



Use of Web-Based Systems to Manage Contractor Submittals: Survey of State Practice

Requested by
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Executive Summary

Background

The Caltrans Division of Construction is seeking to implement a web-based system that allows construction contractors to upload electronic documents (e-documents) and that automates the distribution of e-submittals to appropriate Caltrans reviewers. The system would manage contractors' submittal of e-documents, including shop drawings; stormwater and falsework plans; and other contract-related documents such as insurance confirmation, evidence of good faith efforts, and documents relating to payroll and fringe benefits. Typically, these systems are also used to manage, review, edit, report on and archive these documents.

Implementation of a web-based system that includes an automated notification system to process contractor submittals is expected to facilitate the acceptance of e-documents, improve the timing of turnaround responses and reduce claims associated with untimely responses from Caltrans.

To inform its selection of a web-based system to manage contractors' submittal of e-documents, Caltrans is seeking information from other state departments of transportation (DOTs) about their experience with these systems. To gather this information, CTC & Associates distributed an online survey to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Construction. Survey questions are provided in [Appendix A](#). The full text of survey responses is presented in a supplement to this report.

Summary of Findings

This Preliminary Investigation gathered information in two areas:

- Survey of practice.
- Related research and resources.

Survey of Practice

Fifteen state DOTs responded to the survey. Currently six of these agencies are not using a web-based system to manage contractor submittals but all are reviewing new systems or have plans to transition to an online system that manages contractor submittals.

Ten state DOTs participating in the survey are using a web-based contractor submittal system. Key findings from these respondents are presented below in the following topic areas:

- System description.
- System functionality.
- System implementation.
- Potential impacts.
- System assessment.

(Two Michigan DOT divisions responded to the survey. The Construction Field Services Division is using a web-based submittal system; the Contract Services Division is not currently using such a system but is planning to implement one for prebid submittals.)

System Description

Respondents reported on a range of web-based systems used for managing construction documentation that include commercial off-the-shelf (COTS) products, systems developed in-house, and a combination of COTS and in-house systems. Software as a service and a customized COTS product were cited most often as the types of online systems used. Most of the state DOTs surveyed use systems that do not reside on their agencies' internal network or behind their agencies' firewall. Only three states—Michigan, Pennsylvania and West Virginia—have submittal systems that reside on an internal network and/or behind a firewall.

System Functionality

Nearly all of the 10 states using a web-based submittal system upload or process documentation relating to payroll and fringe benefits to their systems. Shop drawings and falsework plans are also typically uploaded and processed along with contract schedules, material lists and safety plans. In Arkansas, each construction contract issued by the DOT includes a special provision requiring contractors to submit all construction project documentation through the agency's web-based system. Florida DOT's system archives final contract documents in an electronic document management system within the agency's domain.

In addition to reporting on the documentation stored on their systems, respondents were asked to indicate which of 20 features and functions their systems supported. All of the agencies using a web-based submittal system allow upload access to contractors. Other frequently cited features included:

- Upload access for agency staff.
- Automated notification of e-document receipt, modification and approval.
- Document status tracking.
- Document archival.
- Smartphone or tablet access.

Pennsylvania DOT's system also provides links to other department systems, publications, forms and reference location with manuals for its system and other department systems.

System Implementation

Most agencies implemented their web-based submittal systems within the past five years. Implementation time varied or is ongoing for some agencies using multiple systems. All state DOTs using a web-based submittal system except Michigan piloted their systems before purchasing or subscribing to the product.

Cost to implement systems also varied and was based on a range of factors, including total number or value of construction contracts, or a percentage of the total value of active projects. Similarly, information about annual maintenance costs was limited and varied. Alabama and Washington State DOTs paid a one-time contract fee for their systems; Arkansas, Rhode Island and Washington State DOTs pay an annual subscription or licensing fee. Other payment arrangements applicable to states using a web-based submittal system include fees based on user licenses, number of construction contracts and the value of the total construction projects. None of the state DOTs using a web-based system pays a fee for each e-document submitted. Respondents provided limited information related to length of service, contract or subscription.

Potential Impacts

Web-based submittal systems appeared to have little impact on agencies' contract award processes, review and approval of shop drawings, or number of contracts that can be closed out. Arkansas and Michigan DOTs reported improved efficiency with their contract award processes. Respondents from Arkansas, Michigan and Pennsylvania DOTs said their systems significantly improved the speed of approvals. Respondents from North Dakota, Rhode Island and Washington State DOTs reported that their systems were not used to review and approve shop drawings. In reference to the number of contracts that can be closed out, North Dakota DOT's system has made completing the certified payroll portion of a project file quicker and much simpler.

System Assessment

Nearly all respondents reported that their agencies were satisfied to extremely satisfied with their systems overall. Only Florida DOT is less than satisfied with its overall Project Solve SharePoint system. Six states reported specific cost savings as a result of implementing a web-based system. Areas impacted included printing and shipping, and staff and consultant hours. Pennsylvania DOT reported a three-year return on investment of 446 percent, with \$6.3 million in costs and \$34.4 million in benefits. Other benefits of agencies' web-based submittal systems included system efficiency, functionality and labor compliance. Challenges reported by survey respondents were limited and related to system functionality, staff and user buy-in, and training.

Related Research and Resources

National resources highlight e-construction practices and products, including two Federal Highway Administration (FHWA) publications: an overview of e-construction practices in 13 states and a 2018 matrix of the products used by state DOTs for a range of e-construction activities. State research includes a 2015 how-to guide developed by Florida DOT to support the FHWA's Every Day Counts goal of helping state DOTs understand how to implement an e-construction system, a 2016 Minnesota DOT report with best practices for producing and delivering road construction plans and documentation electronically, and a 2017 Utah DOT report about automated systems for contract and invoice management.

Gaps in Findings

While most of the survey respondents using a web-based submittal system provided detailed information about their systems' features and functionality, limited information was provided for aspects of implementation, specifically related to costs and contractual elements of respondents' systems. Follow-up inquiries that target specific areas of interest to Caltrans may lead to valuable additional information.

Next Steps

Moving forward, Caltrans could consider:

- Reviewing the systems described by survey participants using a web-based submittal system to identify attributes of interest to Caltrans. Follow-up discussions with these agencies could provide more information about system impacts and challenges.
- Contacting Rhode Island and Virginia DOTs for information about their applications that is not available externally.

- Contacting state DOTs that are not using a web-based submittal system but that are reviewing new systems or have plans to transition to an online system to learn about the decision-making processes these agencies are using to choose a product.
- Investigating other commercial products not identified by survey respondents that might be of interest to Caltrans.

Detailed Findings

Background

Contractors completing work on a construction project submit electronic documents (e-documents) to Caltrans' Divisions of Engineering Services and Construction. Some submittals require a Caltrans response by a contract-specified date. Currently, there are no electronic contract management tools in place within Caltrans that allow contractors to upload e-document submittals and automate the distribution of e-submittals to appropriate Caltrans reviewers. Contractors can submit bid-related materials through a web interface, but all other submittals are currently handled by standard mail delivery.

The Caltrans Division of Construction is seeking to implement a web-based system to manage contractors' submittal of e-documents, including shop drawings; stormwater and falsework plans; and other contract-related documents such as insurance confirmation, evidence of good faith efforts, and documents relating to payroll and fringe benefits. Typically, these systems are also used to manage, review, edit, report on and archive these documents.

Implementation of a web-based system that includes an automated notification system to process contractor submittals is expected to facilitate the acceptance of e-documents, improve the timing of turnaround responses and reduce claims associated with untimely responses from Caltrans.

Survey of Practice

Survey Approach

To inform its selection of a web-based system to manage contractors' submittal of e-documents, Caltrans is seeking information from other state departments of transportation (DOTs) about their experience with these systems. To gather this information, CTC & Associates distributed an online survey to members of the American Association of State Highway and Transportation Officials (AASHTO) Committee on Construction. Survey questions are provided in [Appendix A](#). The full text of survey responses is presented in a supplement to this report.

Summary of Survey Results

Fifteen state DOTs responded to the survey:

- Alabama.
- Arizona.
- Arkansas.
- Florida.
- Michigan (two responses).
- New Hampshire.
- New Jersey.
- North Dakota.
- Oklahoma.
- Pennsylvania (two responses).
- Rhode Island.
- South Dakota.
- Virginia.
- Washington.
- West Virginia.

Respondents from 10 states—Alabama, Arkansas, Florida, Michigan (Construction Field Services Division), North Dakota, Pennsylvania, Rhode Island, Virginia, Washington and West Virginia—reported on their states' use of web-based systems.

Respondents from six states—Arizona, Michigan (Contract Services Division), New Hampshire, New Jersey, Oklahoma and South Dakota—are not currently using a web-based system to manage contractor submittals but are reviewing new systems or have plans to transition to an online system that manages contractor submittals:

Arizona. The agency is currently reviewing commercial packages to replace an in-house system that does not handle submittals. The suite of commercial packages expected to be adopted will manage contractor submittals.

Michigan. The Contract Services Division respondent reported that funding limitations and a backlog of information technology (IT) projects have delayed implementation of a web-based system. The division plans to use AASHTOWare Project and in-house software for prebid submittals.

New Hampshire. The respondent noted that while a web-based system is needed, cost and other IT priorities have delayed implementation efforts within the agency.

New Jersey. The agency is reviewing e-Builder, a cloud-based project management solution for capital projects.

Oklahoma. The agency is planning a pilot with the Doc Express application from Info Tech, Inc.

South Dakota. The agency is currently “moving toward using a web-based system for contractors to submit their project payroll information.”

Survey results from the 10 states using a web-based contractor submittal system are presented below in the following topic areas:

- System description.
- System functionality.
- System implementation.
- Potential impacts.
- System assessment.

Supplementing these survey results are findings from a limited literature search, which are provided in **Related Research and Resources** beginning on page 27.

System Description

Respondents indicated which of the following applications and services described the type of online systems that their agencies use to accept and process contractors’ web-based submittals:

- Software as a service (SAAS).
- Enterprise (agencywide use).
- Desktop-based (individual desktop use).
- Single/stand-alone online system.
- System developed in-house.
- Custom software developed specifically for agency.
- Commercial off-the-shelf (COTS) product.
- COTS product customized for agency use.

- Multiple tools (part of a larger system).
- Cloud-based system.
- Other.

SAAS and a customized COTS product were cited most often among these applications and services. A single/stand-alone online system was least cited. Respondents from three state DOTs reported on other types of online systems. Florida and Pennsylvania DOTs use a SharePoint-based system. In North Dakota, the only electronic documents currently collected through a web-based system are certified payrolls, workforce reporting and construction site compliance. The agency is considering web-based systems for other documents such as shop drawings and good faith efforts. The table below summarizes survey responses.

Type of Online System Used to Manage Web-Based Submittals											
State	Software as a Service	Enterprise (Agencywide Use)	Desktop-Based (Individual Desktop Use)	Single/Stand-Alone Online System	Multiple Tools (Part of Larger System)	Cloud-Based System	System Developed In-House	Custom Software Developed Specifically for Agency	COTS Product	COTS Product Customized for Agency Use	Other
Alabama						X			X		
Arkansas	X					X			X		
Florida								X			X
Michigan	X	X	X		X					X	
North Dakota	X										X
Pennsylvania 1										X	
Pennsylvania 2							X	X		X	X
Rhode Island	X						X			X	
Virginia	X			X	X	X	X	X	X	X	
Washington			X				X			X	
West Virginia	X	X	X			X			X		
TOTAL	6	2	3	1	2	4	4	3	4	6	3

When asked to further describe their systems, respondents reported on a range of systems used for managing construction documentation that include COTS products, systems developed in-house, and a combination of COTS and in-house systems. The Alabama DOT respondent noted that the agency is piloting Primavera Submittal Exchange and is interested in further pilots with additional software solutions.

Most of the state DOTs surveyed use systems that do not reside on the agency’s internal network or behind the agency’s firewall. Only respondents from three states—Michigan, Pennsylvania and West Virginia—reported that the submittal system resided on the agency’s internal network and/or behind its firewall. The table below summarizes survey responses.

Description of Web-Based Submittal System				
State	System	COTS Product Vendors	On Internal Network	Behind Agency Firewall
Alabama	Primavera Submittal Exchange (pilot)	Oracle Corporation	No	No
Arkansas	Doc Express	Info Tech, Inc.	No	No
Florida	Project Solve SharePoint (PSSP)	N/A	No	No
Michigan	<ul style="list-style-type: none"> • <i>ProjectWise</i>: Manage most field construction documents, such as schedules, materials lists, shop drawings. • <i>LCPtracker</i>: Manage payrolls. 	<ul style="list-style-type: none"> • <i>ProjectWise</i>: Bentley Systems, Inc. • <i>LCPtracker</i>: LCPtracker, Inc. 	No	Yes
North Dakota	LCPtracker	LCPtracker, Inc.	No	No
Pennsylvania 1	PennDOT Project Collaboration Center (PPCC)	<i>SharePoint</i> : Microsoft.	Yes	Yes
Pennsylvania 2	PPCC	N/A	Yes	N/A
Rhode Island	<ul style="list-style-type: none"> • <i>PRISM</i>: Track certified payroll and subcontractor payment. • Project Management Portal (PMP)-Construction Management System (CMS) (in-house system): Track requests for information (RFIs) and shop drawings. 	<ul style="list-style-type: none"> • <i>PRISM</i>: ARES Corporation. • Bluebeam, Inc. • <i>HeadLight</i>: Pavia Systems. • <i>SharePoint</i>: Microsoft. 	No	No
Virginia	<ul style="list-style-type: none"> • Cadac, ProjectWise, PlanGrid (all COTS, with some customization). • Project Document Management System (PDMS) (in-house system). 	<ul style="list-style-type: none"> • <i>Cadac</i>: Cadac Group. • <i>ProjectWise</i>: Bentley Systems, Inc. • <i>PlanGrid</i>: PlanGrid, Inc. 	No	No
Washington	<ul style="list-style-type: none"> • AASHTOWare Expedite. • Apprentice Utilization Reporting Application (AURA) (in-house system). 	<i>AASHTOWare Expedite</i> : AASHTO.	N/A	N/A

Description of Web-Based Submittal System				
State	System	COTS Product Vendors	On Internal Network	Behind Agency Firewall
West Virginia	<ul style="list-style-type: none"> • AASHTOWare. • BidX/Bid Express. • wvOASIS. • ProjectWise. • Citrix. 	<ul style="list-style-type: none"> • AASHTOWare. • <i>BidX/Bid Express</i>: Info Tech, Inc. • <i>wvOASIS</i>: West Virginia OASIS. • <i>ProjectWise</i>: Bentley Systems, Inc. • <i>Citrix</i>: Citrix Systems, Inc. 	Yes	Yes

Related Resources

Documentation provided by survey respondents and other resources related to some of the web-based submittal systems are provided below. The Rhode Island DOT respondent noted that system documentation is unavailable because all of the commercial applications are in development and testing. Most of the documentation regarding Virginia DOT’s systems is on internal sites. Information is available from the respondent.

Alabama

Primavera Submittal Exchange Cloud Service, Oracle, undated.

<https://www.oracle.com/applications/primavera/products/submittal-exchange/>

Primavera Submittal Exchange Cloud Service is “a secure, online system for electronically exchanging, reviewing, and archiving construction communications.” This web site provides a brief overview about the system along with key features and benefits.

Related Resource:

Primavera Submittal Exchange Cloud Service, Oracle, 2017.

<http://www.oracle.com/us/products/applications/primavera/primavera-submittal-exchange-cs-3700087.pdf>

This data sheet provides additional details about the features and benefits of Primavera Submittal Exchange.

Arkansas

Guidelines for Using Doc Express on ARDOT Projects, Construction Systems Administration, Arkansas Department of Transportation, January 15, 2019.

http://ardot.gov/construction_division/Contractor_Guide_DocExpress.pdf

These guidelines provide information for accessing and using Doc Express. The system structure has three general areas (referred to as drawers): contractor submittals, correspondence and department-only. While not a step-by-step procedural manual, the document “discuss[es] the workflow and naming conventions for documents and correspondence submitted and stored in Doc Express. ... Every Contract in Doc Express is similar to a filing cabinet. Within a Contract, there are multiple Drawers. Some Drawers have

Types which allow the user to identify or mark documents based on content. More than one type may be selected for a single document. Also, some Drawers have a designated Workflow allowing a user to review, approve/reject, and pass the document to another user for review and approval. Other Drawers are simply for document storage.”

Michigan

“**E-Construction**,” *Construction Manual*, Michigan Department of Transportation, 2018.

<http://mdotwiki.state.mi.us/construction/index.php/E-Construction>

This resource provides information for using ProjectWise software to access, share and manage electronic files related to Michigan DOT contracts.

“**LCPtracker Supplemental Information**,” *Construction Manual*, Michigan Department of Transportation, 2018.

http://mdotwiki.state.mi.us/construction/index.php/LCPtracker_Supplemental_Information

Information is provided about Michigan DOT’s LCPtracker (labor compliance program tracker), which is used to “receive, review and approve payroll and associated prevailing wage documents.”

North Dakota

LCPtracker, LCPtracker, Inc., undated.

<https://lcptracker.com/>

This web site provides information about this construction payroll software solution for managing construction labor compliance, submitting construction daily reports or accessing labor compliance training.

Pennsylvania

PPCC Training—Portal Site, Pennsylvania Department of Transportation, 2015.

See [Attachment A](#).

This presentation explains how to access the PPCC portal and use the preliminary tabs on the main menu.

PPCC Training—Project Site, Pennsylvania Department of Transportation, 2015.

See [Attachment B](#).

This presentation explains how to use the PPCC for a specific project.

PennDOT Project Collaboration Center—PPCC Training: Submittal Workflows,

Pennsylvania Department of Transportation, 2018.

See [Attachment C](#).

This presentation describes submittal workflows (accepted, revise and resubmit, and rejected) and internal workflows (department to department and department to contractor).

System Functionality

Project Documentation

Respondents indicated which of the following types of documents can be uploaded to and processed by their agencies’ systems:

- Documents relating to payroll and fringe benefits.
- Shop drawings.
- Stormwater plans.

- Evidence of disadvantaged business enterprise (DBE) good faith efforts.
- Falsework plans.
- Insurance confirmation.
- Subcontractor substitution requests.
- Other.

Nearly all of the states surveyed use their systems to upload or process documents relating to payroll and fringe benefits. Shop drawings and falsework plans are also typically uploaded and processed. Survey responses are summarized in the table below.

Types of Documents Uploaded/Processed by Respondents' Systems									
State	System	Payroll/Fringe Benefits	DBE Good Faith Efforts	Falsework Plans	Insurance Confirmation	Shop Drawings	Stormwater Plans	Subcontractor Substitution Requests	Other
Alabama	Primavera Submittal Exchange	X	X	X		X		X	X
Arkansas	Doc Express	X	X	X	X	X	X	X	X
Florida	PSSP								X
Michigan	ProjectWise, LCPtracker	X		X		X	X	X	X
North Dakota	LCPtracker	X							
Pennsylvania 1	PPCC	X		X	X	X	X		
Pennsylvania 2	PPCC	X	X	X	X	X	X		X
Rhode Island	PRISM, PMP-CMS	X				X			
Virginia	Cadac, ProjectWise, PlanGrid, PDMS	X	X	X	X	X	X	X	
Washington	AASHTOWare Expedite, AURA								X
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	X							X
TOTAL		9	4	6	4	7	5	4	7

Additional Documents

Several survey respondents provided information about additional documents that are uploaded to and processed by their systems. The respondent from Arkansas DOT noted that each contract includes a special provision requiring contractors to submit all construction project

documentation through the agency’s web-based system. Florida DOT’s system stores all types of documents related to a construction contract. Final documents are archived in an electronic document management system (EDMS) inside the agency’s domain. While West Virginia DOT currently only uploads and processes documents related to payroll and fringe benefits, the agency is moving most documents to its system. The table below summarizes information about additional documentation stored on agencies’ systems.

Other Documents Uploaded/Processed by Respondents’ Systems		
State	System	Description
Alabama	Primavera Submittal Exchange	Requests for application (RFAs), RFIs, material certifications, schedules, meeting minutes.
Arkansas	Doc Express	Special provision in each contract requires all documentation be submitted through Doc Express.
Florida	PSSP	Types of documents and format are controlled by the EDMS.
Michigan	ProjectWise, LCPtracker	Contract schedules, material lists, safety plans, nearly all contractor submittals.
Pennsylvania 2	PPCC	RFIs, source of supply (SOS).
Washington	AASHTOWare Expedite, AURA	Monthly apprentice tracking report, apprentice utilization plan, apprentice utilization good faith effort, bid proposal, bid deposit.
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	Moving most documentation to AASHTOWare Project.

System Features

In addition to reporting on the documentation stored on their systems, respondents were asked to indicate which of the following features and functions were supported by their web-based submittal systems:

- Upload access for contractors.
- Upload access for agency staff.
- Automated notification of e-document receipt.
- Automated notification of e-document modification.
- Automated notification of e-document approval.
- Automated routing of e-document by task area/responsibility.
- Document markup.
- Document stamping.
- Document signing.
- Document archival.
- Data export to spreadsheet.
- Standard agency reporting.
- Standard contractor reporting.
- Customized agency reporting.
- Customized contractor reporting.

- Customized submittal logs.
- Generation of time-sensitive alerts.
- Document status tracking.
- Smartphone access.
- Tablet access.

All of the agencies surveyed allow upload access to contractors. Other frequently cited features included upload access for agency staff, automated notification of e-document receipt and tablet access. The Pennsylvania 2 respondent also noted that the agency's system provides links to other department systems, publications, forms and reference location with manuals for its system and other department systems. The table that begins on the next page summarizes survey responses.

System Features and Functions

State	System	Upload Access for Contractors	Upload Access for Agency Staff	Automated e-Document Receipt Notification	Automated e-Document Modification Notification	Automated e-Document Approval Notification	Automated Routing of e-Document by Task Area/Responsibility	Customized Submittal Logs	Time-Sensitive Alerts	Document Status Tracking	Document Markup	Document Stamping	Document Signing	Document Archival	Data Export to Spreadsheet	Standard Agency Reporting	Standard Contractor Reporting	Customized Agency Reporting	Customized Contractor Reporting	Smartphone Access	Tablet Access
Alabama	Primavera Submittal Exchange	X	X	X	X	X		X	X	X			X	X	X					X	X
Arkansas	Doc Express	X	X			X				X	X		X	X						X	X
Florida	PSSP	X	X	X	X	X	X	X		X				X	X					X	X
Michigan	ProjectWise, LCPtracker	X	X	X			X			X				X						X	X
North Dakota	LCPtracker	X	X										X		X	X	X	X	X		X
Pennsylvania 1	PPCC	X		X	X	X	X	X		X	X		X	X	X	X		X			X
Pennsylvania 2	PPCC	X	X	X		X	X			X				X		X				X	X
Rhode Island	PRISM, PMP-CMS	X	X	X	X			X		X				X				X			
Virginia	Cadac, ProjectWise, PlanGrid, PDMS	X	X	X	X	X					X									X	X

System Features and Functions

State	System	Upload Access for Contractors	Upload Access for Agency Staff	Automated e-Document Receipt Notification	Automated e-Document Modification Notification	Automated e-Document Approval Notification	Automated Routing of e-Document by Task Area/Responsibility	Customized Submittal Logs	Time-Sensitive Alerts	Document Status Tracking	Document Markup	Document Stamping	Document Signing	Document Archival	Data Export to Spreadsheet	Standard Agency Reporting	Standard Contractor Reporting	Customized Agency Reporting	Customized Contractor Reporting	Smartphone Access	Tablet Access
Washington	AASHTOWare Expedite, AURA	X		X	X	X	X		X							X		X			
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
TOTAL		11	9	9	7	8	6	4	3	8	4	1	5	8	5	5	2	5	2	7	9

System Implementation

Most agencies implemented their web-based contractor submittal systems within the past five years. Michigan DOT implemented its system in 2012, and the West Virginia DOT respondent reported that system implementation has been ongoing since 2009. Implementation for some systems used by Rhode Island and Virginia DOTs is also underway.

Only one state surveyed—Michigan—did not conduct a pilot to test the system before purchasing or subscribing to the product.

Implementation time for agencies' systems ranged from three months to two years. Implementation time can vary or is ongoing for some agencies with multiple systems. In Arkansas, the contract signing portion was implemented over three to four months beginning in 2014, with a few jobs per letting; the construction document submittal jobs were also implemented over three to four months with five jobs per letting. The agency respondent noted that “[i]n hindsight, the first five construction projects should have been tested for at least six months before adding more jobs to this system.”

Cost to implement systems also varied. Of those respondents providing information, some said cost was based on the total number or value of construction contracts, or on a percentage of the total value of active projects. Similarly, information about annual maintenance costs was limited and varied. The respondents from Arkansas and Florida DOTs provided cost information based on the number of active contracts. In Virginia, the respondent noted that in addition to costs for services or software, the agency pays fees to telecommunications providers to support iPad use for field crew members using PlanGrid. North Dakota did not report a fee since staff performs system maintenance.

The table below summarizes survey responses about system implementation and costs.

System Implementation and Costs				
State	Year Implemented	Time to Implement	Cost to Implement	Annual Maintenance Costs
Alabama	2016 (pilot)	6 months to 1 year	Approx. 0.05% of contract cost.	N/A
Arkansas	<i>Doc Express</i> : April 2014. <i>Contractor submittal system</i> : March 2016.	<i>Doc Express</i> : 3 to 4 months with some jobs/letting. <i>Contractor submittal system</i> : 3 to 4 months with 5 jobs/letting.	<ul style="list-style-type: none"> <i>Initial cost</i>: \$50/active contract. <i>Total cost</i>: \$100,000 for 300 active contracts. 	\$125,000 for 500 active contracts.
Florida	May 2014	Approx. 6 months	Approx. \$500,000	Currently \$624,000 (varies based on number of contracts).
Michigan	2012	2 years	N/A	N/A

System Implementation and Costs				
State	Year Implemented	Time to Implement	Cost to Implement	Annual Maintenance Costs
North Dakota	October 2017	18 months	Percentage of total value of active projects.	N/A (staff performs maintenance)
Pennsylvania 1	Late 2015 into 2016	Approx. 18 months	N/A	N/A
Pennsylvania 2	<i>Pilot: November 2013. Some projects: 2014. All projects: 2015.</i>	18 months to 2 years	N/A	N/A
Rhode Island	<i>PRISM: 2017. Bluebeam and HeadLight: Underway.</i>	<i>Bluebeam, HeadLight: Underway.</i>	<i>Pilot: Approx. \$100,000 for \$35 million in construction costs.</i>	N/A
Virginia	<i>Cadac: N/A. ProjectWise: N/A. PlanGrid: Pilot since September 2018. PDMS: In development.</i>	A few years expected	Varies based on cost of product and hardware	<ul style="list-style-type: none"> • Costs for service or software. • <i>PlanGrid</i>: Fees to telecommunications provider to support iPad use.
Washington	<i>AASHTOWare Expedite: 5 to 10 years. AURA: Approx. 5 years ago.</i>	<i>AASHTOWare Expedite: 1 to 2 years. AURA: 1 to 2 years.</i>	N/A	N/A
West Virginia	Underway (started in 2009).	Varies	Varies	Varies

Payment Arrangement for System Use

Respondents were asked to indicate which of the following payment arrangements were applicable to their systems:

- Agency pays a fee for each e-document submitted.
- Agency pays a per-user fee.
- Agency paid a one-time contract fee.
- Agency pays an annual subscription/licensing fee.
- Other.

Most of the states surveyed described a payment arrangement different from the options provided, including fees based on user licenses, the number of construction contracts and the

value of the total construction projects. Alabama DOT pays a one-time contract fee, and Arkansas and Rhode Island DOTs pay an annual subscription or licensing fee. Washington State DOT pays an annual subscription or licensing fee for AASHTOWare Expedite and a one-time contract fee for AURA. None of the state DOTs surveyed pays a fee for each e-document submitted. The table below summarizes survey responses.

Payment Arrangement for System Use				
State	System	One-Time Contract Fee	Annual Subscription/ Licensing Fee	Other
Alabama	Primavera Submittal Exchange	X		N/A
Arkansas	Doc Express		X	N/A
Florida	PSSP			Monthly fee per construction contract.
Michigan	ProjectWise, LCPtracker			<ul style="list-style-type: none"> • <i>ProjectWise</i>: Per-user fee. • <i>LCPtracker</i>: Per-contract value fee.
North Dakota	LCPtracker			Subscription fee based on total dollar value of all projects in system.
Pennsylvania 1	PPCC			N/A
Pennsylvania 2	PPCC			No fee charged for using system.
Rhode Island	PRISM, PMP-CMS		X	N/A
Virginia	Cadac, ProjectWise, PlanGrid, PDMS			<ul style="list-style-type: none"> • <i>PlanGrid</i>: Monthly fee based on user licenses. • <i>Cadac</i>: Annual fee based on project size paid monthly based on services rendered.
Washington	AASHTOWare Expedite, AURA	X	X	<ul style="list-style-type: none"> • <i>AASHTOWare Expedite</i>: Annual subscription/ licensing fee. • <i>AURA</i>: One-time contract fee.
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix			Different licensing options for each system.

Contractual Elements of Respondents' Systems

Respondents were also asked to provide information about the following contractual elements of their systems:

- Length of service (if SAAS).
- Length of contract.
- Length of subscription.

Response to this portion of the survey was limited, and the information that was received varied:

- *Length of service* ranged from the length of the contract (Alabama) or pilot/project (Virginia) to indefinite (North Dakota) or varied (West Virginia).
- *Length of contract* was indefinite (North Dakota) or varied (West Virginia) among those respondents providing information.
- *Length of subscription* ranged from indefinite or varied (North Dakota, Virginia and West Virginia) to every year or every three years (Alabama, Arkansas and Washington).

The table below summarizes survey responses.

Contractual Elements of Respondents' Systems				
State	System	Length of Service	Length of Contract	Length of Subscription
Alabama	Primavera Submittal Exchange	Length of contract	Approx. 3 years	Approx. 3 years
Arkansas	Doc Express	Using software since 2014	Annual	Annual
Florida	PSSP	N/A	5 years	N/A
Michigan	ProjectWise, LCPtracker	N/A	N/A	N/A
North Dakota	LCPtracker	Indefinite	Biannual	Indefinite
Pennsylvania 1	PPCC	N/A	N/A	N/A
Pennsylvania 2	PPCC	N/A	N/A	N/A
Rhode Island	PRISM, PMP-CMS	N/A	1 year beginning May 2018 as test program	N/A
Virginia	Cadac, ProjectWise, PlanGrid, PDMS	Depends on length of project or pilot	Depends on length of project or pilot	Depends on length of project or pilot
Washington	AASHTOWare Expedite, AURA	N/A	N/A	Annual
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	Varies	Varies	Varies

Potential Impacts

Respondents also identified the impacts of implementing the web-based system on the following activities:

- Contract award process.
- Review and approval of shop drawings.
- Number of contracts that can be closed out.

Contract Award Process

Most respondents reported that their web-based systems did not impact the contract award process. Respondents from two states—Arkansas and Michigan—said their web-based systems had impacted the process. The Arkansas DOT respondent reported that with BidX, internet bidding improves efficiency, reduces bidding errors and helps to standardize the bidding documents that highway contractors submit. However, sometimes new contractors don't understand the system and require a more detailed explanation of the process. With Doc Express, the entire process—from contractor submittals to contract signings—is improved and more efficient. The Michigan DOT respondent reported that the agency's systems (ProjectWise and LCPtracker) have generally resulted in "faster approvals and awards."

Review and Approval of Shop Drawings

Similarly, most respondents said their systems either did not impact the review and approval of shop drawings (Alabama, Florida, Pennsylvania 2, Virginia and West Virginia) or their systems were not used to review and approve shop drawings (North Dakota, Rhode Island and Washington). Respondents from Arkansas, Michigan and Pennsylvania 1 DOTs said their systems did impact the review and approval process: The web-based systems in all three states have significantly improved the speed of approvals. Michigan DOT's systems also allowed better tracking abilities.

The Arkansas DOT respondent provided more detail about the agency's experience, noting that while current practices further reduce the overall review and approval time, revisions to current practices are needed. For example, the agency does not have email contacts for all of its fabricators nor does its current web-based submittal system have an easy way to correspond directly with fabricators to speed up the approval process when revisions to shop drawings are required. Also, printing costs to the local budget have increased even though printing costs for the project decreased: "The burden of making any necessary hard copies—when preferred by the reviewer, for example—is now coming from [the agency's] budget." Finally, the submittal system does not easily allow for updates to existing submittals if revisions are required. Whether reviewers are unfamiliar with the preferred process for submitting revisions or the system lacks capabilities, being able to "track down final-approved shop drawings may become cumbersome when there are multiple approved submittals for a particular set of shop drawings."

Number of Contracts Closed Out

Two state DOT respondents commented on the impact of a web-based submittal system on the number of contracts that could be closed out. In North Dakota, the certified payroll portion of a project file has become paperless, quicker and much simpler. The Virginia DOT respondent said the agency would be better able to identify the impacts in the future. Respondents from the remaining transportation agencies reported that a web-based submittal system did not impact the number of contracts that could be closed out.

System Assessment

Respondents were asked to assess their web-based submittal systems, rating a series of characteristics and the overall system satisfaction from the agencies' and contractors' perspective. Using a rating scale of 1 = not at all satisfied to 5 = extremely satisfied, nearly all respondents reported that their agencies were satisfied to extremely satisfied with their systems overall. Only Florida DOT is less than satisfied with its overall PSSP system. The table below summarizes survey responses.

System Assessment										
State	System	Ease of Use	Flexibility	Reliability	Automated Workflows	Ability to Customize	Reporting Features	Archiving Features	Contractor Satisfaction With System	Overall Agency Satisfaction With System
Alabama	Primavera Submittal Exchange	2	2	4	4	2	2	3	4	3
Arkansas	Doc Express	5	4	4	3	3	2	4	4	4
Florida	PSSP	3	1	3	2	1	2	3	3	2
Michigan	ProjectWise, LCPtracker	4	4	5	4	4	4	4	4	4
North Dakota	LCPtracker	4	4	4	4	3	5	5	4	4
Pennsylvania 1	PPCC	4	4	4	4	4	3	3	4	4
Pennsylvania 2	PPCC	5	4	4	5	5	4	N/A	4	5
Rhode Island	PRISM, PMP-CMS	3	3	3	4	4	4	4	N/A	4
Virginia	Cadac, ProjectWise, PlanGrid, PDMS	4	2	4	2	2	3	2	3	3
Washington	AASHTOWare Expedite, AURA	3	3	N/A	4	3	4	3	3	3
West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	4	4	4	4	4	4	4	4	4

Cost Savings and Other System Benefits

As a result of implementing a web-based submittal system, six states—Alabama, North Dakota, Pennsylvania 2, Virginia, Washington and West Virginia—reported specific cost savings in the following areas:

- *Printing and shipping.* In Virginia, PlanGrid alone has allowed the agency to stop printing the majority of its paper plans and contracts for projects, reducing costs. Double entry for inspector diaries has also been eliminated. Alabama DOT reported a reduction in printing and shipping of submittals.

- *Time savings.* Using LCPtracker has resulted in a significant savings in staff and consultant hours in North Dakota. In Washington, employees save time with AASHTOWare Expedite and AURA by entering bids and also by communicating bid results online instead of answering bids.
- *Return on investment (ROI).* Three respondents addressed ROI related to their systems:
 - The Pennsylvania 2 respondent reported a three-year ROI of 446 percent, with \$6.3 million in costs and \$34.4 million in benefits.
 - North Dakota and West Virginia DOTs haven't placed a specific dollar value on the time saved, but respondents from both agencies acknowledge a savings in staff and contractor time. The West Virginia DOT respondent added that the agency can show savings as needed.

Other benefits of agencies' web-based submittal systems included system efficiency, functionality and labor compliance. The Rhode Island DOT respondent noted that the agency is implementing an e-construction program that will enhance the efficiency of its construction management resources. The value of e-construction as a communication tool was immediately evident after implementing 10 projects using some form of this new program.

The table below summarizes survey responses.

System Benefits			
Benefit	State	System	Description
Accessibility	Florida	PSSP	<ul style="list-style-type: none"> • Stores documents in one location. • Allows access to internal and external users (based on permissions given).
	Pennsylvania 2	PPCC	Increases document accessibility.
Efficiency	Alabama	Primavera Submittal Exchange	Reduces time for submittal approval.
	Pennsylvania 2	PPCC	Reduces document review time significantly.
	Virginia	Cadac, ProjectWise, PlanGrid, PDMS	N/A
	West Virginia	AASHTOWare, BidX/ Bid Express, wvOASIS, ProjectWise, Citrix	Saves time.
Functionality	Florida	PSSP	<ul style="list-style-type: none"> • Categorizes documents by group and type, making search and filtering easier. • Provides views that aid in final estimate review.

System Benefits			
Benefit	State	System	Description
Functionality	Rhode Island	PRISM, PMP-CMS	Geolocates entries.
	Washington	AASHTOWare Expedite, AURA	Reduces bid rejections.
Labor compliance/ workforce reporting	North Dakota	LCPtracker	Provides more thorough labor compliance function, allowing all users to view same payroll in real time and advise others at all stages of process.
	Washington	AASHTOWare Expedite, AURA	Improves reporting. Fewer contractors use employees who do not meet apprentice utilization requirements (system requires a valid registration number to report hours).
Quality control/quality assurance	North Dakota	LCPtracker	Easier to find/report errors than manual (paper) review.
	Virginia	Cadac, ProjectWise, PlanGrid, PDMS	Allows staff to quickly search and find information.
Transparency and accountability	Arkansas	Doc Express	<ul style="list-style-type: none"> Increases transparency and accountability between DOT and contractors. Provides audit trail for each document with date/time stamp, submitter and document status.

System Challenges

Respondents were also asked to describe any challenges their agencies experienced using web-based submittal systems. The Alabama DOT respondent said that while its system's setup process per project is very cumbersome, the software seems to function properly after setup. The respondent from Arkansas DOT reported that using Doc Express is intuitive and does not require much training. However, changing the agency's procedures to work with the system has been a challenge. In Pennsylvania, allowing its system to be too flexible in the beginning created challenges. For example, staff members from districts and from individual construction projects were allowed to create their own transmittals and user role names instead of using standardized naming practices. Later, moving from one project to another was confusing for both contractors and department staff because naming conventions were inconsistent across projects.

Training was cited as a challenge by several respondents. North Dakota DOT offered numerous training sessions to staff, consultants, contractors and other interested users. However, during the initial phase of contractor use, staff members experienced a large number of phone and email inquiries daily. Arkansas DOT provided contractor training through a webinar and user

guide (see *Related Resources* below). Washington State DOT produced videos that are available on demand.

The North Dakota respondent noted that use of LCPtracker has gone “largely without issue since mandatory use was instituted one year ago. Approximately 15,000 payrolls have been filed since we offered the system, the vast majority without violations or issues.” Currently the agency is considering or implementing other web-based submittals.

The table below summarizes survey responses.

System Challenges			
Challenge	State	System	Description
Functionality	Alabama	Primavera Submittal Exchange	Cumbersome setup process per project.
	Pennsylvania 2	PPCC	Allowing too much system flexibility.
Staff/user buy-in	Virginia	Cadac, ProjectWise, PlanGrid, PDMS	Implementation difficult among paper users.
	West Virginia	AASHTOWare, BidX/Bid Express, wvOASIS, ProjectWise, Citrix	N/A
System limitations	Florida	PSSP	<ul style="list-style-type: none"> • Separate site location for each contract, making changes and updates across multiple contracts very difficult and expensive. • Third-party plug-ins for routing documents very unreliable.
Training users	Arkansas	Doc Express	Webinar and user guide for contractors.
	North Dakota	LCPtracker	Numerous trainings (staff, consultants, contractors, other users) in addition to staff support after launch.
	Washington	AASHTOWare Expedite, AURA	Training videos available on demand.
Transitioning to online system	Arkansas	Doc Express	Changing agency procedures to work with system.
	Virginia	Cadac, ProjectWise, PlanGrid, PDMS	Procurement difficult with IT security and procurement requirements.

Related Resources:

Guidelines for Using Doc Express on ARDOT Projects, Construction Systems Administration, Arkansas Department of Transportation, January 15, 2019.

http://ardot.gov/construction_division/Contractor_Guide_DocExpress.pdf

This manual provides guidelines for contractors using Doc Express. See page 10 of this Preliminary Investigation for more information about the guide.

Contractor Doc Express Webinar, Construction Systems Administration, Arkansas Department of Transportation, undated.

<http://www.arkansashighways.com/movies/docexpress.aspx>

This webinar provides information about recent changes and new features in Doc Express.

Related Research and Resources

Below are publications and other resources related to web-based submittal systems from a limited literature search for this Preliminary Investigation. These resources are organized into three categories:

- National resources.
- State resources and practices.
- Other research and resources.

National Resources

Addressing Challenges and Return on Investment (ROI) for Paperless Project Delivery (e-construction), FHWA Publication No. FHWA-HRT-16-068, July 2017.

<https://www.fhwa.dot.gov/publications/research/infrastructure/pavements/16068/16068.pdf>

From the introduction: This TechBrief summarizes a program case study that highlights the transformation and automation of the Pennsylvania Department of Transportation (PennDOT) construction process through the development of advanced mobile applications, automated workflows, and their integration with collaboration tools and payment systems to improve overall efficiency. PennDOT projects significant monetary benefits due to operational and time-saving efficiencies achieved through implementation of e-Construction practices. This TechBrief provides an overview of e-construction as a national practice, summarizes PennDOT's history and approach to technology implementation, and describes the investment and benefits realized during a 3-year period. This TechBrief aligns with the Federal Highway Administration (FHWA) research project Addressing Challenges and Return on Investment (ROI) for Paperless Project Delivery (e-Construction), which assesses how transportation agencies are transitioning to a more electronic/paperless project delivery system (e-Construction) and documents the costs, benefits, and challenges during the transition. It is offered as a general aid for those organizations considering starting similar programs or enhancing existing ones and provides a case study of how State transportation departments may expand their use of e-Construction practices.

e-Construction Lead State Profiles, Federal Highway Administration, undated.

<https://www.fhwa.dot.gov/construction/econstruction/leadprofiles.pdf>

From the introduction: This document is intended to provide a brief high-level snapshot of e-Construction practices for 13 lead states. This document is designed to assist exploring states and others interested in implementing e-Construction tools.

e-Construction and Partnering Innovation Matrix by State, Federal Highway Administration, June 2018.

https://www.fhwa.dot.gov/construction/econstruction/peer_exchange/matrix_state.pdf

This document provides information about the products used by state DOTs for the following activities related to e-construction:

- Bid history analysis.
- Bid letting management and estimates.
- Bid preparation and analysis.
- Collaboration portal.
- Mobile devices for inspection.
- Partnering.
- Project management system.
- Project references (e.g., plans,

- Construction management system.
- Digital signatures.
- Document management system.
- Electronic as-builts (GPS/GIS/PDF redlining).
- Electronic bidding and bid bonds.
- e-ticketing.
- Lab Inventory and Materials Management System.
- standards, manuals).
- Quantity measurements (real-time verification).
- Fleet management.
- Queries and reports.
- Virtual meetings.
- Auto-material tracking (RFID/bar-coding).

FHWA Division Office EDC-3 e-Construction Webinar, Federal Highway Administration, September 2014.

<http://aii.transportation.org/Documents/eConstruction/econstruction-webinar-workbook.pdf>

From the document: In order to assist States with implementation of e-Construction, FHWA's Every Day Counts 3 (EDC-3) Program, in conjunction with AASHTO's Innovation Initiative, is hosting two webinars for all FHWA Division Offices to learn more about existing practices, successes from other agencies, and how to help your respective State transportation agency. FHWA Division Office representatives need only attend one webinar, as both events will include the same information but allow for flexibility in attending. This workbook will be available for download after the webinars on the EDC-3 website, and a recording of the event will also be made available.

This workbook is designed to accompany the webinar by providing a copy of presentation slides with an area where participants can take notes on the topics presented. The first presentation will be from FHWA highlighting the background on the joint initiative, followed by presentations from Florida DOT and Michigan DOT on their e-Construction practices, challenges, and successes. The final portion of the webinar will include open discussion on suggestions for the types of activities that FHWA and AASHTO should undertake to help agencies further implement e-Construction nationally.

NCHRP 20-65, Task 43: Best Practices in the Electronic Administration of Federal and State Transit Grants, William Morris, Alexander Bond and Lindsay Martin, November 2013.

Citation at <http://apps.trb.org/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=3515>

From the abstract: Although many State DOT federal transit grant application and management functions are automated with the Federal Transit Administration (FTA) online grant making tools, Transportation Electronic Award and Management (TEAM), and Electronic Clearing House Operation System (ECHO) for disbursements, there are still many grant management processes undertaken by DOTs that are not interfaced with these automated systems or are off-line paper processes. This is especially true for federally funded sub-recipient grants issued by State DOTs as well as state funded transit grant programs that are administered outside of the FTA's TEAM structure. State DOTs employ word processing documents as well as off-line spreadsheets and other databases to support the input requirements for TEAM and ECHO and for FTA reporting requirements not captured in TEAM. The lack of a direct interface of this information into TEAM and ECHO, as well as other reporting requirements creates much duplication of effort by state DOT transit program personnel. This research will describe current best practices by State DOTs in the automation of transit grant management activities as well as

identify common grant management tasks, activities and reports that are need-based candidates for future automation.

State Resources and Practices

Connecticut

Development of the Digital Design Environment ProjectWise—Phase I, William Pratt, Connecticut Department of Transportation, April 2017.

<http://www.ct.gov/dot/lib/dot/documents/dresearch/CT-2253-F-17-4.pdf>

From the abstract: The goal of this research was to develop a project document management system capable of managing Connecticut Department of Transportation (CTDOT) Capital Road and Bridge Program. Primary targets of research and development included the system, contract design deliverables (plans, specs and estimates), digital signing, project submission, submittals, legacy archiving and a portal for construction inspection document management.

The resulting implementation of the Cloud based ProjectWise (PW) Online from Bentley Systems Inc. has delivered CTDOT a robust project and asset document management system. The system is integrated with CTDOT authoritative project and asset tracking data to automate project and asset storage and security management. The Cloud solution offers easy secure access for [the] Department's one hundred plus Consultant Engineers and state forces. The hosting offered a tremendous cost savings of server, backup, disaster recovery and VPN acquisition and maintenance going forward. Contract plan sheets underwent a welcomed transformation from wet signed mylars to a digitally signed PDF contract set. Major asset documents (Bridges and Traffic Signals) installed or rehabilitated within capital projects are managed through their unique ID's tagged to the capital projects, eliminating the need to parse out the documents from the capital project. A Real Time Kinematics (RTK) system for GPS construction inspection allowed the digital design environment to justify 3D model deliverables. In addition, an open source Web-GIS was developed, which offers intuitive interactive maps with hyperlinking to project and asset documents. This integration includes active, completed and legacy project information.

Florida

e-Construction How-To Guide, Florida Department of Transportation, July 2015.

<https://www.fhwa.dot.gov/construction/econstruction/florida/howto.pdf>

From the introduction: This e-Construction How-To-Guide was developed by the Florida Department of Transportation (DOT) to support the FHWA's EDC [Every Day Counts] goal of helping state DOTs understand how to implement an e-Construction system in their states.

Georgia

Project in Progress: Development of Implementation Plan for GDOT e-Construction Program, Georgia Department of Transportation, start date: August 2017; expected completion date: September 2018.

Project description at <https://rip.trb.org/view/1522872>

From the project description: The primary objective of this research is to identify needs for implementing an e-Construction (ECP) program to improve GDOT design and construction; evaluate current e-Construction practices used by GDOT; and, establish an implementation plan to fully execute ECP statewide.

Iowa

Electronic Construction Collaboration System—Final Phase, Jose Perez Reboredo and Charles Jahren, Iowa Department of Transportation, September 2014.

https://lib.dr.iastate.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1084&context=intrans_reports

From the abstract: This phase of the research project involved two major efforts: (1) Complete the implementation of AEC-Sync (formerly known as Attolist) on the Iowa Falls Arch Bridge project and (2) develop a web-based project management system (WPMS) for projects under \$10 million. For the first major effort, AEC-Sync was provided for the Iowa Department of Transportation (DOT) in a software as a service agreement, allowing the Iowa DOT to rapidly implement the solution with modest effort. During the 2010 fiscal year, the research team was able to help with the implementation process for the solution. The research team also collected feedback from the Broadway Viaduct project team members before the start of the project and implementation of the solution. For the 2011 fiscal year, the research team collected the post-project surveys from the Broadway Viaduct project members and compared them to the pre-project survey results. The result of the AEC-Sync implementation in the Broadway Viaduct project was a positive one. The project members were satisfied with the performance of AEC-Sync and how it facilitated document management and transparency. In addition, the research team distributed, collected, and analyzed the pre-project surveys for the Iowa Falls Arch Bridge project. During the 2012 fiscal year, the research team analyzed the post-project surveys for the Iowa Falls Arch Bridge project AEC-Sync implementation and found a positive outcome when compared to the pre-project surveys. The second major effort for this project involved the identification and implementation of a WPMS solution for smaller bridge and highway projects. During the 2011 fiscal year, Microsoft SharePoint was selected to be implemented on these smaller highway projects. In this year, workflows for the shop/working drawings for the smaller highway projects specified in Section 1105 of the Iowa DOT Specifications were developed. These workflows will serve as the guide for the development of the SharePoint pages. In order to implement the Microsoft SharePoint pages, the effort of an integrated team proved to be vital because it brought together the expertise required from researchers, programmers and webpage developers to develop the SharePoint pages.

Minnesota

Modernizing Road Construction Plans and Documentation, Yelda Turkan and Jennifer Shane, Minnesota Department of Transportation, September 2016.

<http://www.dot.state.mn.us/research/TS/2016/201629.pdf>

From the abstract: This project captured best practices for producing and delivering road construction plans and documentation from several Minnesota cities and counties, industry, and several other state departments of transportation (DOTs). The findings will assist Minnesota city and county engineers in getting a better understanding of how and which types of plans, models, and other bid documents are used and delivered electronically in the construction industry, and how best practices can be employed in Minnesota cities and counties.

The project included an extensive literature review, phone interviews with experts, and a brainstorming session with super-users. The brainstorming session was held to help assess the recommendations reached through the study and determine how electronic plans, models, and other bid documents are viewed by the implementers in Minnesota cities and counties.

Based on the results of this work, guidance was developed for the implementation of 3D modeling and electronic document management (EDM) systems for the MnDOT Local Road Research Board (LRRB).

Texas

Guide to Electronic Shop Drawing Submittal, Texas Department of Transportation, December 2017.

ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/bridge/e_submit_guide.pdf

From the introduction: This document provides procedural information that is intended:

- To guide fabricators in the submission of electronic shop drawings to the Texas Department of Transportation (TxDOT), and
- To guide District personnel in providing shop drawing submittal information to contractors at or before pre-construction meetings, and
- To guide reviewers in processing of submittals.

Utah

Transportation Engineering Project Management: Survey of Practice, Utah Department of Transportation, January 2017.

<https://www.udot.utah.gov/main/uconowner.gf?n=34239604200165274>

From the abstract: Utah Department of Transportation (UDOT) project managers (PMs) have identified inefficiencies in the legacy system electronic Program Management (ePM) used to manage consultant contracts and invoices. To help UDOT prepare for potential system improvements, this research examines other agencies' use of similar systems and gathers information about a limited set of other project management practices employed by state departments of transportation (DOTs).

The major tasks of this research included a two-part survey of state DOTs to gather information about the automated systems used to manage consultant contracts and invoices, and about selected project management practices. A second survey of selected state and federal agency contacts focused solely on automated systems for contract and invoice management. A literature search supplemented survey findings.

Responding agencies have found success with a range of commercial and in-house tools and practices to manage contracts and process invoices, and they are generally satisfied with their processes and systems. The survey identified few common project management practices, but did gather details about agencies' current practices for assigning responsibilities to PMs, design managers and resident engineers during the design and construction phases of a project; using design project schedules; estimating cash flow; and training PMs.

Virginia

E-construction, E. Alan Saunders, Virginia Department of Transportation, undated.

<https://www.udot.utah.gov/main/uconowner.gf?n=28161707437934620>

This PowerPoint presentation describes how the Virginia Department of Transportation uses e-construction.

Other Research and Resources

Electronic Document Management Systems for Transportation Construction Industry, Fangyu Guo, Charles T. Jahren and Yelda Turkan, 5th International Construction Specialty Conference of the Canadian Society for Civil Engineering, June 2015.

<https://open.library.ubc.ca/cIRcle/collections/52660/items/1.0076385>

From the abstract: The concept of Civil Integrated Management (CIM) was developed to facilitate better utilization of data and information that would enable effective decisions for transportation agencies. It is important to select appropriate intelligent technologies or tools and use them efficiently. Moreover, data needs to be collected, stored, and managed wisely so that it could be used throughout the life cycle of a transportation facility and even for the next reconstruction cycle. This makes it necessary for agencies to have electronic document management (EDM) systems, so that they can manage and share their data with other stakeholders in an efficient manner. Though EDM systems have been implemented and their benefits are well understood in the building construction industry, they are not as common in the transportation design and construction industry, and there are only a few leader state DOTs implementing EDM at agencywide level. Since there are differences between the building and the transportation industry, it is desirable to analyze early examples of implementation from the transportation industry in order to achieve further progress. 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.

“Submittal-Approval Processes: Scheduling and Submittals-Approval Performance Index (SAPI),” Abdulrahman Alsinaidi, *Journal of Advanced Management Science*, Vol. 1, No. 3, September 2013.

<http://www.joams.com/uploadfile/2013/1024/20131024101631585.pdf>

From the abstract: Portion[s] of the project delay coming from [the] construction materials submittal and shop drawing approval process must be clearly managed, as problems during submittal review can lead to incorrect product installations and other costly mistakes. So there is a need to establish a material submittal and approval performance index which [is] able to determine and clear the progress of consultants, contractors and owners from the first step of submittal (input) to the last step of the process [to] either accept or reject (output). The objective of this paper is to identify and provide the proper material submittal approval performance index (SAPI) to follow the progress of the project and be able to allocate the responsibility of [the] contractor, consultant and owner to finish the process according to the project specification.

“Value-Added Analysis of the Construction Submittal Process,” E. William East and Danielle Love, *Automation in Construction*, Vol. 20, Issue 8, December 2011.

Citation at <https://www.sciencedirect.com/science/article/pii/S0926580511000574>

From the summary: Construction contracts require builders to reproduce and certify paper documents that attest to the quality and or functionality of the systems, equipment, products, and materials planned for inclusion in a finished facility. Once submitted these documents are approved or acknowledged as part of a quality control process prior to placing purchase or fabrication orders. Despite widespread advances in other areas of information technology, the submittal process remains mired in paper-based procedures that add unnecessary cost to

construction projects. This paper describes current practice and then highlights lessons-learned from selected interviews with those adopting innovative technology to streamline that process. The authors discuss their submittal process simulation model. Construction teams may adapt this model to reflect their specific context to justify and monitor the application of new technologies aimed at eliminating submittal transmission, routing, and handling costs within the context of existing contracting processes.

Contacts

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Appendix A: Survey Questions

The following survey was distributed to members of the AASHTO Committee on Construction to gather information about the use of web-based systems to manage contractors' submittal of electronic documents by other state transportation agencies.

Agency Use of Web-Based Contractor Submittal Systems

Note: Responses to the question below determined how respondents completed the survey:

- Respondents who answered "no" to the question were directed to the questions for transportation agencies not using a web-based contractor submittal system and were offered an opportunity to provide additional comments before finishing the survey.
 - Respondents who answered "yes" to the question were directed to the remaining questions.
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1. Does your agency use a web-based system to accept and process electronic documents (e-documents) from contractors, such as shop drawings, stormwater and falsework plans, and other contract-related documents such as insurance confirmation, evidence of good faith efforts and documents relating to payroll and fringe benefits?
 - No.
 - Yes.

Agencies Not Using a Web-Based Contractor Submittal System

1. Why has your agency decided not to use a web-based system to manage contractor submittals?
2. Is your agency considering the use of such a system in the future?

Agencies Using a Web-Based Contractor Submittal System

System Description

1. What type of online system does your agency use to accept and process contractors' web-based submittals? Select all that apply.
 - Software as a service (SAAS).
 - Enterprise (agencywide use).
 - Desktop-based (individual desktop use).
 - Single/stand-alone online system.
 - Multiple tools (part of larger system).
 - Cloud-based system.
 - System developed in-house.

- Customized software developed specifically for our agency.
 - Commercial off-the-shelf (COTS) product.
 - COTS product customized for agency use.
 - Other (please specify).
2. What is the name of your agency's system?
 3. If your agency uses a commercial product, what are the names of the product and the vendor?
 4. Does this system reside on your agency's internal network?
 5. Is this system behind your agency's firewall?
 6. If available, please provide links below to documentation relating to your agency's web-based submittal system. Send any files not available online to chris.kline@ctcandassociates.com.

System Features

1. What types of documents can be uploaded to and processed by your agency's system? Select all that apply.
 - Documents relating to payroll and fringe benefits.
 - Evidence of disadvantaged business enterprise good faith efforts.
 - Falsework plans.
 - Insurance confirmation.
 - Shop drawings.
 - Stormwater plans.
 - Subcontractor substitution requests.
 - Other (please describe).
2. What features and functions are supported by your agency's web-based submittal system (even if your agency is not currently using them)? Select all that apply.
 - Upload access for contractors.
 - Upload access for agency staff.
 - Automated notification of e-document receipt.
 - Automated notification of e-document modification.
 - Automated notification of e-document approval.
 - Automated routing of e-document by task area/responsibility.
 - Customized submittal logs.
 - Generation of time-sensitive alerts.
 - Document status tracking.
 - Document markup.

- Document stamping.
 - Document signing.
 - Document archival.
 - Data export to spreadsheet.
 - Standard agency reporting.
 - Standard contractor reporting.
 - Customized agency reporting.
 - Customized contractor reporting.
 - Smartphone access.
 - Tablet access.
3. Please describe other features and functions supported by your agency's system that do not appear in the list above.

System Implementation and Costs

1. When did your agency implement its web-based contractor submittal system?
2. Did your agency conduct a pilot to test the system before purchasing or subscribing to it?
3. How long did it take to implement the system?
4. Please describe the payment arrangement applicable to your system by selecting the best answer from the options below.
 - Our agency pays a fee for each e-document submitted.
 - Our agency pays a per-user fee.
 - Our agency paid a one-time contract fee.
 - Our agency pays an annual subscription/licensing fee.
 - Other (please describe).
5. Please provide details for each relevant contractual element below.
 - Length of service (if software as a service).
 - Length of contract.
 - Length of subscription.
6. What was the total cost to implement the system?
7. What are the ongoing annual maintenance costs for the system?

Potential Impacts

1. Has your agency identified any impacts to the contract award process as a result of implementing its web-based submittal system?
2. Has your agency identified any impacts to the review and approval of shop drawings as a result of implementing its web-based submittal system?

- We do not use the system to review and approve shop drawings.
 - No, we have not identified any impacts.
 - Yes, we have identified impacts (please describe how the review and approval of shop drawings has been impacted).
3. Has your agency identified any impacts to the number of contracts that can be closed out as a result of implementing its web-based submittal system?

System Assessment

1. Please indicate your agency's level of satisfaction with each system characteristic listed below using the rating scale of 1 = not at all satisfied to 5 = extremely satisfied.
- Ease of use.
 - Flexibility.
 - Reliability.
 - Automated workflows.
 - Ability to customize.
 - Reporting features.
 - Archiving features.
 - Contractor satisfaction with the system.
 - Overall agency satisfaction with the system.
2. Has your agency identified specific cost savings associated with the use of the web-based submittal system?
3. Please describe any benefits (other than cost savings) your agency has experienced in using its web-based contractor submittal system.
4. Please describe any challenges your agency has experienced in using its web-based contractor submittal system.

Wrap-Up

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