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DIGITAL PROJECT DELIVERY IMPLEMENTATION PLAN

NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

Foreword


Mick Syslo, PE

As the Nebraska Department of Transportation (NDOT) embraces Digital Delivery for highway projects, we're entering a new era of infrastructure management. With tools like Building Information Modeling (BIM) and Geographic Information Systems (GIS), we aim to enhance efficiency and safety while emphasizing a real-world, common-sense approach.

Our focus remains on safety above all else, ensuring that every decision we make prioritizes the well-being of our workers and the traveling public. By leveraging digital innovation, we streamline workflows and make data-driven decisions, ultimately delivering resilient, sustainable transportation infrastructure for all Nebraskans.

Together, with collaboration and shared vision, we're poised to unlock the full potential of digital technology, shaping a brighter future for transportation in our state.

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Deputy Director of Operations

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Acronyms

Acronym	Meaning
3R	Resurfacing, Restoration and Rehabilitation
AASHTO	American Association of State Highway and Transportation Officials
ACEC	American Council of Engineering Companies
AGC	Associated General Contractors of America
AMG	Automated Machine Guidance
BIM	Building Information Modeling
BNSF	Burlington Northern Santa Fe
BTS	Business Technology Support
BTSD	Business Technology Support Division
CADD	Computer-Aided Drafting and Design
CSV	Comma-Separated Values
DGN	Bentley Design File
DGNLib	Bentley Design Library File
DNR	Department of Natural Resources
DOT	Department of Transportation
DPD	Digital Project Delivery
FAQs	Frequently Asked Questions
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
GIS	Geographic Information Systems
HR	Human Resources
IHEEP	International Highway Engineering Exchange Program
KPIs	Key Performance Indicators
LiDAR	Light Detection and Ranging
LOIN	Level of Information Need
M&R	Materials and Research
MALD	Models as Legal Deliverables
NDOT	Nebraska Department of Transportation
OBD	OpenBridge Designer
ORD	OpenRoads Designer
RFIs	Requests for Information
SG	Strategic Goal
SME	Subject Matter Expert
SOP	Standard Operating Procedures
TG	Tactical Goal
TS&L	Type, Size and Location
UAS	Unmanned Aircraft Systems
UPRR	Union Pacific Railroad

Introduction

Background and Motivation

The Nebraska Department of Transportation (Department or NDOT) Director's Office initiated an effort to modernize the Department's operational and financial systems as part of its 5-year business plan. Digital Project Delivery (DPD) was identified as a key component of the operational modernization, and an initiative for strategic implementation of DPD at NDOT began in July 2022. This effort is intended to leverage modern technologies and workflows that connect and streamline project development and delivery, as well as maintain the Nebraska infrastructure system. NDOT is committed to enhancing safety, increasing efficiency, and delivering the highest quality infrastructure projects while stewarding taxpayer funds responsibly. The move to digitize NDOT workflows and more efficiently and effectively connect data sources to stakeholders is driven by these core principles. Through this digitization, NDOT can realize these efficiencies through a reduction in change order magnitude related to the overall project cost and better use the staff available to work on the project through automation of basic tasks, freeing them to focus on more complex, high-value activities.

NDOT has defined DPD as the process in which electronic data, such as 3D models and digital workflows, are used in planning, design, and construction to increase the amount of directly consumable data for project stakeholders based on the level of need. DPD begins at project initiation and concludes with the completion of the project as-builts. DPD data is used to support maintenance, operations, asset management, and future projects within the Department.

A core DPD team was established to guide and implement a strategy for incorporating digital delivery at NDOT. When defining the scope of the digital delivery strategy, the team first sought to answer three core questions:

1. What is necessary to design, let, and build a highway construction project?
2. What are NDOT's current capabilities for delivering these needs digitally?
3. How does NDOT close the gap between what is desired and what is required for digital delivery?

To answer these questions, NDOT conducted a detailed gap assessment. The results of that assessment revealed that several components of the Resurfacing, Restoration and Rehabilitation (3R) project delivery process would benefit from digital data or digital workflows. Given that approximately 93 percent of NDOT's projects are 3R in scope, in both urban and rural settings and in communities big and small, it was determined that any advancements made from DPD should begin with 3R construction projects to maximize the impact of DPD implementation. Project examples featuring DPD are typically large, complex projects, and information and guidelines for implementing digital methods on 3R projects is very limited.

NDOT RECOGNIZES THAT THERE IS AN OPPORTUNITY TO PIONEER A PATH TO ESTABLISH GUIDELINES AND BEST PRACTICES FOR IMPLEMENTING DIGITAL DELIVERY ON 3R PROJECTS.

The use of DPD methods and technology will benefit roadway users of all socioeconomic classes and provide significant returns for NDOT across the entire state, such as:

- Improved design quality,
- Reduction in change orders,
- Increased visualization of design intent for construction activities,
- Streamlined data collection and usage,
- Increased confidence in available data,
- Digitally connected management and project inspection,
- Improved as-built collection and future usage.

Additionally, because a 3R project's lifecycle is generally shorter than large-scale projects that implement DPD, modifications to the digital processes can evolve quickly and with relative ease. These results can then be used to scale the digital approach to larger and more complex projects.

Vision

For projects starting design in 2027, NDOT will have the ability to deliver construction projects using contractual models with limited plans and start piloting the collection and acceptance of digital as-builts.

Mission

The mission of the DPD Implementation Plan is to enable NDOT to use DPD to modernize its construction program by creating the processes, standards, and guidelines for implementing 3D technology and increase the amount of directly consumable data for project stakeholders based on the level of information need (LOIN). To that end, NDOT intends to modernize its construction program through the DPD Program by:

- Establishing a short and long-term organizational structure and governance approach to oversee the deployment of DPD use cases;
- Creating detailed action plans to develop the processes, standards, and guidelines for implementing 3D technology;
- Increasing the amount of directly consumable data for project stakeholders based on LOIN;
- Implementing 3D technology and digital models for use in design and construction;
- Advancing the use of accessible digital processes and tools and lifecycle data;

- Creating as-built records that accurately represent the as-constructed and accepted field conditions, and incorporate 2D and 3D models, asset attribution, and metadata for priority assets;
- Developing a sustainable DPD system for future technologies.

Plan Scope and Development

Currently, NDOT's DPD efforts are limited to single asset pilot projects and project data provided to contractors for information only. NDOT's key objective is to implement digital delivery on future projects, starting with a systematic approach to modernize the project delivery process focusing first on 3R projects. This section summarizes the NDOT DPD Program strategy, including key elements and priorities, use cases for digital delivery, tactical goals (TG), and strategic goals (SG).

NDOT DPD Program Core Components

Figure 1 illustrates the key elements of the DPD Program strategy with emphasis on creating a structure for the program that provides leadership, governance, and innovative technology deployment that will enable various use cases for DPD.

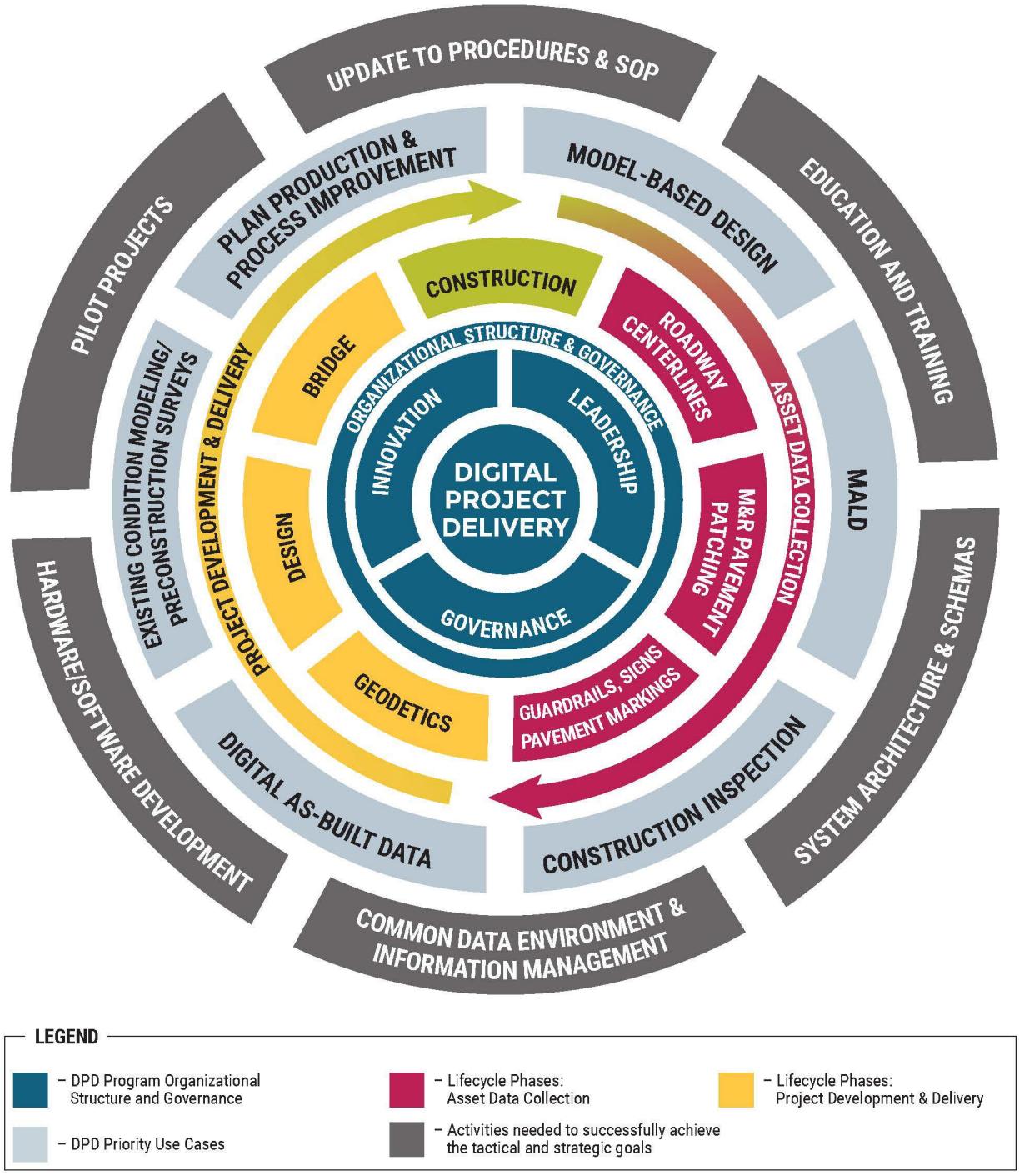
The center of the NDOT DPD Program represents the Program's organizational structure and governance. Without this core component, the Program cannot be successful. The second layer of **Figure 1** illustrates the lifecycle business functions the DPD Implementation Plan activities will support, including project development and delivery (i.e., geodetics, design, bridge, and construction) and asset data collection during field construction activities to support future asset management. The priority assets identified to be included in this implementation plan are roadway centerlines, pavement patching, pavement markings, guardrails, and signs.

NDOT's DPD Program has defined TG and SG to achieve its vision and mission for advancing the use of technology, digital data, and workflows that enhance the project development and delivery and asset data collection lifecycle phases. TG are those that can be achieved within a short time frame, depending on the level of effort and resource availability (e.g., people, expertise, technology, funds). SG are more long-term due to the complexity of the scope of work and/or level of effort to complete activities.

Lastly, each of the activities in this implementation plan have been designed to meet the needs of NDOT staff and external stakeholders and partners, including:

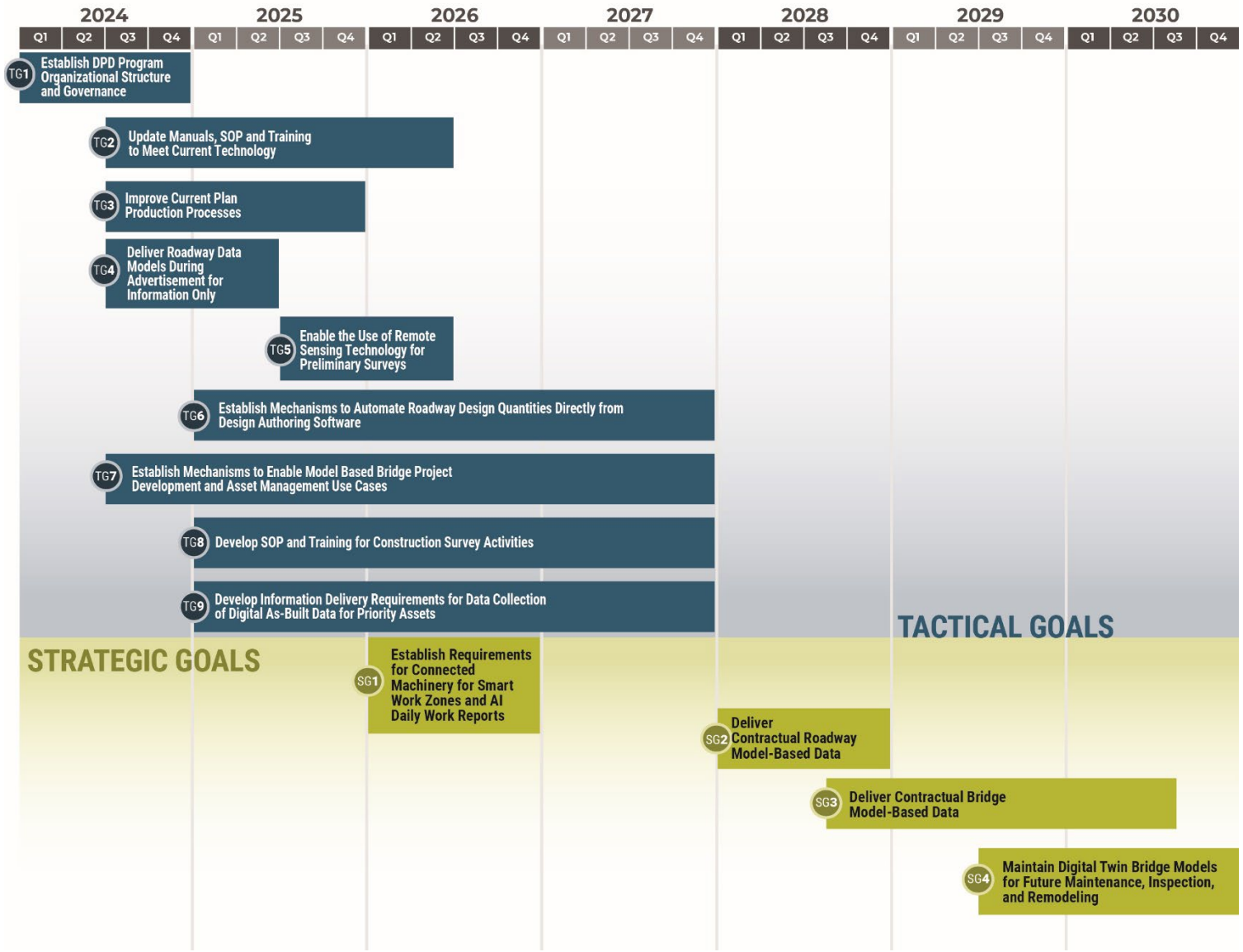
- Updating procedures and standard operating procedures (SOP),
- Education and training,
- Systems architecture and data schemas,
- Common data environment and information management,
- Deployment of hardware and software,
- Testing technology and new methods through pilot projects.

Figure 1: NDOT DPD Program Core Components



The roadmap schedule (Figure 2) shows the sequence of activities that help achieve Digital Project Delivery at NDOT. TGs are the highest priority within this implementation plan to be completed by the end of 2027.

Figure 2: Timeline of Tactical and Strategic Goals



DPD Program Organizational Structure and Governance

From lessons learned shared by peer State DOTs, implementing a DPD Program requires specialized expertise and appropriate resources dedicated to establishing said program, creating and executing action plans for short-term term activities, and providing the framework for long-term management of digital delivery methods and technology.

The NDOT DPD Program is currently overseen by a Core Team, whose work has been instrumental in advancing the Department's DPD initiative through the collaboration of several subject matter experts (SME) from various business groups within the Department. However, executing the activities proposed in this Implementation Plan will take dedicated resources with the appropriate skill sets to setup and test technology, develop SOP, update manuals, create and deliver training, and conduct outreach activities with internal and external stakeholders.

Equally important is establishing a governance plan that defines the various elements of the DPD Program, roles and responsibilities, and overall governance framework to help prioritize adoption of new use cases and the technology to support it, as well as the criteria by which the Department can measure Program success.

A proposed DPD Program organizational structure and strategic recommendations for a governance plan can be found in Appendix A.

Priority Use Cases

Use cases refer to the tasks or processes for which NDOT plans to use digital workflows with an initial focus on survey, roadway design, bridge design, construction, and asset data collection of centerline alignments, pavements, bridges, guardrails, signs, and pavement markings. The DPD Core Team guided the initial digital delivery maturity assessment and has recommended NDOT start with the key priority use cases described below. It should be noted that NDOT has begun to implement some of the use cases defined below as foundational to producing and using digital information. This work will be monitored and incorporated into the implementation strategy contained in this document to align with the overall DPD effort.

1. **Plan Production and Process Improvement (Ongoing Activity)**
   The process of leveraging model-based design to produce traditional plans (PDF) consistent with the authoring source model. Plan sheets can be presented as contractual documents, along with the model-based data for information only, to potentially be used by and collect feedback from the contracting community and internal NDOT inspection and construction management staff. It is anticipated that contractors will use model-based data for bidding, automated machine control activities, and fabrication. Feedback from contractors and NDOT construction staff can inform DPD Core Team (or DPD Program Manager) on any process improvements that can occur with higher quality modeling efforts during the project development phase as it transitions to contractual model-based information exchanges.

2. **Existing Conditions Modeling/Pre-construction Surveys (Ongoing Activity)**
   The process to document the existing conditions for a project to form the basis of design and/or construction. Existing conditions may include the existing ground surface,

surface features (e.g., edges of pavement), surface assets (e.g., signs, lighting, striping), land boundary information (e.g., right-of-way, legal boundaries, property corners), subsurface utilities, structures, and subsurface features (e.g., ground characterization, the existing pavement layers). The digital data may include 2D and 3D geometry, GIS--derived information, documents, images, and analytical models (e.g., geotechnical). It is important to recognize that all elements depicted in existing conditions models carry uncertainty regarding their location and characterization. Model users need to be familiar with the various confidence intervals for all depicted model elements, especially subsurface features.

3. **Model-based Design (Ongoing Activity)**
   The process of developing a model to define and document the design. Typically, each individual discipline (e.g., roadway, structures, drainage) develops a discipline model using a common coordinate reference frame. The individual discipline models are then referenced together into a single, federated model. This is an essential model use case to support many downstream uses, including model as the contract document. Element detail and information increases from conceptual to final design as the project is being designed.

4. **Models as Legal Deliverables (MALD)**
   The process of documenting the existing conditions, design intent, construction specifications, and engineer's estimate for the purposes of bidding and construction. Currently, the process uses documents such as plans, specifications, and spreadsheets. With DPD, most plans will be replaced with digital data, which may comprise 2D and 3D model geometry and documents like spreadsheets with tables of data or 2D project PDF files (e.g., digital roll plots). The "letting model(s)," delivered as the contract document, are at a high level of detail and information.

5. **Construction Inspection**
   The process by which a construction inspector uses the contract bid model to verify, document, and accept construction outcomes. This may include quantity verification and payment to the contractor, daily work logs with model-based references, tagging model objects with any issues or Requests for Information (RFI) that are raised, and potential ties to material testing and acceptance.

6. **Digital As-Builts Data**
   The process of documenting any significant changes to the constructed condition compared to the contract (bid) model. With DPD, the design models and shop models could be updated to reflect the as-built condition and may be supplemented with digital data represented in spreadsheets or other digital files. The digital data includes GIS attributes, 2D/3D geometry, documents, photographs, and/or videos. This data model concludes the DPD phase and constitutes the "handoff" model for post-construction operations.

Future use cases will be evaluated using the proposed DPD Use Case Priority Matrix Form (Appendix B).

Tactical and Strategic Goals

This section defines the TG and SG, respectively, and summarizes the activities to be completed to achieve the NDOT DPD vision and mission.

TG are those that can be achieved within a short time frame, depending on the level of effort and resource availability (e.g., people, expertise, technology, funds). SG are more long-term due to the complexity of the scope of work and/or level of effort to complete activities.

Proposed Tasks and Activities to Achieve Tactical Goals

Activities to achieve TG by the end of 2027 are the focus of this Implementation Plan. The duration for each of the activities to achieve TG is dependent on the level of effort and availability of resources (e.g., people, expertise, technology, funds). Actual timeframes for accomplishing these goals will be established in more granularity through action plans prepared by NDOT's interim or permanent DPD Program Manager with the support of a technical working group(s). The activities included in this Implementation Plan to achieve TG are foundational to the success of the NDOT DPD Program, have a low barrier to entry because the work has already been started, or build upon a previous effort by NDOT, national organizations (AASHTO, FHWA), international organizations (buildingSMART), or peer state DOTs.

Tactical Goal 1: Establish DPD Program Organizational Structure and Governance

The systematic modernization of 3R project delivery requires specialized expertise and appropriate resources that are dedicated to establishing the DPD Program and providing the framework for long-term management of DPD methods and technology. The desired outcome for this task is to create a long-term DPD Program and appropriate management structure to coordinate activities and communicate the requirements for digital projects, particularly focusing on 3R projects before scaling to larger efforts in future phases.

NDOT DPD Goal Alignment: Develop a sustainable system for DPD for future technologies
Resource Focus Areas: Programmatic DPD
Level of Effort: Low-Medium
Cost: Medium
Duration: 3-6 months

Figure 3: Tactical Goal 1 Timeline

Task 1A: Refine the DPD Program Organizational Structure

Description

Review organizational structure proposed in Appendix A, and work with DPD Core Team and NDOT leadership to hire a DPD Program Manager who will oversee the DPD Program and its initiatives. The DPD Program Manager will be expected to manage the initial deployment of activities, provide leadership and guidance to technical working groups developing action plans for short-term term activities, and provide the leadership for long-term management of digital delivery methods and technology.

Activities

- Working with NDOT Human Resources (HR) to refine the proposed job description in this section, which could be used to hire an individual to assume this role. The job description would include a list of duties, responsibilities, and minimum and preferred qualifications.
- Working with NDOT leadership and HR to determine the best approach to hire a permanent or interim DPD Program Manager. Options may include:
  - Creating a new permanent position and hiring an internal or external candidate to fill the DPD Program Manager position,
  - Hiring a consultant to serve as a part-time Interim DPD Program Manager to help NDOT with the activities planned for the first year, as described within this implementation plan.
- Refining the proposed DPD organizational structure (Appendix A), which would include the DPD Program Manager, DPD Technical Lead(s), and ad-hoc working groups, including defining roles, responsibilities, and the channels and rules for team communication.

Prerequisites

- None

Resources Needed

- Leadership support for approving and funding interim or permanent DPD Program Manager position
- NDOT DPD Core Team and HR staff time

- Technical SMEs
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Full job description for hiring an interim or permanent DPD Program Manager
- Interim or permanent DPD Program Manager
- Part- or full-time DPD Technical Leads to assist DPD Program Manager with planning and executing activities to achieve the tactical goals within this plan
- Ad-hoc working groups to assist DPD Technical Leads with executing activities to achieve the tactical goals within this plan

Task 1B: Develop and Publish a DPD Program Governance Plan

Description

Develop and publish a DPD Program Governance Plan that provides an overall strategy for work to be conducted under the purview of the DPD Program. Appendix A provides strategic recommendations for developing a governance plan. The desired outcome is a document that NDOT could use as a guide for long-term administration and maintenance of digital delivery policies, standards, and procedures.

Activities

- Using recommendations provided in this section to develop and publish NDOT's DPD Program Governance Plan
- Identifying, evaluating, and managing risks to enable successful deployment of DPD activities
- Developing a detailed action plan and schedule for each activity within the NDOT DPD Implementation Plan
- Working with DPD Core Team to identify NDOT staff and industry representatives to participate in working groups to assist in the execution of the activities within the NDOT DPD Implementation Plan
- Conducting ongoing technical activities to achieve the DPD Implementation Plan
- Reporting to leadership and DPD Core Team about the progress of activities

Prerequisites

- DPD Program Manager and DPD Technical Lead(s) in place

Resources Needed

- DPD Core Team
- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcome and Deliverables

- DPD Program governance plan
- DPD Program risk assessment workshop facilitation plan
- DPD Program risk assessment workshop summary document

- DPD Program risk assessment worksheet (Excel)
- Detailed action plans for 2024-2025 key activities
- Detailed schedule of activities for 2024-2025 key activities
- Subsequent year activities and schedule to be developed at the end of each year

Task 1C: Update DPD Program Communication Plan

Description

Update the DPD Program Communication Plan, developed in 2023, and continue executing proposed strategy and tactics.

Activities

- Making regular updates to communication plan, as-needed
- Creating and managing DPD Program website
- Developing content for e-newsletters and manage distribution
- Assisting with meeting/event coordination activities

Prerequisites

- None

Resources Needed

- NDOT Communication Lead and DPD Program Manager to guide the communication plan tactics and activities
- Consultant to assist NDOT with planning and executing the tactics and activities approved previously

Desired Outcome and Deliverables

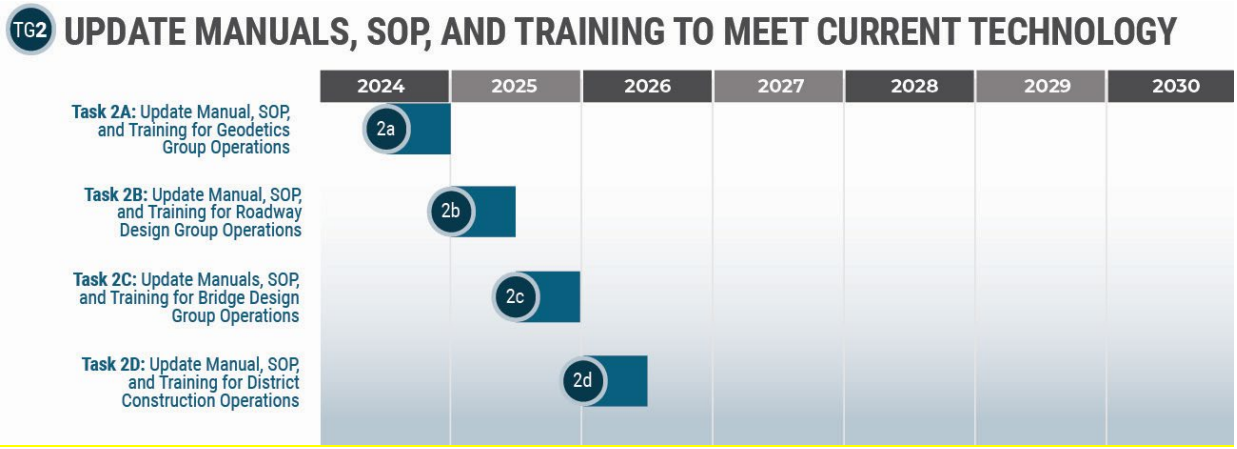
- List of meetings and events to engage with stakeholders (internal and/or external)
- Schedule of meeting/event/engagements
- Presentations and agendas for meeting/events/engagements
- Content for website
- Updated communication plan

Tactical Goal 2: Update Manuals, SOP, and Training to Meet Current Technology

Identify the manuals, SOPs, and types of information that need to be updated, and proceed with the necessary revisions to reflect current technology and procedures for geodetics, roadway and bridge design, and construction operations. This process will begin with an initial review of the existing manuals to ensure they incorporate the latest digital delivery standard practices in place at NDOT. The updated content will not involve a complete rewrite but will serve as enhancements and supplements specifically related to digital delivery, ensuring all information is organized and accessible. The revised manuals and SOPs will then serve as the primary documentation for developing training materials, such as how-to guides and other guidance documents. Following this initial review and update, this process will become integral to all future digital delivery efforts impacting those manuals.

NDOT DPD Goal Alignment: Develop a sustainable system for DPD for future technologies
Resource Focus Areas: Geodetics, Design (Roadway and Bridge), Construction
Level of Effort: Low-Medium
Cost: Medium
Duration: 12-24 months

Figure 4: Tactical Goal 2 Timeline



Task 2A: Update Manual, SOP, and Training for Geodetics Group Operations

Description

Identify procedures and best practices being used currently by the Geodetics Group that are not documented in reference materials, such as manuals, guidance documents, or how-to documents. Develop necessary documentation and update Survey Manual with the appropriate content.

Activities

- Establishing a working group of SMEs
- Identifying scope of work for updating the manual, SOP, and any needed training materials
- Developing a bar chart schedule showing interim and final deadlines for key activities
- Drafting technical content to include in the updates

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance.*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Updated geodetics/Survey Manual

- Training materials

Task 2B: Update Manual, SOP, and Training for Roadway Design Group Operations

Description

Identify procedures and best practices being used currently by the Roadway Design Group that are not documented in reference materials, such as manuals, guidance documents, or how-to documents. Develop necessary documentation and update Roadway Design Manual with the appropriate content.

Activities

- Establishing a working group of SMEs
- Identifying scope of work for updating the manual, SOP, and any needed training materials
- Developing a bar chart schedule showing interim and final deadlines for key activities
- Drafting technical content to include in the updates

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Updated Design Manual
- Training materials

Task 2C: Update Manuals, SOP, and Training for Bridge Design Group Operations

Description

Identify procedures and best practices being used currently by the Bridge Design Group that are not documented in reference materials, such as manuals, guidance documents, or how-to documents. Develop necessary documentation and update Bridge Design Manual with the appropriate content.

Activities

- Establishing a working group of SMEs
- Identifying scope of work for updating the manual, SOP, and any needed training materials
- Developing a bar chart schedule showing interim and final deadlines for key activities
- Drafting technical content to include in the updates

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Updated Bridge Design Manual
- Training materials

Task 2D: Update Manual, SOP, and Training for District Construction Operations

Description

Identify procedures and best practices being used currently by the District Construction Group that are not documented in reference materials, such as manuals, guidance documents, or -how-to documents. Develop necessary documentation and update Construction Manual with the appropriate content.

Activities

- Establishing a working group of SMEs
- Identifying scope of work for updating the manual, SOP, and any needed training materials
- Developing a bar chart schedule showing interim and final deadlines for key activities
- Drafting technical content to include in the updates

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

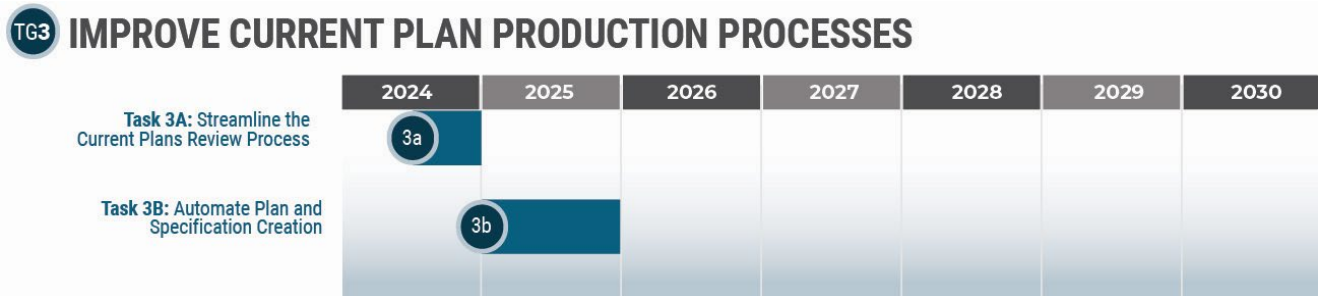
- Detailed action plan and schedule of activities for conducting this task
- Updated Construction Manual (assumes all districts will use the same manual)
- Training materials

Tactical Goal 3: Improve Current Plan Production Processes

Improve efficiencies and quality of final plans using web-based review products that allow for real-time collaboration during project development; and develop and implement a plan for using Bentley Item Types to help automate plan production.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction
Resource Focus Areas: Design (Roadway)
Level of Effort: Low-Medium
Cost: Medium
Duration: 12-18 months

Figure 5: Tactical Goal 3 Timeline



Task 3A: Streamline the Current Plans Review Process

Description

Create a plan for streamlining the current process for reviewing contract plans, documenting review comments, and tracking resolution of reviewer's comments.

Activities

- Establishing a working group of SMEs
- Identifying scope of work for executing this task
- Developing a bar chart schedule showing interim and final deadlines for key activities
- Preparing and implementing procedures for real-time collaboration milestone deliverables review using Bluebeam sessions and traditional plan sets

Prerequisites

- Additional licenses of Bluebeam Revu and set up of Revu Sessions (if needed)

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Updated plan review policy or procedures in the Project Development/Design Manual

Task 3B: Automate Plan and Specification Creation

Description

Create a plan for automating plan creation and link to NDOT Construction specifications.

Activities

- Developing and implementing a plan for using Bentley Item Types to streamline the plan production process
- Expanding or developing standard seed files, including:
  - Standard sheet border that can be attached to each project automatically
  - Standard title block with Bentley Item Types automation for easier plan production, including any necessary text fields or legends
  - Standard view attributes to turn on level overrides, fill, and transparencies, as well as turn off view construction and data fields
  - Standard table seeds for Excel
  - Standard option for match lines, north arrows, and map feature labels for annotation group
  - Standard information, typical sections, and detail sheets
- Developing procedures and training materials
- Updating procedures in Roadway Design Manual and Computer-Aided Drafting and Design (CADD) Coordination Policy
- Link Construction specifications to digital model objects

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Bentley Updated Workspace, configuration files, seed files, Bentley Design Library (DGNLib) files, cell libraries, and Excel templates, etc.
- Training materials for using Bentley Item Types for plan production
- Updated Design Manual/guidelines

Tactical Goal 4: Deliver Roadway Data Models During Advertisement for Information Only

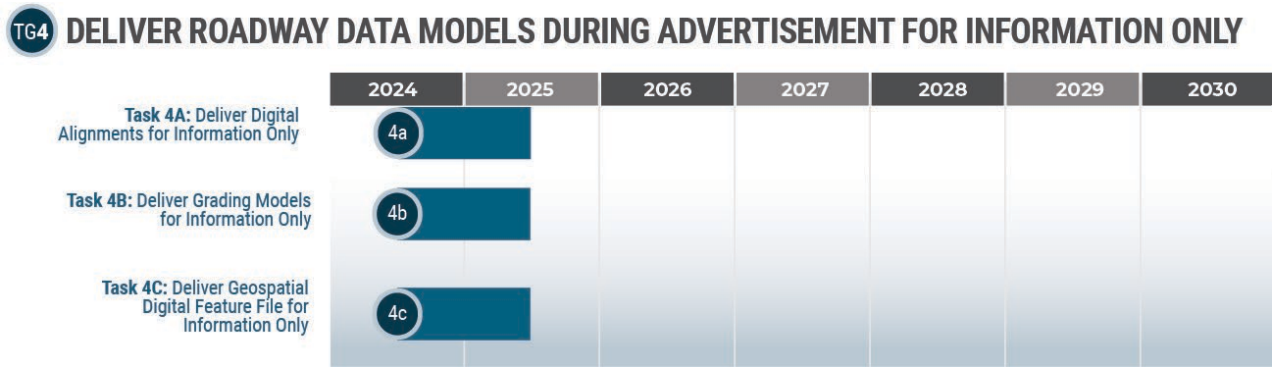
Create a set of procedures that design teams can use to prepare and share three types of roadway data models for 3R projects during the letting advertisement phase as reference documents or (for information only). These activities will serve as an intermediate step toward delivering contractual construction models authorized for construction operations. The current standard practice is to develop roadway corridor models using civil modeling software to produce plan sheets, which are then used as the contractual construction plans. Currently, electronic files are provided to the contractor upon request after award of the contract. The proposed procedure would make the model available during letting advertisement for the

project. While each type of digital data deliverable is different, the activities, pre-requisites, resources needed, and desired outcomes and deliverables for the tasks identified below will be the same.

- Task 4A: Deliver Digital Alignments for Information Only
- Task 4B: Delivery Grading Models for Information Only
- Task 4C: Deliver Geospatial Digital Feature File for Information Only

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data
Resource Focus Areas: Design (Roadway)
Level of Effort: Low-Medium
Cost: Medium
Duration: 6-12 months

Figure 6: Tactical Goal 4 Timeline



Task 4A: Deliver Digital Alignments for Information Only

Description

Develop and implement procedures to formalize the process of sharing digital alignment files with contractors during the bidding process as supplemental information (for information only) with the contractual plan sets. A pilot project is already in progress for this activity to determine standard operating procedures, deliverables, and capture lessons learned before moving forward with contractual deliverables of digital alignments. The file type deliverable would be a LandXML file containing alignment and profile information that is extracted directly from the corridor modeling software.

Task 4B: Deliver Grading Models for Information Only

Description

Develop and implement procedures to formalize the process of sharing grading surface models with contractors during the bidding process as supplemental information (for information only) with the contractual plan sets. This information is typically provided today after an award has been made as requests from the contractors are received by the design team. The file type deliverable would be a LandXML file containing a digital terrain model or surface model that is extracted directly from the corridor modeling software.

Task 4C: Deliver Geospatial Digital Feature File for Information Only

Description

Develop and implement procedures to formalize the process of sharing geospatial feature geometry with contractors during the bidding process as supplemental information (for information only) with the contractual plan sets. The file type deliverable would be a KMZ file or equivalent containing civil features, including centerline alignments, edges of pavements, edges of shoulders, ditch lines, limits of construction, etc. extracted directly from the corridor modeling software.

Activities

- Working with contractors and construction inspection staff through a sequence of meetings to narrow down the information they extract from plans
  - The process would involve redlining/highlighting traditional plan sets and identifying opportunities to provide that information digitally
- Developing standards for level of detail and LOIN specific for AMG grading, construction inspection and verification activities

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Document summarizing contractor data needs, source of information, and recommendations for deliverables
- A set of standard operating procedures to assist design teams in preparing the deliverables

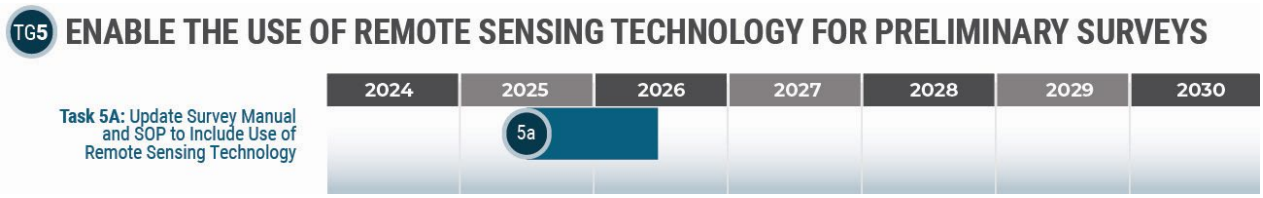
Tactical Goal 5: Enable the Use of Remote Sensing Technology for Preliminary Surveys

Identify gaps that need to be addressed to enable the use of remote sensing technology, such as Unmanned Aircraft Systems (UAS) and LiDAR. Develop and document the SOP for data collection and processing, geospatial positional accuracies and point density requirements, data set validation and processing, and preparing preliminary survey files to be used by design teams. Documentation of SOP will be used as the basis for training content.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data
Resource Focus Areas: Design (Roadway)

Level of Effort: Low-Medium
Cost: Medium
Duration: 6-12 months

Figure 7: Tactical Goal 5 Timeline



Task 5A: Update Survey Manual and SOP to Include Use of Remote Sensing Technology

Description

Conduct a thorough review of the NDOT Survey Manual, SOP, and other reference materials to identify content to be added or updated. The goal of this activity is to develop NDOT standards and processes for collecting and developing preliminary survey data sets using UAS and LiDAR technology.

Activities

- Determining the appropriate positional accuracies for Global Positioning System (GPS) location
- Determining the appropriate point densities for model-based design activities
- Providing guidance on the use of remote sensing technologies for pre-construction survey, which are appropriate for various data acquisition needs, and appropriate LOIN for the downstream user(s)

Prerequisites

- Completion of Task 2A

Resources Needed

- DPD Core Team
- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Updated Survey standards/manual
- Training materials

Tactical Goal 6: Establish Mechanisms to Automate Roadway Design Quantities Directly from Design Authoring Software

Develop and implement a plan to automate roadway design quantities from the authoring (modeling) software using Bentley Item Types to automate the roadway design quantities directly from the digital design files prepared by Roadway Design.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data
Resource Focus Areas: Design (Roadway)
Level of Effort: Low-Medium
Cost: Medium
Duration: 24-36 months

Figure 8: Tactical Goal 6 Timeline

Task 6A: Develop and Implement a Plan to Automate Roadway Design Quantities

Description

Work with Bentley Systems to develop and implement a plan to setup Bentley Item Types for the purpose of automating roadway design quantities.

Activities

- Developing guidelines for how to use Bentley Item Types for automation of roadway design quantities
- Setting up Item Types standards for pay items
- Developing guidelines for exporting roadway design quantities to summary reports and formats compatible with AASHTOWare estimates

Prerequisites

- Completion of Tasks 2B and 3B

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Bentley Workspace files (DGNLIBs, Excel files, and template libraries)

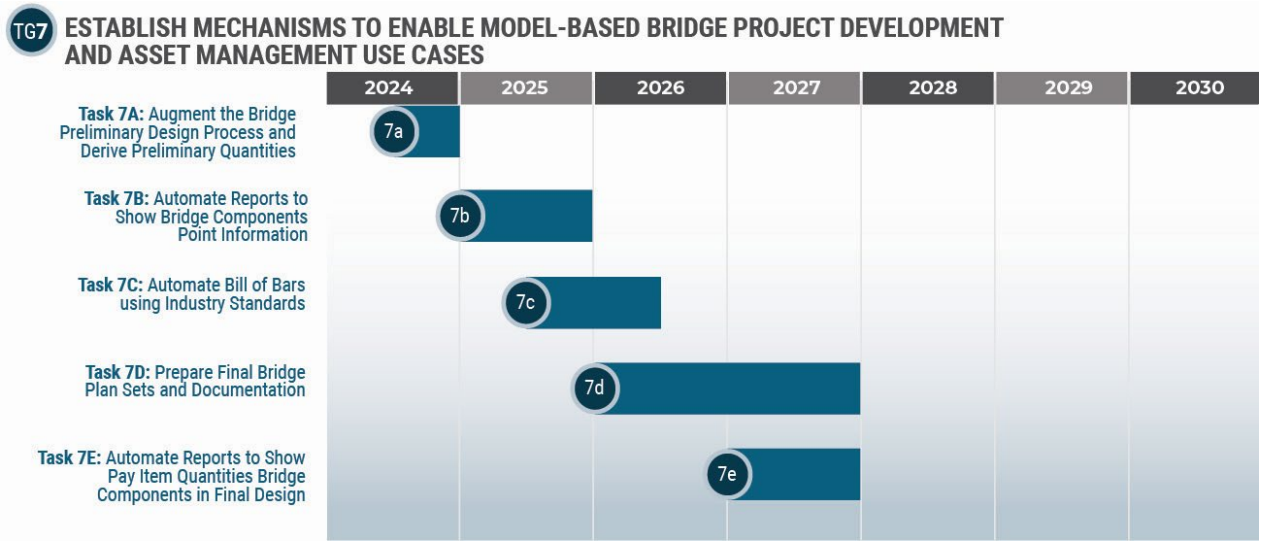
- Training materials for using Bentley Item Types for automating design quantities
- Training materials for exporting quantity reports
- Updated Design Manual or guidelines

Tactical Goal 7: Establish Mechanisms to Enable Model-Based Bridge Project Development and Asset Management Use Cases

Develop and implement a plan for using a 3D bridge model to enable model-based bridge project development and asset management use cases.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data
Resource Focus Areas: Design (Bridge)
Level of Effort: Low-Medium
Cost: Medium
Duration: 24-48 months

Figure 9: Tactical Goal 7 Timeline



Task 7A: Augment the Bridge Preliminary Design Process and Derive Preliminary Quantities

Description

Develop a process for using 3D models in preliminary design.

Activities

- Augmenting concept and type, size, and location (TS&L) plan development with live section cuts and views from the 3D model
- Developing the necessary model templates to facilitate more efficient and consistent model development
- Using the 3D model to extract preliminary bridge quantities by establishing Bentley Item Types for quantity takeoffs needed at preliminary design

Prerequisites

- Completion of Task 2C

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Documented workflows for 3D model development in preliminary design
- Create library of standard bridge components and templates
- Bentley Item Types developed for preliminary bridge design quantities

Task 7B: Automate Reports to Show Bridge Components Point Information

Description

Automate reports to show bridge components point information, such as accurate elevations, stations, and geospatial coordinates.

Prerequisites

- Completion of Tasks 2C and 7A

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task

Task 7C: Automate Bill of Bars using Industry Standards

Description

Work with rebar fabricators and fabrication software vendors to develop and plan for delivering bill of bars information in a digital format that can be consumed easily by fabricators. The plan should include the required file type, format, and process for extracting information if taken directly from a 3D model. NDOT has already invested funds and staff time as part of the TPF-5(372) BIM for Bridges and Structures pooled fund and will leverage any information produced by this national effort. NDOT will continue to collaborate as a sponsor and active member of the TPF-5(523) BIM for Bridges and Structures Phase II Pooled Fund to continue developing standards that will contribute to the overall NDOT Implementation Plan effort.

Prerequisites

- Completion of Task 2C

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Documented process for delivering bill of bar information to rebar fabricators in a digital format.

Task 7D: Prepare Final Bridge Plan Sets and Documentation

Description

Establish working groups to evaluate the use of bridge modeling software to produce final bridge design plans and other deliverables. The working group will explore areas of final bridge design that can benefit from the use of 3D models and other digital exchanges. The focus would be on improving efficiency of current practices and exposing a broader range of bridge designers to 3D workflows. Develop documentation describing the process for implementing these changes in final design.

Prerequisites

- Completion of Tasks 2C and 7A

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Documented processes for modeling and other digital exchange requirements in final design

Task 7E: Automate Reports to Show Pay Item Quantities Bridge Components in Final Design

Description

Develop a complete list of Item Types for NDOT bridge pay items. Develop a process for reporting these pay items in a digital format that can be consumed by downstream users and software. As noted earlier, any efforts being made as part of the BIM for Bridges pooled funds will be leveraged as part of this activity.

Prerequisites

- Completion of Tasks 2C and 7A

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Bentley services (through Blueprints)*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Guidelines for exporting bridge quantities to summary reports and formats compatible with AASHTOWare Estimation software
- Documented process for the use and extraction of Item Type data

Tactical Goal 8: Develop SOP and Training for Construction Survey Activities

Develop SOP and training documentation to assist construction personnel in the use of:

1. UAS to verify completion of construction contract items and measure quantities,
2. Intelligent compaction to document acceptance of asphalt pavement requirements for payment.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data
Resource Focus Areas: Construction
Level of Effort: Low-Medium
Cost: Medium
Duration: 24-36 months

Figure 10: Tactical Goal 8 Timeline

Task 8A: Use UAS for Construction Inspection

Description

Create and implement a plan to develop SOP and training materials for construction survey activities. The procedures and training materials will be used as guidance reference documents and content to update the Construction Manual.

Activities

- Preparing detailed action plan and schedule of activities for conducting this task
- Creating procedures for project setup and file management

- Preparing written guidance for accessing project information; setting up equipment; collecting, post processing, and validating data sets; and preparing documentation for construction acceptance
- Updating Construction Manual

Prerequisites

- Completion of Task 2D

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Hardware/software vendor assistance*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Standards and specifications for using UAS for setting up equipment and collecting, post-processing, and validating construction data sets
- Written procedures for verifying and documenting construction outcomes using UAS

Task 8B: Use Intelligent Compaction for Construction Inspection

Create and implement a plan to develop SOP and training materials for using intelligent compaction for verifying construction outcomes and measuring pay item quantities for asphalt pavement. The procedures and training materials will be used as guidance reference documents and content to update the Construction Manual.

Activities

- Preparing detailed action plan and schedule of activities for conducting this task
- Creating procedures and written guidance
- Updating Construction Manual

Prerequisites

- Completion of Task 2D

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Hardware/software vendor assistance*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- Standards and specifications for using intelligent compaction for the purpose of verifying construction outcomes and measuring pay item quantities

- Written procedures for verifying and documenting construction outcomes using intelligent compaction
- Updated Construction Manual

Tactical Goal 9: Develop Information Delivery Requirements for Data Collection of Digital As-Built Data for Priority Assets

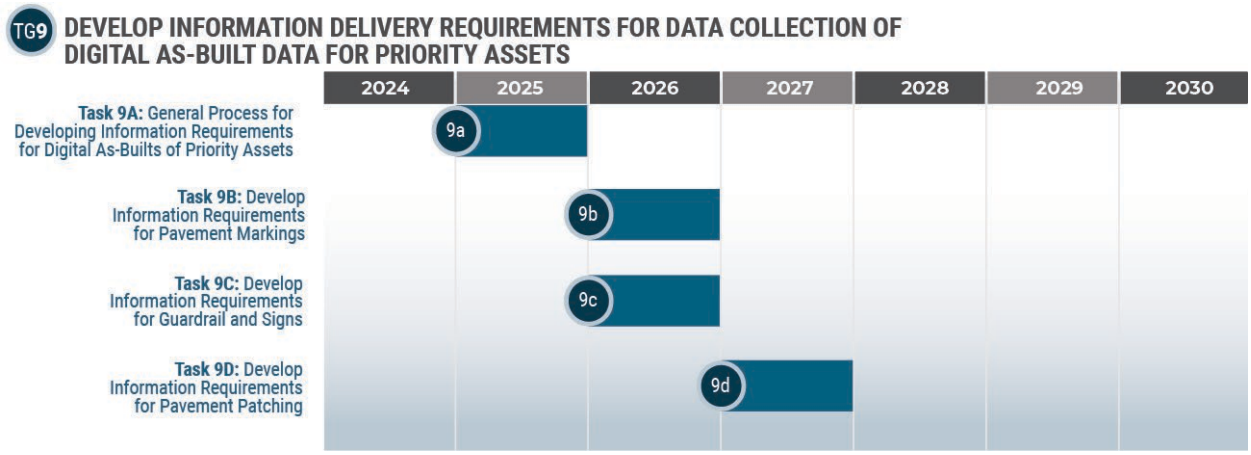
Develop asset information requirements for data collection and deliverables of roadway centerlines, pavement markings, priority safety items (guardrail and signs), and pavement patching.

NDOT DPD Goal Alignment: Implement 3D technology and digital models for design and construction; Advance the use of accessible digital processes, tools, and lifecycle data

Resource Focus Areas: Roadway Network, Traffic, and M&R Asset Management

Level of Effort: Low-Medium
Cost: Medium
Duration: 24-36 months

Figure 11: Tactical Goal 9 Timeline



Tasks 9A, 9B, 9C, 9D: General Process for Developing Information Requirements for Digital As-Builts of Priority Assets

The process for developing information requirements for digital as-builts is similar for all types of assets. This section provides general guidelines to be followed for each of the priority assets

Description

Create and implement a plan to develop information requirements for data collection of digital as-built records during construction.

Activities

- Preparing detailed action plan and schedule of activities for conducting this task
- Planning and holding meetings with asset stewards to determine needed information for lifecycle asset management of the priority asset class and type
- Developing a list of requirements (See examples in Appendix C)

- Developing a schema architecture of asset class information
- Creating Bentley Item Types for asset attributes
- Developing a process and prototype tools to transfer information from 3D objects and attributes developed during design to a construction data collection platform/software
- Developing construction specifications for data collection, validation, and delivery of digital as-built records

Prerequisites

- None

Resources Needed

- DPD Program Manager
- DPD Technical Lead(s)
- Ad-hoc working group(s)
- *Optional: Hardware/software vendor assistance*
- *Optional: Consultant assistance*

Desired Outcomes or Deliverables

- Detailed action plan and schedule of activities for conducting this task
- List of information requirements for each priority asset
- System architecture and schema
- Bentley Item Types library
- Written procedures and guidance for assigning Item Types attributes to 2D and 3D objects during design, and validating data sets
- Written procedures and guidance for collecting digital as-built data during construction
- Construction specification for digital as-built data collection, validation, and delivery of information requirements

Assets in Order of Priority

- Task 9A: Roadway Centerlines
- Task 9B: Pavement Markings
- Task 9C: Guardrail and Signs
- Task 9D: Pavement Patching

Strategic Goals

This section lists the goals that will require a higher level of effort and prerequisites or co-requisites being completed through the NDOT DPD Program Tactical Goals, or other NDOT modernization initiatives. Due to the complexity and cost of activities to achieve desired outcomes, it is recommended that a timeframe of 5-10 years is used for planning purposes. Actual timeframes for accomplishing these goals will depend on many factors, including availability of funds and resources and successful completion of tactical goals defined in this document.

Strategic Goal 1: Establish Requirements for Connected Machinery for Smart Work Zones and AI Daily Work Reports

Proposed tasks to achieve SG1 include, but may not be limited to the following:

- Task 10A: Coordinate with ongoing implementation of HaulHub/AASHTOware AWP to determine how the information provided in a design model can be used to pre-populate construction activity and material information.
- Task 10B: Leverage Bentley Item Types to provide pay item information within the design models and connect to the HaulHub/AASHTOware AWP ecosystem.

Strategic Goal 2: Deliver Contractual Roadway Model-Based Data

Develop information project requirements for developing and delivering contractual roadway model-based data authorized for layout and construction of digital centerlines, as well as Automated Machine Guidance (AMG) operations for grading, milling, and paving.

Proposed tasks to achieve SG2 include, but may not be limited to the following:

- Task 11A: Develop and implement plan for developing and delivering contractual digital centerlines.
- Task 11B: Develop and implement plan for developing and delivering contractual grading models.
- Task 11C: Develop and implement plan for developing delivering milling/paving model.

Strategic Goal 3: Deliver Contractual Bridge Model-Based Data

Develop information project requirements for developing and delivering contractual bridge model-based data with supplemental plans.

Proposed tasks to achieve SG3 include, but may not be limited to the following:

- Task 12A: Develop and implement plan for conducting review methods for model-based deliverables.
- Task 12B: Develop and implement plan for developing grading model as it relates to channel work within the bridge limits.
- Task 12C: Develop and implement plan for developing and delivering contractual bridge models with supplemental plans.

Strategic Goal 4: Maintain Digital Twin Bridge Models for Future Maintenance, Inspection, and Remodeling

Develop and implement a plan to develop, implement, and maintain a digital twin for NDOT bridge digital twin network.

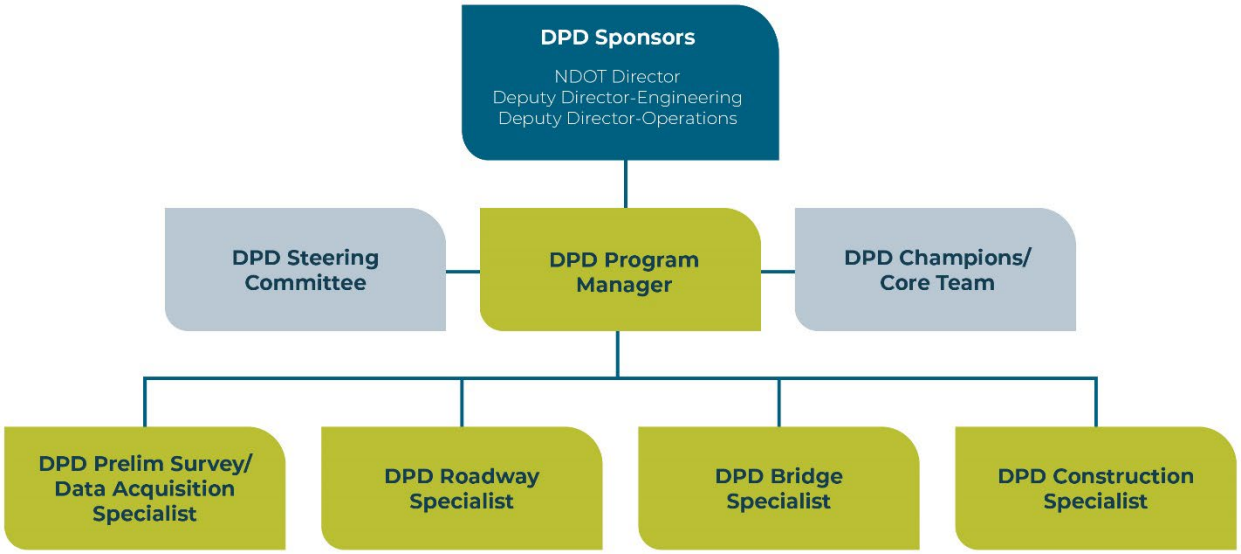
Proposed tasks to achieve SG4 include, but may not be limited to the following:

- Task 13A: Develop asset information requirements and establish data governance framework to maintain information in the bridge management system, and verify the information accurately represents the physical real-world bridge.
- Task 13B: Develop and implement plan for setting up the bridge digital twin system architecture, including data sources and infrastructure (hardware and software) for data collection, storage, and management (aka as data layer); location and management of virtual model that connects the data layer to the physical object (model layer); and user interface and applications that allow users to interact with the digital twin (service layer).
- Task 13C: Create a virtual model of the NDOT physical bridge network using the data developed during design, updated during construction, and maintained during operation and maintenance activities.
- Task 13D: Validate and test the newly created virtual model of the NDOT physical bridge network.
- Task 13E: Deploy the NDOT digital twin bridge network by integrating it into operational processes and systems.
- Task 13F: Create a plan for maintaining and performing regular monitoring of the NDOT digital twin bridge network.

Appendix A: Proposed Strategies for Establishing a DPD Program Organizational Structure and Governance Plan

Figure A-1 illustrates the proposed organizational structure at its full maturity. Establishing this proposed organizational structure for the DPD Program may occur over time, based on the priority use cases being adopted by NDOT. Peer State DOTs, such as the Pennsylvania Department of Transportation (PennDOT) and Texas Department of Transportation (TxDOT), started with a DPD Program Manager and over time built a technical team to support implementation activities and deployment of software. Another strategy for establishing the proposed organizational structure is to start with a DPD Program Manager and part-time, interim DPD specialists. A short description of the roles, responsibilities, and considerations for core competencies for each position is also provided in this section.

Figure A-1: Proposed Organizational Structure (tentative)



DPD Steering Committee

It is recommended that a steering committee be developed comprised of senior management at NDOT. The steering committee will provide strategic direction, make high-level decisions, and ensure the efforts align with broader organizational goals.

DPD Core/Champion Team

The core team represents professionals from various disciplines. They will be involved in decision-making, problem-solving and will work closely with the DPD Manager on planning, executing and monitoring of the DPD program.

DPD Program Manager

Job Description: This position is recommended as the Department's lead responsible for leading the development and implementation of change management strategies, DPD policy, SOP, and training. Also, this position would be responsible for coordinating with Business Technology Support (BTS) staff leading technology projects, managing the training and technical support efforts, coordinating internal and external communication, and representing NDOT as the DPD spokesperson at conferences and events.

Considerations for Core Competencies: A DPD Program Manager should have strong leadership and communication skills, practical project development experience, and general knowledge of technologies applicable for DPD use cases. This position provides guidance and direction to a team of technical experts, and thus would not need to be an expert in any specific software.

DPD Technical Specialists

These positions are recommended as the SME responsible for developing procedures and training materials specific to their disciplines and working closely with BTS staff to deploy new technologies or software. These SMEs should be familiar with the relationship of the various information needs and requirements (e.g., models, attributes, metadata) and have the authority to lead technical working groups to develop and deploy best practices.

Preliminary Survey/Data Acquisition: An individual well versed in the use of technology for collecting and processing data sets and developing pre-construction survey models and who has a strong background in geodetics and surveying practices.

Roadway: An individual well versed in the use of roadway corridor modeling, design review software, and common data environments (e.g., ProjectWise) and who has demonstrated experience in NDOT project development processes, digital delivery methodology, and the desire to learn digital information management and open data standards. This person may be able to assist other disciplines, such as drainage, utilities, and traffic, until there is a need to have a specific specialist to support those business groups.

Bridge: An individual well versed in the use of bridge design and modeling software and common data environments (e.g., ProjectWise) and who has the desire to learn digital information management and open data standards. This person may be able to assist the staff responsible for other bridge data management systems (e.g., AASHTOWare BrM).

Construction[1]: An individual well versed in the use of technology used during construction related to surveying equipment and modeling software (e.g., Trimble Business Center) to verify locations and elevations, measure quantities, and collect digital as-built record data sets. This person should also be familiar with other construction management software used by the Department, such as AASHTOWare Construction and Materials, and interested in overseeing

[1] The Iowa Department of Transportation has job description for an e-Construction Program Administrator having similar responsibilities as the proposed DPD Construction Specialist.

NDOT's e-ticketing deployment. Other core competencies to consider for this position include knowledge of construction inspection processes.

DPD Program Governance Plan

While having the right leader and team in place is a key element of implementing a DPD Program, it is equally important to establish a program governance framework that can be followed by the DPD Program Manager. In general, a program governance plan provides the guidelines for formulating, implementing, and following best practices and structures that are standardized for all initiatives or projects within the jurisdiction of the Program. This section of the document provides the recommendations of key elements for establishing a successful DPD Program Governance Plan:

1. **Establish Scope of Program:** The plan should define the boundaries for the activities under the purview of the DPD Program and establish long-term goals. For example, managing the DPD Program, prioritizing use cases, developing initiatives and action plans for implementing new use cases, coordinating with BTS on technology deployment projects, etc. A governance plan is similar to a project charter, but much broader in scope as it is a document that describes how a collection of projects and initiatives will be managed and carried out.
2. **Create Program Team:** The plan should define the short- and long-term goals for establishing the team that will oversee the program. In addition, the plan should define the organizational and reporting structure, roles, and responsibilities of each member of the team, and the process for filling each of the positions available within the program. The plan should also provide guidance on how the DPD Program team will work with smaller SME working teams in performing specific tasks and activities within a finite period.
3. **Define Program Standards and Procedures:** The plan should define processes and policies that should be followed while planning, proposing, and executing projects (or new activities). The plan should include a simple flowchart of decision-making and criteria to be met before new digital delivery use cases are considered for deployment and adoption. Any process developed for the DPD Program should supplement, but not replace other established processes and protocols for proposing and approving technology projects.
4. **Establish Escalation Mechanisms:** The plan should specify escalation mechanisms for when and how issues regarding current projects or activities within the program need to be escalated for resolution by the Steering Committee or NDOTDPD Sponsors.

Appendix B: Proposed DPD Use Case Priority Matrix Form

Name of person or Division requesting

Digital Delivery Use Case Name :

Digital Delivery Use Case Description :

What are the anticipated benefits of doing this?

What are the anticipated delays or costs associated with this

What are the anticipated process changes that need to happen

What are the anticipated resource needs?

Please describe the anticipated technology requirements.

Are there any time sensitive components?

Please describe the anticipated training needs.

Digital Delivery Use Case Priority Matrix							
Digital Delivery Use Case Description :		Rating Value Range (- value is the opposite, 0 is neutral, + is aligns)	Project Phase				Total
			Initiation (Survey)	Design	Construction	As-built	
Digital Delivery Goals (Does it get us closure to our goal of fully Digital Projects?)	Does it utilize digital information?	-5 to 5					0
	Does it develop a Standard?	-5 to 5					0
	Does it produce a digital product?	-5 to 5					0
	Does it increase the awareness or understa	-5 to 5					0
	Is the technology available to both create a	-5 to 5					0
	Total Per Phase Per Goal	-25 to 25	0	0	0	0	0
Simple Cost Benefit (Does it improve a current process or product and what does it cost?)	Does it make the process safer?	-5 to 5					0
	Does it make the process faster?	-5 to 5					0
	Does it increase the quality of the process?	-5 to 5					0
	Does it make the process cheaper?	-5 to 5					0
	Does it free up resources?	-5 to 5					0
	Total Per Phase Goal	-25 to 25	0	0	0	0	0
Total per Phase		-50 to 50	0	0	0	0	0

Appendix C: Sample Information Requirement for Digital As-Built Data Collection

File	Feature Class	Feature	Coordinates Collect Point	Attribute Collect Information
Pavement Message As-built Survey Data Template	Arrow	Arrow Straight	At center of Arrow	1. Pavement Message Material 2. Pavement Message Area (Sq. Ft.)
		Left Arrow Right		
		Left Straight Arrow		
		Left Straight Right Arrow		
		Left Turn Arrow		
		Right Turn Arrow		
		Straight Right Arrow		
		Transition from Left Arrow		
		Transition from Right Arrow		
		Wrong Way Arrow		
	Rectangular	Railroad Crossing	At right end of rectangle	1. Pavement Message Material 2. Pavement Message Area (Sq. Ft.) 3. Number of Cross Walk Blocks 4. Stop Bar Length (Ft.)
		Cross Walk Rails		
		Cross Walk Block		
		Stop Line		
	Text	Miscellaneous Marking	At center of Text	1. Pavement Message Material 2. Pavement Message Area (Sq. Ft.)
		Yellow Curb		
		Individual 8' Character		
		MERGE		

File	Feature Class	Feature	Coordinates Collect Point	Attribute Collect Information
		ONLY		
		PED XING		
		SCHOOL XING		
		SIGNAL AHEAD		
		STOP AHEAD		
		High Occupancy Vehicle		
	Triangle	24" White Crosshatch	At center of Crosshatch	1. Pavement Message Material 2. Pavement Message Area (Sq. Ft.) 3. Number of Triangles

Pavement Message Feature Collection Index courtesy of Minnesota Department of Transportation Pavement Message Asset Class - GPS As-Built Deliverable - MnDOT (state.mn.us)