# BIM Ready Topographic Surveys

By Jeffrey Lyons, AEC Solutions Business Unit

## A Brief Look Backwards at Survey Innovation

One of my first jobs in the Civil Engineering field was working with an Ontario Land Surveyor (OLS) in a small surveying firm in Durham Region; it was 1988. It was there that I witnessed the relatively quick transition from tapes, theodolites and hand drafting to data collectors, total stations and CAD.

Innovation in the surveying industry over the last 30 years has been significant. The continuous improvement in surveying technology since 1988 could be compared to the computer industry in many ways. Every few months, new hardware, software and digital processes were introduced to the traditional surveyor and if adopted, could increase field productivity, calculation time and plan creation dramatically.

In the mid 90's, while working for a land development engineer, I started to see incoming topographic surveys from ground-based GPS-related systems. The turn-around time, the density of points and overall quantity of incoming data was something that the engineering clients wanted to see. The equipment sold to the surveying profession was starting to infiltrate the construction surveying market and other engineering groups that used to outsource surveying.

Affordable desktop computers and CAD-based plan production was the status quo in the late 90's; engineers were primarily getting text ASCII files (PNEZD) and AutoCAD Drawings (lines, arcs, circles, points, and text) as a deliverable from the surveyor. No matter what technology was used to pick up the data, the end result was generally something that looked like the same product being created with ink on Mylar. OLSs were required to ensure the same standards of the hardcopy plan product no matter what technology was used to create it.

Within the last 10 years, advancements in the Internet, wireless communications, remote sensing and photo mapping technology have created a shift in the ground-based surveying business. From my perspective, one of the most dramatic innovations was the release of Google Earth. Everybody on the planet started using maps, every website had a map link, and recently, every new "app" has some sort of positioning system that links you to a map screen. Google had created a programming "cloud based platform" which allowed even hobbyist programmers to start building map applications with data linked to those maps. Bringing maps into the workplace meant surveyors needed to start providing survey datasets which "matched" associated GIS mapping, including Google. Engineers and construction surveyors started talking about coordinate systems, with little understanding and lots of confusion.

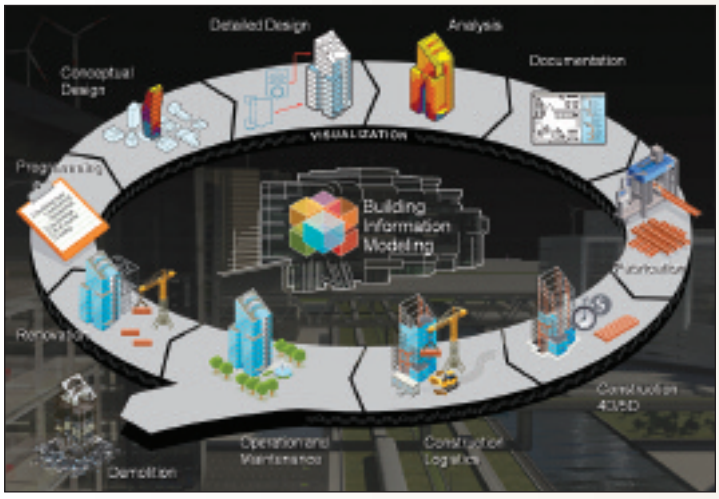
The second major advancement, which is starting to move into mainstream engineering, is LiDAR. In my view, the concept of air and ground based LiDAR surveying will be the "next big thing" where field productivity is again increased, and datasets are even bigger than imagined (millions, possibly billions of points). Unlike Google, I am unaware of an open development platform or "cloud-based" technology that supports LiDAR datasets in a way that Google Earth might support photo, DEM Data and various GIS layers. So the delivery of a LiDAR-based "product" is the solution for the surveying professionals who want to adopt this technology...

Software, Hardware and Data Processing, all built by the surveying and mapping community – true innovation! *Have we seen any BIM yet?*

## What is Built Information Modeling (BIM)?

The definition of BIM states *"An integrated process built on coordinated, reliable information about a project from design through construction and into operations".*

So what does surveying practice have to do with BIM?



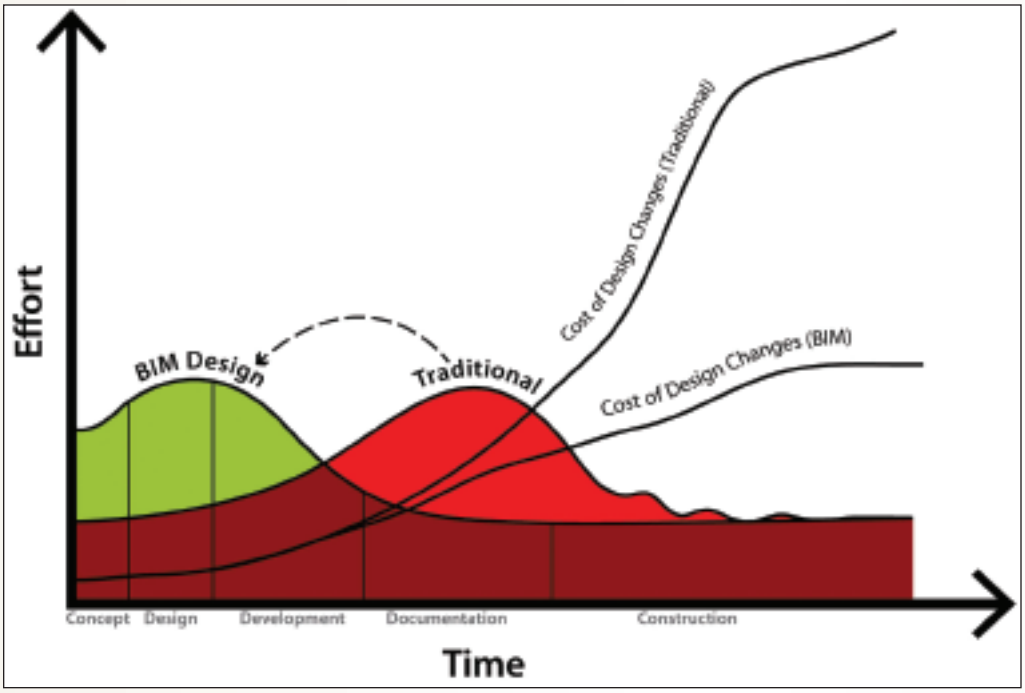

**The BIM Data Lifecycle Model**

While surveyors were innovating in their own way, engineers and architects were busy working with the same CAD Tools in the 80s and 90s. Mechanical Engineers were probably the first to adopt the process of "modelling" in "3D" for part design and assembly. They had early success in creating accurate 3D models for the purposes of simulation and manufacturing (CAM) production. Architects soon

followed with affordable desktop solutions which resulted in models of actual buildings. The term "Building Information Model" was born. Originally, the concept was around an architect digitally creating a model of the building, and then sharing that model with the sub-consultants and ultimately the construction firm. You could design HVAC, Plumbing, Electrical and many other internal designs within the same model ensuring a minimum of construction issues and budget overruns.

## Key Benefits of the BIM Process

- Design-related benefits would include Visualization, Simulation and Analysis during the design phase of a project.
- Construction-related benefits include accurate project wide item estimating, visualizing a construction schedule and costs (4D & 5D Analysis) and reduced or eliminated errors during construction process.
- Owners save money, Contractors keep more money and Designers can sleep at night knowing they have created a better design that can be built with much lower risks.




So what about Civil Engineering and infrastructure? Over the last 3 years, municipal and land development engineering firms have been transitioning from 2D CAD and spreadsheets into a model-based environment, which has significantly reduced 2D drafting and redline revision. For the first time in 20 years we can actually look at using low cost visualization and detailed analysis on every project, from checking for interferences between pipes and utilities within seconds to developing new tools and processes which connect design spreadsheets with BIM objects. It's been a transition that requires commitment from every designer and corporate support at the highest level.

## Disconnected Collaboration

As we develop our own BIM process and experience the benefits we see a disconnection with others in our design eco-system. We are constantly managing incoming survey data, making it fit, and designing on top of it. Exporting data to others including surveyors is a painful experience, when there are no guidelines or policies. This disconnected environment is the single most disappointing aspect of the movement towards BIM. In many cases we are seeing that the infrastructure construction industry has almost bypassed the surveying and engineering dysfunction by building processes outside the project data model to support their own innovation in estimating, automated machine control and layout. Why? The simple answer is, we are not moving fast enough for the construction industry.

Is it because we don't have the technology? No. Is it because we don't have the right innovative attitude? No. It's probably because there is a lack of communication between surveyors and engineers.

Surveyors and engineers have a lot in common, maybe too much. We tend to play it safe, work in a bubble and deliver a solution to our clients with the best intentions. We could generally get away with that before this concept of BIM. This process demands that we work closely with others in a different way. The moment we start communicating with BIM in mind is the day that our lives start to become easier and project design, layout and ultimately construction starts to experience the benefits of BIM in infrastructure.

## What is BIM Ready?

We have already discussed that both engineers and surveyors are working with new technology to improve their internal processes resulting in some form of data that can be shared seamlessly. Even if processes to create data improve, it seems that engineers are still getting survey data that is 2D and conversely, engineers are still providing data to surveyors in a non-standardized format. In the end, when it comes time for construction, contractors are just digitizing or re-modelling our approved design plans (worst case scenario) and laying it out themselves.

So what would it take to work with engineers? Not much more than you are already doing - we need the following drawing "objects" and/or "entities";

- Accurate 3D surface (DTM) from ground survey with spot elevations, breaklines and boundaries,

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- Underground Features - existing manhole structures and pipes,
- Aboveground Features - 2D Planimetric Point features (trees, poles, hydrants, etc.)
- Standard 2D line work and text showing Planimetric features (fences, building pads, legal and property boundaries, etc.)
- Having all of this in a pre-defined coordinate system that matches GIS and orthophoto datasets.

Lastly, being able to download a dataset and start using the "survey" for engineering purposes minutes after receiving the files is considered BIM Ready. Having some confidence that we can then send surveyors smart surfaces and points would also be our part of the BIM Ready process.

## Open Design Data Interchange Format - LandXML?

We discussed that the delivery of BIM Ready data in a single packaged download, providing traditional 2D CAD Drawings (Models and Sheets) with a supporting LandXML Design file containing surfaces, pipe networks, parcels, alignments, profiles, points and breaklines might be the kind of open format this process dictates. In 2012, the CAD Platform can be pretty much anything (DWG or DGN); the importance of developing a process on a global standard like LandXML (www.landxml.org) means design collaboration within the surveying and engineering eco-system can happen regardless of the CAD Platform.

## BIM Ready means Added Value

Promises of increased productivity and lowered costs were achieved in the 90s, survey crews got smaller and competition got bigger... in some cases, fees and perceived service value decreased significantly with the introduction of technology within the surveying profession.

I have just explained briefly what might be considered BIM Ready. The reason we need accurate survey data is for the creation of profiles, sections, earthworks volume calculations and existing design constraint. Connecting proposed networks with existing pipe networks is considered a bonus.

This same data, if provided correctly, can then be used in our "value added" services such as rapid visualization and clash detection between existing and proposed design objects. Currently, the time for engineers to create and manage incoming project survey data is significant. Our clients pay for this data collection, management, creation and re-do. We can significantly reduce this cost to clients (or our own internal budget overruns) if data management is controlled. The delivery of this BIM Ready dataset is valuable and is worth something to those who request it. Surveyors are actually best suited to create these existing ground and feature models, and can charge those services as a value added component to the cost of a survey "product".

## Productizing your BIM Ready Services

If the survey profession defines a BIM Ready "product" or series of products with standardized content and delivery, our design eco-system can respond with refining their own internal practises with confidence.

LiDAR - Going back to the conversation about LiDAR, this technology is positioned to be BIM Ready. Engineers need a survey data product so they can do their work, how we get that data can be from LiDAR Point Clouds if the survey community can ensure its quality and completeness. Developing a cloud based platform for LiDAR data delivery is indeed another subject... but equally as important when looking at LiDAR data as a product to non-LiDAR ready data consumers.

Data Management - Having our project surveyors manage incoming data from a large project with some knowledge of what we need is critical. Getting emails with partial surveys overlapping is not BIM Ready. Having a complete survey with a surface object representing the growing or changing site is what we would consider BIM Ready.

Asset Management - Our municipal clients stand to gain

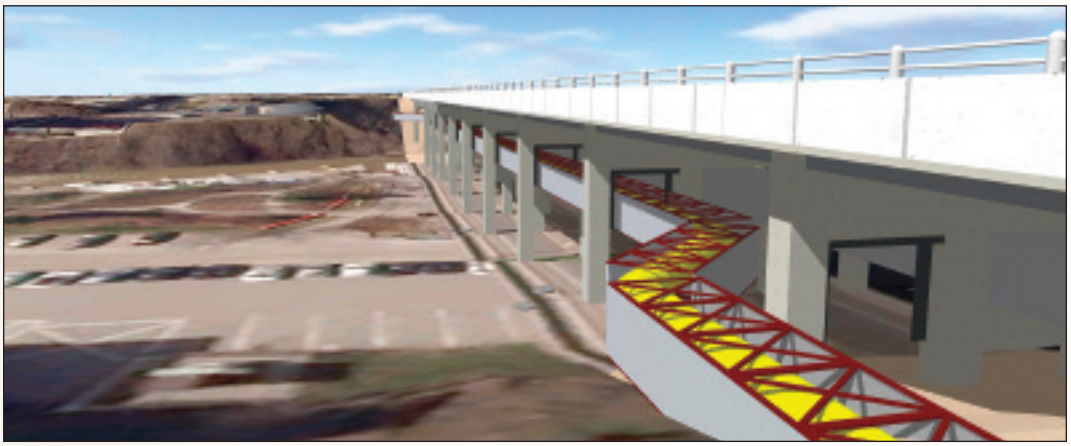
**Actual Model created using Survey Datasets, AutoCAD Civil 3D Design, Trimble Sketchup and then "rendered" using Adobe Illustrator.**

the most, as any As-Constructed survey datasets can be productized and added to asset management databases directly after construction and if considered BIM Ready - should not have to be re-surveyed. Basically, we provide design properties and you provide location properties both horizontal and vertical.

## Next Steps...

When we moved from Pen and Ink into CAD, the industry took some time to come to grips with the change. The movement towards BIM and a more collaborative environment with outsiders means once again that we will be moving out of that comfort zone and into an environment of change and disruption.

Our clients are depending on us with this positive change, and as before they can help by mandating a pre-defined process like they did with CAD Standards. I think as an industry we are well positioned in 2013 to start talking seriously about BIM Ready standards. Having our clients involved in the process early on will ensure that all stakeholders are invested and committed to something that will take our professions to the next level of quality and value.



**Actual Model created using Survey and Mapping Datasets, Regional GIS Datasets, AutoCAD Civil 3D Design and then consolidated using Autodesk Infrastructure Modeller.**

**Jeff Lyons** is the AEC Business Unit Leader at Cole Engineering Group in Markham. His business unit is focussed on BIM related processes and services as it relates to the Infrastructure industry. Prior to joining Cole 3 years ago, he was working as the Civil GIS Technical Sales Exec for Autodesk in Ontario, focused on the adoption of Civil 3D throughout the province. He can be reached by email at **jlyons@coleengineering.ca**