Preliminary Investigation

Caltrans Division of Research, Innovation and System Information

Project Delivery Document Management Systems

Requested by
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October 20, 2016

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Table of Contents

Executive Summary

Background

Currently, the documents associated with transportation projects developed and delivered by Caltrans' Capital Outlay Support (COS) program are not subject to a standardized document management process. A comprehensive electronic document management system (EDMS) is needed to more effectively manage Caltrans' project delivery-related documents from project inception to closeout.

COS sponsored a recently published value analysis study that assessed the program's current document management practices, and identified, analyzed and prioritized key functional needs for document management. To supplement the information contained in this study, COS is interested in learning about:

- How other state departments of transportation (DOTs) electronically manage documents during the project delivery process.
- The off-the-shelf and custom-designed electronic systems used by state DOTs to manage project delivery documents.
- Best practices employed and lessons learned by state DOTs when implementing and using document management systems for project delivery-related documents.

To assist with this information-gathering effort, CTC & Associates conducted a survey of state DOTs to gather information about the agencies' project delivery document management systems and practices. Results of a limited literature search provide additional information about the products used to manage project delivery-related documents.

Summary of Findings

A 30-question survey distributed to members of the AASHTO Subcommittee on Design and selected other state DOT contacts received 22 responses from 20 states (Utah DOT provided three responses). Of these 20 states, three have plans to implement an EDMS; in some cases, implementation is underway.

System Description

Sixteen states provided information about their current use of an EDMS. All but one use an off-the-shelf commercial product that has been customized for agency use, and more than half of these states use ProjectWise as the sole document management system or in concert with other systems. (A 2015 conference presentation cited in this report indicated that 23 state DOTs have standardized the use of ProjectWise; 11 DOTs are implementing the system.) The systems in current use by respondents are presented in the table below.

Product and Vendor	State	Primary Purpose	Implementation Date	Number of Users
Document Management System (custom software) Unspecified developer	**Montana**	Track project delivery documents	1990s	Hundreds

Product and Vendor	State	Primary Purpose	Implementation Date	Number of Users
DocuSign DocuSign Inc.	**Utah**	Contract management	2016	2,000
eDOCS Document Management OpenText Corporation	**Florida**	Document archive to maintain official department records	2005	2,000
	Minnesota	Track project delivery documents	2001-2002	Not known; limited by number of consecutive users and security credentials
Falcon/DMS tsaADVET Inc.	**Alabama**	Archiving documents or project tracking and control	Started testing in 2014; system evaluation continues	25 to 50; still in development
FileNet IBM	**North Dakota**	Comprehensive records management; paper records also maintained	2002	250
	Pennsylvania	Track project delivery documents	2000	Hundreds
	Tennessee	Track project delivery documents	2009	500 or more
ILINX ILINX Software	**Washington**	Act as an approved and archived document store	2005	More than 1,500
Oracle Fusion Middleware (WebCenter Content and Business Process Management) Oracle	**Indiana**	House all electronic documents and manage workflows electronically	2000-2001	Few thousand
Project and Portfolio Management (PPM) Hewlett Packard Enterprise Development LP	**Oklahoma**	Track project delivery documents	2009	100+
ProjectWise Bentley Systems Inc.	**Colorado**	Manage engineering project data based on standard workflows and permission control; also used to create, manage, share, distribute and store project data	2008 (pilot); 2010 (implementation started)	600 internal; 600 external
	Connecticut	Store 2-D/3-D models, asset information and other documents	2008	400

Product and Vendor	State	Primary Purpose	Implementation Date	Number of Users
ProjectWise Bentley Systems Inc.	**Georgia**	Track project delivery documents	2014	1,000
	Idaho	House all project-related documentation	2011	769
	Minnesota	Track project delivery documents	2001-2002	Not known; limited by number of consecutive users and security credentials
	Oklahoma	Track project delivery documents	2009	100+
	Texas	Standardization of agency's project folder structure	Started in 2015; completed 2016	Over 2,000
	Utah	Track project delivery documents	2008	2,500
	Washington	Workspace for project delivery documents and project correspondence	2005	More than 1,500
SharePoint Microsoft	**Minnesota**	Track project delivery documents	2001-2002	Not known; limited by number of consecutive users and security credentials
	Utah	Track project delivery documents	2014	500

System Use

Most respondent systems store a wide range of electronic content. Respondents using the same commercial product do not appear to be using it in the same way, with some respondents storing a wider range of documents and files than others. Almost all commercial products will allow users to store, share, organize, search and secure content, and manage final documents. While most commercial systems support automated workflows, relatively few respondents are using the EDMS to apply a record retention schedule.

System Implementation

Two-thirds of the respondent systems were implemented between 2000 and 2010. Survey responses indicated no typical time frame for implementation, with some agencies implementing their systems in as little as six months to one year while others required three years or more. Only four respondents automated data migration. For several respondents, the EDMS is the agency's first document management system.

Training and System Support

The training provided before implementing an EDMS ranged widely, from one-hour sessions to half-day lectures to multiple-day sessions to train system administrators. Several states prepare designated staff members to serve as EDMS specialists in their districts or regions.

Most agencies have at least one full-time staff member dedicated to supporting and maintaining the EDMS. Some agencies maintain fairly significant staff support, with North Dakota and Pennsylvania both reporting six full-time staff members dedicated to maintaining the agencies' FileNet systems. Minnesota DOT has the highest number of dedicated full-time staff at 10. Many respondents support a Help Desk; fewer employ consultants, either on-call or permanent.

System Costs

Relatively few respondents offered system costs. Several respondents noted that implementation was too long ago for this information to be readily available (two-thirds of the systems were implemented between 2000 and 2010); in other cases, another group or agency managed the implementation.

Total implementation costs ranged from $65,000 to implement Washington State DOT's ProjectWise in 2005, to $12 to $15 million for Texas DOT's 2015 ProjectWise implementation. Annual maintenance costs also varied widely among respondents, ranging from $20,000 to $4 million.

System Assessment

The survey asked respondents to rate their agencies' level of satisfaction with a variety of functions and characteristics associated with an EDMS. Respondents were most satisfied with the basic system functions of scanning, sharing, organizing and storing content. The EDMS function receiving the lowest average rating is the ability of the EDMS to manage a record retention schedule. Survey results indicate that few agencies use this EDMS function.

Many respondents described system successes. Their comments highlighted the ability to collaborate, cost and time savings, a system's ease of use, and the benefits of specific system features and functions. Respondents' challenges are related to identifying and managing consultants, funding, various technical issues, training and user adoption.

Related Resources

A few survey respondents provided user manuals and other guidance for EDMS users. Other EDMS-related publications highlighted in this report include a sampling of national guidance, additional information about state DOT practices, and links to the vendor products used by respondents.

Gaps in Findings

The 20 state DOTs responding to the survey do not represent all DOTs currently using an EDMS. Other commercial products may be available that might meet Caltrans' needs. In addition, the available budget for this Preliminary Investigation limited the depth of the analysis of survey results and precluded any follow-up to gather more information or clarify survey responses. Further investigation could uncover additional details about respondents' systems.

Next Steps

Moving forward, Caltrans could consider:

- Contacting one or more users of each product of interest to Caltrans to gather additional information about these systems.
- Consulting with an agency using multiple products and another using a single product to determine how practices differ and the benefits and drawbacks of each practice.
- Examining the user manuals and other user guidance cited in this Preliminary Investigation to gain additional perspective on the use of an EDMS.
- Contacting agencies just beginning implementation of an EDMS:
    - North Carolina DOT is in the early stages of an EDMS implementation that will employ both SharePoint and ProjectWise.
    - Ohio DOT is implementing ProjectWise.
- Consulting with Arizona DOT to learn more about the research underway on a "master project tracking system" that includes an EDMS.

Detailed Findings

Survey of Practice

Survey Approach

A 30-question online survey was distributed to members of the AASHTO Subcommittee on Design and selected other state DOT contacts to gather information for this Preliminary Investigation. The survey sought information about electronic document management systems (EDMS) used for project delivery-related documents, including a description of the systems and their features, how agencies implemented the systems, system costs, and an assessment of system effectiveness.

The survey questions appear in Appendix A.

Summary of Survey Results

Twenty states provided 22 responses to the survey (Utah DOT provided three responses). Sixteen states use an EDMS to manage project delivery-related documents:

- Alabama
- Colorado
- Connecticut
- Florida
- Georgia
- Idaho
- Indiana
- Minnesota
- Montana
- North Dakota
- Oklahoma
- Pennsylvania
- Tennessee
- Texas
- Utah
- Washington

Four states—Arizona, North Carolina, Ohio and South Dakota—are not currently supporting an EDMS, though some are contemplating or preparing to implement one. Information about these plans appears on page 34 of this Preliminary Investigation.

This report summarizes survey results in the following topic areas:

- System description
- Electronic content
- System integration
- System functions
- Document management
- System implementation
- Training and system use
- System support
- System costs
- System assessment
- Related documents

Note: A few states reported on the use of multiple tools. Utah DOT elected to submit separate survey responses for each tool, while other respondents using multiple tools submitted a single survey response. When possible, the summary tables appearing throughout this Preliminary Investigation associate survey responses with a specific tool.

System Description

All but one of the respondents use an off-the-shelf commercial product that has been customized for agency use. ProjectWise, offered by Bentley Systems Inc., is the most commonly used EDMS among respondents. Only Montana DOT uses a custom system designed specifically for the agency. The table below provides high-level information about respondents' systems.

EDMS System Descriptions

Product and Vendor	State	Internal Name	Primary Purpose	Number of Users
Custom software developed for agency Unspecified developer	**Montana**	Document Management System (DMS)	Track project delivery documents	Hundreds
DocuSign DocuSign Inc.	**Utah**	DocuSign	Contract management	2,000
eDOCS Document Management OpenText Corporation	**Florida**	EDMS	Document archive to maintain official department records	2,000
	Minnesota	eDOCS	Track project delivery documents	Not known; limited by number of consecutive users and security credentials
Falcon/DMS tsaADVET Inc.	**Alabama**	Falcon	Archiving documents or project tracking and control	25 to 50; still in development
FileNet IBM	**North Dakota**	Workplace XT (old FileNet); ICN (new FileNet)	Comprehensive records management; paper records also maintained	250
	Pennsylvania	EDMS	Track project delivery documents	Hundreds
	Tennessee	FileNet	Track project delivery documents	500 or more
ILINX ILINX Software	**Washington**	ECM	Act as an approved and archived document store	More than 1,500
Oracle Fusion Middleware (WebCenter Content and Business Process Management) Oracle	**Indiana**	Electronic Records Management System (ERMS)	House all electronic documents and manage workflows electronically	Few thousand
Project and Portfolio Management (PPM) Hewlett Packard Enterprise Development LP	**Oklahoma**	PPM	Track project delivery documents	100+

EDMS System Descriptions				
Product and Vendor	**State**	**Internal Name**	**Primary Purpose**	**Number of Users**
ProjectWise Bentley Systems Inc.	**Colorado**	ProjectWise	Manage engineering project data based on standard workflows and permission control; also used to create, manage, share, distribute and store project data	600 internal; 600 external
	Connecticut	ProjectWise (PW) Online	Store 2-D/3-D models, asset information and other documents	400
	Georgia	ProjectWise	Track project delivery documents	1,000
	Idaho	ProjectWise	House all project-related documentation	769
	Minnesota	ProjectWise	Track project delivery documents	Not known; limited by number of consecutive users and security credentials
	Oklahoma	ProjectWise	Track project delivery documents	100+
	Texas	ProjectWise	Standardization of agency's project folder structure	Over 2,000
	Utah	ProjectWise	Track project delivery documents	2,500
	Washington	ProjectWise	Workspace for project delivery documents and project correspondence	More than 1,500
SharePoint Microsoft	**Minnesota**	SharePoint	Track project delivery documents	Not known; limited by number of consecutive users and security credentials
	Utah	Interchange	Track project delivery documents	500

Note: More information about the products and vendors cited above appears in the **Related Resources** section of this Preliminary Investigation; see page 35.

Some agencies mentioned other systems or tools used to manage project delivery:

- Idaho Transportation Department uses Microsoft Project Server and AASHTOWare Project SiteManager. Both programs allow links to documents that reside in ProjectWise.
- Minnesota DOT also uses Right of Way Electronic Acquisition Land Management System (REALMS), a right of way (ROW) management tool, and Contracts Agreements

Auditing Tracking System (CAATS), the agency's new system for recording, tracking and reporting on contracts.

- Tennessee DOT's project management system, Program, Project and Resource Management (PPRM), tracks all phases of project development, including state and federal project numbers, local project participation, staff assignments and dates.

Electronic Content

Most respondent systems store a wide range of electronic content. Respondents using the same commercial product do not appear to be using it in the same way, with some respondents storing a wider range of documents and files than others. All but Tennessee DOT use the EDMS to store plans, specifications and estimates. Only a few states reported storing computer-aided design (CAD) files. The table below summarizes survey responses.

Electronic Content Housed in the EDMS

Product	State	Plans	Specifications	Estimates	Other Documents	Photos	Videos	Voice Files	Digital Images	Emails	CAD Files
DMS (custom software)	Montana	X	X	X	X	X	X		X	X	
eDOCS	Florida	X	X	X	X	X	X	X	X	X	
Falcon/DMS	Alabama	X	X	X	X	X	X		X	X	X
FileNet	North Dakota	X	X	X	X	X	X	X	X	X	
	Pennsylvania	X	X	X	X	X			X	X	
	Tennessee	X		X						X	
Oracle Fusion Middleware	Indiana	X	X	X	X	X			X	X	
ProjectWise	Colorado	X	X	X	X	X			X		
	Connecticut	X	X	X	X	X					X
	Georgia	X	X	X	X	X	X	X	X	X	
	Idaho	X	X	X	X	X	X		X	X	
	Texas	X	X	X	X				X	X	
	Utah	X	X	X	X	X	X	X	X	X	
ProjectWise Project and Portfolio Management	Oklahoma	X	X	X	X					X	
ProjectWise SharePoint eDOCS	Minnesota	X	X	X	X	X			X	X	
ProjectWise ILINX	Washington	X	X	X	X	X	X	X	X	X	
SharePoint	Utah	X	X	X	X	X	X	X	X	X	

Some respondents provided more information about the types of electronic content stored in the EDMS:

- **Colorado (ProjectWise)**. PDF, Microsoft Project, Visio and other types of files are stored in their standard file formats.
- **Florida (eDOCS)**. The agency's EDMS supports any type of document.
- **North Dakota (FileNet)**. CAD and computer-aided manufacturing files are not typically stored in FileNet, though the resulting diagrams, estimates and other types of documents are housed in the EDMS.
- **Utah (multiple systems)**. The agency's DocuSign system includes only workflow routing information. ProjectWise and SharePoint house ROW documentation, inspection documents, certifications, financial documentation and evaluations.
- **Washington (ProjectWise)**. The agency uses ProjectWise for many workflows and deliverables.

System Integration

Most EDMS integrate or communicate with at least one of four other internal systems—an engineering project collaboration system, project management and financial management systems, and a geographic information system (GIS). Some agencies commented on integration with other types of internal systems. The table below summarizes survey responses.

EDMS Integration with Other Systems

Product	State	Engineering Project Collaboration System	Project Management System	Financial Management System	GIS	Other System
DMS (custom software)	**Montana**					N/A
eDOCS	**Florida**	X	X	X	X	N/A
Falcon/DMS	**Alabama**	X				N/A
FileNet	**North Dakota**	X	X	X	X	N/A
	Pennsylvania					Electronic construction management system Driver's licensing system Bridge management system Crash reporting system
	Tennessee	X	X			N/A
Oracle Fusion Middleware	**Indiana**	X	X	X	X	N/A
ProjectWise	**Colorado**	X	X		X	N/A
	Connecticut	X	X	X	X	N/A

EDMS Integration with Other Systems						
Product	**State**	**Engineering Project Collaboration System**	**Project Management System**	**Financial Management System**	**GIS**	**Other System**
ProjectWise	**Georgia**		X	X	X	TransPort construction management system
	Idaho	X	X		X	PaeceTrak ROW management system
	Texas	X				N/A
	Utah		X	X	X	Project Development Business System (construction management); SharePoint
	Washington				X	Currently developing ProjectWise Connector for GIS; have not investigated integration with other systems.
ProjectWise Project and Portfolio Management	**Oklahoma**	X	X	X		N/A
ProjectWise SharePoint eDOCS	**Minnesota**	X	X	X	X	Contract management
SharePoint	**Utah**		X	X		Project Development Business System (construction management); ProjectWise

System Functions

The survey provided respondents with a series of system functions and capabilities and asked them to indicate which of these functions/capabilities were supported by their EDMS, even if they were not using them. Only Florida DOT's eDOCS system supports all possible functions presented to respondents. Almost all commercial products will allow users to store, share, organize, search and secure content, and manage final documents. The functionality of Utah DOT's DocuSign system is obviously limited by its narrow focus on e-signatures. The table on page 14 presents survey responses.

System Functions Supported by the EDMS												
Product	State	Store content	Share Content	Organize Content	Search Content	Scan Content	Autopopulate Information	Collaborate on Content	Secure Content	Manage Paper Documents	Manage Microfilm	Manage Final Documents (archive)
DMS (custom software)	Montana		X	X	X				X	X		X
DocuSign	Utah							X				
eDOCS	Florida	X	X	X	X	X	X	X	X	X	X	X
Falcon/DMS	Alabama	X	X	X	X	X	X	X	X	X	X	X
FileNet	North Dakota	X	X	X	X	X	X		X		X	X
	Pennsylvania	X	X	X	X	X	X		X	X	X	X
	Tennessee	X	X		X				X	X		X
Oracle Fusion Middleware	Indiana	X	X	X	X	X	X	X	X			X
ProjectWise	Colorado	X	X	X	X		X	X	X			X
	Connecticut	X	X	X	X		X	X				X
	Georgia	X	X	X	X	X	X	X	X	X		X
	Idaho	X	X	X	X	X	X	X	X	X		X
	Texas	X	X	X	X	X		X	X	X		X
	Utah	X	X	X	X		X	X	X			X
ProjectWise Project and Portfolio Management	Oklahoma	X	X		X	X						
ProjectWise SharePoint eDOCS	Minnesota	X	X	X	X		X	X	X	X		X
ProjectWise ILINX	Washington	X	X	X	X		X	X	X	X	X	X
SharePoint	Utah	X	X	X	X		X	X	X			X

Other EDMS Features

In addition to asking about typical system functionality, the survey presented respondents with a list of special features their systems might support:

- Provide mobile access to content
- Permit customization
- Integrate e-signature

- Allow data analysis
- Enable/filter geo-referencing

Only Alabama DOT's Falcon/DMS system supports all five of these special features. The most commonly supported special feature is mobile access to content; allowing data analysis and enabling geo-referencing are the least common. While other FileNet users use at least some of these features, Tennessee DOT's FileNet application is not employing any of them. Montana DOT's custom DMS software and Oklahoma DOT's Project and Portfolio Management are the only systems that do not support any of these system features. The table below presents survey responses.

Special System Features Supported by the EDMS

Product	State	Provide Mobile Access to Content	Permit Customization	Integrate e Signature	Allow Data Analysis	Enable/Filter Geo Referencing
DMS (custom software)	**Montana**					
DocuSign	**Utah**	X		X		
eDOCS	**Florida**	X	X	X	X	
Falcon/DMS	**Alabama**	X	X	X	X	X
FileNet	**North Dakota**	X		X	X	X
	Pennsylvania		X			
	Tennessee					
Oracle Fusion Middleware	**Indiana**	X	X		X	
ProjectWise	**Colorado**	X	X	X		
	Connecticut	X				
	Georgia	X				
	Idaho	X	X	X		X
	Texas	X	X	X		
	Utah	X	X	X	X	X
Project and Portfolio Management	**Oklahoma**					
ProjectWise **SharePoint** **eDOCS**	**Minnesota**			X	X	X
ProjectWise **ILINX**	**Washington**	X	X		X	X
SharePoint	**Utah**	X	X	X	X	X

Some respondents provided more information about their use of, or inability to use, these special features:

- **Colorado (ProjectWise)**. The agency is currently implementing e-signature approval and support for mobile devices.
- **North Dakota (FileNet)**. Microfilm is stored and managed separately; however, the agency has triggers built into FileNet to help with the process. The agency's GIS does generate some references back to FileNet objects.
- **Washington (ProjectWise)**. Applying digital signatures requires accessing each file. Signing documents in a batch mode solely from within ProjectWise is not an option the agency is aware of.

Automated Workflows

Most of the respondent systems support automated workflows. The table below summarizes survey responses.

Systems Supporting Automated Workflows

Product	State	Description of Workflow
DocuSign	**Utah**	Allows users to configure with each document.
eDOCS	**Florida**	Currently not using but system supports it.
Falcon/DMS	**Alabama**	Currently not using but system supports it.
FileNet	**North Dakota**	FileNet is typically used for hierarchical signoff by management. A custom contract management system uses documents stored in FileNet and leverages the FileNet workflow to move documents through the process.
	Tennessee	Activities are assigned in PPRM (the agency's project management system) with dates of projected completion. Each deliverable and the final scanned documents for each project are housed in FileNet.
Oracle Fusion Middleware	**Indiana**	The Business Process Management element of the system is used for workflows.
ProjectWise	**Colorado**	See page 172 of the agency's ProjectWise Reference Manual for information about workflows and states (see https://www.codot.gov/business/designsupport/cadd/projectwise-reference-manual/at_download/file).
	Georgia	Manual workflows are currently used; the agency is moving to automated workflows using document states (i.e., draft, review, accepted, etc.).
	Idaho	Currently not using but system supports it.
	Texas	Project delivery workflow process moves from district office to division office to plans online.
	Utah	Workflow involves ROW processes and agency's motor carrier division.

Systems Supporting Automated Workflows		
Product	**State**	**Description of Workflow**
	Washington	ProjectWise provides a mechanism to move documents through a workflow from monitoring activity to submittal and review processes. The agency is just beginning to use this feature but can "see the potential."
ProjectWise **SharePoint** **eDOCS**	**Minnesota**	Workflows engage other agency systems, including CAATS, REALMS and AASHTOWare products.
SharePoint	**Utah**	User-defined workflows are available.

Record Retention

Few respondents apply a record retention schedule in the EDMS. Several respondents noted that while their systems (Falcon/DMS and ProjectWise) support a record retention schedule, the feature is not used. Other respondents not applying a record retention schedule did not indicate whether they chose not to apply it or a record retention schedule is simply not available.

The four respondents applying a record retention schedule within the EDMS include:

- **Florida (eDOCS)**. Record retention is managed using document types.
- **Georgia (ProjectWise)**. A custom tool developed by Bentley Systems was recently implemented.
- **North Dakota (FileNet)**. Record control numbers manage retention and deletion. A hybrid manual/automatic process handles disposal of documents.
- **Pennsylvania (FileNet)**. Documents are managed using an ad hoc file type and the record retention schedule.

Document Management

Managing Electronic Documents

Most respondents described the processes used to store and manage electronic documents in the EDMS. The table below summarizes their responses.

Managing Electronic Documents		
DocuSign	**Utah**	Documents can be generated from a template or pulled in from individually created files.
eDOCS	**Florida**	Multiple methods are used to process and store records:

Managing Electronic Documents		
Product	**State**	**Storage and Management Processes**
		• Desktop application • Web application • Automated imports • Custom integration with many internal applications
Falcon/DMS	**Alabama**	Once scanned, the documents (including optical character recognition files) are added to the EDMS.
FileNet	**North Dakota**	Options to store and manage documents include: • Mainframe jobs to upload documents or file transfer protocol. • An in-house-built "filewalker" application that walks through directories to pick up files dropped into the directory. • ILINX email capture, ILINX scanning, ILINX ARM. • Built-in method FileNet uses to add documents called *entry templates*.
	Pennsylvania	Scanned documents are placed in proper document type.
Oracle Fusion Middleware	**Indiana**	Documents are entered by the user directly through Oracle's WebCenter Content interface or through multiple web sites that have access to the system's service calls. From there, documents are retained in the database as BLOBs. (A BLOB (binary large object) is an Oracle data type used to store digitized information such as images, audio and video.)
ProjectWise	**Colorado**	Project documents are stored with a standard project template used to create projects in ProjectWise.
	Idaho	Files are saved directly into ProjectWise or simply dragged and dropped.
	Texas	A standardized project folder structure was developed and implemented statewide to allow for consistency and collaboration.
	Utah	Users place documents into the system, applying attributes established by their respective departments.
	Washington	ProjectWise operates much like Windows Explorer. Project Properties take advantage of attribute inheritance, access control is used for security, and a "final status" property maintains deliverable document integrity.
ProjectWise SharePoint eDOCS	**Minnesota**	The agency focuses primarily on eDOCS for long-term retention and ProjectWise for program delivery. SharePoint is used to collaborate with external vendors and contractors.
SharePoint	**Utah**	Documents are submitted by users and attributes are applied.

Managing Electronic Documents		
Product	**State**	**Storage and Management Processes**
		Workflows can be used for notification and approval. Documents ready to be archived are automatically moved to the archival storage system.

Managing Paper Documents

The survey asked respondents how they dealt with paper documents—if all or only some paper documents are entered in the EDMS, how paper documents are handled after entry in the EDMS, and whether the agency creates other backups of paper documents. The table below summarizes responses.

Practices to Manage Paper Documents	
Practice	**State**
Scan and enter ALL paper documents in the EDMS	
Discard paper	Alabama, Idaho, Tennessee
Scan and enter SOME paper documents in the EDMS	
Discard paper (if entered in EDMS)	Florida, Georgia, Minnesota, North Dakota, Oklahoma, Pennsylvania, Washington
Retain all paper	Colorado, Connecticut, Indiana, Montana, Texas, Utah
Create backup of paper documents outside EDMS	Alabama, Indiana, Montana, Texas, Utah

Some respondents provided more information to clarify their responses:

- **Colorado (ProjectWise)**.Colorado DOT now retains all paper project documents. An update to record retention procedures is in process.
- **Idaho (ProjectWise)**. The agency avoids generation of paper copies by sharing one document in ProjectWise.
- **Indiana (Oracle Fusion Middleware)**. Indiana DOT retains all paper documents, including documents that are tracked in the EDMS.
- **North Dakota (FileNet)**. North Dakota DOT scans and discards as much paper as possible. The agency's in-house records management system tracks paper and microfilm records.
- **Texas (ProjectWise)**. Texas DOT retains all paper documents, including documents that are tracked in the EDMS.
- **Washington (ILINX)**. The agency stores ROW, acquisition, construction as-built and other final documents in the ILINX system. These documents are often copies of documents stored in ProjectWise.

System Implementation

The table below provides information about respondents' EDMS implementation—when the system was implemented, how much time was required for implementation and whether data was migrated automatically to the new system.

Two-thirds of the systems were implemented between 2000 and 2010. Survey responses indicated no typical time frame for implementation, with some agencies implementing their systems in as little as six months to one year while others required three years or more. Only four respondents automated data migration. Some respondents noted that the current EDMS is the agency's first document management system, so migration of existing data was not an option. For other states, data was added to the new system as of a chosen start date (Idaho) or as needed (Washington). The table below summarizes survey responses.

EDMS Implementation

Product	State	Implementation Date	Time Needed to Implement	Automated Migration of Existing Data (Yes/No)
DMS (custom software)	**Montana**	1990s	Not provided	Not provided
DocuSign	**Utah**	2016	Less than 6 months	No
eDOCS	**Florida**	2005	6 months to 1 year	Yes
Falcon/DMS	**Alabama**	Started testing in 2014; system evaluation continues	Ongoing	Yes
FileNet	**North Dakota**	2002	4 to 18 months	No
	Pennsylvania	2000	1 year to less than 2 years	No
	Tennessee	2009	1 year to less than 2 years	No
Oracle Fusion Middleware	**Indiana**	2000-2001	2 years to less than 3 years	No
ProjectWise	**Colorado**	2008 (pilot); 2010 (implementation started)	3 years or more	No
	Connecticut	2008	6 months to less than 1 year	No
	Georgia	2014	1 year to less than 2 years	No

EDMS Implementation				
Product	**State**	**Implementation Date**	**Time Needed to Implement**	**Automated Migration of Existing Data (Yes/No)**
ProjectWise	**Idaho**	2011	1 year to less than 2 years	No
	Texas	Started in 2015; completed 2016	1 year to less than 2 years	No
	Utah	2008	3 years or more	Yes
	Washington	2005	6 months to less than 1 year	No
ProjectWise Project and Portfolio Management	**Oklahoma**	2009	1 year to less than 2 years	Yes
ProjectWise SharePoint eDOCS	**Minnesota**	2001-2002	3 years or more	No
SharePoint	**Utah**	2014	Ongoing	No

Some respondents provided more information about system implementation:

- **North Dakota (FileNet).** The agency began with small pilots and is "constantly implementing." The respondent estimates that other agencies implementing an off-the-shelf product like IBM's FileNet should expect an implementation period of four to 18 months.
- **Washington (ProjectWise).** While the agency's ProjectWise system could be implemented quickly, the respondent noted that evolution of the software requires ongoing updates to take advantage of new functionality.

Implementation Lessons Learned

Some respondents shared lessons learned from their experience with data migration and the implementation process in general. Several noted the significance of careful planning and preparation; others offered advice about technical issues. The table on page 22 summarizes responses.

Lessons Learned From Data Migration and Implementation		
Product	**State**	**Recommendation/Comment**
eDOCS	**Florida**	Plan carefully.
Falcon/DMS	**Alabama**	• Have a champion at the highest level possible. • Know the end goal. • Take an "all or nothing" approach within the department. One step at a time "has become a disaster and takes forever to implement."
FileNet	**Pennsylvania**	• Better classify data. • Use additional metadata to enhance search capabilities.
	North Dakota	• Hire a third-party vendor with experience. • Have a good backup and recovery strategy.
Oracle Fusion Middleware	**Indiana**	Choose your consultant carefully.
ProjectWise	**Colorado**	Change management is required to implement any new system.
	Connecticut	• Piloting is required to develop storage architecture. • Prepare for a learning curve.
	Texas	Ensure that sufficient storage is available.
	Utah	Pull attribute information when migrating data.
	Washington	• Ensure multiple system integration or compatibility is optimized to reduce silos. • Work with other ProjectWise agencies/customers to develop as many specific functions as possible prior to user implementation. • Initial implementation may not hit the optimal target as users and developers learn how the system works in their environment. System adjustments will likely be needed a year after initial implementation.

Training and System Use

Training Prior to Implementation

Two survey questions asked respondents to describe the training associated with the EDMS. The first question asked about the training provided prior to implementing the new EDMS; the second question sought information about ongoing training. The table on page 23 describes the scope of respondents' training to prepare for EDMS implementation.

Training Required for Implementation		
eDOCS	**Florida**	Training provided at all district offices; continuing occasional training as needed. The agency has also created computer-based training modules.
FileNet	**North Dakota**	Internal DOT staff trained other staff on uses and best practices. Each new employee attends a two-hour FileNet training session.
	Pennsylvania	Multiple-session classroom training; identification of EDMS specialist in each district.
	Tennessee	A brief training document was distributed to staff; FileNet is referenced often in the agency's design guidelines.
ProjectWise	**Colorado**	Instructor-led class and online training.
	Connecticut	Unspecified administrative training.
	Georgia	All users received half-day lecture-type training due to number of users; respondent would have preferred hands-on training.
	Idaho	Each district trained "power users" who conducted one-hour training sessions for smaller groups around the state. Vendor provided administrative training and over-the-shoulder guidance along with online training courses.
	Texas	Instructor-led one-day training class; also online training.
	Utah	On-site and online training.
	Washington	Three-day session for ProjectWise administration and server training for support staff. Two-hour introductory training for users (could easily be expanded to a four-hour session to introduce more functionality).
SharePoint	**Utah**	On-site training, as requested.

Staff Support or Training After Implementation

The table below summarizes respondents' descriptions of the staff support or training provided after initial implementation of the EDMS. Some of the details included in this table also appear in the table below describing the staffing and resources required for ongoing system support.

Staff Support or Training After Implementation

Product	State	Staff Support or Training Description
eDOCS	**Florida**	Three dedicated EDMS support staff plus additional technical support such as database and network support; functional area support personnel.
Falcon/DMS	**Alabama**	Requires extensive IT support until the product is up and running. After departmentwide implementation, the IT support required is typical of the support needed for any software.
FileNet	**Pennsylvania**	Minimal support (three staff members). Specialists in each district assist others when needed.
	Tennessee	Recommend 10 half-day sessions for ongoing support.
Oracle Fusion Middleware	**Indiana**	Five dedicated staff: three in Indiana DOT Management Information Systems and two in Indiana Office of Technology (IOT). One other IOT staff member can assist if needed.
ProjectWise	**Connecticut**	A cloud-based architecture requires minimal support. An administrator, continued development and training will be required.
	Georgia	Three full-time ProjectWise administrators.
	Texas	Currently, the agency has very little staff support; plans are in place to implement a support group of four to five part-time staff members, along with some IT staff to address issues.
	Washington	ProjectWise user conferences and regular contact with Bentley support provide ongoing assistance to users. The agency coordinates a ProjectWise Admin conference call that includes state and consultant ProjectWise administrators. The call addresses current issues, system functionality and implementation.
ProjectWise **SharePoint** **eDOCS**	**Minnesota**	A significant level of training and technical support is required for end users.
SharePoint	**Utah**	System administrator and hours devoted to development.

Staff Classifications Using the EDMS

Almost all respondents indicated that clerical, engineering and management staff use the EDMS. A few states noted that system use was more extensive, reaching to all areas of the agency. The table below summarizes responses.

Staff Classifications Using the EDMS					
Product	**State**	**Clerical Staff**	**Engineering Staff**	**Management Staff**	**Other Staff**
DMS (custom software)	**Montana**	X	X	X	N/A
DocuSign	**Utah**	X		X	N/A
eDOCS	**Florida**	X	X	X	N/A
Falcon/DMS	**Alabama**	X	X	X	Anyone using a computer.
FileNet	**North Dakota**	X	X	X	All areas of the DOT.
	Tennessee	X	X	X	N/A
Oracle Fusion Middleware	**Indiana**	X	X	X	N/A
ProjectWise	**Colorado**		X		N/A
	Connecticut	X		X	Construction staff.
	Georgia	X	X	X	N/A
	Idaho	X	X	X	N/A
	Oklahoma	X	X	X	N/A
	Texas	X	X		N/A
	Utah	X	X	X	All agency staff and consultants.
ProjectWise Project and Portfolio Management	**Oklahoma**	X	X	X	N/A
ProjectWise SharePoint eDOCS	**Minnesota**	X	X	X	Different staff throughout the agency.
ProjectWise ILINX	**Washington**		X	X	N/A
SharePoint	**Utah**	X	X	X	Anyone wishing to use the system.

System Support

Most agencies have at least one full-time staff member dedicated to supporting and maintaining the EDMS. Some agencies maintain fairly significant staff support, with North Dakota and Pennsylvania both reporting six full-time staff members dedicated to maintaining the agencies' FileNet systems. Minnesota DOT has the highest number of dedicated full-time staff at 10. Many respondents support a Help Desk; fewer employ consultants, either on-call or permanent.

The table below highlights the types and numbers of in-house staff members and other resources respondents use to support and maintain the EDMS. Additional information appears below the table for each instance of an asterisk (*) in the table.

Staffing and Other Resources Supporting and Maintaining the EDMS

Product	State	In House Staff			Other Resources			
		Full Time (dedicated)	Part Time (dedicated)	Nondedicated Staff	Help Desk	On Call Consultants	Permanent Consultants	Vendor Support
DMS (custom software)	Montana	0	0	0	X			
DocuSign	Utah	0	1	1				
eDOCS	Florida	3	0	20	X		X	
Falcon/DMS	Alabama	2 to 4	0	2 to 4				X
FileNet	North Dakota	6*	0	0	X	X	X	
	Pennsylvania	6	0	0			X	
	Tennessee	5	0	0				
Oracle Fusion Middleware	Indiana	5	0	1	X	X		
ProjectWise	Colorado	*	*	*	X		X	
	Connecticut	3 to 5	0`	0		X	X	
	Georgia	3	0	0	X			X
	Idaho	1*	0	6	X			X
	Texas	2	4 to 5	0	X	X		

Staffing and Other Resources Supporting and Maintaining the EDMS									
		In House Staff				Other Resources			
Product	State	Full Time (dedicated)	Part Time (dedicated)	Nondedicated Staff		Help Desk	On Call Consultants	Permanent Consultants	Vendor Support
ProjectWise	Utah	1	2	1		X			
	Washington	1*	4*	3*		X			
ProjectWise Project and Portfolio Management	Oklahoma	0	0	0		X			
ProjectWise SharePoint eDOCS	Minnesota	10	3	4		X	X	X	
SharePoint	Utah	1	2	1		X	X		

* See the additional information below.

Some respondents offered additional information about support and maintenance of the EDMS:

- **Colorado (ProjectWise)**. All support and maintenance is provided by a consultant associated with the agency's Computer Aided Design and Drafting Program.
- **Idaho (ProjectWise)**.The respondent noted that two or three full-time staff would be preferred to the current single full-time staff member. The agency's Help Desk is provided by the vendor.
- **North Dakota (FileNet)**. The server, infrastructure and some system development (in-house tools) are managed by state IT staff, which includes 3.5 server administrators, 2.5 developers and an EDMS architect.
- **Washington (ProjectWise)**. The agency's one full-time staff member is a ProjectWise administrator. Of the four part-time staff, one is a ProjectWise administrator (30 percent), two are Help Desk staff (10 percent), and one is a computer-aided engineering manager. Of the three nondedicated staff, two provide server support (0.4 percent) and one is a GIS database administrator (0.4 percent).

System Costs

Relatively few respondents offered system costs. Several respondents noted that implementation was too long ago for this information to be readily available (two-thirds of the systems were implemented between 2000 and 2010); in other cases, another group or agency managed the implementation.

Total implementation costs ranged from $65,000 to implement Washington State DOT's ProjectWise in 2005, to $12 to $15 million for Texas DOT's 2015 ProjectWise implementation. Annual maintenance costs also varied widely among survey respondents, ranging from $20,000 to $4 million. The first table below identifies the costs for initial implementation; the second table presents annual maintenance costs.

Initial Implementation Costs

Product	State	Software Cost	Hardware Cost	Total Cost to Implement
DocuSign	**Utah**	$9,000	0	$15,000
FileNet	**Pennsylvania**	$700,000	$200,000	$1 million
ProjectWise	**Connecticut**	Enterprise licensing	Cloud-hosted	Not provided
	Georgia	Enterprise licensing	$50,000	Enterprise licensing; approximately $200,000
	Texas	$2 million	$1.5 to $2 million	$12 to $15 million
	Utah	$200,000	$48,000 (server) $200,000 (data storage)	$750,000 (for project delivery plus current annual fees)
	Washington	Enterprise licensing	$1,600 plus integration and caching servers	$65,000 (2005)
SharePoint	**Utah**	$60,000	$108,000	$600,000

Annual Maintenance Costs

Product	State	Staff Cost	Licensing Cost	Technical Support Cost	Other Cost
DocuSign	**Utah**	0	$20,000	0	N/A
eDOCS	**Florida**	$122,000	$102,000	Included in licensing costs	N/A
FileNet	**Pennsylvania**	$250,000	$200,000	$50,000	N/A
ProjectWise	**Connecticut**	0	0	0	$150,000 (hosting)

Annual Maintenance Costs					
Product	**State**	**Staff Cost**	**Licensing Cost**	**Technical Support Cost**	**Other Cost**
ProjectWise	**Georgia**	$275,000	Enterprise licensing	Enterprise licensing	N/A
	Texas	$4 to $4.5 million	$1.5 to $2 million	$2 million	$3.5 to $4 million (training)
	Utah	$120,000	$355,000	$10,000	N/A
	Washington	$160,000	$100,000*	0	N/A
SharePoint	**Utah**	$120,000	$75,000	$60,000	N/A

* This cost is determined by the number of users * maintenance cost * earned volume discount.

System Assessment

Rating System Functionality

The survey asked respondents to rate their agencies' level of satisfaction with a variety of functions and characteristics associated with an EDMS. Respondents were most satisfied with the basic system functions of scanning, sharing, organizing and storing content. The EDMS function receiving the lowest average rating is the ability of the EDMS to manage a record retention schedule. Survey results indicate that few agencies use this EDMS function.

The table below provides an ordered list of the EDMS functions or characteristics included in the survey that reflects the average rating for each (5 = extremely satisfied; 1 = not at all satisfied). The higher the rating, the greater the level of satisfaction.

Rating EDMS Functionality	
EDMS Function or Characteristic	**Average Rating**
Scan content	4.25
Share content	4.18
Organize content	4.12
Store content	4.11
Search content	4.00
Collaborate on content	3.93
Secure content	3.88
Manage final documents	3.88
Reliability	3.83
Ease of use	3.67
Manage paper documents	3.63
Vendor support	3.44

Rating EDMS Functionality	
EDMS Function or Characteristic	**Average Rating**
Automate workflows	3.43
Manage microfilm	3.40
Flexibility	3.33
Opportunity to customize	3.33
Manage record retention schedule	3.11

System Successes

Many respondents described system successes. Their comments highlighted the ability to collaborate, cost and time savings, a system's ease of use, and the benefits of specific system features and functions. The table below summarizes survey responses.

System Successes			
Type of Benefit	**Product**	**State**	**Comment**
Collaboration	**FileNet**	**Pennsylvania**	Multiple applications can reference a document from central location.
		Tennessee	All divisions can identify the appropriate contact person for each project.
	ProjectWise	**Georgia**	Increased information sharing among offices.
		Idaho	More collaboration statewide.
		Texas	Allows agency to collaborate on projects more efficiently and effectively on current design files.
		Washington	Collaboration with internal and external partners in same workspace.
Cost savings	**Oracle Fusion Middleware**	**Indiana**	Reduction in costs due to going paperless.
Ease of use	**FileNet**	**North Dakota**	Less paper allows for easier searches.
	ProjectWise	**Idaho**	No "snail mailing" of documentation. One design workspace and one location for all users.
		Utah	Ability to access documents wherever the internet is available.
	SharePoint	**Utah**	Easier attributing and file naming; easier movement of documents to archive.

System Successes			
Type of Benefit	**Product**	**State**	**Comment**
Time savings	**DocuSign**	**Utah**	Expedites contract acceptance.
	eDOCS	**Florida**	Significant time savings over working with paper.
	Oracle Fusion Middleware	**Indiana**	Faster turnaround on lettings allowed for an increase in the number of lettings per year.
Other	**Falcon/DMS**	**Alabama**	Archived extensive engineering records that were rapidly deteriorating but must be retained. Freed up extensive floor space for other purposes. Documents are now readily available, searchable and—most important—usable.

System Challenges

Among the challenges reported by respondents are identifying and managing consultants, funding, various technical issues, training and user adoption. The table below summarizes survey responses.

System Challenges			
Type of Challenge	**Product**	**State**	**Comment**
Consultants	**Oracle Fusion Middleware**	**Indiana**	Finding a trusted consultant.
	ProjectWise	**Texas**	Allowing outsourced consultants a working space or container in the system.
Funding	**DocuSign**	**Utah**	Growth and demand is exceeding budget.
Identifying a system	**Falcon/DMS**	**Alabama**	The most difficult task was to find and then implement the system.
Technical issues	**Falcon/DMS**	**Alabama**	Difficult to digitize (or scan) documents (some 80+ years old).
	FileNet	**Pennsylvania**	Cumbersome to use; challenging to find documents. Classification of files is difficult when importing into the EDMS.
		Tennessee	No automatic notices generated when data is entered into the agency's project management system.
	Oracle Fusion Middleware	**Indiana**	Issues with browser support and specific versions.
	ProjectWise	**Connecticut**	The system does not provide a complete project management solution.
	SharePoint	**Utah**	Undefined processes.

System Challenges			
Type of Challenge	**Product**	**State**	**Comment**
Training	**eDOCS**	**Florida**	Continual training of new personnel.
	Oracle Fusion Middleware	**Indiana**	Huge learning curve on these products.
	ProjectWise **SharePoint** **eDOCS**	**Minnesota**	Spotty training and ill-planned initial rollout; staff hesitant to use the EDMS even with updates that make it easier to use.
User adoption	**Falcon/DMS**	**Alabama**	Encouraging the rest of the agency to embrace and use the system.
	ProjectWise	**Colorado**	User adoption.
		Georgia	User adoption.
		Idaho	Getting everyone comfortable with relying on electronic documentation.
		Utah	User acceptance.
		Washington	Transition to EDMS approach/mindset.
	SharePoint	**Utah**	User adoption.

Related Documents

Respondents from Colorado, Connecticut, Georgia, Utah and Washington provided documents related to their use of ProjectWise. Additional information about state DOT use of ProjectWise and other EDMS appears in the **Related Resources** section of this Preliminary Investigation; see page 35.

Colorado

ProjectWise Reference Manual, Colorado Department of Transportation, August 2016.
https://www.codot.gov/business/designsupport/cadd/projectwise-reference-manual/at_download/file
Excerpt from the introduction:

> The guide is made up of three important sections. The first section covers material specific to ProjectWise like terminology, software installation, project setup, security and information on how to use and access project folders and documents.
>
> The second section is specific to the CDOT Project Folder structure including folders specific to Specialty Groups. This section concentrates on folder structure and key document locations.
>
> Each folder structure has been or is being structured with suggestions and guidance from each Specialty Group.
>
> The third section of the reference manual covers additional helpful information including using MicroStation and InRoads with ProjectWise, consultant access, archived projects, and additional training material.

Connecticut

ProjectWise: Collaboration System, Connecticut Department of Transportation, September 2016.
http://www.ct.gov/dot/cwp/view.asp?a=3194&Q=575830
From the web site:

> ProjectWise (PW) Online is CTDOT's current document management system for all capital project contract documents (plans, specifications and other contract documents).
>
> PW Online is a cloud based database with access through both a thick and thin client interface. The thick client interface uses a software called ProjectWise Explorer that offers integration with Microstation, InRoads and Microsoft Office and is primarily used within the CTDOT main office in Newington. The thin client interface is accessed through the web increasing mobility to external users and consultant engineers.
>
> PW Online gives CTDOT robust document management and workflow utilities to maintain version control and eliminate document duplication. Additionally PW Online allows for robust securities, accessibility through the cloud and geospatial attribution of projects and assets.
>
> Along with current design and construction plans, specifications and other contract documents there is a large data set of as-built recorded legacy project plans. In addition to project data, bridge and sign support structure inventory inspection information is being managed with asset to project tagging.

Georgia

ProjectWise, Georgia Department of Transportation, 2015.
http://www.dot.ga.gov/PS/DesignSoftware/Projectwise
This web page provides a wealth of links to ProjectWise user materials, including documents related to workflow, a user manual and instructions for using specific elements of ProjectWise (plotting, deliverables management, and working with ProjectWise features).

Utah

ProjectWise Home, Utah Department of Transportation, 2015.
http://www.udot.utah.gov/go/pw
Training manuals, discussion forums and ProjectWise user guidance are available at this site.

Washington

ProjectWise, Washington State Department of Transportation, March 2016.
http://www.wsdot.wa.gov/Mapsdata/geometrix/projectwise.htm
This web site provides links to a variety of ProjectWise-related resources. From the web site:

> WSDOT originally incorporated ProjectWise in 2005 within the state mega-projects. The Alaskan Way Viaduct, SR520 Floating Bridge, Tacoma HOV, Columbia River Crossing, Triangle Interchange and I-90 Two-Way Transit projects use ProjectWise to manage files and collaborate with internal and external customers. More recently ProjectWise has been used in minor projects and offices that leverage its ability for file access from anywhere in the world. ProjectWise can be accessed through the full-featured ProjectWise Client or through a web browser. WSDOT recommends using the ProjectWise Client whenever possible.

Deliverables 8: ProjectWise, Electronic Engineering Data Standards, Washington State Department of Transportation, August 2015.
http://www.wsdot.wa.gov/publications/manuals/fulltext/M3028/Deliverables8.pdf
This section of a standards manual defines the standards and requirements for using ProjectWise on Washington State DOT projects.

Agencies Preparing to Implement an EDMS

Three states reported that an EDMS implementation is either planned or in process:

- Arizona DOT is researching a "master project tracking system" that includes an EDMS. The agency currently supports several systems that store some electronic documents, but these systems are not actively used to manage documents through the project delivery process.
- The North Carolina DOT respondent provided information about an ongoing initiative:

  > NCDOT is currently developing a cloud-based collaboration initiative which will utilize SharePoint (Microsoft) and ProjectWise (Bentley) technology. The goal will be to provide a content management platform which connects global project teams in a federated security environment, and allows for document, approvals, deliverables management and automated business workflows. File exchange with non-DOT partners is a priority, and they will have access permissions granted based on role assignments. (Likely controlled by an identity management system.)
  >
  > NCDOT's project scheduling system is called StaRS and is developed on the R/3 software platform offered by SAP. A future goal will be to hopefully tie project schedule information into the file collaboration system to further automate business workflow intelligence.
  >
  > We are just beginning a limited rollout of the service after 2-3 years of development.

- Ohio DOT is "kicking off" implementation of ProjectWise.

Related Resources

Below we highlight publications in three categories:

- National guidance
- State DOT practices
- Vendor product information

National Guidance

NCHRP Report 754: Improving Management of Transportation Information, Cambridge Systematics Inc., 2013.
http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_754.pdf
From the Foreword:

> *NCHRP Report 754: Improving Management of Transportation Information* presents (1) a selective review of current practices of state departments of transportation (DOTs) and other agencies that collect, store, and use transportation data and information and (2) guidance on strategies and actions a DOT can implement to improve information capture, preservation, search, retrieval, and governance. The guidance is intended to be sensitive to the diversity of state DOTs; the range of transportation information that DOTs use (related, for example, to project delivery, environmental review, network configuration and design detail, and operations performance); and the variety of formats for transportation information (such as text reports, photographs, plans and drawings, geo-coded databases, and financial analyses).

From page 42 of the report (page 52 of the PDF):

> Many states appear to have effective methods/tools for preserving data/information. Oracle databases, Microsoft SharePoint, and Microstation Project Wise appear to be most commonly used as document management tools for storing and preserving electronic documents.

Case studies include a description of the use of SharePoint by the following states:

- Illinois (page 57 of the report; page 67 of the PDF).
- Minnesota (page 61 of the report; page 71 of the PDF).
- Mississippi (page 67 of the report; page 77 of the PDF).
- Virginia (page 74 of the report; page 84 of the PDF).

Advances in Civil Integrated Management, Scan Team Report, NCHRP Project 20-68A, Scan 13-02, National Cooperative Highway Research Program, April 2015.
http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_13-02.pdf
Electronic Document Management (EDM) Systems, which begins on page 40 of the PDF, offers brief descriptions of several agencies' systems, including Michigan (ProjectWise), Virginia (SharePoint) and Iowa (Doc Express).

Related Resource:

"Electronic Document Management Systems for Transportation Construction Industry," Fangyu Guo, Charles T. Jahren and Yelda Turkan, *5th International/11th Construction Specialty Conference*, June 2015.
https://open.library.ubc.ca/media/download/pdf/52660/1.0076385/1/1695
Excerpt from the abstract:

> The purpose of this paper is to present and analyze current state of the EDM systems within the state DOTs that lead with regard to EDM implementation. During a United States National Cooperative Highway Research Project Domestic Scan effort, seven state DOTs and their contractors collaborated to present their extensive experience on CIM related practices and tools. Of these seven, four distinguished themselves with leadership in the area of EDM systems implementation while others were leaders in other areas. In this paper, those four agencies who are leaders with regard to the EDM systems implementation are analyzed and their practices are documented in detail.

State DOT Practices

Below we highlight two AASHTO surveys that gathered information about state DOT use of an EDMS, along with publications from state DOTs using Falcon/DMS, FileNet and ProjectWise.

AASHTO Surveys

Electronic Document Management Systems (EDMS) and Electronic Signatures, Missouri Department of Transportation, AASHTO Research Advisory Committee (RAC) Member Survey Results, September 2015.
http://research.transportation.org/_layouts/15/aashtorac/racsurveyresultdetail.aspx?surveyid=293
Prior to developing a SharePoint site with workflows to manage the agency's entire agreement process, Missouri DOT used an AASHTO RAC survey to gather information from other states using an EDMS or electronic signatures for agreements. The agency noted that this 2015 project gathered information to update two 2012 projects—an AASHTO survey on digital signatures and an Urban Transportation Monitor survey on electronic document management.

The survey questions included:

- What EDMS are you using?
- What are you using it for?
- How was your EDMS deployed?
- What were the lessons learned?
- What are the capabilities of your EDMS?
- How are documents uploaded?
- What file formats can it accept?
- What security features does it have?
- Does your EDMS interface with other systems within your DOT?
- What does the workflow looks like?
- What type of electronic signatures are you using (and for what)?

Survey responses and related information are included in an Excel workbook available at http://research.transportation.org/_layouts/AASHTORAC/FileDownload.aspx?SurveyFileID=361. This workbook includes survey responses from:

- Arizona
- California
- Colorado
- Connecticut
- District of Columbia
- Florida
- Georgia
- Illinois
- Indiana
- Maryland
- Maine
- Missouri
- Montana
- Nevada
- New York
- Pennsylvania
- Texas

Included in the Excel workbook is this table summarizing the systems used by respondents:

EDMS System	Number of States	States
ProjectWise	4	CO, CT, GA, IL
SharePoint	3	GA, IL, MO
OpenText	2	FL, ME
EMC ApplicationXtender (AX)	1	NV
EMC Captiva	1	PA
Falcon Document Management System	1	CA
IBM FileNet	1	PA
OnBase	1	AZ
Oracle Universal Document Management System	1	IN

Electronic Records, AASHTO Subcommittee on Construction, 2009. http://construction.transportation.org/Documents/SOCSurveyElectronicRecords2009.xls
This AASHTO subcommittee survey gathered information from state DOTs on the use of an EDMS for construction records. Findings from the survey include:

- Almost two-thirds of respondents require retention of both paper and electronic copies of construction records.
- Respondents were evenly split as to when the agency converts construction-related paper documents into electronic files—at the end of the project or as they are received.
- Respondents cited costs, staffing and training most often when asked to provide the top five critical concerns that could challenge implementation of an EDMS.

Falcon/DMS

Virginia

Appendix E: Falcon Document Manager, CADD Manual, Virginia Department of Transportation, April 2016.
http://www.extranet.vdot.state.va.us/locdes/electronic_pubs/cadd_manual/Appendix_E_Falcon.pdf
This manual appendix provides step-by-step instructions, screen shots and database information related to Virginia DOT's use of Falcon.

FileNet

North Dakota

Enterprise Document Management System (EDMS), North Dakota Information Technology Department, 2016.
https://www.nd.gov/itd/services/enterprise-document-management-system-edms
This web site provides a brief description of the various elements of FileNet used by North Dakota DOT and includes links to resources for authorized users.

ProjectWise

Highlighted below are publications describing the use of ProjectWise in nine states—Colorado, Georgia, Kentucky, Maryland, Michigan, New York, Oregon, South Carolina and Texas. Three of these states—Colorado, Georgia and Texas—responded to the survey. Additional information about these states' experiences with ProjectWise appears in the preceding section of this Preliminary Investigation. A New Mexico DOT feasibility assessment that recommended ProjectWise is also included.

A 2015 conference presentation cited below estimates the number of state DOT ProjectWise users:

- 23 states have standardized use of ProjectWise.
- 11 states are implementing the system.

Colorado

CDOT's Office of CADD & ProjectWise Programs, and Highway Engineering Design Processes, Design and Construction Project Support, Colorado Department of Transportation, undated.
https://www.codot.gov/business/designsupport/cadd
This web site offers links to a variety of ProjectWise-related materials including the training videos described below.

Related Resource:

> **ProjectWise User Training Materials**, CDOT's Office of CADD & ProjectWise Programs, and Highway Engineering Design Processes, Design and Construction Project Support, Colorado Department of Transportation, undated.
> https://www.codot.gov/business/designsupport/cadd/projectwise%20-training
> This web site offers a series of training videos that focus on individual aspects of ProjectWise use.

Georgia

"Case Study: ProjectWise at GDOT: Helping Organize Content for User Access and Records Management," Kristi Patterson, Bentley Systems Inc., *2015 Mid-America CADD Community Conference* (user community focusing on Bentley software), August 2015.
http://files.midamericacadd.org/2015presentations/MACC_2015_GDOT_PWcasestudy.pdf
Slide 9 of this conference presentation provides a map graphic illustrating the state DOTs that have standardized the use of ProjectWise (23 states) or are implementing it (11 states). The presentation also offers information about Georgia DOT's ProjectWise implementation, screen shots of the product and a discussion of records management.

Kentucky

ProjectWise Standard Project Folder Structure Policy, Kentucky Transportation Cabinet, undated.
http://transportation.ky.gov/Highway-Design/Documents/ProjectWise%20Standard%20Project%20Folder%20Structure.pdf
This document describes the agency's ProjectWise folder structure for all highway projects.

Maryland

Collaboration Technologies/IDS, Maryland State Highway Administration, undated.
http://www.roads.maryland.gov/Index.aspx?PageId=686
This web page provides links to installation instructions and other ProjectWise user guidance.

Michigan

MDOT ProjectWise: General Information and ProjectWise Support, Michigan Department of Transportation, 2016.
http://www.michigan.gov/mdot/0,4616,7-151-9625_21540_36037-321341--,00.html
This web site offers information for ProjectWise users on the design and construction sides of a project, including enhanced email and folder search tools.

Special Provision for Construction Document Management, Michigan Department of Transportation, September 2014.
http://mdotcf.state.mi.us/public/dessssp/spss_source/12SP-104E-01.pdf
This special provision describes contractors' responsibilities in accessing and using ProjectWise.

ProjectWise: A Change in Construction (Michigan Department of Transportation), Bentley Systems Inc., 2016.
https://www.bentley.com/en/project-profiles/michigan-department-of-transportion_projectwise-a-change-in-construction
This project summary provided by the ProjectWise vendor describes Michigan DOT's transition to the use of ProjectWise for both design and construction documents:

> Because MDOT had used ProjectWise for years to manage design project files, it was a natural choice to use those software for their construction documentation. To start, management initiated four pilot projects that totaled USD 130 million in infrastructure investment. Project stakeholders were required to electronically submit and store all project files in ProjectWise. Additionally, all documents requiring signatures had to be electronically signed, and all documents requiring approval had to be managed using an electronic

approval process. To enhance collaboration and speed information sharing, contractors used mobile devices.

Peer Exchange on e-Construction, Oregon and Michigan Departments of Transportation, Every Day Counts, Federal Highway Administration, March 2015.
http://www.fhwa.dot.gov/construction/econstruction/cai15006.pdf
Page 6 of this peer exchange report describes Michigan DOT's use of ProjectWise to manage documents from design to construction. Among the topics covered are the agency's pilot, costs and licensing, folder and file structure, document access and security, storage and archiving. A discussion of ProjectWise workflow begins on page 12, including project closeout; partnering with IT is addressed on page 17.

Michigan DOT workshop participants offered these recommendations for agencies implementing similar systems:

- Have a small, key team. Use subject matter experts as needed.
- Review and validate communication prior to release.
- Establish a partnering relationship with the IT team.
- Think about additional positions that will need to be established or filled.
- If an issue is really a game changer, treat it like one and get it rectified.
- Funding for servers, IT project staff and other issues may need a champion or high-level support to get timely results within the department.

New Mexico

CADD Content Management Feasibility Assessment, Market Study and Implementation, Mehrdad Razavi and Claudia Mara Dias Wilson, New Mexico Department of Transportation, November 2012.
http://dot.state.nm.us/content/dam/nmdot/Research/NM11ADM-01_CADD_Final%20Report.pdf
Researchers determined the feasibility of using a content management system to aid in managing CAD data throughout New Mexico DOT in conjunction with the agency's consultants. A concise overview of the research and researchers' recommendations appear in the presentation cited below.

Related Resource:

CADD Content Management Feasibility Assessment, Market Study and Implementation, Mehrdad Razavi and Claudia Mara Dias Wilson, New Mexico Department of Transportation, November 2012.
http://dot.state.nm.us/content/dam/nmdot/Research/NM11ADM-01_CADD_MultimediaPresentation.pdf
From the conclusions on slide 30:

- The Autodesk Buzzsaw file sharing system is recommended for immediate use to increase data collaboration throughout the agency and with the extended consultant community.
- The research team recommends ProjectWise should the agency decide to adopt a full file management system.

New York

About NYSDOT ProjectWise…, New York State Department of Transportation, undated.
https://www.dot.ny.gov/main/business-center/engineering/cadd-info/general/projectwise
From the web site:

> ProjectWise is used to manage engineering data at NYSDOT. Consultant engineering firms are required to submit project documents into NYSDOT's ProjectWise System. Consultants must obtain an account to use ProjectWise.

The site also offers links to a ProjectWise Web Parts Reference Guide and other user-related documents.

Oregon

"ODOT ProjectWise: eConstruction Why, How and When," Joe Squire, State Construction and Materials Engineer, Oregon Department of Transportation, *Associated General Contractors Annual Meeting,* February 2016.
https://www.oregon.gov/ODOT/HWY/CONSTRUCTION/docs/AGC_AnnualMtg_2016/06_ConstructionJoe.pdf
This conference presentation describes Oregon DOT's implementation of ProjectWise to manage documents and Arx's Cosign to manage digital signatures. The agency was in the final stages of testing at the time of the presentation. The presentation addresses folder structure, naming conventions, an implementation strategy and external training.

South Carolina

What is ProjectWise?, Doing Business with SCDOT, South Carolina Department of Transportation, November 2015.
http://www.scdot.org/doing/constructionletting_projectwise.aspx
This web site provides instructions for consultants to submit documents to South Carolina DOT using a ProjectWise account. As the web site notes, the agency is planning to expand its use of ProjectWise:

> SCDOT is currently using ProjectWise to manage electronic submission and retrieval of proposals, templates and project documents from Engineering Firms. SCDOT's future goal is to fully utilize ProjectWise to store and backup project documents, share data across project teams to include primary consultants no matter where they are located, and provide SCDOT project managers with additional tools to manage their engineering projects.

Texas

e-Construction Peer-to-Peer Exchange, Summary Report, Texas and Montana Departments of Transportation, Every Day Counts, Federal Highway Administration, November 2015.
https://www.fhwa.dot.gov/construction/econstruction/peer_exchange/tx_mt.pdf
The first topic for this peer exchange, Document Management Systems and Workflows (ProjectWise), was presented by a Texas DOT staff member who described the agency's use of ProjectWise (see page 9 of the report). Implemented on a limited basis in 2009, ProjectWise was recently rolled out statewide. Montana DOT was considering a document management solution at the time of this peer exchange.

File Management System, San Antonio District, Texas Department of Transportation, March 2011.
https://ftp.dot.state.tx.us/pub/txdot-info/sat/specinfo/fms-projectwise.pdf
This document provides an example of one Texas DOT district's application of a ProjectWise file management system, including screen shots, procedures and folder descriptions.

Vendor Product Information

Information about the commercial products used by survey respondents is provided below.

DocuSign, DocuSign Inc., 2016.
https://www.docusign.com/
This product is used by Utah DOT for electronic signatures and approvals.

eDOCS, OpenText Corporation, 2016.
http://www.opentext.com/what-we-do/products/specialty-technologies/edocs-information-management
From the web site:

> eDOCS provides a simple and intuitive way of organizing, working with, and sharing business information—including documents, emails, images, and more. By streaming critical information across digital processes, eDOCS ensures the latest versions of content are available for consumption. In addition, analytic capabilities drive further value, uncovering insights for improved decision-making and competitive advantage.

Falcon/DMS, tsaADVET Inc., 2016.
http://www.tsa.advet.com/
From the web site:

> Whether the focus is general document, CADD, high-volume reprographics, scanning, indexing, document vaults, or locating and viewing documents over the Web, Falcon has a robust solution.

FileNet Content Manager, IBM, undated.
http://www-03.ibm.com/software/products/en/filecontmana
FileNet is described as a "single repository for enterprise content to provide centralized access and better control." FileNet can integrate with Microsoft SharePoint and Office to increase productivity.

ILINX, ILINX Software, 2016.
http://ilinx.com/
Washington State DOT uses ILINX in conjunction with ProjectWise to manage documents. As the web site indicates, "ILINX is designed with a focus on functionality, simplicity, reach and affordability. Implement end-to-end automation or augment existing ECM systems for improved efficiency."

Oracle Fusion Middleware, Oracle, undated.
https://www.oracle.com/middleware/index.html
From the web site:

> Oracle Fusion Middleware is the digital business platform for the enterprise and the cloud. It enables enterprises to create and run agile, intelligent business applications while

> maximizing IT efficiency through full utilization of modern hardware and software architectures.

Project and Portfolio Management, Hewlett Packard Enterprise Development LP, 2016.
http://www8.hp.com/us/en/software-solutions/ppm-it-project-portfolio-management/index.html
As this web site indicates, PPM "standardizes, manages and records project and portfolio activities."

ProjectWise, Bentley Systems Inc., 2016.
https://www.bentley.com/en/products/brands/projectwise
From the web site:

> First released in 1998, ProjectWise has always been the workhorse for design coordination based on organizational and project workflows, or industry standards such as BS1192. With the CONNECT Edition, ProjectWise extends beyond design coordination to comprehensive worksharing, empowering the project team to collaborate throughout the entire project delivery lifecycle.

SharePoint, Microsoft, 2016.
https://products.office.com/en-us/sharepoint/collaboration
This web site offers plans and pricing, a description of add-ins and future plans for SharePoint.

Appendix A: Survey Questions

The following survey was distributed to members of the AASHTO Subcommittee on Design and selected other state DOT contacts to gather information for this Preliminary Investigation.

Survey Introduction

1. Does your agency use an electronic document management system (EDMS) to manage project delivery-related documents?
2. If your agency does not use an EDMS, are there plans to implement one?

System Description

Your agency's EDMS may be composed of more than one tool. When we use the term "EDMS" throughout the survey, we refer to a single system or a suite of electronic tools used to manage documents generated from project inception to closeout.

1. What type of EDMS does your agency use? Select all that apply.
    - Enterprise (agencywide use)
    - Desktop-based (individual desktop use)
    - Single tool
    - Multiple tools
    - Customized software developed specifically for our agency
    - Commercial off-the-shelf (COTS) product
    - COTS product customized for agency use
    - Other (please describe)
2. What is the internal name your agency uses for its EDMS? An example is DOTS (Director's Office Tracking System).
3. If your agency uses a commercial product, what are the names of the product and the vendor?
4. What is the *primary* purpose of your agency's EDMS?
    - Tracking project delivery documents (plans/specifications/estimates)
    - Tracking correspondence
    - Other (please describe)
5. How many users does your agency's EDMS have?
6. Are there system limitations for the number of users or volume of records/data the EDMS can support?
7. What type of electronic content is housed in your agency's EDMS? Select all that apply.
    - Plans
    - Specifications

- Estimates
- Other documents
- Photos
- Videos
- Voice files
- Digital images
- Emails
- Other (please describe)

8. Please provide links to documentation (system specifications, user manual, procedures or other documents) related to your agency's EDMS. Send any files not available online to Chris Kline at chris.kline@ctcandassociates.com.

System Features

9. Which systems used by your agency does the EDMS communicate with? Select all that apply.
    - Engineering project collaboration system
    - Project management system
    - Financial management system
    - Geographic information system
    - Other system (please describe)
10. What functions are supported by the EDMS (even if your agency is not currently using them)? Select all that apply.
    - Store content
    - Share content
    - Organize content
    - Search content
    - Scan content
    - Autopopulate information
    - Collaborate on content
    - Secure content
    - Manage paper documents
    - Manage microfilm
    - Manage final documents (archive)
    - Provide mobile access to content
    - Permit customization

- Integrate e-signature
- Allow data analysis
- Enable/filter geo-referencing
- Other (please describe)

11. Does your agency's EDMS support collaboration with automated workflows? These workflow processes facilitate interaction among work units by sharing information and documents, and providing notifications and status updates.
12. Does your agency's EDMS apply a record retention schedule?

Document Management

13. Please briefly describe the process used to store and manage electronic documents in your agency's EDMS.
14. How does your agency manage paper documents? Select all that apply.
    - Scan and enter all paper documents in the EDMS; discard paper
    - Scan and enter all paper documents in the EDMS; retain paper
    - Scan and enter some paper documents in the EDMS; discard paper if entered in the EDMS
    - Scan and enter some paper documents in the EDMS; retain all paper
    - Retain all paper documents in paper form; do not track in the EDMS
    - Retain all paper documents in paper form; track in the EDMS
    - Create an electronic file backup of paper documents outside of the EDMS (thumb drive, CD, server, cloud, etc.)
    - Other (please describe)

System Implementation and Support

15. When did your agency implement the EDMS?
16. How long did it take to implement the EDMS?
    - Less than 6 months
    - 6 months to less than 1 year
    - 1 year to less than 2 years
    - 2 years to less than 3 years
    - 3 years or more
    - Other (please describe)
17. Was the migration of data from your agency's existing systems to the new EDMS automated?

    Please describe how your agency populated the new EDMS with data and documents.

18. Please share any lessons learned from your agency's experience with data migration and the implementation process in general.
19. What type of training, and how much, was required to implement the EDMS?
20. What type of staff support and/or training, and how much, is needed to provide technical support and equip staff to use your agency's EDMS after the initial implementation?
21. What staff classifications use the EDMS? Select all that apply.
    - Clerical staff
    - Engineering staff
    - Management
    - Other (please describe)
22. Please indicate below the number of each type of in-house staff required to support and maintain the EDMS.
    - Full-time dedicated staff
    - Part-time dedicated staff (as full-time equivalents)
    - Nondedicated staff (as full-time equivalents)
    - Other (please describe)
23. What other resources does your agency use to support and maintain the EDMS? Select all that apply.
    - Help Desk
    - On-call consultants
    - Permanent consultants
    - Other (please describe)

System Costs

24. What was the cost to purchase the software for your agency's EDMS? Please indicate software cost only.
25. What were the hardware-related costs for the EDMS?
26. What was your agency's total cost to implement its EDMS? Include costs for implementation, system customization, training and any other aspects of the implementation process.
27. What are the ongoing annual maintenance costs for the EDMS?
    - Staff costs
    - Licensing costs
    - Technical support costs
    - Other costs (please describe)

System Assessment

28. Please indicate your agency's level of satisfaction with each EDMS characteristic/function listed below using the rating scale of 1 = not at all satisfied to 5 = extremely satisfied.
    - Ease of use
    - Flexibility
    - Reliability
    - Opportunity to customize
    - Vendor support
    - Store content
    - Share content
    - Organize content
    - Search content
    - Scan content
    - Collaborate on content
    - Automate workflows
    - Secure content
    - Manage paper documents
    - Manage microfilm
    - Manage final documents
    - Manage record retention schedule
29. What successes has your agency experienced in using its EDMS?
30. What challenges has your agency experienced in using its EDMS?

Additional Comments

Please use this space to provide any comments or additional information about your previous responses.