Using BIM Technology to Reduce the cost of Highway Construction

Presented by
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LandAir Surveying Company
Presentation Objectives

- How does BIM Apply to Transportation, Construction & Design?
- Project work flows.
- 3D Utilities..
- Understand the 3D Data Capture Process
- Modeling Process
- Clash Detection Process
- Benefits & Cost

**Disclaimer** We do not sell any hardware or software shown in this presentation!
Original Data Collectors 1968

Speed up to 1 point per minute!
Current Data Collectors

3D Data Collectors  Lidar & Photography
Speed 1,000,000 Points per second!

Laser Scanners
What is 3D Laser Scanning?

• “LiDAR”…..Light Detection and Ranging.
• High speed lasers. Aerial Mobile Tripod
• 50,000 – 1,000,000 points per second.
• Collecting geometric data points.
• Precisely registered in space.
• “Point Cloud” = “Hologram”

• Lidar Allows you to collect ALL the visible Information!
Aerial Lidar Scan and Surface Model
Ground accuracy with Survey Support
1” to 3”
3D Data Set generated with DJI Phantom using Photography
Surface Accuracy 1” to 3”
THE PROJECT

Pre Construction Analysis
Birmingham CBD
Reconstruction Project
3D Analysis by
ALDOT & LandAir Surveying Company
A sample of what was in the existing conditions model:

- 1400 bridge columns
- 8 miles of bridges
- One very old tunnel
- Hundreds of light poles
- Miles of underground utilities
- Adjoining buildings and structures
- Large overhead power lines
- Parking meters, sidewalks, traffic signals, store fronts
- Subsurface heated petroleum fuel line
- Existing sanitary and storm sewers of the city

All of the elements that could be documented in the existing conditions were included in the final model.
The Project Flow

- 3D Data Collection using...
- Helicopter, Laser Scanner, Fixed Wing, County GIS.
- Process and check the data ± .07 all data combined.
- Produce Standard MicroStation InRoads Plans.
- Model the existing data into useable 3D cad files.
- Model the future design plans in 3D cad format.
- Run clash detection software to Compare the existing and proposed and identify clash interference events.
- Produce Clash Detection Files and exhibits.
- Give information to the designers and contractors.

**CLASH:** When a design element interferes with an existing structure or entity.
The Project:

Improving Birmingham’s Interstate Assets

I-20/59
Central Business District Bridge Replacement
Birmingham, Alabama
Models
Overall Combined Project Data Sets
Example of Existing Conditions Producing Model.
Proposed Design Models
Mapping Utilities in 3D
Utilities Inserted into model
Clash Detection

Dynamic Project Review and Analysis

Bentley Navigator is used by infrastructure teams to review and analyze project information. With highly versatile viewing capabilities, Bentley Navigator delivers a more intuitive user experience and improves the interactive quality of information. This alone enables greater project insight and helps avoid costly on-site errors. In addition, teams can analyze projects virtually - to detect and resolve clashes and to simulate project schedules - they can augment data by registering comments in the I-models, and they can produce 2D and 3D PDFs for consumption by a wider audience.
Clash Detection

Step 1: Overlay proposed design onto asbuilt
Clash Detection

Step 2: Select sets of elements to clash
Example Clash Detection

Step 3: Run the Clash Detection algorithm

ALABAMA DEPARTMENT OF TRANSPORTATION
Project No. ACIMF-1059(383), Jefferson County
CBD Bridge Interchange Modifications on I-59/20 at I-65

Location (Alabama WEST Stateplane NAD83
US FOOT) - 2175956.62, 1277225.83, 570.47

ELEMENT A: Shared Cell: CLOUMN FOOTING - CLOUMN FOOTING-2299685-Export 3D
ELEMENT B: EXTG-COMO-LINE-CNTR
Clash Detection

Step 4: Perform “soft clashing” for comparison

Hard clashes = 67
Soft clashes = 361
Viewing/Editing Markups
Reviewing Clashes
Design Review: Reviewing 3D Model

- Task lead representation example

- Project Manager
- Ex. Utilities
- Structures
- Real Estate
- Signals
- FTMS
- Roadway
- Drainage
- Plats
- Lighting
- Pr. Utilities
What is the Return on the Investment for the State of Alabama?

Let's look at Two Studies.

3D preconstruction analysis for from this type of study?

**3D Engineered Models for Construction**

UNDERSTANDING THE BENEFITS OF 3D MODELING IN CONSTRUCTION: THE WISCONSIN CASE STUDY

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**BIM FOR INFRASTRUCTURE**

Study by AutoDesk 2012

BIM contributes to a deeper understanding during construction by providing a more accurate engineering representation of the project.

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**Profit from project insight**

Implementing BIM on capital projects can provide benefits across planning, design, delivery, and operational areas. Access to coordinated and consistent model views by all stakeholders supports:
What is the ROI of 3D Preconstruction Analysis?

Construction Cost

= Existing conditions + New Design + Unknowns

The following study was documented by the Wisconsin Department of Transportation and the FHWA
Mitchell Interchange I 94
Part of a $1.7 Billion Project
Total Estimated Cost Savings
$9.5 Million Dollars!
30:1 ROI !!!

Mitchell Interchange I 94
### Areas of Cost Savings

<table>
<thead>
<tr>
<th>DIN Category</th>
<th>Estimated Percent of Reduction</th>
<th>Total Cost ($ millions)</th>
<th>Average Cost Per Issue</th>
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<tbody>
<tr>
<td>General Structures</td>
<td>30.5%</td>
<td>6.8</td>
<td>$45,674</td>
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<tr>
<td>Roadway/Drainage</td>
<td>25.5%</td>
<td>5.7</td>
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<td>Wet Utilities/Drainage</td>
<td>11.1%</td>
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<td>Bridges</td>
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<td>Noise Wall</td>
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<td>Retaining Wall</td>
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<td>Earthwork</td>
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<td>Electrical/ITS/FTMS</td>
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<tr>
<td>Traffic</td>
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<td>0.5</td>
<td>18,174</td>
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<tr>
<td>Sign Structures</td>
<td>0.1%</td>
<td>0.02</td>
<td>738</td>
</tr>
</tbody>
</table>

Table 1. Estimated Cost Impact from the Use of 3D Modeling on the Mitchell Interchange Project
Where are the Savings?

The following ROI calculation is meant only to provide a theoretical example. The assumptions and results come from Autodesk Consulting confirmed by FHWA Study. Assumptions:

**BIM implementation costs average 0.5 percent** of the total program budget (average accepted by the industry as standard for major capital projects/programs).

Cost overruns in project delivery may usually be reduced by **15 percent** (a conservative estimate) from industry average of 20–24 percent, primarily due to a reduction in RFIs, addenda, and engineering change orders.

Savings from reduced rework after project close is estimated at **5 percent** of program budget.

Savings due to better visibility of the contractors’ cost breakdown is factored into both the bidding and negotiation phases, as well as controlling the as-built.

An **average saving of about 5.5 percent** of the total program budget based on industry experience in major capital projects where BIM is implemented.

Expected ROI can be between **10 to 30 times the investment.**
Summary

Lidar (all types) is an excellent way to Document existing conditions.

Preconstruction BIM analysis saves $$.

BIM is becoming BEST PRACTICES!
Questions or Comments?

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See more at:
- www.LandAirSurveying.com
- LandAir Surveying’s YouTube Channel