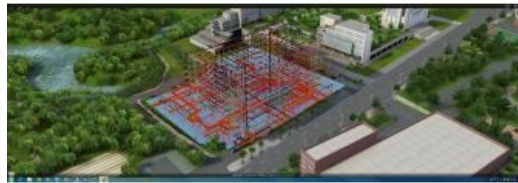
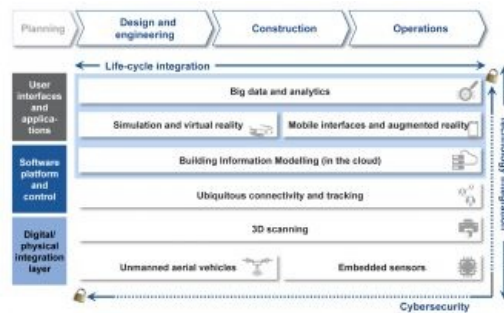


Data Sharing is Smart – Geo-related Trends in Engineering & Construction



There could be many keywords representing important trends in the capture and use of spatial data in the engineering & construction industry, but 3D, BIM, AR and UAV are definitely high on the list. As this article examines, uniting them all is one major cross-industry challenge: interoperability and data integration in support of much-needed higher workflow efficiency in the

whole value chain.

The engineering & construction sector has been slower than most to adopt new technologies. While innovation may have occurred on the enterprise level, overall productivity in the market has remained almost flat for 50 years. In fact, labour productivity has fallen in the USA over the last 40 years. This slow pace of innovation matters because of the industry's sheer scope and scale; it accounts for about 6% of global GDP and is still growing. The world's urban populations are increasing by 20,000 people per day, all of whom need affordable housing plus well-functioning infrastructure for transportation and utilities. Successful adoption of modern processes will not only heighten productivity, but can also enhance the quality of construction work and improve safety, working conditions and environmental compatibility. The potential financial impact is high: a 1% rise in productivity worldwide could save USD100 billion a year. These conclusions all come from the World Economic Forum in its very thorough and well-informed first report on the sector (May 2016): *Shaping the Future of Construction: A Breakthrough in Mindset and Technology*. The recommendations in the report emphasise collaboration, a holistic view of project management and information sharing. "In other industries, the digital transformation is now well underway; construction companies need to act quickly and decisively: lucrative rewards await nimble companies, while the risks are serious for hesitant companies."

Whole Lifecycle

What is needed is better collaboration and information sharing between stakeholders throughout a construction's whole lifecycle. Further adoption of building information modelling (BIM) is crucial. No one can avoid the use of modern planning technology and smart design techniques any longer. Survey data from all possible sources can be integrated in the phase of parametric modelling, for simulation and augmented reality. A geospatial information system (GIS) is used in the location selection, planning, coordination, communication and asset management. It also plays its part in central tracking systems to increase the utilisation of equipment throughout the firm or across project partners. Sensor data, whether wireless or otherwise, is real-time integrated for performance and deviation analytics in all phases. While laser scanning itself is valuable as a tool for comprehensively capturing an environment as it actually appears, integration with CAD is needed in the design process. The software integrates point cloud data with the CAD drawings. The *CAD Trends 2016* report, published by Business Advantage, shows that – in the worldwide CAD community – 27% of design work produces 3D models and 34% produces both 2D drawings and 3D models. 2D drawings automatically generated from 3D CAD or BIM models are regarded as important, yet BIM itself shows a drop in perceived importance since the same report in 2015. That can suggest a stagnation in the modernisation at the start of all processes involved. According to the World Economic Forum, optimising existing processes can lead to a reduction of completion times by 30% and costs by 15%. To put those figures in perspective: the UK government wants to achieve a 33% reduction in both the initial cost of construction and also the whole life-cycle costs of built assets by 2025.

Interoperability

Technical challenges are likely to be overcome, but some financial incentives will probably be needed to change existing processes and increase collaboration. In the Autodesk publication *Redshift* Dominic Thasarathar, Autodesk's strategist for the construction industry, referred to the market research findings that worldwide construction will grow by 85% over the coming years. The required financial input will be enormous. He expects that investors will start to require the use of BIM for new-build infrastructure projects as a condition of funding, because of the reduction in construction risk. Also, the projects will be embedded in a smart city philosophy. "Today, infrastructure planning is often focused on 'costs and assets'. Tomorrow, (spatial) big data, infinite computing, gaming engines and reality capture will support evaluating potential projects with the end goal in mind." Such as, 'What's the best combination of infrastructure to support increased economic growth in this part of the city?' According to Thasarathar, the construction and infrastructure sector will be asked to approach projects from the perspective of smart transport, smart energy, smart buildings, livable cities, etc.

But all this needs interoperability. “The lack of robust global arrangements on standards could in future forfeit the potential inherent in digital technologies,” concludes the World Economic Forum report. “Standards in software systems, interfaces and communication protocols will facilitate the digitalisation of the industry as a whole; in particular, companies should establish standards in machine code for automated construction equipment, and in interfaces between different systems such as BIM and GIS.”

Geodigital Mesh

An important development for the building industry is the fact that Autodesk and Bentley are working together to enhance interoperability between their portfolios of construction software and to ensure that design data exchange can now be extended to others. The commitment of GIS market leader Esri to work on the broadening of data sharing in the construction sector is also evident, such as in the annual Geodesign summits for instance. The 2017 event will focus on smart planning technology and geo-design techniques. In effect, all important players in the geomatics industry have signed or are due to sign agreements to increase interoperability: Topcon, Faro, Trimble, Bentley, Autodesk, Hexagon (including Leica products), Esri, and so on. They are adding functionalities and modelling dimensions, improving usability and simplifying reuse of data. They are taking the initiative to reach agreement on standards to improve the interoperability of different systems and disciplines. This will enable a workflow between GIS, design tools and asset management products as well as survey and machine control systems. Survey data will go directly into design, can be used to control smart building equipment, and then flow into asset management as as-built records. The partnerships are innovating the use of cloud and mobile technologies to extend the aspects of building information modelling, even at the point of work and in direct connection with ERP systems, etc. But progress is slow; even further integration between GIS and CAD is still welcome.

3D

Now that 3D capability is being delivered across the GIS platforms, the spotlight is shifting onto a tighter integration between BIM and 3D GIS. It remains difficult to use data not only in different formats but also of different levels of construction detail – from the different partners in an engineering project – in a GIS at the same time. The amount of modelling data to be handled is also a challenge. Chris Andrews, Esri's product manager for 3D, stated on ArcGIS Blog (April 2016): “We are seeing many examples of users attempting to merge GIS and BIM into higher value information projects and running into different issues when using industry-focused exchange formats when compared with agnostic geospatial ETL formats. The density of BIM information is often not only an issue for the traditional geospatial modelling paradigm but also for the end visualisation platform which, in 2016, is ubiquitously expected to be either web or mobile. We will be exploring how we can better adapt and extend our new and emerging 3D platform capabilities for distributing GIS and BIM 3D content, visualisations, and analysis.”

All software vendors face the challenge of customers asking for high-quality visualisation of integrated data, bi-directional flow of edits and better tools for communicating integrated 3D content. Augmented reality (AR) is expected to assist: the (customer and) designers of all disciplines will be able to walk around the same site and visualise exactly how any changes would look and identify where the combined designs are less functional. Last year, at the largest European geomatics trade show Intergeo, many companies showcased their AR applications for urban planning, utility companies, etc., combining 2D and 3D GIS and CAD data with details otherwise invisible to the human eye.

Laser Scanning

The trend towards 3D data capture and service delivery poses a challenge for surveyors too. 70% of American surveyors agree that the demand for 3D services is growing, but only 28% of them use 3D tools, concluded BNP Market Research in its market study to look at the trends in 3D surveying (*Point of Beginning* magazine, April 2016). Improved technologies and lower costs relative to the capabilities of the technology remain the top drivers. “Despite the speed of adoption of 3D surveying, many professional surveyors feel the profession risks being left behind if it does not move faster.” To give some study results, having increased to 66% since the previous study, modelling software continues to lead the list of 3D tools used by those 28% of surveyors. The use of aerial Lidar has declined to 23%, but a fierce rise could be seen in phase-based stationary terrestrial laser scanning (to 37%).

The differences between 3D laser scanners and conventional surveying equipment are large – not only in terms of the type of data collected and delivered, but certainly also the scanning speed and resolution (Faro, for example, achieves 976,000 points/second and 2 million points per square metre). Laser scanning solutions are now being developed specifically for surveyors who have to deliver georeferenced point clouds for an intelligent 3D model. BIM is for a large part about raising efficiency, so that is what the new products have to focus on. The time per scan decreases significantly thanks to enabling the operators to work as easily and smartly as possible. And allowing the creation of 3D BIM models directly from the registered point clouds can increase the processing productivity of the related office software by 50%.

Low Cost, Low Altitude

Worldwide, laser scanning is enjoying steady adoption in construction and extensive renovation projects to capture 3D data, and is increasingly being combined with the use of unmanned aerial vehicles (UAVs) or ‘drones’. *Last year, the Finnish Geospatial Research Institute* reported that for small-area surveys with complex terrain or objects rich in features, a UAV performs well to do the laser scanning – especially a rotorcraft, which allows for slow or even stationary flight speeds. In combination with relatively low-cost sensors, UAV-based laser scanning is becoming accessible to many construction companies for low-altitude missions; typical operation altitudes are 40-70 metres. When a simultaneous capturing of the terrain and street infrastructure is needed besides the construction features, the sensor package can include a GNSS-IMU device for observing and recording the sensor flight path and orientation. Depending on the accuracy and sensor performance of the flight path solution, it is possible to obtain a point cloud accuracy of 5 to 10cm, according to the Finnish experts.

‘Photo capture’ of 3D environments (or ‘automated photogrammetry’) refers to such a relatively low-cost sensor that could be mounted on a UAV. All that is needed is the use of a good digital camera, plus software to create accurate 3D models. According to marketing information from Bentley, processing multiple photos into complex 3D models is now simple and delivers good results, providing you take sufficiently close-range shots with a high-quality camera. “We’ve done many comparisons between laser scanning and photo capture, and

we can absolutely achieve comparable resolution.” For truly useful models in the construction sector, precisely located control points are still needed, along with a knowledge of state plane coordinates. And, as in laser scanning, edges and other fine features continue to be a challenge, so experts will be necessary to certify a model.

The CAD software development community also promotes ‘reality meshes’: much smaller and lighter files that are faster to process and work with, even in web browsers. Thinned clouds, for instance, are welcome for dynamic 3D models, such as in serious gaming for the engineering & construction market. Animation functionalities for virtual design & construction will be one of the next steps – as will, of course, figuring out how to economically store gigabytes worth of historical project data and serve on demand.

<https://www.gim-international.com/content/article/data-sharing-is-smart>
