e-Construction PEER-TO-PEER EXCHANGE

Summary Report



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Maryland SHA, Florida DOT, North Carolina DOT, and Utah DOT e-Construction Peer Exchange

October 17-18, 2017 Hanover, MD





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1. Background

The Maryland State Highway Administration (MDSHA) hosted a peer exchange on e-Construction with the North Carolina Department of Transportation (NCDOT), the Florida Department of Transportation (FDOT), and the Utah Department of Transportation (UDOT) in Hanover, Maryland, on October 17–18, 2017. The focus of the peer exchange was e-Construction, a paperless construction administration delivery process that includes electronic submission of all construction documentation by stakeholders, electronic document routing/approvals (digital and electronic signatures), and digital management of all construction documentation in a secure environment. The event was sponsored by the Federal Highway Administration (FHWA); representatives from FHWA Headquarters, the FHWA Resource Center, and the Maryland FHWA Division Office also participated.

The morning sessions on the first day served as an introduction to the peer exchange and allowed participants to share background information on each State's construction program and e-Construction activities. The afternoon of the first day consisted of discussion sessions on implementation of project collaboration sites including application of electronic business processes and workflows such as use of digital signature software tools. The morning of the second day consisted of discussion on field devices for use in inspection documentation and reporting, both with internet connectivity and without (including tools that allow remote area input and synchronization of data once connectivity is established). The afternoon of the second day included a discussion session on implementation of electronic tools such as Bluebeam Revu for as-built plan development and use of e-Construction data in asset management and Civil Integrated Management. The event concluded with a summary discussion on next steps, action items, and plans for follow-up.

MDSHA's focus is on upgrading legacy systems by developing an in-house project collaboration software tool that is linked to mobile devices in the field. This peer exchange allowed agencies to focus on e-Construction software tools developed internally by the Departments of Transportation (DOT), including FDOT's Project Solve SharePoint system, UDOT's Interchange system, and NCDOT's SharePoint system.

The peer exchange was the thirteenth in a series designed to assist States with implementation while allowing peers to network and share information in a relatively small group setting. The list of attendees (representing construction and IT personnel) is provided as an appendix to this document.

This report includes a summary of key findings from the event, links to relevant documents, contact information, and the full notes from the peer exchange discussions.

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2. e-Construction Implementation – Key Peer Exchange Findings

Group roundtable discussions during the peer exchange identified several relevant, practical findings. This section summarizes implementation ideas, document exchanges, or focus areas—all of which will assist with future implementation within the States' e-Construction programs. Where available, website links are provided for documentation and guidelines on current agency practices. Maryland SHA, Florida DOT, North Carolina DOT, and Utah DOT also shared presentations given at the peer exchange and provided copies of documents that are not available online.

In implementing digital signatures and workflows, practitioners recommend establishing a memorandum of understanding (MOU) between stakeholders. FDOT shared an MOU signed by

FDOT and the Florida contractor and consultant associations that established an agreement on the use of digital signatures. The MOU identifies levels of approval based on document type and outlines required levels of signature security based on the activity or document. This document helped make implementation of digital signatures easier by establishing early buy-in. Firewalls, access, acceptance, and business processes are all addressed in the MOU. Early completion of the MOU ensured that all key stakeholders were in agreement on the process. FDOT also developed templates and guidance for use of electronic professional engineer seals on drawings. FDOT shared information on the application process for third-party digital certificate authorities (notary form, identification needs, and process description). UDOT also shared its digital signature requirements guide.

Link to FDOT MOU with contractor associations: <u>http://www.fdot.gov/construction/forms/ElectronicSubmit/MOU-E-Commerce.pdf</u>

Link to FDOT digital certificates guide: http://www.dot.state.fl.us/construction/forms/electronicsubmit/digitalcertificatesguide.pdf

Link to FDOT guidelines on application of digital signatures: http://www.dot.state.fl.us/construction/forms/ElectronicSubmit/AcquisitionGuidelines.shtm

Link to UDOT digital signature requirements: https://www.udot.utah.gov/main/f?p=100:pg:0:::1:T,V:2076,

In planning for e-Construction implementation, agencies evaluate legacy systems and determine whether custom-developed or commercial-off-the-shelf (COTS) software tools fit their organization. FDOT hired a consultant to customize the Project Solve SharePoint Solution (PSSP) for construction documentation and collaboration. NCDOT also implemented a SharePoint-based system customized to its business process. UDOT decided that a commercial software tool, Masterworks by Aurigo, fit its business processes well. MDSHA is evaluating the best approach for the agency and will likely implement new software tools to replace legacy systems in the future. The process may be simplified by adopting software and then revising business processes to match the software functions.

Link to FDOT invitation to negotiate for the development of the collaboration site: <u>https://facts.fldfs.com/Search/ContractDetail.aspx?AgencyId=550000&ContractId=BDY06</u>

Link to Utah DOT return on investment case study on the use of Masterworks software tool: https://www.aurigo.com/wp-content/uploads/2016/01/AurigoUDOTCaseStudy.pdf Link to NCDOT memorandum on the use of SharePoint for design-bid-build projects: https://connect.ncdot.gov/projects/Roadway/RoadwayDesignAdministrativeDocuments/Use%20of%20Pr econstruction%20Sharepoint%20Application.pdf

Reaching contractors and consultants in implementation requirements is key to successful adoption of *e-Construction*. FDOT developed an e-Construction specification for use on projects that outlines the requirements for delivering projects electronically for contractors and consultants and the use of digital signatures to eliminate paper.

SCOPE OF THE WORK (ELECTRONIC SUBMITTAL OF DOCUMENTS). (REV 12-15-14)

ARTICLE 4-1 is expanded by the following:

Upon execution of the contract, the Contractor and Department agree that all informational, contractual and other business required for this project will be through a system of paperless electronic means. When the specifications require a written submission of documentation, such documents must be submitted electronically.

All documents requiring a signature must be executed electronically by both parties in accordance with Chapter 668, Florida Statutes, and have the same force and effect as a written signature. The Department will provide a web-based collaboration site to facilitate the electronic document exchange. All persons requiring access to the collaboration site shall be identified during the preconstruction conference. All persons that normally sign paper documents, and will be using the site, must acquire digital signature certificates.

The future of e-Construction involves application of technologically advanced hardware and

software. States are looking to unmanned aerial systems not only for assisting inspectors (such as obtaining views of bridge pier caps without the need for human intervention) but also in documenting material quantities. NCDOT is implementing another technology to track material samples and units using radio frequency identification (RFID) tags. Such high-tech features will allow States to further realize the benefits of e-Construction applications.

Link to NCDOT standard operating procedures for RFID tagging: <u>https://connect.ncdot.gov/resources/Materials/</u> <u>MaterialsResources/2016%20SOP%20for%20RFID%20Scanning.pdf</u>

Link to NCDOT presentation on RFID tracking:

https://connect.ncdot.gov/projects/construction/Structural%20Design%20AGCDOT%20Joint%20Bridge %20Design%20Commi/RFID%20Asset%20Tracking.pdf

Link to UDOT policies and procedures for using unmanned aerial systems for construction: https://www.udot.utah.gov/main/uconowner.gf?n=33969713855476803

Implementing e-Construction will require additional IT staff resources initially and after implementation. Building a relationship with IT is key to developing appropriate enterprise systems and processes, managing assets, and managing valuable data for future reuse. MDSHA, for example, plans to place asset managers in the field to identify additional user requirements, and agencies often perform field reviews to determine what additional tools or process improvements will benefit field personnel in daily job functions. The use of applications (apps) may optimize time spent in the field, and IT must understand the data needed and how the data will be used. Technical support will also be an important factor in any successful software or hardware deployment.

While these items represent the primary highlights of the peer exchange, the remaining report sections provide additional notes. The full agenda is included as an appendix to this document, along with a roster of

participants with contact information. This report is designed to facilitate additional networking and discussion.

3. Agency e-Construction Overview Presentations

3.1 e-Construction at MDSHA—Current State and Future Goals

Stephen Bucy with MDSHA provided a presentation on State government functions and Maryland's current and planned use e-Construction tools. The Maryland Department of Transportation (MDOT) is an organization comprised of several business units and one authority. These units include the Secretary's Office, State Highway Administration, Maryland Transit Administration, Motor Vehicle Administration, Maryland Port Administration, Maryland Aviation Administration, and the Maryland Transportation Authority.

In the 1990s, a consultant developed the Maryland Construction Management System (MCMS). MDSHA still generates the majority of its materials (such as pay estimates) using paper records. MDSHA is starting to require submission of electronic shop drawings and other submittals. As with other States, MDSHA uses ProjectWise during design and may consider how this tool could apply during construction. In 2018, MDSHA plans to use field tablets for inspection activities and expand pilot tests statewide, along with implementing a file storage and transfer tool.

MDSHA is working to upgrade the MCMS to current technology to form the Construction Contract Management System (CCMS). Currently, five pilot projects are in progress to migrate the platform onto the MDSHA servers and to increase and enhance e-Construction-directed IT support. MDSHA learned about and applied for a STIC grant, and in the next year will be supplying tablets for all state inspectors in the field. MDSHA will not provide tablets to consultants, as they will be required to bring their own devices.

Another Maryland initiative includes an electronic specification book with wiki format, enabling implementation of live updates. MDSHA also piloted the use of Bid Express for electronic bidding, and is investigating the potential for smartphones use by State inspectors in the field. The materials management system is in phase 2 of an upgrade. Planned upgrades include storm water and asset management documentation and reporting. MDSHA is also transferring right-of-way plats into electronic format.

The introductory presentation sparked a discussion on electronic ticketing. MDSHA collects paper tickets from drivers, but intends to move toward e-Ticketing in the future. FHWA noted that Delaware and Pennsylvania are working on pilots for e-Ticketing and those may provide good lessons learned. The FHWA website provides a recording of FHWA's e-Ticketing webinar from September 2017, where Iowa DOT presented its application for electronic concrete and asphalt weight tickets.

Q&A

Q: What is the CCMS platform based on?

A: The CCMS platform has a document web application front end, and is browser-based. It uses Cordova to work with either iPads or Androids.

Q: Does Maryland use or plan to use AASHTOWare?

A: AASHTOWare is AASHTO's Cooperative Computer Software Development Program. AASHTOWare Project (formerly TRNS*PORT) is a trade name for a series of construction management products. MDSHA is currently utilizing four of the available modules: Preconstruction, Bids, CAS – Construction Administration System, and DSS – Decision Support System. All construction contract phases are addressed with AASHTOWare from the initial engineer's estimate; through awards, contractor payments; and finally, a database of historical contract data for bid monitoring and vendor analysis.

Q: Have others had good success with AASHTOWare?

A: FDOT has had success with AASHTOWare, but uses Project Solve SharePoint (PSSP) for construction management, most document management, and all forms. FDOT also uses AASHTOWare SiteManager for estimates and has a separate materials management system. Everything can be exported from PSSP into the other systems, with no need for interfaces—files are exported as a PDF. SiteManager contains contract management information and presents an entirely different dashboard.

NCDOT uses SiteManager primarily for bidding and uses SharePoint for document management. A custom integrated construction management system called Highway Construction and Materials System (HiCAMS), developed in the 1990s, is still used heavily. NCDOT is using the AASHTOWare Civil Rights and Labor Module and a future goal is to integrate the module into the NCDOT system for payment verification. UDOT finds customized commercial systems simpler to develop to fit the State's needs with less need for programming expertise in-house.

3.2 Utah DOT e-Construction Overview

Rob Wight and Mark Lefler with UDOT outlined some of the e-Construction applications in use and planned. Historically, UDOT has experienced funding challenges for e-Construction initiatives. UDOT uses Project Development Business System (PDBS) on a PowerBuilder platform. In the early 2000s, UDOT developed an internal system to input field data and had inspectors synchronize information at the end of each day. While the system was advanced at the time and served the original need, it reached the end of its functional life. To update the process, UDOT started doing dual entry—entering data into notebooks and then keying in the data at the office.

UDOT is in the process of replacing the legacy system with Masterworks, a COTS system. The department found that most COTS systems require too much tailoring to be practical for DOT usage, but determined that Masterworks would perform as required and has used it. Masterworks has been in use for several years.

In 2016, UDOT received an FHWA AID grant to advance e-Construction, with funds allocated specifically for administering civil rights and disadvantaged business enterprise (DBE) certification compliance. With the need to enhance management of civil rights and DBE information, this focus area was determined to be a high priority. The civil rights information also impacts the certified payrolls submitted by the contractor. The current system does not work well. UDOT also uses SharePoint, ProjectWise, and e-signature software.

Q&A

Q: Is there a component for the subcontractor to log in to verify payment?

A: UDOT anticipates having that feature in the new system. Currently, verification is a complaint-based system—when a payment was not received, the subcontractor calls to inform UDOT; UDOT passes the complaint to the prime contractor for resolution.

NCDOT is using the AASHTOWare Civil Rights and Labor (CRL) module and has a future goal of integrating the function of labor compliance (such as contractor payrolls) into the system. There is a strong interest in providing subcontractors a way to verify payment. However, some subcontractors are reluctant to log in and use the system at all.

3.3 Florida DOT e-Construction Overview

Amy Tootle and Quinton Tillman with FDOT provided an overview of the implementation of PSSP and other tools. FDOT is a decentralized organization where the central office sets policy and procedures and the district offices implement the process. FDOT included five components in the original deployment of e-Construction, including a collaborative sharing site, mobile devices, digital signatures, form automation, and electronic as-built plans. The collaborative site is an externally hosted, off-the-shelf, dynamically configurable product with workflows that automate construction management.

FDOT has a large construction program planned from 2017–2022 (\$25 billion), with \$11.3 billion funding 478 active construction contracts, with design-build contracting for nearly half of all contracts. Additionally, all of FDOT's construction engineering inspection is consultant-based, and any device can be used to capture information. Based on this approach, FDOT wanted a document management platform that would work for any project type, and where inspection information could be captured on any type of device.

Based on the needs of both traditional design-bid-build and design-build projects, FDOT established specifications and researched "dynamically configurable" COTS software—that is, a hybrid of COTS with customization. FDOT identified PSSP as a collaborative solution and began customization in August 2014, with a few years to foster culture change before full implementation in July 2017. In 2016, FDOT changed its specifications to require electronic submittals. FDOT uses other tools such as Bluebeam for as-built plan development.

Q&A

Q: Does e-Construction apply only to the conventional projects or also to design-build projects? A: e-Construction applies to both conventional projects and the design-build projects. Some software tools may not be designed to capture data on design-build projects, as the contract and payment terms vary (such as with unit price pay items versus quantity payments).

Q: Does FDOT provide licensing for Bluebeam users?

A: Florida provides licensing for field users. Consultants are allowed latitude on the tool used, but many use Bluebeam because it is easier in the field.

3.4 NCDOT e-Construction Overview

Ellen Dickson and Marc Clifford with NCDOT discussed the current state of e-Construction implementation in North Carolina. NCDOTs construction program encompasses more than 750 projects annually, with some centrally administered but with most projects administered by districts across the State.

NCDOT decided to implement a SharePoint solution for document management, workflows, and approvals. Currently, information resides on the SharePoint site for more than 1,400 projects. NCDOT's original vision for the system was to maximize use while minimizing any additional requirements for IT support staff, familiarization needs, and any internal customization that might be required by purchased systems.

NCDOT also uses an AASHTOWare Proposal and Estimate System/Letting and Award System (PES/LAS) called SPECS and HiCAMS. SPECS is tailored to NCDOT needs. Pre-construction project sites on SharePoint result in each plan being electronically signed. These plans are then placed into the site created for that contract—the site becomes a central clearinghouse for plans, the contract, and the current versions with revisions.

NCDOT uses RFID tagging for materials samples and construction elements. The benefits of applying this technology to materials management include increased productivity, accurate traceability, reduced human error, and more standardized methods across districts. Information is transmitted to HiCAMS via a mobile app. NCDOT plans to expand RFID use to prestressed concrete in the future, along with similar information for guardrails, signs, and structural steel.

Q&A

Q: Are the software tools that help process the RFID information used statewide? A: Yes.

3.5 UDOT Project Collaboration Demonstration

UDOT demonstrated a software tool named Interchange that is used for project collaboration. Interchange is an open source e-commerce platform that UDOT uses for document submittals and to provide a single source of truth (one record) in conjunction with contractors and consultants.

UDOT used project resources for some large projects to fund and develop Interchange. UDOT found that, historically, projects typically varied in how users managed documentation, and the data were stored on different media (such as CDs) and in different locations. In some cases, data were stored using ProjectWise, as this is one of the primary tools used during the design phase for projects.

The purpose of using Interchange is to standardize data and reporting from all projects. UDOT sets up the project using a template and identifies a user with document control privileges to change workflows as needed. UDOT appoints a single person on the project delivery team to set up the workflow for proper internal DOT routing. Currently that person is a consultant, but UDOT's intention is to eventually designate an internal administrator for each project. After the contractor submits a document, it is routed through the process and through reviews, resulting in more standardized business practices.

The most powerful part of Interchange is its integration with ProjectWise. A searchable area with dropdowns allows selection of a search attribute. At the point of publishing to ProjectWise, Interchange pushes the information to the database.

In the future, UDOT plans to link Interchange to Masterworks software, avoiding a need to log into three different programs.

UDOT is beginning to implement training so that users will feel comfortable with the system and can establish an appropriate pace before it mandates electronic submission. A few years ago, contractors submitted documents through emails with attachments, but sometimes these would get missed or not arrive. Roughly 20 to 30 percent of the full potential user group is using the software now. UDOT is working on training users on Masterworks first.

UDOT's construction analyst has been learning IT concepts to help with the implementation. That technical expertise (construction and IT together) is key to a successful system. At the crew level, people need to understand how to use, but not necessarily how to program, the software. The system must be easy to use or field operators will not be inclined to use it.

This is the point where transition occurs in the work force. Technology is changing. Harnessing that technology simplifies an inspector's job. The technology enables the inspector to focus on doing the job of inspecting, rather than spending an hour each day transcribing notes into the system.

Another important element is to appropriately manage individual access in some cases and group access in others. Granting access by groups and then assigning roles to people enables tracking of every change, who did it, and when.

- Q: Does UDOT search more easily through Interchange or through ProjectWise?
- A: Internally, ProjectWise is UDOT's preferred system for searching for project records. ProjectWise saves searches for reuse, simplifying searches.
- Q: With documents stored in both places, does searching across platforms become an issue?
- A: As a user, it comes down to what the DOT is used to. NCDOT noted that a novice user, in particular, would have difficulty knowing which system stores which document, and would have to search through both.
- Q: Who assigns the routing for workflows?
- A: Eventually, each UDOT project will have a designated project administrator to assign the routing for that project; for now, the consultant assigns the routing. FDOT found that electronic routing works much the same as paper routing did. FDOT sets up who has what role and what responsibilities. After start-up, e-Construction removes the paper shuffling.
- Q: How large is each DOT's IT department?
- A: FDOT has four consultants and four staff to handle applications, web, and SharePoint, with one more to support pay estimates, for a total of eight to ten statewide. FDOT uses only consultants on

AASHTOWare. The UDOT staff includes developers, business analysts, consultants, and one other person—but only two total FTEs. UDOT believes it needs at least two more.

3.6 FDOT Project Solve Demonstration

Project Solve provides for a solution that is outside FDOT's firewall, while the Electronic Document Management System (EDMS) provides for a final archive inside the State's firewall. The implementation of these two systems allows for contractor and consultant access to working files, while providing for final integrity in project archives to meet records retention requirements.

When a contract reaches award status in the preconstruction software, project information is emailed to the project collaboration site that automatically asks if the approval person wants to start a site for the new project. When activated, FDOT personnel add information to the project (resident assigned, etc.) and the project collaboration site is updated. The preconstruction conference then includes requests for access, proper project roles for contractors and consultant inspectors – when a workflow kicks off that is set to notify the "contractor" group, for example. Control of user accounts was complicated; when something changed, all sites hosted had to be changed. The FDOT solution was to create an active directory group for FDOT that includes control; if a group needs global access to projects, it is added.

All projects are stand-alone site collections, which do not require user access changes across project sites. The third-party authenticator has a site that explains the process for internal digital certificates.

Each new feature on the PSSP site is voted on by the Consistent, Predictable, and Repeatable (CPR) group prior to the initiative or change going statewide. There are areas within the PSSP site where FDOT allows users to experiment on and test various applications. DOT uses a share site add-in product to develop workflows within the site, which creates a graphic interface.

The FHWA noted that at the Federal level, there are laws that encourage paperless administration of projects such as that accomplished by tools like PSSP. Under Every Day Counts 4, FHWA combined e-Construction with Construction Partnering, providing an opportunity to more proactively solve problems.

- Q: To create a new document, does the user need to add filters? Where does the system put the resulting document?
- A: The system puts metadata in the entire document and puts the document in the project folder.
- Q: Does Bluebeam work directly from a local machine in a multiuser environment like PSSP?
- A: No, the user downloads it locally. Another product, Bluebeam Studio, provides collaborative features when commenting on drawings or developing or reviewing as-builts.
- Q: How does the FDOT manage multiple changes on drawings?
- A: For as-builts, only a few people have the access to make changes.
- Q: Are people marking up anything else on the plan other than for the purpose of as-built development?
- A: If something actually moves, that is marked up. For design changes, the plan is returned to the engineer of record, new sheets inserted, and obsolete sheets marked out.

3.7 NCDOTs SharePoint Project Collaboration Tool

NCDOT uses a SharePoint-based project collaboration tool. The reports on the site are shown in SharePoint lists, with each report displayed as one entry. Currently the system contains 38 unique lists in libraries where information is stored. The system is being expanded to asphalt inspectors, and NCDOT is optimizing the lists to include that expansion.

NCDOT has more than 311 project sites in SharePoint, one for each construction contract. Everything generated for the contract is on the corresponding project site: diaries, reports, and contractor claim information. NCDOT creates the sites in preparation for letting the projects. Each site is organized based on Federal requirements for documentation.

On the preconstruction side, NCDOT has more than 100 consultants who access the system, with specified procedures for adding files. Each preconstruction site has libraries, and the administrator can assign roles to provide access as needed or required. NCDOT will be focusing on how to encourage contractors to use the system, and may require use eventually.

Users can review inspector daily reports and see approval status for certain documents. Inspectors can set alerts for approvers to review, or reminders to check an item that needs attention. A user can limit a search for one item within a single project if desire. The site also has a central location for help documents, specifications, and other project resources.

There are challenges in how to communicate changes to users. The front page of the NCDOT collaboration site announces new features or system issues with links to further information. Inspectors using iPads don't see the site because they are using Share Plus and enterprise mobile collaboration tool. Some areas of North Carolina are outside of coverage for cellular service, creating a need for a mobile solution that does not need to be connected at all times. The central part of the State has metropolitan areas, but the north and northwest contain mountainous areas with less coverage. If out of range, the inspector can come back to the office and synchronize the data. This system has pros and cons, but the major pro is the ability to sync data once connectivity is restored.

NCDOT has noticed that inspectors are not always aware of changes to their projects as they do not see a front page like SharePoint for a desktop user if they are using a tablet. NCDOT is going to add an announcement page for each division to inform those users of changes that affect them. NCDOT uses an email address to allow users to report issues and input.

- Q: Is management of the site all internal to the DOT?
- A: Yes. NCDOT has a team of five people dedicated to designing and developing the site.
- Q: Is SharePoint designed as one main site by project or by local office?
- A: No, the site collection is by division. There are pros and cons to having separate site collections for each division. At the time, this step conserved space, which might not be as much of a concern today. It does add a management burden. The hub doesn't always work perfectly. But, rather than upgrading everything monolithically, NCDOT can roll out one change to one division to test it out, allowing upgrade of forms one division at a time. Some things cannot be controlled through the hub: more labor-intensive items

may take a few weeks to be dispersed to all divisions. The site content is based on size, and SharePoint has size limits.

- Q: If NCDOT updates one template, will it cascade?
- A: NCDOT's hub cascades the template changes. An administrator makes the changes and pushes them to the other templates. For example, an Occupational Safety and Health Administration (OSHA) finding required NCDOT to perform additional data collection. By updating the template on the hub, NCDOT accomplished this change in a relatively short time compared with updating each location individually.
- Q: Is the system available to contractors?
- A: There is a path for contractors to gain access, but few have. NCDOT delegated user administration. Using Optimal, the vendor set up all the structure, but the method for requesting access was unwieldy. The vendor fixed the feature, making external requests easier, but, given the earlier experience, the contractors are not eager to pursue access. NCDOT needs to examine how to gain contractor buy-in.

4. Discussion on Digital and Electronic Signatures

FDOT uses IdenTrust for digital signatures. Each person is issued a digital certificate that is loaded onto that individual's device. The user downloads the file, opens it with software capable of applying a digital certificate, applies the certificate, and then uploads the file.

FDOT pays a vendor to maintain the metadata. The certificate records date back to the time of signature. If someone modifies a document and then re-signs it, it shows that all the earlier signatures are invalidated. If the server data is removed, even an expired certificate still shows that the document has not been altered, and that the signer did sign it. FDOT cannot verify certain information on the server, but can see that the sign was valid on the date of signature. Regardless of whether the company server is online, it will invalidate the signature if the document is changed. The purpose is to verify that the document has not been modified since it was signed. For this application, users submit an application that is linked to their personal information and then, once verified, is issued the digital certificate credentials.

UDOT began with IdenTrust, but often found it difficult to use in signing long forms. About a year ago, UDOT considered other options, such as CoSign and DocuSign. Several of the UDOT consultants use DocuSign because it provides a strong automatic routing capability.

Adobe Sign was considered too expensive at first, but the State of Utah was able to negotiate a lower price for the software and now has the full suite for all State employees. The governor realigned the IT department, and the State overall decided to use the Adobe Sign product statewide.

With respect to new initiatives, the business case NCDOT must be able to present to obtain support is how the software makes it easier for employees to do their jobs. A question that is often asked by management within the DOT is how much money this will save. NCDOT views the change more in terms of efficiencies and production of more and better data. Because inspectors do not have to drive from the field back to the office at the end of the day to enter data manually, they spend more time doing the primary tasks and less time doing paperwork. There are cost savings, but they are sometimes difficult to quantify. The main benefit for NCDOT is the efficiency in processes. Thinking long term and building the business case around long-term benefits are critical in selling the initiative to management.

NCDOT distinguishes between completely internal processes and external ones, and does not use DocuSign for the internal processes requiring less stringent verification of identity. Occasionally, NCDOT still distributes paper copies, and those still need to be signed in ink. All centrally let projects (\$5 million and up) get printed automatically and sent to RE office and, usually, also to the contractor. If they are e-signed and NCDOT is printing them, that e-signature is not verifiable on the print copy, but the official plan still contains the electronically signed sheets.

MDSHA representatives said they will use the guidance and lessons learned from the other DOTs represented to determine a recommended implementation path.

Q&A

- Q: Can the recipient see a list of people who have signed the document based on the metadata?
- A: The FDOT system uses public key infrastructure (PKI) technology. With PDF documents, FDOT can extract the PKI data embedded in each signature as a verification technique.
- Q: A key concern about digital signatures and PKI is the vetting process. How does UDOT vet the sender? What sort of personally identifiable information is needed or provided?
- A: Users apply for a PKI with personal information that is similar to the way the notary process works in person. The actual contracts are still wet signatures as required by Utah's attorney general. A change order, which is a mini-contract, doesn't need a wet signature and UDOT is working on ways to extend that benefit to actual contracts. Part of the issue is verification of the contractor or subcontractor.
- Q: Does using multiple solutions with e-signatures present complications for verification?
- A: UDOT has not identified any such concerns with either CoSign or Adobe Sign software. Most of UDOT's signatures are for correspondence, rather than electronic contract and change order signatures.
- Q: Does UDOT's e-signature software require a password?
- A: Yes, the person has to log in with a PIN.
- Q: Now that the FDOT is paperless, do personnel re-sign archived copies?
- A: There is almost no wet ink on current documents, except for a few surety documents. For those, FDOT scans hard copies of those into archives. Everything before the conversion date was wet-signed and archived, and will not be converted.
- Q: Were business processes changed? Did FDOT perceive that more signatures were needed than before?
- A: FDOT did look to see what documents required digital signatures. Some forms, such as storm water, require only electronic signatures, but if digital signatures are easy to use there may not be a reason to need electronic signatures. Notary forms have been replaced by this process of using digital keys.

5. Materials Management and Data Integration

MDSHA demonstrated its MMS and discussed data integration. The Office of Material Technologies, contractors, suppliers, labs, and field inspectors use the MMS. The MMS allows a user to see content such as general information, location, bid items, producer, and supplier based on the user's role.

MDSHA started materials management 8 to 10 years ago to provide one storage place for quality assurance (QA) data, sampling, inspection records, and other data. Phase 1, mainly the source of submission, was implemented a few years ago. There were delays in rolling it out. Having spent a lot of time to develop the MMS, MDSHA decided to continue with the investment. MDSHA staff members are conducting gap analysis for improvements and meeting with lab personnel to make sure functional requirements are understood.

The biggest users of MMS are contractors entering the source of supply for each product and MDSHA verifying that what was approved was brought to the site. Now contractors create PDFs for their sources and reuse the files for new jobs rather than re-creating source of supply, submission, and approval. Phase 2 will include payment data.

A separate source-of-supply pre-qualification links to the MMS, and a contractor submits data based on that approved source. AASHTOWare provides the bid item information. The user can check the information from any device since it is web-based.

MDSHA has to do a manual check on payment. In this system, MDSHA can make a payment without 100 percent materials clearance. The system picks up the additional clearances after the fact and balances payment out the next month.

The next phase will link source of supply with sampling data. A new module will enable the user to access sampling data from labs and will link the data with the supplier approval process, providing QA on the MDSHA part and quality control on the contractor's part. MMS reroutes approvals as needed. Links to the sample database and lab clearance will follow.

A final phase will include material clearance. Other systems, such as for asset management, pull from MMS to monitor what goes in, improve determination of quality, and incorporate information into materials modeling.

UDOT has an in-house legacy system and does indirect cost reimbursement for Federal projects, using previous materials databases. The FHWA authorized UDOT to do cost recovery for lab equipment and other high-cost items. UDOT is developing a Masterworks module and plans to integrate with the construction management system. The module will allow inspectors to record test data, then the data could be processed for payment. Other features include testing with iPads at a test location, with the information being retained for asset management. For example, if there was a low reading at Point X, UDOT would be able to track the test information and declare that the structure failed prematurely. That sort of information could provide insight into whether penalties are sufficient to offset loss-of-life of material. The system has other functionality as well. It routes mix design approvals, with regional labs doing some approvals and central labs doing others. UDOT can track the approvals to determine status. UDOT also processes penalties using spreadsheets, and the calculations will be included in the new system.

The NCDOT materials office is fully integrated with its custom in-house construction management system, HiCAMS, which NCDOT has used for 15 years. All approved materials, testing, sources, asphalt plants, mix designs, and formulas reside in one database. NCDOT cannot receive material on a job site that is not in the system. The database also includes other materials and field inspection reports. When requirements change, NCDOT modifies HiCAMS and issues updates. The system is not web-based; current remote access requires Citrix Receiver.

Users can enter through the public website to search for an approved product list. A database view allows product lookup. NCDOT lets contracts through AASHTOWare, then, after award, passes the contract to HiCAMS for materials management.

For tracking of materials, NCDOT has been using RFID tagging for pre-tested materials, and is expanding the tagging to other materials. All concrete suppliers use RFID tags and cast the tag right into the concrete, enabling quick location of any source in the supply yard. The information is stored in a database. NCDOT sends an inspector to the supply yard and when the truck comes in to the project site, the inspector can use a mobile device to pick up all of the IDs for all the concrete on all of the trucks, avoiding transcription errors. The user enters these directly into HiCAMS, scans the bar code, and ships the sample to the lab. The lab uses an RFID reader to pick up all of the samples and to find the one to be tested.

NCDOT currently uses RFIDs for some samples and for some concrete products to be used, such as precast and pre-stressed concrete, but wants to expand RFID use to other materials. The tag used now, for example, doesn't lend itself to application to steel components, but NCDOT is reviewing other materials that are precast where the tag can be attached to the product.

FDOT performed a pilot embedding RFIDs into asphalt, but the resulting benefits were not conclusive. Geozones may provide more accurate identification of material location. A GPS unit allows better isolation. The RFID tagging provides all of the information that is typically on a material ticket. The producer stores the information in a third-party system and transmits it to the management system every night. The web service picks up all the items accepted on site during the day. FDOT is not aware of anyone using RFIDs on structures.

MDSHA is examining how dynamic friction values change for composite skid resistance of a mix of aggregate and how performance values change friction values. The link is the contract number. A user in pavement management can use that contract number to link the mix, determine the sources that are assigned to the mix, and relate it to location. At this point these relational analyses are being done manually and other factors, such as density or non-materials based factors, are not tied in yet. Currently, the process is manual; the future intent is to link all of the information.

- Q: Do the DOTs separate construction and materials, and if so, why?
- A: UDOT put together a Quality group several years ago, and the group felt that it required authority to check materials so Materials was moved under the Quality group. MDSHA has Construction and Materials under one group but in two separate offices. FDOT has two construction offices and one materials office.
- Q: Why did DOTs go with their own materials system rather than AASHTOWare?
- A: FDOT has always had its own system. Many states have legacy systems in use, requiring consideration of the level of effort involved in making the transition to a new type of tool.

6. Mobile Devices and Applications

The first part of this session was an open discussion, led by Mark Lefler of UDOT, on how to present a business case for culture change. Each DOT discussed how it handled or intends to handle introducing mobile devices to field personnel.

The key to culture change in implementing e-Construction is to instill excitement beforehand, lead by example, and show clear benefit to the users. It's not just getting millennials excited; other generations must be "infected" with the idea of being able to move faster, get jobs done faster and more accurately, and have more time to do the real job at hand. The DOT can require people to try the new way, but if it does not make the job easier or is seen as a stumbling block, those people will find a workaround and not use the new devices.

Classroom training is helpful, but working side by side with people—sitting with field personnel in their trucks, showing them how to use the system as they are doing their tasks—seems to engender greater buy-in. They see forms filled in and submitted, without having to return to the office at the end of the day.

For example, Amy Tootle from FDOT went into the field with the inspectors to walk them through the process. Another technique discussed was to highlight co-workers who are using the new system to do tasks faster than the manual process, thus applying peer encouragement to change.

Familiarity helps gain buy-in. Using the iPad was helpful in some cases, for example, because some of the users were already familiar with it from having a similar personal device. Using a familiar-looking interface helped.

Having a champion helps. For example, UDOT focused first on the millennials demographic, and Mark Lefler served as a champion. For FDOT, a senior FDOT staff member embraced the use of the iPad and converted the inspection forms to Excel and other electronic formats to accelerate its use by inspectors in the field. There was pushback at first from people who were not familiar with the iPad. FDOT held a process review, which revealed that there was no technical fault involved; rather, the pushback arose from a fear of change. People who had never used an iPad needed to start with basic steps. After they started using it, they started figuring out other uses on their own. A good place to start is learning to save e-books into i-books. Having Office 360 also helped because they were familiar with Office products. On the iPad, the regular Office functionality is available, although some higher functions are not. The iPad can cover most tasks that are needed.

NCDOT found that some of the more experienced inspectors found it difficult to type on the iPad, but when they found they could dictate instead, they were enthusiastic at being able to provide more detailed and higher quality information.

UDOT has a requirement for its software to synchronize the data through Wi-Fi. All of UDOT's maintenance sheds have Wi-Fi, so when the inspectors return to the sheds, the information on their iPads downloads to the main system.

UDOT found that Masterworks works better on the iPad than on HP and Asus Windows machines; these were clumsier to use and had more problems with software. The iPad was also more robust and had a better battery life. iPads were also easier to buy; at the time, they were not considered computers, so UDOT was able to buy 100–150 units

outside of the normal computer procurement process. UDOT received positive feedback from the field on these devices.

The UDOT mobile system for field crews has only very basic functions. The system is device-neutral. Forms are more difficult to read on a phone due to screen size and how much the user has to magnify the screen. There is no admin function on the device; it is strictly for gathering data. Admin work requires a login to the system via the web. On a mobile device, the field user clicks the job, fills out the progress report, and is done. If the report is done offline, then the user has to initiate syncing when back in range. By setting synchronization as a manual initiation, the device will not download when picking up Wi-Fi. Most inspectors now are very glad to have this and would not return to the manual process, if given the choice. An admin sees all projects, and the general user only sees his or her projects.

FDOT provided a solution for Android devices to support contractors who use devices with that operating system. FDOT has a policy of one connected device per user—either the smartphone becomes a hot spot for iPad connectivity, or, if the user doesn't have a smartphone, the iPad becomes the hot spot. Users are not allowed to have both an iPhone and an iPad since each can accomplish similar functions and provide connectivity.

About four years ago, NCDOT started researching mobile devices to facilitate daily reports from the field, starting small to show benefits quickly. NCDOT started in three regional offices. These offices already used SharePoint, so NCDOT tried Share Plus from the app store and settled on the iPad as the mobile device. At the time, NCDOT's research did not identify Android versions that matched the needs. The primary reason for choosing the iPad was the need for devices with connectivity—cellular coverage was critical because a few areas of the state have low levels of connectivity. iPad was the only device providing a data plan; for example, some Windows devices require a separate hot spot hardware device. The iPad came with a tough case, had good battery life, and was able to use Share Plus. The pilot projects in the three offices were successful.

Q&A

- Q: Public perception is an important point. Is there enough visibility about the fact that using iPads saves the taxpayer money?
- A: Perception has changed in the last several years. Now that many users carry multiple devices and the cost has decreased, perception has changed for the better.
- Q: Are the DOT apps available to contract inspectors?
- A: NCDOT contract inspectors are not supposed to add apps to their own devices, but some do anyway. The mobile management device tool (AirWatch for the iPad) shows NCDOT what is on the mobile devices. Reimbursing the contractors for use of their devices is a little tricky. NCDOT worked out details with the inspector general's office for partial reimbursement (a percentage of the device's cost).

FDOT's solution was to allow inspectors to bring their own devices and to directly reimburse for that through a special overhead expense. However, usage has not been very heavy. The FDOT system has a few issues with the new iOS, and the DOT has no authority to prevent people from upgrading to it. FDOT did send an email telling its personnel not to upgrade until told and spent a week to make sure its apps work on iOS 11.

FDOT was originally Android/Windows-based. In a test of three Windows tablets, construction field users found battery life was too short and the display had field challenges. FDOT tried smaller tablets, but

again the display was not adequate for use. FDOT met with Michigan DOT and learned that the REs in Michigan liked the iPad. FDOT brought the information back to the CIO and showed videos captured with iPads at MDSHA. The CIO supported the change and bought into the pilot.

The FDOT iPad pilot project started small, with 10 iPads—three for central office and seven for districts—in progressive, engaged districts, and short (15-minute) weekly meetings with representatives from those districts to check status.

- Q: On the iPads, did UDOT have to bring in any extra tech support for iOS?
- A: No. Some internal personnel volunteered to help, but mostly it involved just downloading from the app store and figuring out how it works. Aurigo Software Technologies helped with some items. When iOS 10 rolled out there were some compliance issues and UDOT upgraded the system when iOS 11 came out. UDOT works closely with Aurigo tech support when there are upgrades. The advantage of using an outside vendor is the vendor takes care of such problems.
- Q: Is the app publicly available, or is it UDOT-specific?
- A: The user needs credentials from the app store to download the app.
- Q: Do people at UDOT ever use the wrong name or multiple names for companies?
- A: Only three people at UDOT can handle libraries, and only one person can change the library.
- Q: Is there a self-check for form data?
- A: Yes, the user gets error messages for fields that are required but not filled in. The admin configures required fields in forms. UDOT is getting more and more accurate (and complete) information than before.
- Q: Is it possible to roll out the plans on the iPad and see the details?
- A: A user zooms into the area needed by pinching the screen. FDOT has not heard any negative comments about the visibility of the details.
- Q: Are there any environmental issues with iPads (e.g., extreme heat or cold, or sunlight)?
- A: There were no issues with sunlight. A field user's iPad overheated, but that may have been an anomaly.
- Q: What other helpful things does the standard FDOT iPad contain?
- A: Specification books, standards, manuals, and links to favorites. FDOT's Office of Information Technology (OIT) authorizes all software that can be loaded on the iPad, but the Apple configuration should allow mirroring so that the iPads can be preloaded.

7. Piloting e-Construction: Lessons Learned and User Acceptance

Perhaps the most critical lesson learned is that, even before launching a pilot, the DOT needs to gain management, OIT, and user buy-in and support, through business cases and demonstrations. For example, in beginning its pilot, MDSHA worked to gain support and buy-in from OIT. However, MDSHA directed that these devices would be used without first gaining user or local district management support. This technique did not lead to successful use of the devices. Recently, MDSHA was able to gain full buy-in and solicit willing participants before pushing out the trial devices. This step allowed MDSHA to determine the pros and cons,

tweak the system, and identify other items needing adjustment before moving into statewide pilots. The organization has used the electronic tools completely for some projects and by 2019, every project will be fully using this system. Collection of feedback is ongoing as a continuous process of system improvements. One challenge is that although there are several agencies under the primary Maryland DOT organization, the DOT has multiple IT groups in each sub-agency. Higher-level DOT officials need to encourage agency participation. MDOT is moving toward "One MDOT" BidExpress; it's set up for MDOT and could be applied to MDSHA as well.

8. Commercial Products vs. In-House Development

A lesson learned is that in-house programming, although allowing change, may become convoluted and single-sighted. For example, for FDOT's PSSP, district personnel offered to do the programming, but the code tended to be district-specific, limiting its use. Redundant documentation of the architecture is needed if this route is taken. Otherwise, when original programmers (who understand the system's architecture) leave or move to a different project, it may be difficult to introduce changes to the system.

In terms of internal versus external development, think about the DOT's top priorities to accomplish. Once started down one path, it can be hard to change to another. One reason agencies don't change is that the 20-year-old system represents investments. Another important question is whether the DOT has the IT resources to support an internal system. UDOT decided its strength lies in developing roads, not software. Some State DOTs do have significant IT resources, and those may have internal staff who can develop the system.

UDOT's experience is similar to Maryland's. UDOT was at a point where it needed to move to an upgraded system just to maintain its existing capabilities. UDOT used a custom in-house system, but one thing became evident early on: maintaining an internal system is expensive. Also, UDOT found that it did not have much control over the software—functionalities were added without informing Central Construction and without considering how best to integrate the change into the system. The Masterworks vendor is customizing this software specifically for UDOT and has been easy to work with. But to make a long-term commitment, a DOT needs to have a system that really works with the process. In retrospect, UDOT would still use the OTS but might write the contract differently, or use a different procurement method. The request for proposals (RFP) could be written to put the burden on the vendor to describe how it would learn the process and customize the software based on the process. A non-replace clause in the contract would have helped.

UDOT does not own the source code, but does own the data. UDOT has to rely on the vendor for some things, such as business process changes, but the contract contains a clause to accommodate that. An attractive selling point for this system was that UDOT will be able to change some processes internally (workflows), but that function is not rolled out yet. When development concludes, UDOT will test the functionality and the vendor will provide documentation on this feature. One benefit is the ability to create workflows and reports internally. The report builder and workflow builder functions are still under development.

Pieces of the UDOT legacy system are still functioning and UDOT needs to determine how to roll out and transfer data back and forth until the new system is fully functional. Internal UDOT personnel programmed some application programming interface (API) tools. Having an enterprise license so that UDOT users can

implement the system without limitation was critical. Outsourcing and using configurable OTS is still better than an internal development.

NCDOT has a mixture of COTS, customized COTS, and in-house development. In NCDOT, a business unit cannot do IT procurement without going through IT. Partnership with IT is the most important way to succeed.

Q&A

- Q: Did the Masterworks vendor present prices in the beginning for additional enhancements?
- A: Yes, the vendor presented prices for additional enhancements, as written in the original contract or a negotiated supplement. For example, the Materials division was not originally part of the contract. The materials management module is currently under development. When done, all of the main functions will be under one umbrella. There will still be some integration—UDOT personnel are writing APIs for preconstruction project management, which will be used in Masterworks.

9. As-built Plans, Bluebeam Software, Data for Asset Management, CIM, Managing Progressive Design-build Project Data

In 2013, FDOT decided to move to electronic as-built drawings, as construction personnel in the field were manually marking changes to the drawings. Because the construction personnel are not always experienced with advanced technology, FDOT evaluated solutions for ease of use. The three evaluated programs were Adobe, Bluebeam, and Nuance. FDOT regarded Adobe as expensive. An FDOT consultant used Bluebeam Revu eXtreme, a PDF-based software for plans review. Bluebeam has an interface similar to MicroStation, and thus MicroStation users feel comfortable with it. Unlike MicroStation, users can apply Bluebeam in the field on tablets. It meets the objective of moving to paperless documentation. However, FDOT regarded Bluebeam to be expensive in bulk. The only other feasible option was Nuance, which focuses on administrative use, not plans review, as is needed by construction. FDOT's State Construction Office thus chose Bluebeam Revu as its primary PDF software, but FDOT does not mandate its use by other stakeholders. As long as users comply with department policies and procedures, any tool can be used.

- Q: Is the difficulty in quantifying a competitive evaluation documented for FDOT's acquisition?
- A: FDOT bought hundreds of copies of Bluebeam, decreasing the cost, and had agreement for its use from the construction teams. At FDOT, a group has to be able to justify the use. For example, Finance and Administration have to use Nuance instead of Bluebeam because of the nature of their work..
- Q: Has NCDOT used a pilot to prove the value of one solution over another?
- A: North Carolina has very specific rules about sole sourcing, so NCDOT cannot use a pilot as part of an intent to purchase.

- Q: Does FDOT provide licensing?
- A: FDOT provides licensing for field users. Consultants can choose a different software, but many use Bluebeam because it works better in the field. 3D modeling also limits the software solutions that can handle the original model.
- Q: If a consultant uses a different software, does that cause problems?
- A: No, the back end contains a PDF rather than a database. As FDOT proceeds to add 3D modeling, using a different tool might cause issues and then FDOT would have to adjust.
- Q: Are the as-built drawings used later by asset management and maintenance personnel?
- A: FDOT asset management and maintenance personnel do use as-built drawings. Those personnel are currently migrating to e-maintenance, using the Bluebeam solution and collecting data.
- Q: Are the FDOT archives large enough to store all the documents?
- A: The documents and data are stored in the EDMS, and maintenance can retrieve them as needed.

Appendix A – e-Construction Peer Exchange Agenda





Maryland SHA, Florida DOT, North Carolina DOT, and Utah DOT e-Construction Peer Exchange Agenda

7450 Traffic Drive Bldg 4 – OMT/OOC Training Rm Hanover, MD 21076





| Time | Торіс | Presenters / Facilitators |
|-------------------|---|---|
| 8:00am - 8:10am | Welcoming Remarks and Introductions Peer Exchange Background and Overview Goals and Objectives | Kat Weisner – FHWA Stephen Bucy – Maryland SHA Tom Zagorski – Michael Baker International |
| 8:10am - 8:30am | Maryland SHA - e-Construction Legacy Systems; Current Plans; Desired Peer Exchange Outcomes | Stephen Bucy – Maryland SHA |
| 8:30am - 9:00am | Utah DOT e-Construction Overview | Rob Wight – Utah DOT Mark Lefler – Utah DOT |
| 9:00am - 9:30am | Florida DOT e-Construction Overview | Amy Tootle – Florida DOT Quinton Tillman – Florida DOT |
| 9:30am - 10:15am | North Carolina DOT e-Construction Overview – SharePoint Platforms | Ellen Dickson – North Carolina DOT Marc Clifford – North Carolina DOT |
| 10:15am – 10:30am | Break | |
| 10:30am – 11:30am | Interchange Software for Project Collaboration | Rob Wight – Utah DOT |
| 11:30am – 12:30pm | Lunch (on our own) | |
| 12:30pm - 1:30pm | ProjectSolve SharePoint (PSSP) System | Quinton Tillman – Florida DOT |
| 1:30pm - 2:30pm | Discussion on Digital Signatures: Electronic Contracts and Change Orders Cosign, Adobe, and IdenTrust | MDSHA/UDOT/FDOT |
| 2:30pm – 2:45pm | Break | |
| 2:45pm – 3:45pm | Future Plans for Materials Management and Data Integration | All |
| 3:45pm – 4:00pm | Discussion on Day 1 Takeaways for Implementation | Tom Zagorski – Michael Baker International |
| 4:00pm | Adjourn | |

| Day 2 – October 18 | Deservations (Excilitations | |
|--------------------|---|--|
| Time | Торіс | Presenters / Facilitators |
| 8:00am - 8:15am | Recap of Day 1 Discussion Themes | Tom Zagorski – Michael Baker Internatior |
| 8:15am - 10:00am | e-Construction Mobile Devices and Applications: Demonstration and Discussion | MDSHA/UDOT/FDOT/NCDOT |
| 10:00am - 10:15am | Break | |
| 10:15am – 11:00am | Piloting e-Construction: Lessons Learned and User Acceptance | All |
| 11:00am - 1130am | Commercial Versus In-House Software Development Discussion | All |
| 11:30am - 12:30pm | Lunch (on our own) | |
| 1230pm - 2:30pm | As-built plans, Bluebeam software, data for asset management, CIM, managing progressive design-build project data | UDOT/FDOT/MDSHA |
| 2:30pm - 2:45pm | Discussion on Takeaways for Implementation | Tom Zagorski, Michael Baker Internation |
| 2:45pm - 3:00pm | Closing Remarks, Feedback on Peer Exchange, and Next Steps | All |
| 3:00pm | Adjourn | |

Appendix B – e-Construction Peer Exchange Roster

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|-----------------|--------------------------|---------------------------------|
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