

# TopoD T M Tech Notes

## Certainty 3D

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To: General Release

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### Re: Maximize Productivity Using LiDAR System Data Across Operations (#1014)

### Introduction

Recent dramatic increases in LiDAR system productivity coupled with high performance and low cost processing applications such as TopoDOT<sup>™</sup> are facilitating the flow of LiDAR system data across all operations. At this point, LiDAR system data still remains predominately within survey/mapping operations. However several of the most progressive design and engineering companies are consistently finding that exploiting this information rich data across their operations will:

- Streamline Operations
- Reduce Costs
- Accelerate Schedules
- Improve Communication
- Improve Quality
- Minimize Risk
- Increase Profits

Modern LiDAR systems are briefly discussed along with an overview of the acquired data. This is followed with specific examples of productivity increases and cost savings from front end survey/mapping operations through design and engineering. Finally the document concludes with recommendations for low risk/ low cost approach to integrating LiDAR system data across operations.

### LiDAR System Productivity

From late 2009 through 2010, the introduction of highly efficient LiDAR survey systems capable of acquiring large amounts of 3D spatial data efficiently and quickly has brought down acquisition expense dramatically. These new systems have fundamentally changed process economics. There is now more than sufficient time to extract 3D models and topographies in the office while still achieving significant overall savings in cost and time when compared to traditional methods.



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### LiDAR Data Processing

Modern LiDAR system data is primarily comprised of three data components: 1) The control network survey data, 2) the point cloud(s) and increasingly, 3) calibrated images. TopoDOT<sup>™</sup> has been developed to import and exploit the information contained in this content rich data in a user-friendly and intuitive way.

Prior to the advent of high productivity LiDAR systems and processing programs such as TopoDOT<sup>™</sup>, point cloud data collected within survey/mapping operations was of limited interest to downstream design, engineering and construction processes. Essentially, measurements, features and 3D models extracted from point cloud data were passed on to downstream operations while the point cloud data remained within the survey/mapping and CAD processing operations.



As designers and engineers start to experience TopoDOT<sup>™</sup>'s user-friendly and intuitive tools designed to exploit the rich data provided by modern LiDAR scanning systems, there is increasing interest in allowing this data to flow directly to the design/engineering and downstream operations. Below are just a few examples of point cloud data and calibrated images displayed in the TopoDOT<sup>™</sup>/ MicroStation<sup>™</sup> environment.



### Point Cloud Cross Section Mapped to Calibrated Image

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**Extract Features from Structures** 

TopoDOT<sup>™</sup> provides the opportunity to rethink the very linear workflow described earlier. Those first progressive companies who support the LiDAR system data flow directly to design/engineering and other downstream operations are experiencing very positive productivity results.



# Increased productivity has been found to contribute directly to the bottom line. The following are a few real world examples provided by TopoDOT<sup>™</sup> customers.

### Productivity Examples

### Illinois Interstate 80 – Courtesy HNTB Technology Incubation Center

Initial Illinois DOT budget estimates for the I-80 project's 15 mile survey totaled approximately \$1.1 million with about \$250,000 attributed to utility survey and the remaining \$850,000 to surface topography survey. IDOT requested HNTB's TruvVis Pulse™ team to investigate applying a modern mobile LiDAR scanning system to the surface survey.

HTNB responded with a complete plan for I-80, ramps and secondary intersecting roads. Local surveyors were employed to establish certified control. HNTB managed the data collection and handed the data off to their project team for extraction and 3D topography modeling.

With only three hours of TopoDOT<sup>™</sup> training, the HNTB project team extracted a design model exceeding requirements.



Extracted Breaklines/Points for Input to DTM Engine

Contributions to the bottom line can be summarized as:

- Reduced project cost from \$1.1 million to \$500,000 55% savings!!
- Eliminated complex MOT and increased safety
- Took months off schedule
- Delivered a much higher quality survey

The I-80 project represents the "front-end" savings potential of employing modern LiDAR technology and TopoDOT<sup>™</sup> processing. In the following two examples, we focus on efficiencies gained by allowing data to flow to downstream design, engineering and construction operations.

#### Dulles Transit Corridor Phase I Project – courtesy Bechtel

Early in TopoDOT<sup>™</sup> development, Bechtel employed TopoDOT<sup>™</sup> to process mobile LiDAR data on their Dulles Transit Partners project. This project included a tunnel under Virginia Route 7. In the first on-site training, Bechtel's chief surveyor requested Certainty 3D representatives to

compare mobile point cloud data against a very detailed 3D tunnel design model Bechtel had developed.

As shown in the following TopoDOT<sup>™</sup> screenshot, a section (slice) of raw point cloud data was selected (top view) and displayed simultaneously along the tunnel centerline axis (side view). A quick measurement revealed only three feet of clearance between the road surface and the proposed tunnel; far too shallow. The Bechtel Design/Engineering team re-routed the tunnel accordingly.

Allowing LiDAR system data to flow directly to the engineering level clearly resulted in identifying a problem sooner and resolving it quickly. It is difficult to quantify the savings attributed to this situation specifically. However, clearly this type of feedback available directly to downstream operations results in more streamlined operations, faster response and improved communication across operations.



### **Design Model Comparison to Point Cloud Cross-Section**

Virginia Route 395 – courtesy Woolpert

During a recent demonstration to an engineering company, the participants were asked for common information required by engineers during design-build operations. An example given was the need for precise elevations after the construction of a highway section has been completed prior to the design/build of the adjacent section. When asked about the current process for receiving that information in engineering, the following summary was given:

- 1. Submit written request to survey operations
- 2. Request forwarded to survey team
- 3. Team goes in the field and extracts measurements to best of ability
- 4. Response to engineering is typically 2-3 weeks

Given the cost of dispatching a survey team, cost associated with waiting for the information, potential for information being incomplete or higher/lower accuracy than needed, it would not be difficult to asses at least several thousand dollars to this process.

Now consider the TopoDOT<sup>™</sup> screenshot below wherein mobile LiDAR data acquired in hours could then be passed to engineering and a cross section of raw point cloud data extracted in 10 seconds!!





This is clearly just one example of a few mouse clicks saving thousand of dollars, avoiding dangerous field operations, accelerating schedules, streamlining operations and improving communications across operations.

#### Integrating LiDAR System Data into Operations

Certainty 3D has supported many of our customers successful and profitable integration of LiDAR system data into their operations. From field to deliverable, Certainty 3D can assist a company's reorganization around this emerging technology quickly with minimum cost, low risk and very high rates of success.

Certainty 3D assists our customers in:

- Understanding LiDAR system data
- Organizing operations around LiDAR processes
- Developing requirements for LiDAR data
- Developing metrics for assessment of LiDAR data
- Processing LiDAR data effectively

These steps are neither difficult nor expensive. The Certainty 3D team has collectively decades of experience in the acquisition and processing of LiDAR data. Our TopoDOT<sup>™</sup> licensing programs are designed for very low entrance costs and are scaled up with usage.

Certainty 3D will focus on data processing with TopoDOT<sup>™</sup> first. The first objective is to develop a core processing competency among a small focused group within the customer's organization. Since a TopoDOT<sup>™</sup> enterprise initial license cost is inexpensive (see <u>http://www.certainty3d.com/purchase/</u>), web-based training is included and TopoDOT<sup>™</sup> is very user-friendly and quickly learned this core competency can be achieved quickly at very low cost.

Depending on the customer's familiarity with LiDAR data, Certainty 3D will spend time accordingly on understanding LiDAR data, data requirements, and assessing LiDAR data with respect to acceptance criteria. Note that if a customer does not have their own LiDAR equipment, Certainty 3D can offer contacts among its' many surveying/mapping customers with such systems. *There is no immediate need to purchase hardware.* 

While we start by training small groups within an organization, we typically see the most successful and progressive companies grow their processing teams dramatically. This is due to the productivity of modern LiDAR systems whereas it now requires a much higher ration of CAD processing to field technicians to keep up with the inflow of data.

### **Survey Field Crew to CAD Tech Ratios**



Having established this core competency within the customer's organization, Certainty 3D can continue to educate our customer's downstream operations as this content rich data flows across operations. Since TopoDOT<sup>™</sup> operates in MicroStation<sup>™</sup> and its annual maintenance cost is a function of usage, the annual cost of TopoDOT<sup>™</sup> will be proportional to and orders of magnitude below the consequent economic benefits of using this data. Bottom line, an engineer can install TopoDOT<sup>™</sup> at no additional cost, use TopoDOT<sup>™</sup> one day, cut a cross section saving thousands of dollars as described above and that one day will cost a few dollars at the end of the year in maintenance.

Clearly at Certainty 3D, we have designed our products and programs for maximum value to our customers. Our dedicated staff will do all we can to position our customers for success in exploiting this new and rapidly emerging technology. Please do not hesitate to contact Certainty 3D with more questions or to ask for references.

Questions and/or Comments

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