Point Clouds at Brisbane City Council

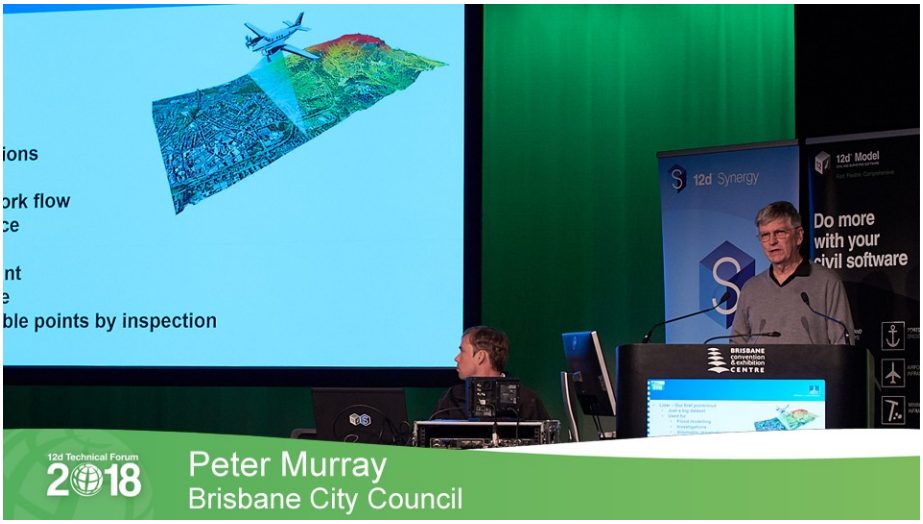
Brisbane City Council
Using Point Clouds in 12d Model

SCOPE:

12d Model Point Clouds functionality

12d DIMENSIONS:

- Design
- Surveying



Peter Murray addressing the 2018 12d Technical Forum delegates

Summary and Background

Peter Murray spoke to our 2018 Technical Forum delegates about Brisbane City Council (BCC)'s use of Point Clouds in 12d Model software.

Peter works in the Surveying area of BCC, which is actually run as one large local authority covering the whole city; it's unusual in that sense. It's the largest local authority in Australia, by both budget and population (it covers a population of around 1.2 million and an area of 1,367 square kilometres). It works to an annual budget of around $3.1 billion – to cover traffic management and infrastructure, public transport, parks and opens spaces, economic development, and lifestyle and leisure. This leads to a great deal of variety in work – large projects and many smaller ones as well.

There are nearly 8,000 people working in the organisation. In Planning and Design, there are nearly 350 people – surveyors, road designers, drainage designers, bikeway designers, Geotech, pavement designers, landfill management, GIS, architects, landscape architects, water management, flood modellers, urban planners, and environmentalists.

What is a point cloud?

A point cloud is just a huge collection (thousands-billions) of points – they're unrelated despite looking like they're related. The enormous scale causes issues – bigger projects lead to more things that can go wrong. Point clouds have been in use since the mid-1990s…which gives some pause as to whether they're still as relevant as they're sometimes deemed to be.

How to acquire point clouds

A point cloud can be generated by laser scanning (e.g. Terrestrial, Mobile, Aerial), via photogrammetric techniques (e.g. UAVs), or using SONAR (e.g. Hydrographic Surveys).

Why use point clouds?

They appear to be very detailed and intuitive – they look almost like photographs (and it's possible to measure between the points), which makes people think they're loaded with useful information. Point clouds can also be captured rapidly and at a relatively low cost (particularly using LiDAR – this can lead to being able to capture, within days, huge amounts of information that would otherwise take surveyors years to collect). They allow for measuring of areas with difficult access, allowing for increased safety in areas such as freeways and dangerous industrial areas (e.g. through use of drones). And they're intimately intertwined with BIM, which makes them unavoidable, especially as they become more and more mainstream and accessible to a wider audience.

Challenges

What are the potential downfalls of using point clouds?

Highly specialised skills are required to produce a high-quality point cloud. The size of the datasets required is also prohibitive. It is also an issue that point clouds don't fit well with traditional design processes, and are technology hungry – a variety of sophisticated equipment is required for their successful use.

Solutions

How to collect the datasets for point clouds

LiDAR – used since about 2010 by BCC for flood plain modelling, concept designs, investigations, and volumetric resumptions, LiDAR is regularly incorporated into their workflows and is an accepted data source. Data is generated by a plane flying over the ground with lasers pointing below and measuring downwards. As the lasers hit the ground, the beams are reflected back up to the plane so the plane can take measurements, at a rate of about two million measurements per second!

For more information

To find out more about how you can create better designs faster with the 12d Model solution for civil engineering design, visit www.12d.com.

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12d Model

Unfortunately, vegetation and water are the 'natural enemies' of LiDAR, so it can't be used everywhere. Over time, their teams have learnt that not every point is required, nor is every point reliable…and unfortunately it isn't always possible to pick the reliable points

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LAS files (which have evolved from LiDAR) with categories, which are generated when reflections bounce off e.g. leaves and trees, leading to greater ability to filter out extraneous information, determine roof heights, interpolate floor levels, etc. LAS files are very useful in particular circumstances, and are included (with accompanying macros) in a number of BCC workflows.

The new 'Point Cloud Surface Thinning' option in 12d Model 14 – a very neat function allowing draping of strings through point clouds. This means points can be concentrated where changes in grade occur, leading to a reduction in ALS points. The result is better-looking contours which are closer to the original…at 12% of the size of the original dataset.

UAV LiDAR using drones – this can be great for working in what would otherwise be very dangerous areas.

Mobile Laser Scanning – this is more accurate and less expensive than LiDAR, but also more difficult to control.

UAV Photogrammetric Point Clouds – this method is quick and inexpensive, but again there are issues with control.

Terrestrial Laser Scanning – BCC had experience with this years ago, for bridge scans. Using this method, small amounts of important information can safely be obtained.

Point cloud functionality in 12d Model

Peter said there is definitely value in point clouds, but they're not yet civil design ready, at least not universally. 12d Model manages point clouds well, though – it will read them in with ease.

12d Model will import common formats of point cloud, convert between formats, and perform projection transformations. It uses a 'String_cloud' element. In 12d Model 14, these processes have been improved even further – there is now capability to import multiple files, selected in Perspective view (which has also been made more responsive and reliable). Threaded views have also been added.

Peter also outlined some of his favourite point cloud functionality in 12d Model – including manipulating categories, deleting/undeleting, draping against point clouds, drawing flags, limiting clouds, pinning clouds, and of course the aforementioned Point Cloud Thinning.

Results

What they've learnt at BCC

Overall, point clouds are an efficient and practical way of collecting a dataset. It is important to remember that not all the points are needed, and that not all clouds are the same. Also, file extensions are not a reliable indicator of contents – there are standards in existence, but they are not always followed. Peter also cautioned against such marketing claims as 'Scan to BIM capability' as they are not always what they seem.

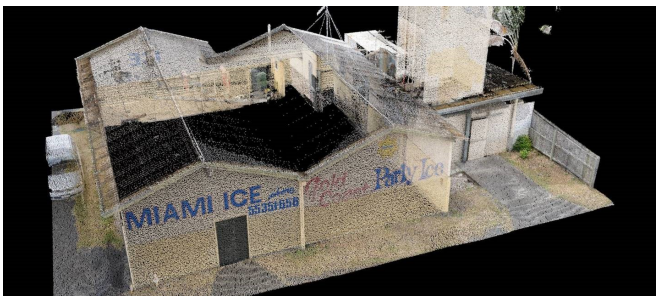
Some of the point cloud outputs include a full point cloud (which is a good record of what was there), extracted objects, vectors and points, surfaces (TINs), and viewers. These can be used in such areas as geospatial, forensics, and film.

Where to now for BCC and point clouds?

As they've now reached such a level of success with LiDAR point clouds, they're now looking at scanning drainage chambers, scanning buildings, and data extraction and modelling (including vectors, trimeshes, and pipes). Peter showed examples of terrestrial laser scanning they've done (in particular with manholes). He has been investigating ways to utilise point clouds, including a macro (within 12d Model) to slice them, meaning he could extract a trimesh out of a point cloud to reduce it to a manageable number of points. By colouring the trimesh, surrounding spots have been made visible, and the clouds have become more valuable in his day-to-day work. By combining an image and a point cloud on some other projects, further usefulness has been discovered.

BCC has been developing a specification for the extraction of trimeshes from point clouds, as well as mapping files and 12d Field codes. They have utilised DTM auditing routines for trimeshes. Recently they purchased a BLK 360 scanner, and they are working on developing in-house skills to take their use of point clouds even further.

In essence, keeping full point clouds is a good way of maintaining an accurate record for future reference, and with some ingenuity, their day-to-day usefulness can be harnessed on some projects, too.



An example of point clouds

Roads and Highways

12d Model's design option is the smarter solution for the design, modification and maintenance of Road and Highway projects.

Enjoy advanced 3D tools to design local and major roads, intersections, roundabouts, highways, interchanges and much more.

Ports and Dredging

12d Model is the solution for port infrastructure and dredging, easily managing the very large datasets and complex volume calculations often required by these projects.

A complete range of flexible and customisable volume calculation tools allow teams to extract and present the information quickly and easily.

Land Development

12d Model is the most versatile solution for the creation of sustainable land development projects, including residential, commercial and industrial developments, recreational areas, landfills, and agriculture projects.

Easily manage all aspects of your land development project from earthwork quantities, road design utilities and drainage design.

Airport Infrastructure

12d Model provides a solution for the design, construction and analysis of new airports, as well as the upgrade and maintenance of existing runways and airport infrastructure.

Easily manage large airport infrastructure projects and share data across multi-disciplinary teams.

Rail

12d Track has been specifically designed for the survey, design and construction of light, heavy and high speed rail projects.

Extensive railway tools in 12d Track allow the rail designer to quickly and easily design their projects. These options are built on the existing 3D modelling and design tools available in 12d Model.

Mining Infrastructure

12d Model's powerful set of exploration, site investigation, survey and analysis tools are crucial for the initial design, construction and ongoing operation of mining projects.

Comprehensive tools for the survey, design and construction of access roads, railways, earthworks and services allow for the coordinated design and management of mining infrastructure from within 12d Model.

Drainage, Sewer and Utilities

12d Model provides comprehensive tools for the design, analysis and optimisation of stormwater and sewer projects using rational, dynamic (hydrograph) and 2d drainage methods.

Powerful clash detection management allows for efficient 3D modelling of service networks such as gas, electricity, telecommunications and water prior to construction.

Surveying

12d Model is a complete surveying package providing the tools to manage all facets of surveyed data including LIDAR, topographical, as-built, conformance, traversing, geodetics, data mapping, labelling and much more.

The 12d Field option runs on a ruggedized tablet and gives the user access to full 12d Model functionality, allowing you to take the entire project into the field with the most comprehensive pick-up and set-out tools.

Oil and Gas

12d Model assists with the design, construction and mapping of oil and gas pipelines, original site exploration and the wide range of infrastructure required for oil and gas projects.

Accurate 3D modelling and the ability to share data between users allow teams to quickly and easily coordinate designs.

Construction

12d Model is the ultimate software for construction with powerful set-out options, direct interfaces to machine control and detailed conformance reporting and auditing.

Manage 3D data and control volumes, quantities and progress claims with 12d Model. Set-out your project and undertake conformance and as-built surveys live on-site using 12d Field.

Rivers, Dams and Hydrology

12d Model handles very large datasets and interfaces with a wide range of analysis packages, making it perfect for flood studies and the management of rivers and dams.

12d has partnered with industry leading analysis software, allowing users to apply 2D drainage analysis from within 12d Model.

Environmental

12d Model's ability to handle very large datasets combined with flexible and comprehensive 3D analysis and modeling tools make it perfect for a wide variety of environmental projects.

Existing workflows can adopt 12d Model easily as it allows users to directly interface with GIS systems and most software packages and file formats.

Why Choose 12d?

- **Powerful data processing & intelligent functionality.**
- **Modular, easy to update & completely customisable.**
- **Seamless integration with major industry software and hardware.**
- **Used in over 55 countries worldwide.**
- **Friendly support & training from industry experts.**

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