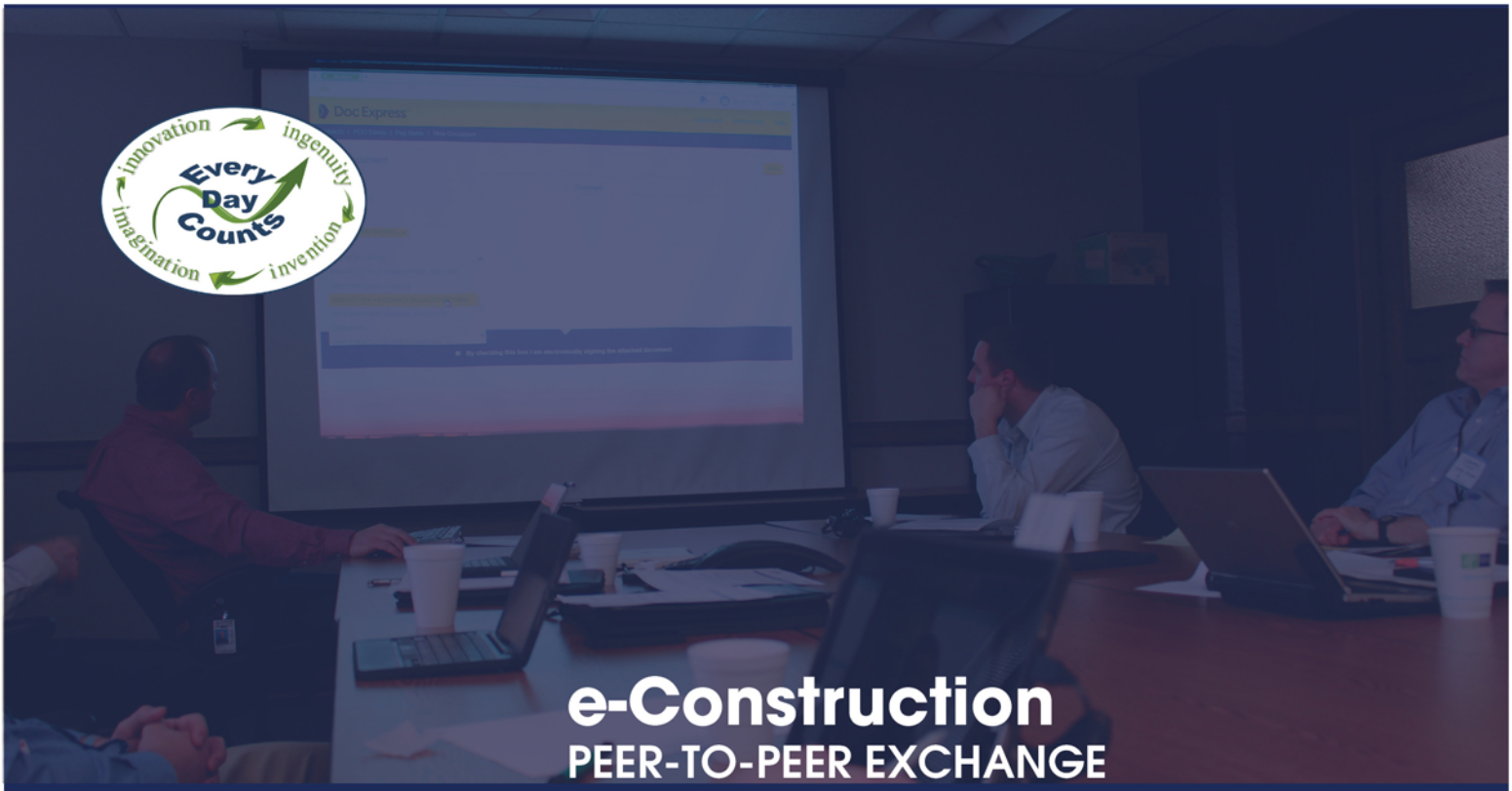
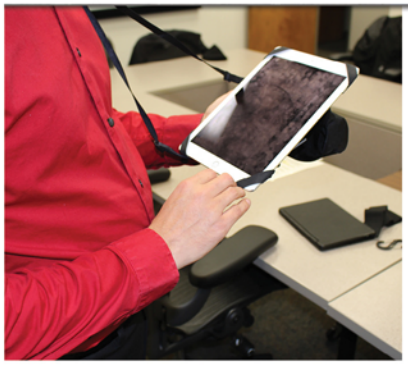
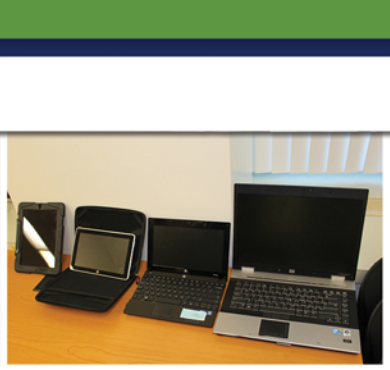


e-Construction
PEER-TO-PEER EXCHANGE

Summary Report






Iowa Department of Transportation and
North Dakota Department of Transportation

Ames, Iowa
December 15-16, 2015

IOWA DOT
SMARTER I SIMPLER I CUSTOMER DRIVEN

NDDOT
North Dakota
Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

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1. Background

The Iowa Department of Transportation (IADOT) hosted a peer exchange with the North Dakota Department of Transportation (NDDOT) in Ames, Iowa, on December 15-16, 2015. The focus of the peer exchange was e-Construction, which is defined as paperless construction administration delivery processes that include electronic submission of all construction documentation by all stakeholders, electronic document routing/approvals (e-signatures and digital signatures), and digital management of all construction documentation in a secure environment that nonetheless allows distribution to all authorized project stakeholders through mobile devices. The event was sponsored by the Federal Highway Administration (FHWA), and representatives from FHWA Headquarters (Construction and Information Technology) and each participating State's FHWA Division Office also participated in the event.

The morning sessions on the first day (see Appendix A for the full agenda) served as an introduction to the peer exchange and allowed for personal introductions, along with background information on each State's construction program and e-Construction activities. The afternoon of the first day consisted of discussion sessions on technologies and systems in use in Iowa including DocExpress for management of active project files, IADOT's internal Electronic Records Management System (ERMS) for archiving final files, Geographic Information Systems (GIS), and pavement data technologies. The morning of the second day consisted of additional discussion sessions on e-Construction field devices—with a focus on using the iPad for inspection and maintenance activities—along with a discussion on contractor perspectives provided by the Associated General Contractors of America – Iowa Chapter. The peer exchange also included a session on a topic that is relatively new to these discussions: an electronic weight ticketing system (e-ticketing) piloted by IADOT. The event concluded with a summary discussion on next steps, action items, and follow-up activities.

The event also included a presentation and discussion session on a current FHWA project to deploy mobile devices in five FHWA Division Offices, including Florida, Iowa, Michigan, Texas, and Utah. The purpose of the pilot project is to assist FHWA engineers and inspectors by enhancing e-Construction efficiencies and increasing access to real-time data in the field.

The Peer Exchange is the fourth in a series designed to assist States with implementation while allowing peers to network and share information across State departments of transportation in a relatively small group setting. Construction and information technology (IT) leaders, inspectors, managers, and engineers from each agency participated in the event. The list of attendees, along with contact information for each, is provided as an appendix to this document to promote further networking among participants.

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

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2. e-Construction Implementation – Key Peer Exchange Findings

The peer exchange produced several relevant and practical findings identified through group roundtable discussions. The following sections outline the items that were highlighted by the group as next steps, implementation ideas, document exchanges, or focus areas—all of which are designed to assist with future implementation within the States' e-Construction programs. Where available, Web site links are provided for some of the practices currently in use by the agencies. NDDOT and IADOT also shared some documents by email that are not publically available on the internet. Additional documentation is provided in Appendices C and D.

IADOT piloted an electronic ticketing and materials tracking solution in 2015. The system is designed to tag and track trucks from their source to the material delivery location using Global Positioning System (GPS) technology and proprietary software. IADOT sees great benefit (such as improved inspector efficiencies and enhanced safety) in future uses of this system with full integration of weight scale information for asphalt and, potentially, Portland cement concrete (PCC).

> Link to IADOT blog site and post on e-ticketing for asphalt: http://www.transportationmatters.iowadot.gov/2015/12/eticketing-show-promise-of-speeding-process-and-improving-accuracy-at-asphalt-job-sites.html

NDDOT uses a **contractor-provided haul sheet as the source document** for weighed materials in order to avoid ticket storage.

> See Appendix C for NDDOT guidelines for daily weight ticket method.

State policies vary in their use of **a standard set of applications (apps) and the associated protocols for users in downloading and testing new apps**. Many States allow users to download and test new work-related apps, with a feedback mechanism for pros and cons and suggestions for future use. This is an important concept, as new technologies are rapidly changing and new inspectors benefit from a shortened learning curve on mobile device use. Participants also made a recommendation for AASHTO or similar entity to organize all assessment information on software and applications or host a site where users can provide input to assist others with selecting the best tools to fit their needs.

> See Appendix D for IADOT list of standard apps installed on mobile devices.
>
> Link to IADOT external ArcGIS Online for Organizations (AGOL) applications: http://www.iowadot.gov/gis/applications.html
>
> Link to Fulcrum app for mobile data collection and core sample position logging: http://www.fulcrumapp.com/
>
> Link to IADOT snow plow tracking application: http://iowadot.maps.arcgis.com/apps/SocialMedia/index.html?appid=cb8b98296a3444a09b49e102ad57bfe8

Standard software tools are developed and/or procured for use by State DOTs in managing construction programs electronically. IADOT and NDDOT shared their experiences with developing

and integrating document management systems such as **DocExpress** and **Construction Automated Records System (CARS)**, respectively. Additionally, NDDOT uses a tool named "**Business to Government (B2GNOW)**" for managing disadvantaged business enterprise certifications and documentation. **LCPTracker** is another software tool in use by NDDOT for managing certified payrolls and other labor compliance related documents, including Davis-Bacon Act wages. NDDOT implemented this tool with an optional special provision for contractors to use it within the 2-year pilot window. Use will be mandatory after the pilot program.

Link to a presentation on NDDOT's CARS e-Construction tool: http://www.dot.nd.gov/conferences/construction/presentations/2013/CARS-ConstRecordsDocumentation-Bargmann.pdf

Link to DocExpress case study on IADOT's use of the software: https://www.infotechfl.com/downloads/docexpress/doc_express_case_study.pdf

Link to NDDOT resources on civil rights certification and compliance: https://dotnd.diversitycompliance.com/

Link to information on LCPTracker software application: http://www.lcptracker.com/

Mobile devices take a variety of forms. IADOT and NDDOT piloted iPads in the field, and IADOT also tested the Microsoft Surface Pro for inspection and maintenance documentation. For field inspection, IADOT chose the iPad due to simplicity of apps and geospatial orientation. Field inspectors have limited engagement with IADOT mainframe legacy software applications and database systems from mobile devices. IADOT also uses an app called Airwatch to manage software pushed out to all DOT devices, and recent software versions are compatible with various operating systems. Some other agencies use iPads and some use Microsoft Windows-based tablets; however, both IADOT and NDDOT noted a desire to implement systems that are compatible with multiple devices. Additionally, iPads have built-in cellular technology, while the Surface Pro requires a hotspot for wireless access. Both have a GPS receiver, but the Surface Pro requires a special configuration to use GPS for positioning and location data (added to photographs, etc.).

Links to IADOT and NDDOT Construction Electronic Reference Libraries:
http://www.iowadot.gov/erl/index.html
http://www.dot.nd.gov/manuals/construction/constr-records/constructionmanual.htm

Link to Washington State research study on the benefits of using tablet devices for inspection: http://www.wsdot.wa.gov/Research/Reports/800/840.2.htm

Link to Airwatch mobile device application management tool: http://www.air-watch.com/

Software-as-a-Service (SAS) is becoming more common as e-Construction systems may be subscription based with data housed in the Cloud as opposed to a one-time purchase model with future upgrades. Additionally, many State DOTs opt to use third-party document management hosting in the Cloud to avoid issues with internal DOT system access while still being able to archive files on internal systems inside the firewall once projects are completed. An annual contract subscription can provide benefits for ongoing

projects in helping agencies more easily manage stakeholder access to all e-Construction documentation and data.

> Link to FHWA standards for approved Cloud-service providers:
> http://www.fedramp.gov/

IADOT is using PDF Expert to provide comments on documents electronically and to support as-built documentation. Inspectors and others from IADOT stated that this e-Construction tool is user friendly with minimal learning curve as opposed to other drawing tools that are also commercially available. This tool was tested with success on the iPad.

> Link to more information on the PDF Expert software application:
> https://readdle.com//products/pdfexpert5/

3. Peer Exchange Discussion Notes

This section provides additional notes following the organization of the agenda. Question and answer sessions followed each presentation and demonstration (labeled "Q" and "A" in the notes). As noted above, the full agenda for the peer exchange is included as an appendix to this document, along with a roster of participants with contact information for each attendee.

Greg Mulder with IADOT welcomed participants and provided opening remarks. Cal Gendreau provided opening remarks for NDDOT. He noted that NDDOT has piloted tablet devices in two districts and captured information on what worked well and what areas had room for improvement. Users provided positive feedback on the tablet devices and suggested that they continue to be used. Bryan Cawley provided opening remarks for FHWA. The newly implemented "Fixing America's Surface Transportation Act" (FAST) includes an element of taking innovation and continuing forward with efficiencies and productivity gained. There is a dynamic movement to increase productivity in highway construction, and FHWA's peer exchange program is designed to help foster expanded use of innovation in support of this movement. Several States have shown cost savings of approximately $40,000 per construction project per year by using e-Construction.

3.1 Exploring State Presentation – North Dakota e-Construction Status and Plans

Cal Gendreau presented on NDDOT's construction program, current practices, and future vision. NDDOT uses BidExpress and requires use of the software by bidders. The agency no longer accepts paper bids. NDDOT charged contractors $30 to bid on paper during implementation, but provided a year for contractors to obtain a BidExpress account. For any architectural features such as rest areas, NDDOT allows architects to use their individual processes outside of BidExpress. NDDOT is piloting LCPTracker for electronic payrolls, and the software is currently an option for contractors through a special provision for submitting the electronic payrolls. An estimate of 50-80 percent efficiency is gained through this process, although some contractors have their own software, which must interface with LCPTracker. NDDOT will use this software for a year, review the process, and provide full implementation of the software at that time. The vendor offers an option to pay a one-time fee to customize the LCPTracker software.

B2GNOW is another disadvantaged business enterprise (DBE) certification and participation tracking software tool that provides for electronic reviews of certifications, submittal of good faith effort documentation, and cloud data storage. DBE goals and good faith effort documentation for non-met goals

are included electronically. Additionally, contemporary payment tracking and confirmation supports the "prompt pay" provision. After the prime contractor receives a progress payment, the system notifies them to indicate the subcontractors/suppliers that are to be paid. The subcontractor/supplier receives notification of the prime's payment through the system and requests concurrence with the prime's payment. The system tracks all participation and provides accurate, timely data to support the required FHWA semi-annual report on DBE awards or commitments and payments. Labor compliance interviews are also performed electronically through the LCPTracker system. This process will remain active throughout the construction process.

Electronic plans and design information are openly available on the internet. Electronic plans and contract documents are posted about 4 weeks prior to bid opening. No paper plans are printed, and no addendums are posted within 48 hours of the bid openings. Contractors acknowledge in their bids that they have checked the website for the latest addendums.

NDDOT has an electronic library of available materials to support construction projects such as specifications, standard drawings, field sampling and testing manuals, design manuals, forms, and records manuals.

The Construction Automated Records System (CARS) is an in-house Java application developed to generate and store daily project documentation, generate pay item documentation, and generate pay estimates. The system is web-based and is used by NDDOT, counties, and consultants. Access to CARS is controlled through district engineer access and project information based on project numbers coded. The CARS system was a year-long system development project with additions and updates for improvement. Since tablets have begun being used, updates have included the ability to add photos captured by the tablets to CARS. There are two internal staff and some staff from another State agency working on the system. Future plans include adding materials forms to the system. Work zone updates are also included in CARS via project engineer entry of data for traveler information. Contractors do not have access to CARS, but NDDOT is considering the possibility. NDDOT provides training to new users.

The future vision for e-Construction is to utilize electronic technologies in NDDOT construction operations, from bid document preparation to as-built archiving. The plan includes more robust modeling and better results in the field from improved processes, including 3D/4D/5D design data and models, document workflow management, and accessibility for all stakeholders (RFIs, change orders, etc.). Additionally, NDDOT is planning to use digital signatures on plans and contract documents. The NDDOT is looking for a way to manage materials testing and results electronically. NDDOT uses FileNet as the official document management system – files are added to FileNet and indexed through CARS.

A Technology Advancement Team was formed in November of 2015 to create a technology roadmap for the future, including system updates and associated costs. Some smaller CARS updates are being worked in parallel with the Technology Advancement Team activities. NDDOT has asked all department divisions to submit information on technology implementation plans for the 2017 budgeting process.

Q. How is the information stored and used?
A. Part of the service is cloud storage, and the Civil Rights Office will just be storing the information but will not download for data mining for prompt pay analysis, etc. LCPTracker will also keep track of payments to those firms.

Q. Will use of LCPTracker be piloted and then made mandatory?

A. The electronic labor interviews will be mandatory. The certification module of the system is up and running now. All DBE documentation input is mandatory with assistance provided for uploading documentation. Prime contractors will be required to maintain prime approver accounts and accept certified payroll electronically from any subcontractor in any tier who wishes to file electronically. Other than the prime approver role, use of LCPTracker is optional during the pilot period. Project engineers and their support staff will place any payrolls received in paper in the system for storage and accessibility – no paper records will be retained. Labor interviews will be completed on iPads in the field, and this process should also be paper free. Training for all contractors and project personnel continues in anticipation of the 2016 construction season and the participation of contractors in these training sessions has been encouraging.

Q. How does risk management work with posting all plans for bridges, utility infrastructure, etc.?
A. All information is posted online. Cameras are used on some projects for monitoring for security issues.

Q. Does your local FHWA require tickets to be generated for deliveries or is the daily weight summary acceptable?
A. FHWA has approved the use of the summaries for long-term project record storage. Each truck weight ticket still travels with the truck and is picked up at the project site by an inspector. Once the individual truck tickets are quality checked with the daily summary, the individual truck tickets can be disposed of and the daily summary becomes the final record for payment. In North Dakota, contractors are required to develop daily haul summaries and provide that information to NDDOT. The summaries are signed and added to the pay quantity report. A haul ticket is generated but the source document is the daily haul summary.

Q. How do you handle tablet connectivity issues in remote locations?
A. The inspector documents information in the notes app on the tablet and then information is pasted into CARS when connectivity is restored. Working offline and future synchronization would be of benefit for users. FHWA, Office of Federal Lands, has some experience with this and is developing offline forms that populate once connectivity is restored.

Q. What is the final document of record and where is it kept?
A. Contract plan sets are the final record for the project. MicroStation working documents are not kept in FileNet but PDF versions of final plans are in FileNet.

3.2 Host State Presentation – IADOT e-Construction Overview

Greg Mulder with IADOT presented on e-Construction activities in Iowa. IADOT has six districts with 14 resident engineer offices and approximately 300 inspectors (both cross-trained maintenance workers and full-time inspectors). IADOT also uses BidExpress, which is required on all projects that require precertification. Electronic bids may not be required on small demonstration projects, landscaping projects, and other minor projects. All other projects require the use of BidExpress, and IADOT has used this system since 2006. The agency uses FieldManager (started in 1997) and FieldBook for contractor payment documentation.

DocExpress has been in use for approximately 5 years as the document management system, which started as a materials certification data collection warehouse but has since grown into a complete document management system for all contract-related documents. The first paperless projects were implemented in 2014. The IADOT is already using DocExpress' internal electronic signature tool to sign a majority of the contract documents (including change orders), perform shop drawing reviews, and process final contractor paperwork. IADOT has explored use of BidExpress for electronic signatures and has also used DocuSign in a pilot project for the contracts. Going forward, IADOT is planning to expand the use electronic signatures

within DocExpress to include contracts and bid bonds. Contract documents are available to the public, while materials information and contract-specific documents are access-controlled. IADOT developed an online search tool for contract documents. Additionally, materials suppliers are inputting documents into DocExpress, while prime contractors and subcontractors are also able to input certificates.

A web-based contractor pay system is desired for the future – the current system is not web-based in Iowa. The e-Construction process involves planning, design, contract letting, and construction in Iowa.

IADOT has an Electronic Reference Library (ERL) for standard specifications, plans, manuals, and handbooks. The site includes a search feature for the documentation. Fillable PDF documents are used for mobile forms. IADOT also uses an Electronic Records Management System (ERMS) for internal archiving of files and project documentation to meet the needs of records archive requirements. There is also a web-based technical training and certification program with use of electronic tests being piloted in 2015.

Designers are using ProjectWise for document management in Iowa, and this was implemented after the Construction Division implemented DocExpress, to which end users upload information. Integrating design and construction document management would have required significant investments in training for users. Contractors in Iowa have embraced paperless delivery, and some provided input into the DocExpress process development activities. Contractor input shows that change orders and claims are processed more quickly, providing significant benefits in productivity and efficiency. DocExpress was a catalyst for standardizing processes statewide, allowing every contractor to use the same process regardless of their location within the State. Training programs focus on the workflow processes that are included within each software tool.

IADOT developed a concept for an app that would allow input of lane closure information on projects as opposed to a daily written report of traffic information.

Q. Have you experimented with Bentley Navigator or Open Roads Navigator?
A. IADOT has not used this tool in construction. If the contractor builds the 3D model, this tool can be used to inspect specific areas on the project based on the model data.

Q. Is there a reason why Iowa did not use the materials module?
A. Now that IADOT is one construction and materials office there are plans to explore additional effort in this area. A homegrown Laboratory Information Management System (LIMS) is currently in use as well.

Q. Can field personnel take a picture of the material documentation and submit?
A. Yes, anyone with access to DocExpress can submit documentation to the project file in DocExpress. Iowa requires material certifications to be submitted electronically. As a standard practice, the prime contractors and sub-contractors have asked the material suppliers to submit the material certification documentation to DocExpress.

3.3 Technical Exchange Topic #1 – Demonstration of Host State e-Construction Technologies and Systems (DocExpress)

Dean Herbst provided an overview presentation on the use of DocExpress in Iowa.

In developing an e-Construction architecture and the decision to use DocExpress, IADOT drew a connection between the newer tech-savvy generation and more experienced personnel who have been

managing processes a certain way for some time. It is important to understand the differences in how user experiences will impact deployment of new technology. Iowa implemented its first developmental specification in 2013 for the process that is used for DocExpress from the lessons learned in the pilot projects that they had been experimenting with since 2010. In 2015, IADOT implemented a standard specification for use of e-Construction technologies such as DocExpress. DocExpress is hosted by a third party under an agreement that all information is kept for a designated time period defined by the Department, allowing access by users as needed. Once projects are closed out, the documents are archived inside DocExpress and removed from the active area on the system.

IADOT uses Microsoft Project internally; however, project scheduling software tools are not specified by the DOT, leaving flexibility for the contractor. Some contractors also use Primavera P6 for project scheduling activities.

DocExpress has a search feature, and the software will sort data by contract number, for example. Administrators can see all projects for the State, while resident engineers can only see projects associated with their District. Red-line markups have to be performed on a downloaded version of a file and then resubmitted to DocExpress if changes or additions are made. There are "drawers" within the system such as a contract documents drawer and a pay items drawer where documents are placed. FHWA approves contract documents and change orders for Projects of Division Interest (PODI) within DocExpress. The Iowa Division Office is capturing information on forms in the field through the use of tablets within the pilot project. IADOT has asked the AASHTOWare developers for a linkage from any other external document management system to the AASHTOWare Project software as an enhancement.

Settings can be managed within DocExpress. For example, users can set notification preferences for submissions and manage how many email updates are sent. The system is easily customizable for the user. Another level exists below the drawer structure and includes information by type of report. The administrator adds and configures each contract from each monthly letting into the DocExpress system. The administrator noted an estimate of ½ to 1 hour per month to set up all projects let that month for IADOT. Agency users are the only users that can receive documents, while any user can submit documents.

The DocExpress software has a 50 megabyte size limit for file submissions. This limit was designed in at the request of IADOT.

DocExpress adds a signature page to the PDF file when it is signed. Documents are transitioned between users as part of the workflow process. A signature is then typed in and placed in the document based on the user login credentials. The system verifies the spelling of the name and will not allow another name to be typed in for the approval that is different from the login credentials.

IADOT pays one annual fee for statewide, unlimited users, including contractors. This is an annual contract without any additional usage-based fees.

DocExpress includes a dashboard with charts and data displays to help users track statistics. This information could be used in progress meetings with contractors to help manage schedules. To store files from DocExpress permanently, users can export a .zip file, transfer it through the firewall, and save the files to ERMS. A .zip file can also be created from all project files stored within DocExpress. The .zip file includes all folder structures and all associated files for electronic archiving. The DocExpress files are working files, while ERMS is the final archive of the project files. The directory structure generated in the .zip file is the same as the DocExpress directory structure.

Q. How is correspondence managed?
A. IADOT did not want DocExpress to be used as a communication tool – if correspondence needs to be added to the project files it can be. Emails and letters are added to DocExpress manually.

Q. Does IADOT specify a naming convention and structure?
A. The DOT has not set a certain naming convention example that must be used. There are items such as on a work day report where user guidance shows a specific numbering convention (01, 02, etc.). The use of document types within each drawer makes developing naming conventions and locating specific documentation easy.

Q. Do you have discovery of information for legal proceedings?
A. Iowa works closely with contractors to avoid claims from happening. This has been a successful practice for the State. All documentation is saved in DocExpress or transferred out to ERMS, so finding specific information is easy when necessary for any reason.

3.4 Internal Archiving and ERMS, Electronic As-builts, GIS Data, and Asset Management

Scott Schram presented on electronic tools for pavement management in Iowa.

Pavement design and mix design are performed in the same step, and pavement mechanistic empirical (ME) design is estimated during the design process. During construction, Iowa uses an app called Collector on the iPad to log the position of core samples. Density, binder content, thickness, and volumetrics are then all known for that location on the roadway. INRIX traffic volume data is also used for the specific locations, and traffic conditions are compared with original estimates. Weather information from nearby stations is also compared to estimates. Performance prediction curves are used to determine the reliability values for the pavement based on age.

In the future, ArcGIS Collector will be used. Feature Manipulation Engine (http://www.safe.com) is an app that captures data from the Cloud and pulls it out for analysis and to refine performance models. Questions can be answered from this data, and it also provides information for as-builts.

Q. Is Oracle the long term repository? If data is collected for the 10 years previous, there may be no program currently available that accepts those file types.
A. Yes, we take a snap shot of the database and work from a production version. Annually, a copy of the database is stored for that time period. There are certain file types that are used (such as comma separated value - .csv) to ensure that data can be viewed in the future.

Q. Does the contractor core the pavement?
A. Iowa witnesses the core sample being taken, but the contractor gets the sample. IADOT makes sure that there is consistency from the core location to the test results.

Q. HPMS data – is pavement condition data collected geospatially and converted to linear referencing system for FHWA?
A. Yes, that is the process.

Applications for Maintenance Activities

Shawn Blaesing presented on software applications and the use of data from field devices for maintenance applications in Iowa.

Culvert inspections were historically performed using binders and cards with hand-written documentation. IADOT has an instructional memorandum for performing these inspections at specific intervals. Data are collected for infrastructure components such as signs, barriers, end treatments, etc. All locations are shoulder-based, and updates are planned for the geometry. This has application for electronic as-built drawings.

Tablets are being used due to the limited mobility of a laptop in the field. The iPad was selected for implementation in Iowa, although other platforms were deemed feasible as well. Inspectors use the iPads to capture information from inspections in various applications. Airwatch is a software tool that allows the DOT to push and pull apps and also review the applications downloaded by field personnel. This tool is also a gateway to the email systems to manage multiple user login information for shared devices. There is also a maintenance portal on the iPad where users can obtain data and information in the field.

IADOT developed a training manual on electronic documentation of inspection activities and use of apps in the field.

Iowa also uses a snow plow tracking application, where trucks have a camera on the front of the truck that shows the visual the truck driver would see. This information is available on the internet and is open to the public.

Maintenance is working with design to have a one-button push at letting that pulls CAD information, places it in an enterprise database, is used in construction, and is updated as needed.

Q. Is the data public?
A. IADOT has received requests for the data and has provided it, but it is not currently available to the public via the web.

Q. Does NDDOT use as-builts?
A. Changes made are integrated into final plans but quantities are not changed.

Q. Is there a mobile device policy for Iowa?
A. Users can sign a waiver and use their own device to access the network systems and applications.

3.5 Discussion on IT Security Solutions, Firewalls, and Outside Access

Dave Anderson, Deb Shafer, and Linda Torgeson with IADOT's IT Division joined the group to discuss IT security and outside access to e-Construction systems with IT and construction personnel from NDDOT.

IADOT is testing AASHTOWare Preconstruction and additional modules within AASHTOWare Project. Contractors will not have access to those modules, but AASHTOWare Project Construction and Materials might be hosted remotely once implemented, thereby providing for ease of access for contractors due to the third party hosting outside the firewall. Currently, select contractors have a license for FieldManager and the

DOT will provide read-only versions of weekly and monthly inspector information. These files are provided for contractor information and are emailed.

AASHTOWare web-based products will allow for activities that are field device independent, allowing greater use of a variety of devices in addition to the iPad.

The Software as a Service (SAS) concept allows users to run software from the cloud as opposed to being installed on devices. This may become more common for DOTs.

Iowa posts payments made to contractors on the civil rights Web page. A PDF of the pay estimate is also generated and posted to the contract documents drawer in DocExpress. North Dakota is not posting similar payment information.

Device identification is certificate based and is managed through Airwatch. IADOT suggests use of a mobile device manager application that will allow updates to be pushed all at once to each device. Having individual users install apps is not a desired approach.

e-Construction has helped provide for a 3 day completion time for processing change orders in Iowa. Recent dashboard analysis in North Dakota showed an average of 17 days for processing. In addition, requests are often made for data on infrastructure items—with specific regard to their age. This can be easily handled through an e-Construction database on infrastructure components (guard rail, lights, etc.) so that questions can be answered easily.

Q. How does IADOT handle security for outside entities?
A. Devices have Virtual Private Network (VPN) connections as well as two-factor authentication for contractors. Bomgar is a tool that will provide a secure link and record the contractor session.

Q: How do field inspectors access FieldManager remotely?
A: The FieldBook program is a subsection of FieldManager – reports are developed and a file is pulled into FieldManager. Inspector daily reports are then combined into one document which becomes the record, and a VPN connection can be used to gain access to areas within the firewall for file submittal.

Q: What about Cloud data security and vetting of Cloud applications?
A: All services planned for use have to be vetted through the Iowa Chief Information Officer. Only non-confidential information resides in the Cloud, which is required by State statute (Iowa Code 22).

Q: How is funding secured for mobile devices and software?
A: Support from management and taking small steps has helped. Iowa purchased 30 iPads initially, and funding was then allocated for additional device purchases. Construction was able to earmark funds with a well thought-out approach, and State Transportation Innovation Council (STIC) Grant funds are available as well. Getting the contracting industry involved in implementation may also help – they are investing in technologies for automated machine guidance for example.

3.6 Contractor Perspectives, Change Order Processes, and Contractor Access to Electronic Systems in Iowa

Ron Otto with Associated General Contractors of America – Iowa Chapter provided perspectives for e-Construction from the contractor's view.

As with anything new, the more experience that users have, the better, and Iowa has piloted many of the available applications, including DocExpress. The system then became mandatory. Benefits include faster finalization of projects, enhanced change order processes, and more rapid acceptance of items. Getting suppliers on board with DocExpress and e-Construction was challenging; the scan/upload process involved a learning curve. A key part of the success that Iowa has had with private entities involved incrementally rolling out the solutions to contractors and subcontractors. Leadership within the IADOT required the paperless initiatives to go forward. As an example, IADOT no longer prints plan sets or specification books.

Ensuring compliance with the Davis-Bacon Wage Act is another important point from the contractor perspective as a key benefit from application of e-Construction. Maintaining official representation from the trade associations provides key input to the process and maximizes the likelihood of success for the implementation. When marketing e-Construction tools, users should include the key benefits, including impacts to costs, safety, transparency, and efficiency. Being positive about change is also key. For example, LCPTracker provides key benefits to NDDOT districts and to the contracting industry, because the tool is used to ensure accuracy and make checking wages simpler.

Contractors are using 3D models and automated machine guidance for earthwork on nearly all projects, and some are using stringless paving on projects. IADOT encouraged feedback from contractors on these technologies. IADOT also implemented fillable forms for storm water reports in conjunction with the contractor.

NDDOT also engages the North Dakota Chapter of the Associated General Contractors of America and will continue to do so in implementing e-Construction technologies.

3.7 Technical Exchange Topic #2 – e-Construction Mobile Devices (iPads)

IADOT is encouraging their inspectors to download all work-related applications that can be used on the iPad and submit feedback. The DOT then monitors any security issues that might arise. If the applications have costs, then requests must be submitted for approval.

The CITRIX receiver application provides access to ERMS, timesheets, Microsoft Office Suite, and others. Software tools such as FieldManager and FieldBook do not work on the iPad, and some of the Office tools do not display well on the iPad due to the way FieldManager has been set up by the DOT. Diaries are all developed in FieldBook; when the web-based AASHTOWare products are deployed, this can be done on the iPad.

Storm water inspection reports are fillable PDF files accessed from the iPad that also allow electronic signatures (handwritten using a stylus). PDF Expert has no limit on the number of signatures that can be used. The IADOT policy for electronic signatures allows handwritten electronic signatures on non-contract documents. Electronic signatures for change orders are performed in DocExpress, and digital signatures are used in BidExpress. IADOT's design office also uses electronic professional engineering seals on design plans and is also working on electronic seals for 3D models.

A LIMS system is currently in use for materials data, test results, and data management. The LIMS system is not web-based. In conjunction with LIMS, IADOT has a site where inspectors can find information on approved suppliers and approved products. System design should include requirements for what is needed as opposed to designing systems around processes that have been in use for a long time.

Skitch is another app that IADOT uses and NDDOT has investigated for annotating documents.

Q. What forms or applications do you use with GPS location information?
A. There is a site inspection form that IADOT is working to add GPS coordinates to. With a GPS reference, stations and offsets can be viewed along with cross sections using a 3D model. Also, the ArcGIS Collector app is used for filling out construction sampling information.

Q. What value do you see in the iPad versus another type of operating system?
A. They have been easily accepted by all users and have been easy to train users on. Also the cellular functionality and the ability to use GPS built in to the device is a benefit of the iPad. Facetime is also a key feature that saves travel time to visit a project site and see a feature in question. The durability of the iPad has been very good.

Q. Have you evaluated using the iPad GPS for surveying applications?
A. The add-on GPS might be something that would allow for survey grade application, although the accuracy may be an issue.

Q. How do you deal with photographs and manage them?
A. IADOT personnel do take photographs, many of which are emailed. There are also cloud storage locations for them. Example: Photographs are sometimes taken for stamps on guardrail and inspectors then add the documentation to DocExpress. Photos can also be imported into plan sets.

For materials management, IADOT is investigating the app "Stockpile Reports" for use in measuring and managing stockpiles.

IADOT is also planning to investigate use of AASHTOWare Construction and Materials once the software is complete and becomes available. Iowa uses the electronic version of BlueBook for equipment rental rate calculations, and districts have licenses available for users in each district.

3.8 Technical Exchange Topic #3 – e-Ticketing Pilot: Materials Management, Pay Factors, and Certifications

Greg Mulder with IADOT and Mike Schulz with Earthwave Technologies presented on a paperless ticket pilot project in Iowa in 2015 (Materials Delivery Solution).

A large amount of paper was being generated for weight tickets that were needed to satisfy Federal requirements for quality assurance. Tickets can also be lost and require a summary for contractor payment. Safety issues also exist with climbing on the side of trucks to gather the weight ticket from the driver. The electronic system was designed to tag and track trucks at the source, and the tracking process follows the truck to the site to ensure that the source provided the material from the source to the paving location, for example. In addition to the e-ticketing pilot, the software includes a fleet management system (fleetwatcher.com). Users of the system, typically the contractor, will visit a website and set up the project using a map with boundaries. Users can also track the truck movements using a dashboard and generate reports. The data can then be exported to a spreadsheet file for further analysis. The primary benefit is the reduction in large amounts of paper tickets and greater inspector efficiencies.

The units placed in truck cabs can be hard wired or include a cigarette lighter adapter, and both have an internal battery backup. The piloted system also includes a mobile field application for smart phones and tablets. There are a variety of features in the system, including labeling for trucks that are stopped for more than 2 minutes, calculation of travel times, and notation of the times when the engine is running.

Satellites triangulate the location and the Verizon network is used for communication. The system stores all packets received, so if there is a dead zone the system catches up when coverage is back. The plant needs consistent internet service, but the paver does not need a connection at all times. The backup process is printing a paper ticket if any connectivity issues arise – similar to a printer running out of ink. If a device can access the internet it can be incorporated into the system, such as computerized loads (loaders with scales). The scale ticket information is updated in the software every 15 seconds.

It would also be useful to have tare weights for trucks to determine if a truck is overweight before it leaves the plant to allow corrective mitigation to occur prior to the truck traveling on the road. This system also has the ability to enhance the contractor/subcontractor relationship, as paying by time increment instead of quantity could alleviate any issues with full payment for downtime, such as refueling time. By using this e-Construction tool, the benefits of reducing one truck per day for a 10 hour shift can save approximately $1,000 per day. DOT cost savings comes in efficiencies in inspector resources used.

In North Dakota, delivery tickets for each load are collected in the field and then the contractor develops and certifies a daily haul summary. The inspector then evaluates the summary in comparison to the collected delivery tickets and it is either accepted or sent back for revision. This system has the potential to automate some of this process. Operator performance can also be monitored to build in enhanced safety features of the process.

Q: How does all the data get recorded in the IADOT records system?
A: The plan is currently under development. A haul summary can be exported to a PDF to be attached to pay quantity reports.

Q: As the trucks approach the site, what is the inspector doing with the information?
A: They can look at the tablet device to see progress of truck or pull a yield check for the day, which is helpful to know since they are engaged in other activities such as inspecting the roller.

Q: How is the information transferred from the plant to the truck?
A: It is transferred to the fleetwatcher software – the black box in the truck sends information to the software, and the plant reports on the quantity being loaded, and the software ties the two together. Then the paver submits information about location.

Q: If you lose internet at the plant, what would the backup plan be?
A: There have been no reports of loss – these are running on replication servers so there should be adequate redundancy.

Q: If an inspector needs to reject a load how does that occur?
A: There is an option to be able to document rejected material quantities and place them in reports.

Q: Can you export this data to the geospatial database?
A: Yes, the information is available and a future enhancement will be determining how to export the data and assemble it for use.

Q: How do you anticipate using this in the future regarding specification development?
A: IADOT will implement this system on another project in the future and include a developmental specification as we work toward a standard specification with industry input.

3.9 Technical Exchange Topic #4 – e-Construction FHWA Division Office Discussion

Andrew (Andy) Wilson of the Iowa FHWA Division Office reported on how the e-Construction FHWA Division Office pilot was going. The Iowa FHWA Division Office has received iPads to assist them in performing their Federal-aid construction area responsibilities.

They reported the following benefits of using this technology: enhanced mobility with the mobile device, enhanced data through real-time access to specifications and documentation, and enhanced efficiencies through better field data collection. Users have also created Excel forms for inputting data during field reviews, which assist in capturing information in real-time. GPS coordinates can also be added to pictures, enhancing the data and documentation for inspection reports. Quick Edit and iAnnotate are apps used by the Division Office to comment on or edit content in place.

They also reported the following areas for improvement when using this technology. Currently, the FHWA secure legacy software systems that require a Personal Identify Verification (PIV) login are not accessible with the iPad. The iPad does not have a solution for the use of the PIV cards. Users have tested ways to transfer files since PIV cards are required to access DOT email accounts on the iPad. Additionally, the iPad screen size can make some tasks difficult, and users may fill out forms and use word processing and spreadsheet software on a laptop or a desktop in the office instead. The functionality of free versions of apps for scanning documents is limited as well.

Q: How have these devices impacted your communication with your partners at IADOT?

A: We use the devices routinely to take to meetings and have quicker access to information at the meeting. In addition, when in the field doing CAP or other field reviews, we have all the documents available to us. The data plans provide us the opportunity to access all of IADOT electronic systems to support the field review without having to go back to an office to find a paper manual or other paper documentation. In essence, we are able to respond to IADOT and others needs much quicker. IADOT supported these findings and noted that instead of it taking 30 days to process a change order we are now able to process one through in 3 days or less with the FHWA Division Office's concurrence.

Appendix A – e-Construction Peer Exchange Agenda

North Dakota/Iowa e-Construction Peer Exchange

Central Complex Conference Room
800 Lincoln Way
Ames, Iowa 50010

Agenda

Day 1 – December 15, 2015		
Time	**Topic**	**Presenters / Facilitators**
8:00am – 8:15am	Welcoming Remarks and Introductions	Iowa DOT North Dakota DOT Bryan Cawley, FHWA
8:15am – 8:30am	Peer Exchange Background and Overview	Tim Luttrell, Leidos Tom Zagorski, Michael Baker International
8:30am – 9:00am	North Dakota e-Construction Status and Plans	Bryan Strasser, North Dakota DOT Cal Gendreau, North Dakota DOT
9:00 am – 10:00 am	Iowa e-Construction Overview	Greg Mulder, Iowa DOT
10:00am – 10:15am	Break	
10:15am – 11:45am	Technical Exchange Topic #1 - Demonstration of Host State e-Construction Technologies and Systems – DocExpress	IDOT/All
11:45am – 1:00pm	Lunch	
1:00pm – 2:30pm	Internal Archiving and ERMS, Electronic As-Builts, GIS Data, and Asset Management	NDDOT/IDOT/All
2:30pm – 2:45pm	Break	
2:45pm – 3:45pm	Discussion on IT Security Solutions, Firewalls, and Outside Access	All/IT Personnel
3:45pm – 4:15pm	Discussion on Day 1 Takeaways for Implementation	Tom Zagorski, Michael Baker International Tim Luttrell, Leidos
4:15pm – 4:30pm	Preview of Day 2 Agenda Items and Field Review Safety Briefing	Tom Zagorski, Michael Baker International
4:30pm	Adjourn	
Dinner on your own		

Day 2 – December 16, 2015		
Time	**Topic**	**Presenters / Facilitators**
7:00am – 7:15am	Recap of Day 1 Discussion – Challenges and Themes	Tom Zagorski, Michael Baker International
7:15am – 9:30am	Technical Exchange Topic #2: e-Construction Mobile Devices (iPads)	IDOT/All
9:30am – 9:45am	Break	
9:45am – 11:00am	Contractor Perspectives, Change Order Processes and Contractor Access to Electronic Systems	IDOT/NDDOT/AGC/All
11:00am – 12:00pm	Lunch	
12:00pm – 1:30pm	Exchange Topic #3: E-Ticketing Pilot: Materials Management, Pay Factors, and Certifications*	IDOT/NDDOT/All
1:30pm – 2:00pm	Discussion on FHWA Division Office Pilot Program for Tablets*	FHWA/All
2:00pm – 2:15pm	Discussion on Takeaways for Implementation – Suggestions for NDDOT Implementation Plan*	Tom Zagorski, Michael Baker International Tim Luttrell, Leidos
2:15pm – 2:30pm	Closing Remarks, Feedback on Peer Exchange, and Next Steps	All
2:30pm	Adjourn	

U.S. Department of Transportation
Federal Highway Administration

*Web-Based Presentation and Discussion (All times Central)

Appendix B – e-Construction Peer Exchange Roster

Name	Agency	Email Address
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Appendix C – North Dakota DOT Construction Records Manual Section on Contractor Produced Daily Haul Summaries

Computerized weighing systems not only weigh the load and produce a weigh ticket but are also required to produce a daily haul summary. The contractor produced daily haul summary must include the information in Section 109.01 J.6.c of the Standard Specifications.

Check the tickets turned in by the inspector against the contractor produced haul summary. The beginning and ending ticket numbers should correspond with the tickets turned in by the inspector as should the total tons hauled. The total and running total on the contractor's haul summary may be adjusted for voided tickets or partial loads used.

If any corrections to the haul summary are necessary, inform the contractor and have them re-submit a corrected haul summary.

After the contractor's haul summary is verified, the individual who has verified the contractor's haul summary shall sign the haul summary to approve it.

Signed contractor haul summaries are the source document and should be attached to the pay entry in CARS. Once the haul summary has been prepared in accordance with Section 109.01 J.6 and uploaded into CARS, the tickets may be disposed of at the discretion of the Engineer.

For more information see Section 109.01 J.6 of NDDOT Standard Specifications:
https://www.dot.nd.gov/divisions/environmental/docs/supspecs/2014StandardSpecifications.pdf

Appendix D – IADOT List of Standard Mobile Device Applications

PDF Expert – annotations to documents and drawings.

For GIS information, **Collector ArcGIS** (previously used Fulcrum) – Used to gather geographic information on signs, barriers, lighting, and culverts. Used in construction for HMA cores and hotbox samples on a few pilot projects, and IADOT is fully implementing it during the 2016 construction season for all HMA projects with the information gathered by full time inspectors. IADOT is also getting ready to develop a PCC form in it to gather air and slump data for mainline paving.

GPS Outline – Used to gather Latitude and Longitude at a requested location.

ProjectWise – File storage and retrieval from preconstruction to construction.

Citrix Receiver – A portal to the DOT network.

Yammer – Social media within IADOT.

DTN, Weatherbug, Weather Channel, My Radar, Radar Now, and Storm – Weather Apps.

Faster Scan HD – Scanning documents and photographs.

Distance Measure, Area: Calculate my Area, A2, Measure Your Land – Distance measuring applications (still testing others to find one to use).

Iowa 511, Track a Plow – Links as apps that open a webpage.