# 3D Intelligent Models

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# Who is this guy and what does he do?

# Change is inevitable

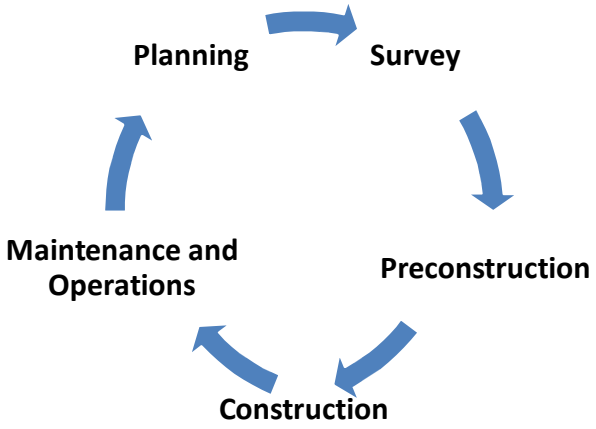



3D Workflow Study and Implementation plan
**(Gap Analysis )**

- Hired Bentley Systems
- Completed Feb 2016
- Objective

  Identify changes/impacts to MDT's organizations, business processes, practices and standards required to implement 3D model workflows into MDT's highway program.

# 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

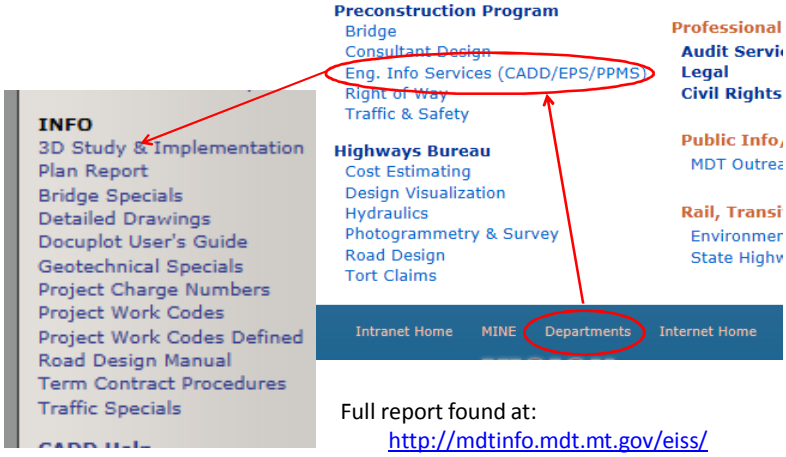
- Accelerate developing a culture of inter-disciplinary teams collaborating throughout the lifecycle to develop better designs
- Supports the use of 3D intelligent models when implementing Transportation Asset Management plans



## **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:
  - http://mdtinfo.mdt.mt.gov/eiss/
  - Three documents under INFO section

# 3D workflow Gap Analysis




Full report found at:

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Three documents under INFO section

**Report & two appendices**



# 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

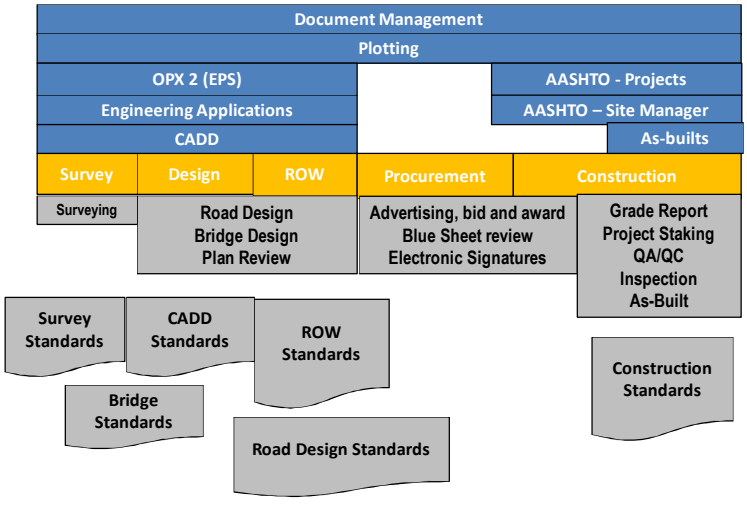
- Survey Section
- Road Design Section
- Bridge Design Section
- Consultant Design Bureau
- Engineering Information Services Section
- Hydraulics Section
- Materials Bureau – Pavement Analysis Section, Physical Testing Section, Geotechnical Section, Non-Destructive Testing Unit, Pavement Engineering 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

Low impact
Medium impact
High impact

| Survey | Design | | | ROW | |
|---|---|---|---|---|---|
| Survey | Roadway | Geometrics | | Acquisition | |
| | Consultant Design Bureau | Safety | | Lands | |
| | Bridge | Traffic | | Utilities | |
| | Hydraulics | Environmental | | | |
| | Geotechnical | | | | |
| | Pavement Engineering | | | | |

Engineering Information Services Section

**Functional**

IT Systems & applications

Pavement Analysis

Non-destructive Testing

Physical Testing

# Construction Impacts

Low impact
Medium impact
High impact

| Procurement | Construction | Operations and Maintenance |
|---|---|---|
| Procurement | Non-Destructive Testing | Maintenance MMS |
| Legal | Field Construction | |
| | Contractors | |
| | Construction Reviewer | |
| | Constructability Review | |
| | Const. Administration | |
| | As-Builts | |
| | Environmental | |

# 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

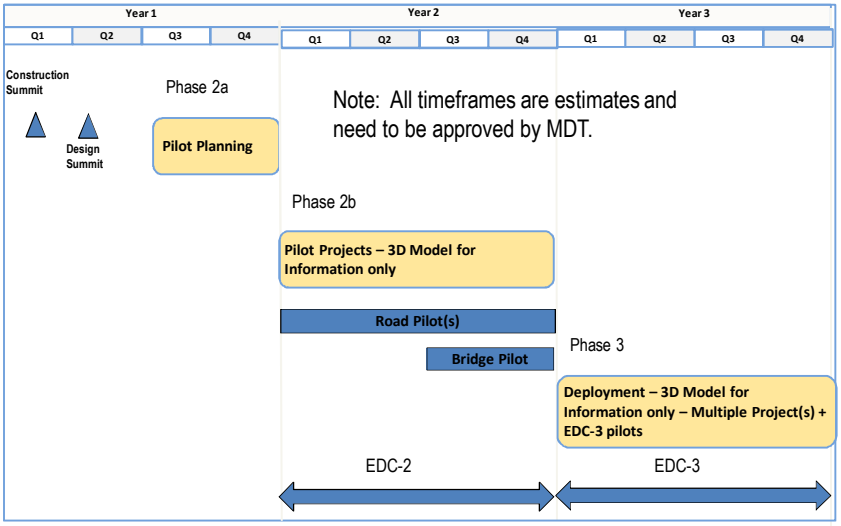
- Communication Between Design and Construction Staff
- Design / CADD Standards
- Training
- Legal
- Contracting



# 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

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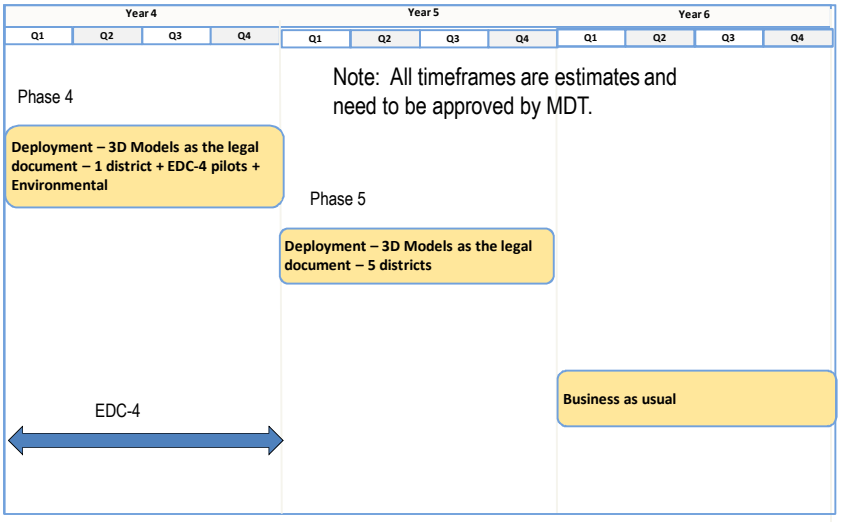

## Moving forward with 3D Guiding Teams

- 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

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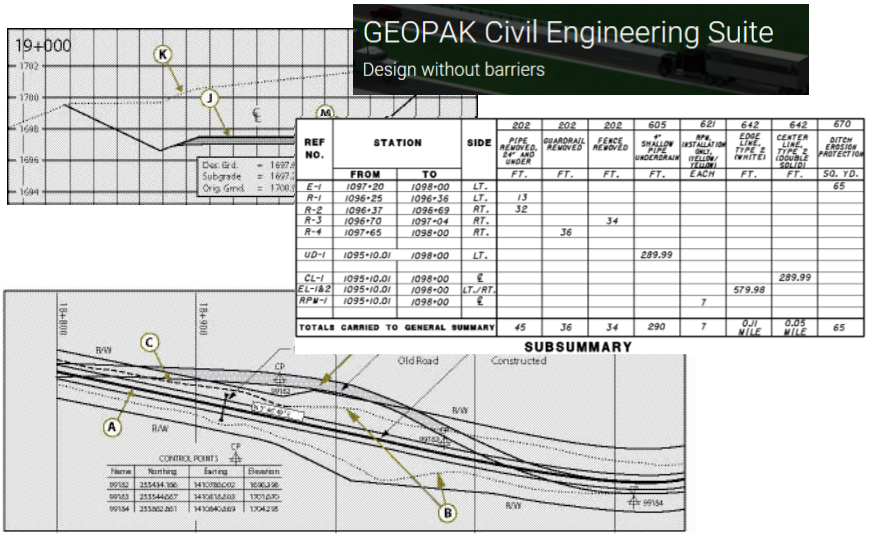

# Questions

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