Cristiano De Leonardis, CEO and founder of Seikey Srl

Italian drone company Seikey is using an innovative method for inspecting 11,800 radio base stations (RBS) in Italy for risk prevention, compliance, and the maintenance and development of the 3, 4, 4.5 and 5G networks. Inspections are carried out through high-definition photography, light detection and ranging (LiDAR) sensors, thermographic cameras and spectrum analysers. During an inspection, it is possible to view the data that the drone is acquiring in real-time through project management platform ProjectWise.

Using Bentley software programmes ContextCapture, MicroStation and Bentley Map, data is collected, processed and managed in ProjectWise. A detailed photogrammetric reconstruction takes around 1,700, 40 megapixel photos, up to 30GB of photos for each RBS, and more than 400TB of data for all the RBSs.

Through Bentley Navigator, 3D visualisation provides a comprehensive and realistic view of situations requiring intervention. The management of flight schedules, the collection and preparation of necessary permits, and the management of collected and processed data posed significant challenges. The inspection method led to a reduction in the risk to human life and a reduction in inspection times. While it previously took five days to perform an RBS inspection, it can now be done in six hours.

On the Telstra telecommunications tower in Brisbane, Australia, local cell tower analysis company SiteSee used ContextCapture to create reality meshes for as-built auditing and analysis of the tower. In doing this, it reported a reduction in asset inspection and maintenance costs of 69 per cent, along with a reduction in project delivery lead time of 86 per cent.

Corrosion detection
ContextCapture enabled SiteSee to export a dense point cloud for further analysis in its web-based application for remote site inspection to support automated corrosion detection and antenna identification with model, height, azimuth and mechanical tilt, as well as preliminary radiation hazard simulation within the 3D-reality mesh scene.
SiteSee also developed a 3D tile viewer that enabled users from field teams, engineering, health and safety, real estate, and asset management to remotely view and analyse assets and run reports. The reality mesh can also be linked to the user's internal asset management system to align records with the data extracted from the reality mesh, bridging the gap between reality and the database of records.

**Laser scanning**

In the US, Eye-bot Aerial Solutions produces 3D engineering ready meshes of structures, such as the monopole cell tower in Springdale, Pennsylvania. Modelling vertical structures with UAV photogrammetry is extremely difficult when the structure has complex cross bracing that can be seen through. Eye-bot relies on the unique capability of Contex-TCapture to use photogrammetry and UAV laser scanning to consistently generate accurate models. The models can be used to check for structural deformities and the surface area of components can be measured for wind and ice load calculations, allowing for well-informed decisions that no longer rely solely on the person climbing the tower.
Using Building Information Modelling (BIM) to its fullest extent means extending its reach from design development into site activities and long-term asset management. In Switzerland, Siemens Real Estate has taken a huge leap forward in digital construction by working with Austria’s Strabag to digitise construction of its new $124m facility. The new headquarters consolidates group operations, bringing together a production facility previously located 40 kilometres away in Volketswil, and providing modern office and laboratory space.

The result will be two new buildings co-located, each with 18,400 square metres of floor space and 250 underground-parking spaces. Together with the core refurbishment of an existing office building of 13,700 sq m for R&D functions in 2021, Siemens will take up 30 per cent less space than before and overall rental costs to the company will fall by more than 20 per cent.

Construction began in April 2016 and Siemens specified the use of BIM throughout the project. Christoph Leitgeb, project manager from Siemens Real Estate, explains that a range of responses came back, providing a reflection of the maturity of the local market in terms of BIM preparedness. Some contractors told Siemens that incorporating BIM would add more than $1m to the price; for others it was already part of their business model. This included Strabag.

“We could do things as we have always done them in the past or we could look to the future. We decided to do the latter.”

Christoph Leitgeb, Project Leader, Siemens Building Technologies’ new HQ, Siemens Real Estate

The new facility was constructed using BIM to its fullest extent, with the digital twin providing an as-built database for maintenance and operations.
Digital twins

Construction began in April 2018 and is scheduled for completion this summer which had not only been using BIM for a decade, but was able to use it to manage site processes including time and cost – so called 4D (time) and 5D (cost) BIM.

Using the model to prepare work packages and compare progress onsite to the model improved transparency on the project compared to traditional approaches, and reduced management time. Monthly progress meetings were informed with site pictures recorded by contractor personnel using hand-held devices to provide daily updates of activity. Such measures also reduced unnecessary paperwork.

Digital transformation

During construction, the site team also built an object database, which is to become the digital as-built model used to operate and maintain the buildings. Extension of BIM into these six dimensions makes this a pilot project for both Siemens and the industry, as it seeks to harness true digital transformation.

The scheme is scheduled for completion this summer and many lessons have been learnt. One of which was the use of a closed BIM model. Utilising Strabag’s existing expertise and systems meant using the Autodesk suite of software was specified throughout the project.

This use of a single data format meant that the team was dependent on the capabilities of one software vendor. This is in contrast to an open BIM model, where project teams can use non-proprietary Industry Foundation Class (IFC) files to update the consolidated model.

Cost savings

Siemens Building Technologies’ BIM expert Wolfgang Hass explains that this is an important lesson for future projects, along with the need to create standards around the format of the as-built data repository, better known as the digital twin.

Financial benefits from the project are yet to be measured, but the team is expecting these to exceed industry statistics as outlined by the US’ Stanford University of 10 per cent savings due to prevention of clashes on site, 40 per cent lower costs due to the prevention of change orders, and a 9 per cent saving in the lifetime operational costs.
HONG KONG, ZHUHAI AND MACAU BRIDGE

Digital technology and offsite fabrication were used to reduce costs and accelerate construction on a critical section of this iconic bridge project.

The Highways Department for the Government of Hong Kong Special Administrative Region (SAR) is building a mega-size sea crossing to link Hong Kong, Zhuhai and Macau. Vehicles will enter and leave Hong Kong through new boundary crossing facilities on a 150-hectare reclaimed island and the revolutionary project includes 50 kilometres of bridges and tunnels.

The Leighton-Chun Wo joint venture won the $4.6bn contract to construct the passenger clearance building and associated works. As the lead on BIM utilisation for contractor works, Leighton Asia used Bentley’s BIM technology as the common platform for anticipating and rectifying construction problems, as well as building the as-built digital model for delivery to the Highways Department. Leighton Asia’s innovative BIM strategy saved about 12 per cent of the construction budget.

Construction of the project commenced in 2014 and the passenger clearance building’s wavy steel roof was a signature design feature and one of the major construction challenges of the project. Each steel roof segment was 60 metres long, 25m wide, and weighed more than 670 tonnes. Given the height restrictions imposed by the nearby airport, the constructors elected to use a horizontal installation method. The fabrication stages were performed at multiple locations, including Yinchuan, Hangzhou and Dongguan, and pre-assembly also took place offsite at ZhongShan. These steps progressed the roof’s construction at twice the usual rate.

“Bentley’s civil BIM advancements bring BIM to the next stage by multiplying its benefits, especially in challenging and large-scale infrastructure projects. This platform has enhanced our collaboration with various stakeholders to import, acquire and exchange valuable information.”

Michael Kin Wong, Survey Manager, Leighton Asia

A rendering of the pre-fabricated, pre-assembled roof structure, which was moved into place horizontally, eliminating the need for vertical movement above the airport height restrictions

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Adopting a BIM-enabled approach offered the team several advantages. The platform facilitated communication and collaboration among all participants. Bentley’s civil software enabled Leighton Asia’s survey team to organise and analyse the 2D drawings submitted by contractors and convert their designs into up-to-date 3D models.

**Visualisation**

Using MicroStation, Bentley’s modelling, documentation and visualisation software, the BIM platform enabled models from the eight contracts to be combined into one geo-referenced 3D model.

Leighton Asia partnered with The Earth Solutions to construct and maintain a geo-referenced as-built 3D model and Leighton Asia’s survey department performed 3D laser scanning of the construction progress. The point cloud data was processed with applications called Pointools and Descartes to create as-built models. The survey team compared the 3D design models to the point cloud as-built models to assess the accuracy of the work and this process was integral to the project’s quality assurance programme.

By continuously updating the as-built models, the survey team created accurate as-built BIM models suitable for facility lifecycle management by the Highways Department. The cost-effective method pioneered by the Leighton Asia Survey Department streamlined the workflow, saving 15 per cent of the survey budget.
HEILONGJIANG RIVER ROAD BRIDGE CONNECTING CHINA AND RUSSIA

A comprehensive BIM strategy supported delivery of a new road bridge between China and Russia built by Long Jian Road & Bridge Company

The $383m Heilongjiang River road bridge connects Heihe, China, to Blagoveshchensk, Russia, making it the first highway connection in the trade route between North East China and Far East Russia. The 19.9-kilometre route incorporates a 1,284-metre cable-stayed bridge spanning the sensitive Black River Basin. The location has extreme seasonal temperature variations and strict environmental protection.

An ambitious, three-year construction schedule was planned to lessen the impact of these challenging conditions. As the contractor responsible for all civil construction, Long Jian Road & Bridge Company, part of the Heilongjiang Province Construction Group, implemented Bentley's collaboration and coordination platform ProjectWise for construction management and information sharing. This improved the contractor's project management efficiency by 25 per cent.

Construction began in November 2016, with the bridge scheduled to open in October 2019. The agreement called for China to build approximately 6.5km of the structure, starting in Changfatun Village, a suburb of Heihe City. Russia will build 13.4km, starting in Canikulgan Village. The Russian team is also tasked with connecting the two bridge sections.

Design information

The site posed numerous obstacles to construction progress, including seasonal weather extremes, ice flows, limited channel width and a protected river basin. To overcome the hurdles and meet the project delivery deadline, the team had to rapidly build a bridge model within tight time constraints; create a digital environment to manage and exchange all civil design information; and define a BIM strategy that enabled the 3D monitoring of incremental bridge launching. The clear solution was adopting BIM methodologies to effectively manage the bridge construction.

The project team researched and developed standardised 3D design modelling methods that enabled members to collaborate effectively, including the use of software programme OpenBridge Modeler’s 3D parametric modelling capabilities to achieve the required degree of accuracy for the bridge’s superstructure. Parametric modelling sees a series of algorithms or ‘parameters’ used to generate the digital model and these rules create relationships between different design elements based on project and site-specific information.

“Bentley’s comprehensive software solution provided the management and collaboration capabilities that allowed us to increase efficiency on the project by 25 per cent, while coping with the engineering challenges faced in a complex construction environment”

Xuyuan Liang, Director, Technology R&D Centre, Long Jian Road & Bridge Company

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Digital platforms

Integration between OpenBridge Modeler and the OpenRoads software used for road design enabled precise positioning of the substructure and customisation of more than 60 structures. As a result, the team improved efficiency by 50 per cent, compared to traditional methods.

ProjectWise enhanced collaboration and coordination among the different disciplines involved in construction of the bridge, roads, culverts, civil works and related infrastructure. Together with MicroStation, ProjectWise became the platform for 5D construction information management, creating a common data environment that allowed all participants to share, review and update information in real time. This collaboration improved modelling efficiency by 35 per cent and accelerated decision-making among management teams.

To date, Long Jian Road & Bridge Company has achieved a number of critical objectives, including reducing material waste by 1 per cent, using machinery and labour 15 times more efficiently, and limiting the cost of schedule deviations to under $80,000.

Upon completion, the project team will turn over the reality model-based asset management database to the owner for use in the operation and maintenance management phase.
INNOVATION CUTS COST ON THAMES TIDEWAY EAST

Using model-based design delivery has resulted in a 32 per cent saving in required design resources and shaved six months from the project schedule.

The Thames Tideway Tunnel in London is one of the most complex construction projects of its type in Europe. At $6.2bn, the 25 kilometre-long, 66 metre-deep tunnel is the UK’s largest-ever water project and is designed to protect London’s River Thames from sewage pollution for the next 100 years.

It is being built under three major contracts and the eastern section of the new 7.2m-diameter sewer is under construction by a joint venture of the UK’s Costain, France’s Vinci Construction Grands Projets and Bachy Soletanche. Working with lead designer Mott MacDonald, the team has embraced model-based delivery for design, replacing paper-based documentation required for traditional design milestones through stage gate reviews with digital information. The result has been a reduction of the design schedule by six months and design resources by 32 per cent.

In a traditional project, even those using Building Information Modelling (BIM), 2D information via a series of drawings is prepared and handed over to the client for review and

“We want to make better use of data by digitising our engagement and measuring what that is giving us. What is the return on investment? Collaborative understanding is the key. You engage around the topics in a very collaborative way rather than a transactional way. The client can visualise what the outcome is.”

Mert Yesugey, Project Manager, Mott MacDonald, Thames Tideway East
approval at each of the design stage gates. On the Thames Tideway East contract, these stage gates are: brief, concept, developed, detailed, construction and operation.

Providing the physical information for these stages takes a lot of time as clients review and question the drawings, which then require updating and reissuing before final approval will be given. However, as the design evolves, these drawings quickly become outdated, leading to wasted time and effort. It can also mean that some designers continue working on the latest version of the model, when others are using earlier versions to cut the drawings – meaning there is more than one version of the design in circulation.

Design model

Instead the Thames Tideway East team moved away from this 2D paper-based approach and introduced model-based delivery into the concept and developed design gates. Information was shared through the design model, which was accessible to all parties involved in the project. Data was delivered to the client within the project model within hours (an average of 0.9 days), rather than days or weeks.

As a design-and-build contract, collaboration between the contractor and the designer was crucial and required very early appreciation from the designer of the construction methodologies to be employed by the contractor, who in turn had to make early decisions about their requirements to inform design.

Since the contract was awarded in September 2015, all parties have met weekly to discuss design development on what is described as BIM Wednesday. This clarity and collaboration enables the client and contractor to monitor design evolution and gain confidence as it progresses. Required stage gate review information is shared in the model and approval for this information on first review cycle is now at 82 per cent, up from 76 per cent six months ago. Although this is considered to be high, comparing it to traditional approaches is not easy, because historically this data has not been digital, and not been measured. Having hard data on revisions and updates is another benefit of the model-led delivery approach.

Using Bentley’s cloud-based ProjectWise common data environment, the team used software applications such as AECOSim Building Designer to view the model in both 3D and 2D. Although these tools were critical, the project team says that the initial collaborative approach and the move away from transactional assurance into a digital delivery is what has really accelerated design.

Model-based delivery versus drawing-based delivery

Source: Mott MacDonald written for ICE Proceedings
ABOUT MEED
Established in 1957, MEED has been delivering business information news, intelligence and analysis on the Middle East economies and activities ever since.

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ABOUT MASHREQ
Established in 1967, Mashreq is the oldest bank in the UAE, with award-winning financial solutions and services. Throughout its 50 years' history, Mashreq has differentiated itself through innovative financial solutions, making it possible for its customers to achieve their aspirations.

Today, Mashreq has a significant presence in 11 countries outside the UAE, with 21 overseas branches and offices across Europe, the US, Asia and Africa.

Mashreq launched its new Vision and Mission recently, outlining its commitment towards its clients, colleagues and the community. In line with its vision to be the region's most progressive bank, Mashreq leverages its leadership position in the banking industry to enable innovative possibilities and solutions for its customers across corporate, retail, international, treasury and Islamic banking.

Mashreq is proud to be the first financial institution in the UAE to be awarded the Gallup Great Workplace Award for four consecutive years from 2014-17. Mashreq also continues to invest in recruiting, training and developing future generations of UAE national bankers.