3D Intelligent Models

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Who is this guy and what does he do?
3D Workflow Study and Implementation plan

(\textit{Gap Analysis})

\begin{itemize}
  \item Hired Bentley Systems
  \item Completed Feb 2016
  \item Objective
    \begin{itemize}
      \item Identify changes/impacts to MDT’s organizations, business processes, practices and standards required to implement 3D model workflows into MDT’s highway program.
    \end{itemize}
\end{itemize}
Why change to 3D

Expected benefits of 3D Workflow

- Save time and money during construction
- FHWA has estimated a time savings of 30–40% and a 6% construction savings
- time savings is realized during construction/earthwork operations
- Obtain better bids for construction
- Improved site design
**Expected benefits** of 3D Workflow

- Accelerate developing a culture of interdisciplinary teams collaborating throughout the lifecycle to develop better designs
- Supports the use of 3D intelligent models when implementing Transportation Asset Management plans

**Key Questions** addressed by 3D workflow Gap Analysis

- What are the key issues that has kept MDT in the paper world?
- What are the high level challenges that need to be addressed moving forward?
- Full report found at:
  - Three documents under INFO section
Workflow Study Vision Statement

• Utilize intelligent 3D CAD models to support the lifecycle of transportation projects that provides:
  – More economical and efficient project delivery
  – Improved public safety
  – A focus on benefits to the tax payer
• “A Journey”
Initial 3D Project Objectives

The workflow study focused on these project delivery business processes:

- Preconstruction
- Procurement
- Construction
- Emphasis on Automated Machine Guidance (AMG) for roadways

A call to action

- A “Vision”
- Dedicated team
- Organizational change plans
- An implementation plan
- Management commitment to the change
Requires Organizational Transformation

- Creating a Climate of Change
  - Increase Urgency
  - Build Guiding Teams
  - Get the Vision Right

- Engaging and Enabling the Whole Organization
  - Communicate for Buy-In
  - Enable Action
  - Create Short Term Wins

- Implementing and Sustaining the Changes
  - Don’t let up – monitor and measure progress
  - Make it stick – “the way we do business here”

Discovery Sessions for Pre-Construction

- Survey Section
- Road Design Section
- Bridge Design Section
- Consultant Design Bureau
- Engineering Information Services Section
- Hydraulics Section
- Materials Bureau – Pavement Analysis Section, Physical Testing Section, Geotechnical Section, Non-Destructive Testing Unit, Pavement Engineering Unit
- Right-of-Way – Acquisition Section, Lands Section, Utility Section
- Traffic and Safety Bureau – Geometrics Section, Safety Section, Traffic Section
Discovery Sessions for Construction, Contracting and Contractors

- Procurement Section
- Legal
- Maintenance MMS System
- IT
- Field Construction
- Environmental
- Contractors
- Construction Reviewer and Constructability Review
- Construction Administration
- As-Built

Project Delivery Impacts 2D to 3D
### Preconstruction Impacts

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<tr>
<th>Survey</th>
<th>Design</th>
<th>ROW</th>
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<td>Survey</td>
<td>Roadway</td>
<td>Acquisition</td>
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<td>Pavement Engineering</td>
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**Engineering Information Services Section**

**Functional**
- IT Systems & applications
- Pavement Analysis
- Non-destructive Testing
- Physical Testing

### Construction Impacts

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<tr>
<th>Procurement</th>
<th>Construction</th>
<th>Operations and Maintenance</th>
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Recommendations - Survey

- Field Survey
- Point Cloud Features
- Photogrammetry
- Construction Project Survey
- Survey Standards
- Lidar Point Clouds
- Aerial Imagery

Field Survey Recommendation

The current MDT practice is capturing survey shots at a 25 feet grid and any breaks in between. Surveys design files are currently delivered in 2D or 3D based upon requests from Design.

Decrease the maximum distance between points (point density) of some survey shots. Since the 3D design models should be processed at a fine interval, field surveys need to increase accuracy with respect to point density. For tie-ins to existing sewers, curbs, culverts, pavements, utility covers, bridge elements, use a 5 foot maximum distance between points. For minimum grades on pavements or ditches, existing pavements that will be modified, use a 10 foot maximum distance between points.
**Recommendations – Design**

- Field Reviews
- 3D Modeling – Road Design Section
- Electronic Deliverables
- 3D Modeling and Design - Hydraulics Section
- 3D Modeling - Utilities Section
- 3D Modeling - Geometrics Section, Safety Design, Consultant Design Bureau, and Lands Section
- 3D Modeling - Geotechnical Section
- 3D Modeling – Bridge Design

**Electronic Deliverable Recommendation**

Contractors are currently using different software for 3D modeling and AMG vendors that use different input files.

Deliver a full selection of electronic 3D model files to construction bidders. A standard list of deliverables needs to be developed. Delivering LandXML files (.xml), MicroStation Design files (.dgn), and Infrastructure Construction Models files (.icm) is recommended.
### Recommendations

- Communication Between Design and Construction Staff
- Design / CADD Standards
- Training
- Legal
- Contracting

### Implementation Risks and Barriers

- Other DOTs have performed a workshop to identify risks for the implementation plan
- Need to develop a collaborative project delivery process when using 3D models
- Learning curve
- Impact on design taking more time to create 3D models
- Significant changes for DMS and Docuplot
- Budget
### Proposed Implementation Plan

#### Phase 2a
- **Year 1**
  - Phase 2a: Pilot Planning

#### Phase 2b
- **Year 1**
  - Pilot Projects – 3D Model for Information only
- **Year 2**
  - Deployment – 3D Models as the legal document – 5 districts

#### Phase 3
- **Year 3**
  - Deployment – 3D Model for Information only – Multiple Project(s) + EDC-3 pilots

#### Phase 4
- **Year 4**
  - Deployment – 3D Models as the legal document – 1 district + EDC-4 pilots + Environmental

#### Phase 5
- **Year 5**
  - Deployment – 3D Models as the legal document – 5 districts

#### Business as usual
- **Year 6**

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Note: All timeframes are estimates and need to be approved by MDT.
Moving forward with 3D Guiding Teams

- 3D Models for Bidding & Specifications
- 3D Model Review
- 3D Roadway Design
- 3D Bridge Design
- 3D Survey & Real Time Verification
- 3D IT infrastructure
- 3D As-Built & Asset Management

3D CADD Implementation

**Delivery of MicroStation SS4 (Open Roads)**

- Currently in test phase
- Full install by end of 1st quarter 2017
- Will allow both Geopak & Open Roads
- Critical Workspace development
- Training program
How will 3D effect your work?

Guiding teams will influence transition to 3D design.

- What type of training
- Project conversion from 2D to 3D
- What type of projects are 3D candidates
- What information is in a 3D model
- How to check 3D model
- How to transfer 3D data to construction
- What does MDT Construction need
- What does the contractor need

IT Challenges

- New Microstation technology
- Dept of Admin Convergence Directive
- DMS at end of life
- Docuplot at end of life
- Cost of data storage
- Connectivity and transfer speed
- Budget
Change is inevitable
Questions

\[(x + a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}\]