MDT CIVIL INTEGRATED MANAGEMENT

IMPLEMENTATION PLAN

VISION

Civil Integrated Management (CIM) includes the technologies and methods that facilitate the transition from traditional project delivery and facility management (i.e. 2D paper plans and specifications) to digital project delivery and asset management. The transition to CIM requires high accuracy advanced survey methods, intelligent model-based design, digital project delivery, and a digital database for asset management.

A key element of CIM is the use of intelligent models. Intelligent models begin with high accuracy surveys. This information is used by design to develop 3D models that not only allow stakeholders to easily visualize our projects, but also allow the design team to identify issues and conflicts early in the design. Ultimately the Intelligent Model will become the binding contract for construction of select projects and the constructed 3D model will be included in our asset management system.

Construction Engineering will incorporate the 3D models into their staking, quality assurance, and measurements. The constructed 3D model will become the "Model of Record" for future projects and asset inventory. Maintenance will have access to the Model of Record for use during incident management, system impact review, and for inclusion in their asset management system.

Planning will have detailed information on roadway geometrics; plant mix and surfacing depths; signing; culvert and guardrail lengths; detailed drainage information; etc. to include in corridor studies, system impact reviews, environmental assessments, Highway Performance Monitoring Systems (HPMS), and Performance Programming Process (P3) funding allocation decisions.

The Civil Integrated Management target implementation date is January 2022. Pilot 3D design projects have been initiated this year (2016) and the target date provides an additional 5 years to fully integrate CIM. We fully anticipate significant technology advances over the next 5 years and the plan will be adjusted as necessary to adopt these advances.

Expected Benefits for MDT

- Save time and money during construction
- The 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
- 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
- Improved public communication on projects

- Align with FHWA "Every Day Counts" which provides resources, learning and best practices for the use of 3D models
- Improved construction project quality
- Improved safety

The key components of MDT's Civil Integrated Management implementation plan are described below:

Organizational Change Plan

- Build Guiding Teams – Establish implementation teams with goals, tasks, and deadlines.
- Communication – Develop Q&A and single page flyer to announce Intelligent Model roll-out and benefits to MDT.
- Cultural and Technological Shift – implementation teams to provide recommendations and plans for both the cultural shift and technological shift necessary to support the CIM transition.
- Enable Action – Encourage and allow innovation through full leadership support. Remove barriers and allow staff to expand their use of intelligent models.
- Monitor – Continue to monitor and measure progress of the implementation. There will be valleys – work through them and stay positive.
- Standard Operating Procedure – MDT leadership and staff must remain dedicated to the Civil Integrated Management Implementation Plan until it becomes "Standard Operating Procedure".

IT Conversion

- CIM Support - Pursue a strategy to ensure the IT Convergence team supports the needs of all other CIM teams.
- Data Storage – Develop projections for data storage requirements. 3D models require high accuracy survey and will require higher density conventional survey methods and point cloud topographic surveys pre-design. Development of the 3D models is also a data intensive process. Future storage of 3D as-built data and 3D sub-surface utility data storage must also be included. (Initial projections have been developed – Spring 2016)
- Data Retention – Identify current data retention practices and recommend adjustments to data retention plans.
- Data Transfer – Continue requirement gathering for replacement of existing CADD Document Management System (DMS) and future Enterprise DMS. Develop projections and requirements for data transfer rate and bandwidth requirements for sharing data between headquarters and the 5 Districts and field offices. Also, develop 3rd party collaborative site, or portal to allow sharing of files and documents through our firewall.
- Connectivity – Identify current connectivity status and challenges to improve performance. Recommend strategy to address connectivity shortcomings.
- Data Format – Develop standardized data format and data governance procedures that can be exchanged across all lifecycle phases.
- Hardware – Determine hardware performance measures and determine if existing hardware will meet these requirements. If necessary, deploy necessary hardware upgrades to allow users the ability to efficiently work with 3D models.

- Electronic/Digital Signatures – Determine requirements for electronic/digital signature. Pursue an electronic/digital signature standardized procedure for the CIM effort.
- Peer Exchanges - Leverage knowledge from other state DOT's who are actively implementing a CIM effort. States such as Ohio, Iowa & Utah are excellent resources.

<u>3D Roadway Design</u>

- Project Selection - Develop a process for determining which projects are appropriate for 3D modeling and delivery. Begin with pilot projects converting 3D Design to plan sheet based bid packages and provide 3D model files to construction bidders for information only. Determine design transition from 2D to 3D for projects in design.
- Inter-discipline Coordination – Develop work flow process for Intelligent Model design and coordination (survey, road design, bridge, utilities, geotechnical features, environmental, geometric design, signing and pavement markings, MMS data, etc.)
- Visualization – Develop work flow process for developing 3D visualization (public involvement, RW negotiations, construction staging, etc.)
- Clash Detection – Develop 3D design review process to identify conflicts (sub-surface utility, bridge abutments, signals, ADA ramp design, etc.)
- Training – Determine training needs and utilize knowledge base of pilot testers and guiding team members.
- Move from pilot projects to single District followed by Department wide roll-out of 3D design models.
- Models for AMG – Develop 3D model deliverables that can be used seamlessly for automated machine grading.
- Models for Bid Documents – Coordinate the development of model deliverables, plan package, and cost estimate, including protocols for the interim (informational purposes only) to potential future legal contract.

<u>Structural 3D Design</u>

- Continue to use the current workflows and software, while transitioning from GEOPAK to OpenRoads.
- Continue to use proven structural 3D design platforms where appropriate
- Monitor the work of AASHTO SCOBS-T-19 (Software and Technology) Committee in standardizing a format for bridge and structural information models for sharing data between platforms.
- Investigate using 3D bridge modeling software.
- Investigate using 3D modeling concrete and rebar detailing software.
- Investigate ways to transition between Bridge and Road Design coordinate systems. Investigate if Bridge and Road Design can be on the same coordinate system.
- Coordinate with Road Design, Hydraulics, Environmental, and Geotech on the level of 3D Design detail necessary for bridge layout, visualization, agency coordination, etc.

- Develop and document workflow processes for creating 3D Bridge Site Plans. Site Plans may include contour grading plans, riprap layout, concrete slope protection, bridge substructure elements, and superstructure blobs.
- Visualization – Develop work flow process for developing 3D visualization (public involvement, RW negotiations, construction staging, environmental permitting, etc.)
- Coordinate with contractors, fabricators, and suppliers to investigate current and future workflow processes.
- Models for Bid Documents – Interim (info only), future (legal contract)

<u>3D Model Review</u>

- QA/QC of 3D Design Models – Develop review process for 3D design models that allows input from all disciplines including non-CADD users.
- Clash Detection – Develop 3D design review process to identify conflicts (sub-surface utility, bridge abutments, signals, ADA ramp design, etc.)
- Models for AMG – Develop 3D constructability review process

<u>Bidding & Specifications:</u>

- Adopt a CIM methodology that improves project collaboration by eliminating silos. The model is shared by everyone working on the project throughout all stages of design and the transition from design to construction should be seamless.
- Provide a transition to using 3D models as the legal contract document. (Coordinate with Legal on contract language requirements).
- Incorporate 3D models into standard specifications – Update special provisions and standard specifications to address the use of 3D models.

<u>Survey Requirements for 3D Models</u>

- Equipment – Expand the use of modern survey technologies such as LIDAR on select projects to increase speed, efficiency, safety of personnel, and to provide the necessary base model for 3D Design.
- Workflow – Based on project type; develop survey related guidance and procedures to ensure stakeholder needs are met.
- Training – Determine training needs to support the expanding demand for accurate and complete survey data.
- Develop guidance and training related to the use of conventional survey equipment to ensure adequate point density is gathered when conducting preliminary surveys.

<u>Construction & Real Time Verification</u>

- Investigate deliverable requirements and formats that will assist contractors and department field staff to better utilize available project data and minimize rework.
- Reviewing and accepting construction control – Develop review and acceptance procedures for construction control.
- Evaluate possible quality control procedures on the existing terrain model to determine the need for supplemental survey requirements.
- Evaluate Trimble Business Center software as the replacement for Engineering Applications software.
- Reviewing and accepting work in accordance with 3D design Plans - Develop review and acceptance procedures for acceptance of 3D model construction.
- Measuring quantities - Develop procedures for quantity measurement of 3D model construction
- Collecting Digital As-Built Records "Model of Record" - Develop procedures for updating and accepting the Model of Record post construction.

As-Builts, Constructed Models of Record, and 3D Asset Information

- Increase accuracy, accessibility, value and trust of MDT's as-built, construction models of record, and asset information.
- Determine the various end users of as-builts and construction records, along with those users' needs, requirements and available technologies.
- Determine the process and technology needed to manage as-builts, construction record data, and other asset information from multiple sources that provides adequate accessibility and security of the records, and suits the needs of various users.
- Create uniform written guidance for the creation, handling and storage of as-builts and construction records that maintains consistency of practice over time.
- Determine the process to convert and enhance current as-built and construction records in 2D formats (both analog and digital) to contain 3D information which can be migrated into a secure central storage area.
- Develop workflow processes to capture and translate as-builts and Record Drawings from 3D Construction Models of Record into usable formats for various users and asset information systems.
- Develop a plan to incorporate as-built, construction, and record data from various sources and inventories into a comprehensive 3D asset information system. These sources include, but are not limited to:

    - As-Built Scan System
    - Structure Management System (SMS)
    - Maintenance Management System (MMS)
    - Pavement Management System (PvMS)
    - Landslide Monitoring System (in development)
    - Right of Way records management (system in development)
    - Utility and Subsurface data (system in development)
    - ADA compliance data
    - AASHTOWare Project (SiteManager, Construction & Materials)

Asset Management

- Determine requirements of ultimate data users of the as-built information.
- Determine how to utilize Asset Management System inventories (pavements, bridges, sign structures, signs, culverts, guardrail, luminaires, etc.) with As-Built data.
- Assist in the development of a Department Data Governance effort for use of Asset Management System maintained data.
- Assist in enterprise asset management education needed to assist in culture change

Cross Asset Resource Allocation

- Develop interim plan to integrate asset inventory into our future resource allocation decisions.

4D & 5D Model

- Begin requirements gathering to allow future implementation of schedule (4D engineered models) and cost data linked to scheduling (5D modeling). The use of 4D engineered models allows stakeholders to visualize construction sequencing. The 5D modeling links the scheduling component to cost data allowing stakeholders to see how design changes can affect a project's overall cost and schedule.