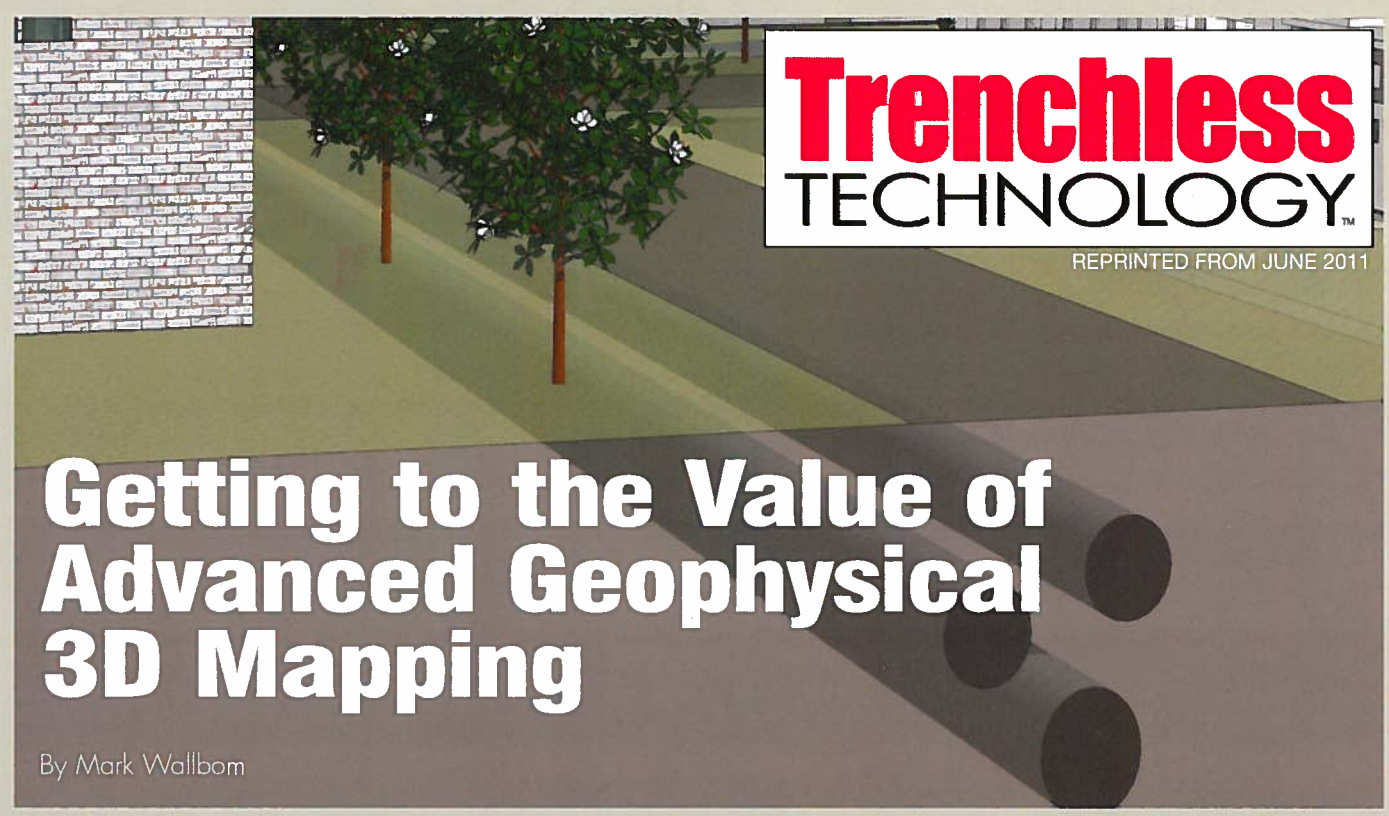

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REPRINTED FROM JUNE 2011

Getting to the Value of Advanced Geophysical 3D Mapping

By Mark Wallbom

Advanced geophysics based subsurface mapping delivers measurable return on investment (ROI) in a number of ways. This article draws parallels between the value of Building Information Modeling (BIM), or as it is alternatively referred to as Virtual Design to Construction (VDC), as well as some of BIM's perceived shortcomings when compared to advanced geophysical subsurface surveys.

The parallel exists in what Underground Imaging Technologies LLC (UIT) calls SUE PLUS, which is essentially the gathering of precise digital subsurface and positioning data that is georeferenced and ready for integration into BIM, geographic information systems (GIS), or machine control and guidance systems.

By way of comparison, BIM took time to gain traction but has recently seen significant growth. Designing a building in a virtual environment before a shovel ever breaks ground has undeniable benefits as unscheduled delays and costly change orders are eliminated or greatly reduced. Due to the multi-disciplinary approach of BIM, when one element of a project changes, all other dependent elements that are affected are identified long before they are found during construction — where last minute changes are the most costly and unexpected situations create the greatest safety concerns. Once the project design is in a 3D digital format, innumerable benefits are possible.

In like fashion, SUE PLUS is a moniker UIT adopted as a way of differentiating its multi-discipline approach to subsurface utility engineering (SUE) because SUE and its associated Quality Levels are uniquely defined by ASCE 38-02 and relate to only the collection and depiction of underground utility data and not so much how the data is obtained. SUE PLUS stands for Subsurface Utility Engineering that provides Precision Locating of Underground Structures. Some would say that SUE PLUS simply expands the scope of the spatially registered geophysical dataset to include all other observed subsurface features, both known and unknown, such as abandoned structures, bedrock or water table levels.

UIT uses its own proprietary hardware and software, as well as some of the same tools and methods generally employed at the SUE 38-02 Quality B threshold, from which UIT makes geophysical interpretations of the subsurface. The process can be augmented by a reduced number of SUE Quality Level A test holes for QA/QC purposes. Simply said, SUE PLUS is a method that uses precise above-ground positioning such as differential GPS and robotic total station data tied to very accurate XY and Z locations of subsurface features over the entire project area from which a 2D CAD map is delivered, as well as a 3D digital dataset. That digital dataset can be incorporated into a BIM or VDC model, uploadable to a GIS, or it can become part of a machine control and guidance system that notifies machine operators of obstructions or avoidance zones in real time where obstructions are so they can be avoided — thus increasing production and safety.

The rapid emergence of BIM over the past five years is changing the way architects, engineers and contractors (AEC), as well as owners work together to communicate, collaborate, solve problems and build better projects faster and at less cost. This fact is based on a recently completed survey by McGraw Hill in which it contacted thousands of AEC participants in North America and learned that almost 50 percent of the industry is now using BIM in some capacity and it is expected to exceed 70 percent within five years.[1]

In the early stages of BIM adoption, it was perceived that many benefits could be derived but engineers questioned if the cost was justifiable. It has only been over the past five years where real growth in the use of BIM has occurred. The similarities, in terms of adoption rates, between subsurface 3D mapping and BIM is noteworthy, i.e., they both are innovative technologies that were slow in gaining traction but as actual business benefits are demonstrated, and a positive ROI is realized by contractors and owners alike the use of these "game changer" approaches is becoming mainstream.

With all of the known and expected benefits derived from using BIM, what took so long for this innovative approach to

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take root? Many studies show predicted and measured field performance, in relationship to stated project performance objectives, are positively impacted, and these studies consistently find that they improve business performance and ROI.[2] The answer to why it might be that BIM was slow to take off has an interesting twist — one we are familiar with.

As it turns out, the early adopters took the measured risk of investing in BIM with the belief it would result in a competitive advantage, create goodwill with clients and decrease overall project costs. In the McGraw Hill article, it provides a rich insight into the perceptions of stakeholders and how these different entities had differing opinions on the value proposition and business benefit. The overall assessment by owners and contractors of BIM's value exceeds 70 percent, however, this was not shared across the board with engineers and architects. As reported in the Sept. 30, 2009 issue of *ENR*, "a third of the engineers surveyed … say they get a negative return on BIM investments; a fifth say they break even. The perceived ROI for architects is better, with 19 [percent] saying they have a negative ROI and 23 [percent] saying they break even."

Although I cannot speak to the significant difference between the stakeholders, with a 25-plus year background in construction, I can say declaratively that safety and production are of seminal importance to a contractor. Some muse that the word contractor is euphemistic for "risk taker." One of the most critical risks to a successful contractor is pricing risk. The more a contractor knows about the project, the better the bid is likely to be because risk can be scaled. So it is easy to understand why contractors are so pleased with BIM because it allows for digital models for design and construction that can be used to better pre-plan and communicate imperatives.

In the case of BIM for the subsurface, SUE PLUS reduces underground conflicts that could put the rest of the project into a tailspin. Knowing as much as possible about the subsurface environment through a digital dataset that can be incorporated into a building model has obvious value and benefit. Owners are champions of BIM because they have come to understand that as the risk of the unknown goes down, so too does the price of the project, and the bid is much closer to the actual cost of completing the work. Owners also "realize the benefit of a team all working together for the mutual good of all parties — this in turn results in a positive return on their investment in BIM," according to the McGraw report. Therefore, the business drivers for BIM come more from the contractor and owner. Since the owner is the ultimate client, this bodes well for BIM and advanced subsurface mapping.

As with BIM, UIT has experienced a sustained increase in the demand for its services. As noted in the McGraw Hill report, BIM will increase as more and more companies understand its value. UIT believes other companies like it that provide advanced 3D geophysics based mapping will see the same kind of growth going forward. For early adopters and contractors/owners who are concerned about safety, cost over runs and production, advanced subsurface engineering will be a growth area for their companies until such time as it becomes commonplace.

As an industry leader, Caterpillar Inc. (CAT) has long been committed to adding value to the machines they manufacture. One of these advancements is the GPS-based AccuGrade system that works in conjunction with machine control and guidance capabilities. CAT's acquisition of the majority share of UIT in July 2010 was based on a number of factors, most significantly is UIT's ability to provide precise digital maps for specific pieces of CAT equipment. The machine control and guidance systems will use UIT's 3D subsurface datasets which will in turn enhances the value of owning CAT equipment.

SUE is no less important than any other engineering discipline and it has direct project cost impacts, it has social benefits, and it is of immense importance since it increases safety and reduces potential liability of project stakeholders. The literature is replete with examples of direct and indirect benefits derived by the proper application of subsurface surveys. When these surveys are tied to exact above-ground stationing, in such detail that depth of cover and actual elevation can be reported on the plans, it makes the benefits of being part of a broader BIM or VDC self evident.

Mark Wallbom is CEO of Underground Imaging Technologies LLC, a Caterpillar affiliate company.

1) McGraw Hill in their Smart Market Report: "The Business Value of BIM – Getting Building Information Modeling to the Bottom Line."

(2) John Kunz & Martin Fischer "Virtual Design and Construction: Themes, Case Studies and Implementation Suggestions" Stanford University CIFE Working Paper # 97, October 2009