Getting a ✓ Reality Check

– Putting the 'As-built' into Digital Construction

Mark Senior explains how seamless integration of as-built data within a Digital Construction environment marks a step change in the application of Reality Capture

We are currently seeing another shift in the use of GIS, not only to mapping in 3D and real-world visualisation, but also greater convergence with the traditional 'CAD' market and Building Information Modelling (BIM). Managers of infrastructure and other location-based assets now want all data in one place, so they don't have to deal with different sets of data held in different systems.

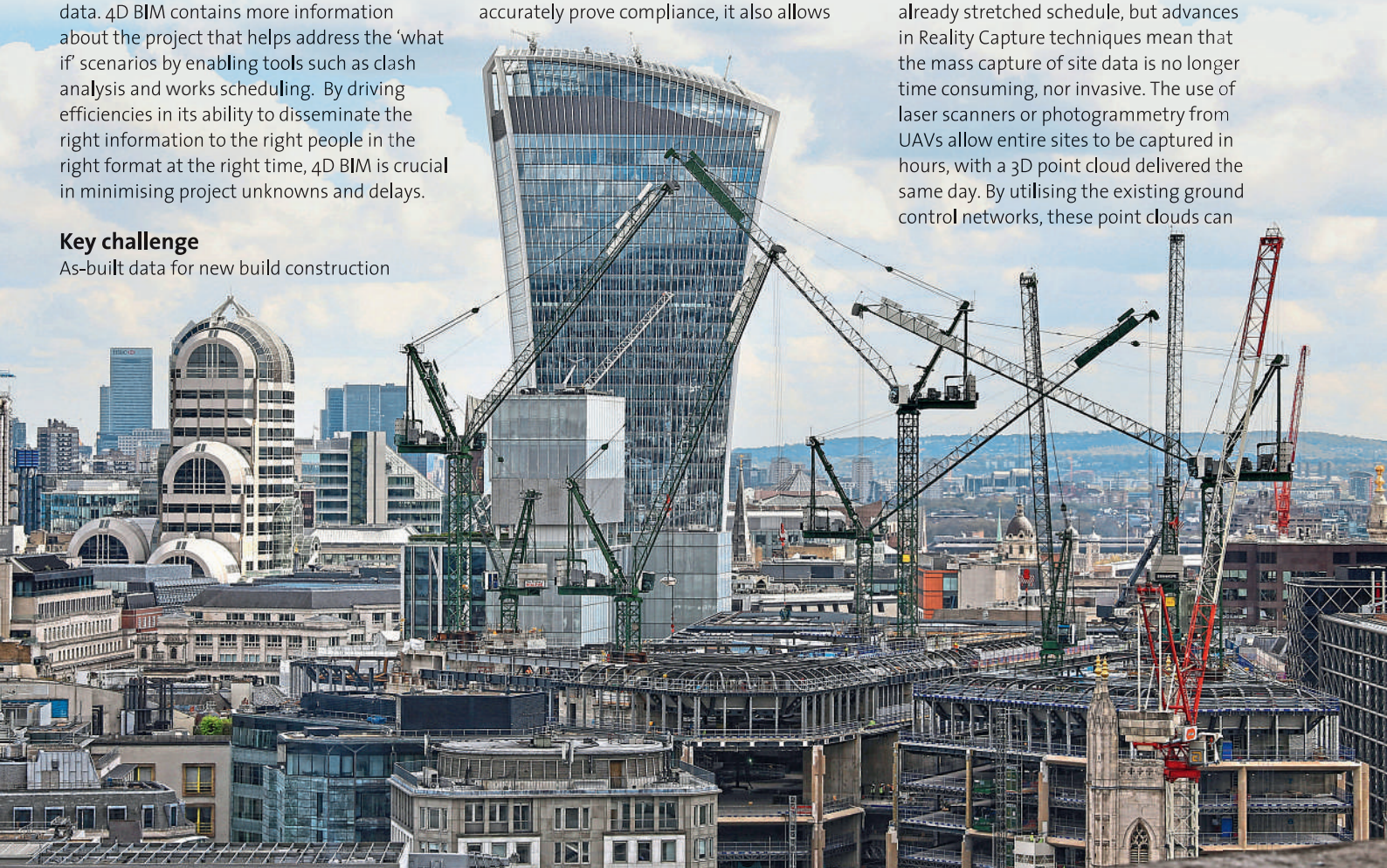
What is 4D BIM? 3D models are widely used throughout the AEC and MEP industry sectors and provide comprehensive design data. 4D BIM contains more information about the project that helps address the 'what if' scenarios by enabling tools such as clash analysis and works scheduling. By driving efficiencies in its ability to disseminate the right information to the right people in the right format at the right time, 4D BIM is crucial in minimising project unknowns and delays.

Key challenge

As-built data for new build construction and renovation is increasingly the requisite extension to the 4D BIM collaborative process and represents a key differentiator. The key challenge is that 'Reality Capture' technologies create unwieldy point clouds that are difficult to manage and share and lack of intelligence when combined with design data.

Adding real-world as-built information throughout the 4D BIM process can eliminate potential risk, by providing snapshots by trade at every stage of the construction process. As well as providing a way to accurately prove compliance, it also allows for comparison between actual and planned design milestones. As such, clashes can easily be flagged and progress monitored. This means more accurate and collaborative information sharing, with any amendments to the bill of materials or time scales being made available throughout the process.

Margins are very tight on construction projects, so every workflow process needs to be costed and evaluated. The addition of frequent as- built data capture may seem like adding unnecessary extra work into an already stretched schedule, but advances in Reality Capture techniques mean that the mass capture of site data is no longer time consuming, nor invasive. The use of laser scanners or photogrammetry from UAVs allow entire sites to be captured in hours, with a 3D point cloud delivered the same day. By utilising the existing ground control networks, these point clouds can



be millimetre-accurate representations of exact site conditions at that exact moment.

Start small

When contractors see savings, efficiencies and the reduced risk during the build, technology such as this becomes an integral part of the construction process. It is imperative to start small, maybe on one trade or part of the build, as there is nothing like success to promote adoption

Methods for utilising this raw data have been traditionally cumbersome and offset the efficiencies in the capture. Using point clouds directly is often not achievable, especially for large scale projects, as they can be too large to work with effectively. It can take weeks to manually model directly from the point cloud into a useful format, a process which, in itself, is highly subjective and requires highly trained personnel. By the time a final model is ready, construction would have progressed and the model outdated.

Spatial analytics is one of the main capabilities of GIS that enables designers and project managers to analyse the impact of their design in the conceptual stage ... a process dubbed Geodesign. Taking this into consideration, the importance of providing the 'as-built' data in the right data structure offers obvious efficiencies in terms of data operability and integration with third party platforms hosting the design data. Importantly, it also provides a base for which analytical processes can be used to harvest more intelligence from such rich sources of data.

Bridging the gap

Technical specialists have, for some time, grappled with the problem of bridging the gap between Reality Capture and Digital Construction. To address it, software experts at Pointfuse decided to completely rethink the way point cloud data has been processed. The solution was to convert points on the same plane into a series of separable meshes based on their geometry, which can be referred to as a segmented mesh model. The resulting software automatically converts point clouds into high fidelity, intelligent mesh models that are highly optimised. By reducing the size of working data by a hundred-fold, it makes the models significantly easier to use and share, as compared to the original point cloud.

Key to the Pointfuse process, however, is removing human involvement in the modelling process, thereby eliminating a significant bottleneck and removing any chance of subjectiveness. By delivering the same result over and over again, it makes Pointfuse models repeatable and directly comparable ... an ideal characteristic for accurate project validation.

Once converted into a segmented mesh model, it is possible to select and classify groups of objects within the Pointfuse software, either to isolate relevant features, such as walls and floors, or remove noise such as people and debris. When exported using the industry standard ifc. or fbx. formats, this intelligent mesh model maintains this classification so it is easily recognisable within a BIM environment. The result is a cleaner mesh, in a recognised format, that contains only those features that are required, with none of the noise inherent to point cloud data.

Clash detection ... and avoidance

So, with Pointfuse it is possible to create an accurate, highly detailed model in just a few hours, and with regular, up-to-date models achievable in a single day, it is now possible to employ as-built data as part of a standard 4D BIM workflow. This allows detailed clash detection analysis by comparing design information with real world scanned data. Potential design clashes can be then identified and rectified before a contractor arrives on site, avoiding costly hold-ups. After all, it is estimated that each clash can cost $17,000† to resolve once construction has begun, a cost that can quickly multiply into millions on big budget schemes.

† O'Donnell & Naccarato, 2012. *Clash Detection in BIM Modelling*. Association of Construction & Development.

Mark Senior is the Business Development Manager at Pointfuse (www.pointfuse.com) based in Maidenhead, Berkshire

CASE STUDY: AVECO DE BONDT

One company already benefiting from this new technology is Aveco de Bondt, a Dutch engineering firm that employs over 300 specialist staff. Working on behalf of social housing providers across The Netherlands, the company is helping to regenerate properties in terms of sustainability; by making them energy-neutral or more energy economical and structurally safer.

Using laser scanners, Aveco de Bondt captures every external detail of single occupancy buildings or more complex multi-residential structures in a fraction of the time taken by traditional survey techniques. The vast point clouds - often comprising millions if not billions of individual measurements - are then processed, using Pointfuse, into segmented mesh models complete with selectable surfaces, for use in the onward workflow.

Using Pointfuse, Aveco de Bondt processes laser scanned data into segmented mesh models, complete with selectable surfaces, for use in the onward workflow

"Point clouds are not that user friendly! Therefore, we needed a way to convert the laser captured data into 3D models that were accessible in terms of file size and usable, both in our onward workflow and by the end client," comments Edu Jonkman, a consultant in 3D scanning and modelling at Aveco de Bondt. "Pointfuse offers us exactly that. Using Pointfuse we can reduce the overall size of the dataset without losing any of the detail contained within. We can also create as-built models to support engineering decisions across the design, construction and management, of a range of improvement works.

"Since introducing Pointfuse into our workflow we have transformed our offering to the market. In fact, Pointfuse has become such a fundamental part of our laser scanning work that we have multiple copies of the software running virtually around the clock!" says Jonkman. "While Pointfuse does not deliver the end model *per se*, what it *does* provide is an integral step in the process from data capture to information delivery. You could say that, for our unique recipe, Pointfuse is a key ingredient."