e-Construction:

- Integrate local agencies with State DOT e-Construction systems to realize benefits of going paperless.
- Advance seamless data integration—from 3D design to construction to asset management and maintenance—is of primary importance for lead States when expanding their application of e-Construction technologies.
- Promote solutions to the issue of custom-developed versus commercially available e-Construction systems. Business processes should drive the software requirements.
- Promote topics that several States are interested in, including e-Ticketing, remote video monitoring, survey grade data on mobile devices (for use by project inspectors), seamless data integration throughout project life cycles, and unmanned aerial systems for quantity calculations.
- Promote use of a project collaboration tool as a first step for new States exploring implementation of e-Construction.
- Facilitate information sharing among neighboring States and regional contractors to ensure mutual understanding of how practices differ.

Over the past several years, FHWA has obtained detailed information on the state of the practice for e-Construction. Several sources provided information including peer exchanges and the resulting EDC-3 Lead State Profiles, the maturity matrix sheets from the Summits, and the survey of each FHWA EDC coordinator in each State. Figure 3 presents a national assessment of the maturity levels (current state of the practice) for States using e-Construction and is a result of only the survey of EDC coordinators as collected by FHWA's Center for Accelerating Innovation.
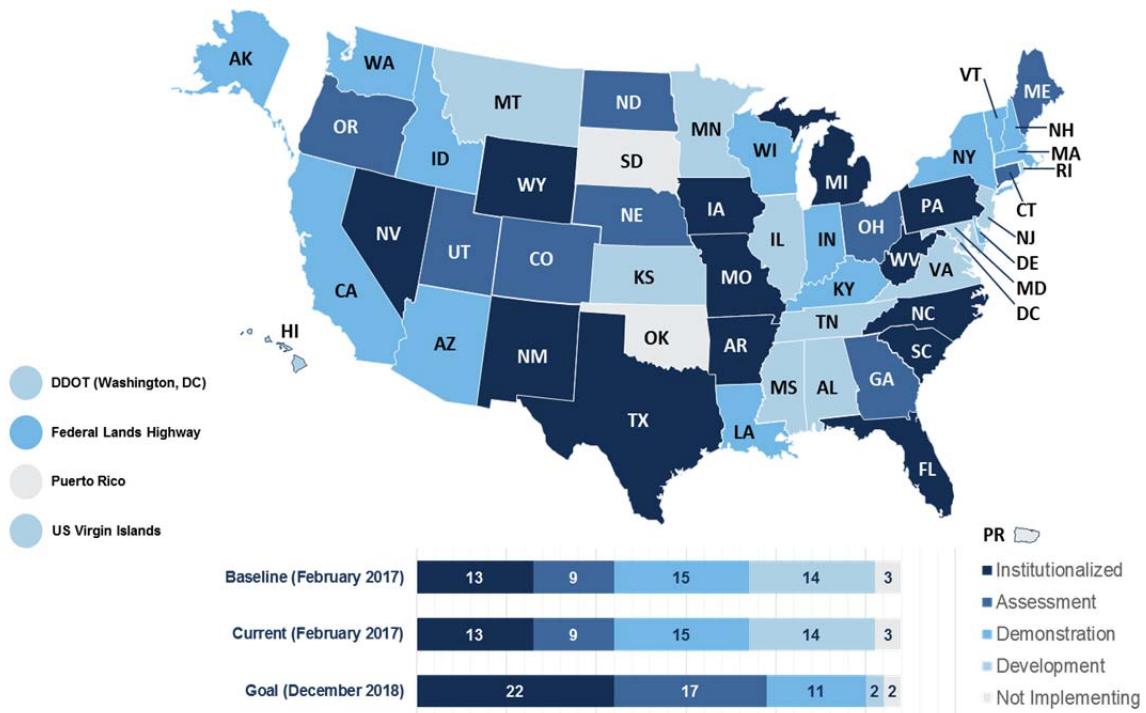
Not Implementing	The state is not pursuing the innovation.
Development	The state is collecting guidance and best practices, building support with partners and stakeholders, and developing an implementation process.
Demonstration	The state is testing and piloting the innovation.
Assessment	The state is assessing the performance of and process for carrying out the innovation and making adjustments to prepare for full deployment.
Institutionalized	The state has adopted the innovation as a standard process or practice and uses it regularly on projects.

Figure 3. e-Construction Maturity Levels by State (February 2017)

Although data on e-Construction maturity levels for each State has been available for some time, FHWA EDC coordinators also evaluated and rated combined State e-C&P practices in early 2017. Figure 4 shows these data, as collected by FHWA's Center for Accelerating Innovation.
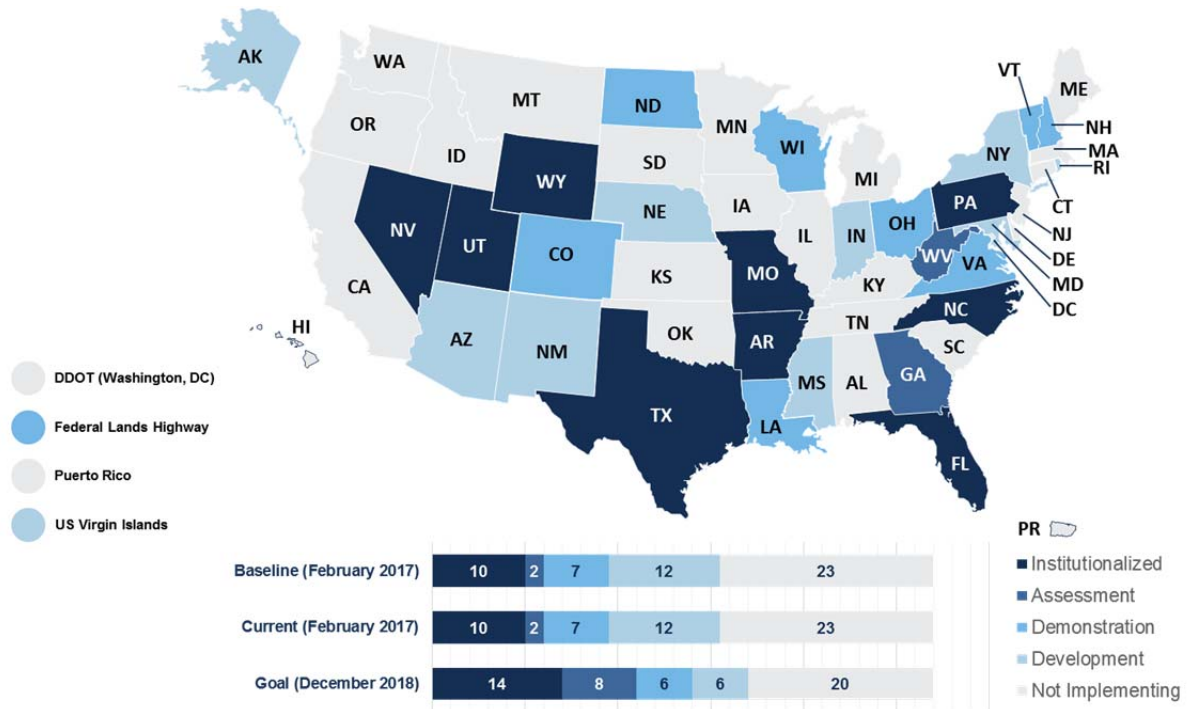

Figure 4. e-C&P Maturity Levels by State (February 2017)

Target Audience

Different groups will approach this initiative in a variety of ways, depending on several factors, including their role in the project delivery process, available funding, management support, maturity level and experience with e-Construction and Construction Partnering. Table 1 summarizes some of these factors and presents how the implementation plan strategies can ensure that a broad range of stakeholder groups will implement e-C&P.

Table 1. Target Audience Descriptors

Target Audience (TA)	Characteristics, Challenges, and Opportunities	Example Strategies and Product Types
TA-1: FHWA	Set strategic direction for implementation, fund activities, facilitate deployment.	Workshops and Webinars; awareness-level information; marketing and implementation plan.

Target Audience (TA)	Characteristics, Challenges, and Opportunities	Example Strategies and Product Types
TA-2: DOT Management and Decision-Makers	Make decisions on funding; make strategic decisions on business processes, activities, and tools; identify a leadership-level champion for implementation at their agencies.	Peer exchanges, training, executive-level marketing concepts, presentation materials, return on investment (ROI) information and analysis tools, and analysis assistance of available technologies.
TA-3: DOT Construction Engineers, inspectors, and IT personnel	Implementation and user-level champions for e-C&P, pilot technologies and practices and report on results.	How-to guides, presentation slides for selling concepts, software and process assessment results, case studies, regional and national discussion boards/blogs/workshops, in-person technology exchanges, self-paced web-based training, and podcasts/YouTube videos on specific tools and technologies.
TA-4: Contractors and Industry Representatives	User-level champions, very supportive of DOT led technology deployment, often demonstrate innovation, require access to DOT systems and can provide suggestions (through industry representation) on policies and practices implemented by owners.	Partnership exchanges, training, executive level marketing concepts, and presentation materials; Resource libraries, case study examples, benefits and ROI, and vendor showcases; Collaboration with agencies in technology development and deployment.
TA-5 Academia, University Researchers, Technical and Vocational Schools	Often funded by State DOTs to help improve practices; students and researchers that will have careers in the highway construction industry.	High-level overview information, guidance documents, and resources to assist with research to improve practices, marketing techniques that draw future employees to industry.
TA-6 Local Public Agencies	Implementation and user level champions for e-C&P, these users pilot technologies and practices and report on results. Typically follow DOT lead.	How-to guides, presentation slides for selling concepts, software and process assessment results; case studies, regional and national discussion boards/blogs/workshops, in-person technology exchanges, self-paced web-based training, and podcasts/YouTube videos on specific tools and technologies.

State of the Practice for Implementation

Implementation success relies on understanding current practices and the challenges that agencies face. By implementing strategies during the next two years (2017–2018), FHWA will help:

- Institutionalized States advance the state of the art for e-C&P.
- Assessment and demonstration States institutionalize the state of the practice.
- Development States advance their states of practice to implement e-C&P by taking the first step in implementation, such as developing a project collaboration tool.

Table 2 summarizes the strategies and benefits of implementation as they relate to each target audience group.

Table 2. e-C&P Deployment Strategies by Target Audience Group

Audience Group	Strategy	Anticipated Benefit
Lead States A lead State is in the institutionalized category of implementation maturity.	■ Fund technical assistance for lead State pilot projects as well as evaluate and report on seamless e-Construction data integration; from 3D design to construction and asset management. ■ Develop and publish use cases on digital data and automated processes that use real-time data as the official e-Construction project record. ■ Develop and publish a business case to help other States achieve lead State status, and to document the need for continued focus and support of these efforts as technology continues to advance at an ever increasing pace. ■ Evaluate and document automated procedures for using e-Construction data post-construction, such as for maintenance of infrastructure components and future design. ■ Advance the state of the art for this target audience. Technical topics include unmanned aerial systems (for quantity calculations and inspections); e-Materials; digitally signed contracts, bonding, plans, and 3D models; use of advanced software	Integrated management of digital data for seamless delivery, 100% paperless project execution from project inception through closeout.

Audience Group	Strategy	Anticipated Benefit
	applications on mobile devices; and life-cycle uses of e-Construction data for asset Management and Civil Integrated Management (CIM). ■ Expand e-Construction from use solely on State DOT projects to include local agencies and Tribes that currently do business with or through the institutionalized State DOTs.	
Advancing States The State is testing/piloting e-Construction innovations for project planning, design, and construction of highway facilities. An Advancing State is in the Assessment or Demonstration stage. The State is assessing the performance and the processes to prepare for full statewide deployment.	■ Fund a webinar series focused on detailed technical topics that can help advance the state of the practice for this target audience. Technical topics include e-Ticketing, data storage on collaboration sites, development and procurement of project collaboration sites, and use of basic software applications on mobile devices. ■ Provide labor and travel funding directly to State DOTs for e-C&P SMEs to fund State-to-State resource sharing by institutionalized States for technical support in advancing from piloting to statewide implementation. ■ Hold key stakeholder group discussion forums and support network with all State DOTs (through AASHTO). ■ Help expand e-C&P from use solely by State DOT employees to include local agencies, consultants, contractors, and subcontractors that currently do business with State DOTs. ■ Fund technical assistance to States to update policies and procedures for Construction Partnering. Research and document current state of the practice for Construction Partnering and publish benefits information on practices that can generate renewed interest.	Institutionalized practices for e-C&P, with a focus on collaboration, transparency, and trust.

Audience Group	Strategy	Anticipated Benefit
New Exploring States The State is in the development or not implementing stage. They are compiling guidance and best practices, building support, developing processes, and moving toward testing and piloting. They have a desire for implementation but need management buy-in, deployment champion identification, funding identification and assistance, and a plan for where to start.	■ Fund peer exchange opportunities for advancing and lead States to travel to the new exploring State and provide technical assistance. ■ ROI calculation assistance, tools to obtain management buy-in and support, change management, identify e-Construction champion, hold Implementation Plan or work plan development workshop, or both. ■ Fund roadmap to demonstration, capability matrix for self-evaluation and goal setting, and deployment of how-to guide and workshops. ■ Fund You-Tube video shorts (similar to Federal-aid essentials) focused on technical topics that can help advance the state of the practice for this target audience, facilitate entry into the e-Construction realm, share best practices and lessons learned, and provide framework to follow and resources to reach out to and use when first deploying e-Construction. ■ Provide labor and travel funding directly to State DOTs for e-C&P SMEs to help exploring States with implementation, including concepts of operation, system design, and procurement of commercial off-the-shelf systems, outsourced custom development, or in-house development. Further promote State Transportation Innovation Council (STIC) Grant Program. ■ Enhance the FHWA e-Construction and Partnering websites. ■ Establish a follow-up process to develop action plans for exploring states who participated in peer exchanges. Provide additional technical support to help them meet implementation goals. ■ Fund Regional workshop opportunities where multiple institutionalized States and industry travel to one location to provide technical assistance.	Initiating paperless practices and increasing communication and collaboration—taking the first step, such as through implementation of project collaboration site, electronic inspector daily reports, or electronic bidding.

Audience Group	Strategy	Anticipated Benefit
All stakeholder groups	■ Fund guidelines on application of Construction Partnering at the programmatic level, with industry associations and local governments. ■ Include examples based on project complexity and type of contracting mechanism. ■ Fund Research on e-C&P to advance the State-of-the-Art and support continued advancement of deployment.	Greater interest early in the project development process from all stakeholders. Real-time peer access to help with implementation

Goals

National

The national goal is to continue the EDC-3 momentum to have 22 States reach institutionalized status for e-Construction by December 31, 2018. The definition of institutionalized is *e-Construction innovations for project planning, design and construction have been adopted by the State's transportation community as the standard of practice and are used on all projects, or within the program, where appropriate,* for 100% paperless project execution from project inception through closeout. In addition, advance 17 States to the assessment stage for e-Construction with all States at least having demonstrated the technology.

For the integrated practice of e-C&P, the national goal is to have 14 States reach institutionalized status by December 31, 2018, and advance 8 States to the assessment stage. Discussion and interactions with specific agencies will help FHWA determine how to optimize these numbers.

Innovation Goal

For e-Construction, one primary goal is to accelerate adoption (change management and return on investment [ROI]) to create a new norm in construction-related project management, communication, and workflows.

Second, agency e-Construction use will reach the highest maturity level, and local agencies and contractors will expand use. This goal includes advancement in technology application, such as inspector use of survey grade positioning data on tablets and real-time data processing and analysis to automate functions. The materials management and asset management areas

could provide significant cost savings through advanced e-Construction applications that lead States are currently considering.

For Construction Partnering, a primary goal is to expand knowledge to all stakeholders about how today's technologies and modern methods can enhance partnering processes. As the state of the practice has advanced, States now can apply solid, time-tested principles in an environment that is rich in technology and takes advantage of new and innovative business relationships. The focus of partnering will be on "proactive" practices that help agencies and the private sector advance this new model while reducing risk and improving efficiency and project performance.

A primary goal of EDC-4 is to expand the use of e-Construction to advance Construction Partnering. Practicing e-C&P will raise accountability, improve communication, and add transparency in the management of projects. Practicing both together improves project collaboration by facilitating information sharing and the ability to identify a single, standardized repository for critical project records. In addition, e-C&P will provide for proactive digital project management and issue resolution in a way that reduces contract costs and time for all stakeholders.

Challenges

e-Construction. Each State's situation is unique—from the size of the construction program to the information technology (IT) resources available for implementation.

A key challenge lies in whether to develop a custom system or purchase a commercial product. Developing or procuring a new system requires meticulous decisions as to which approach would best match an agency's business processes or could be readily tailored. Rarely does the purchase of a commercial "off-the-shelf" product suffice without having to change long established processes and procedures. Such change can intimidate future users accustomed to the legacy systems. In addition, business processes might not match the design of these new systems.

The existence of legacy systems can complicate innovation deployment. Legacy systems might no longer meet the organization's needs, or agencies might use outdated or unsustainable technology. Some agencies are hesitant to

abandon legacy systems because they are often intertwined with other technology solutions serving other needs or departments. Ultimately, staff must decide and recommend to their management whether to upgrade or to replace legacy systems.

Another challenge is obtaining management buy-in so that critical resources including personnel and funding can be dedicated to implementation. Experience has shown the importance of credible ROI information for both agency management and those who control legislative budget processes. e-Construction technologies could have significant up-front costs, and ROI might not be achieved for 2 to 7 years, depending on the technology and level of deployment.

Construction Partnering. State DOTs have been using Partnering for several decades. This project management strategy began as a very formal and structured collaboration approach that suited the project delivery environment at the time. Construction Partnering, however, has not kept pace with innovations in project delivery, technology advances, and complexities inherent in today's project delivery environment. Policies
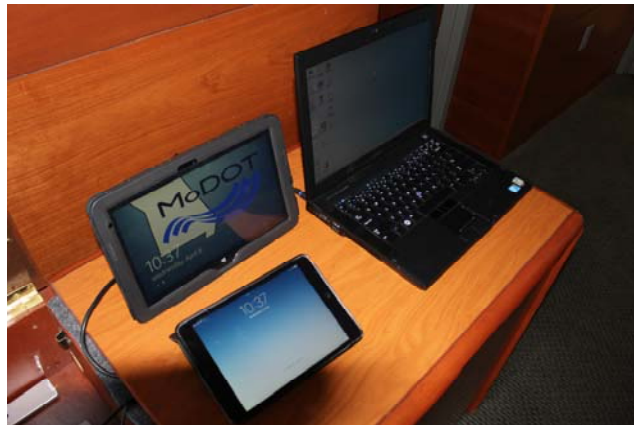

Figure 5. Mobile Devices for Enhanced Construction Inspection in Missouri

and practices need to change and adapt to innovations in areas such as e-Construction to remain relevant and effective for the effective delivery of projects.

Although States are using both e-Construction and Construction Partnering practices across the United States, challenges for advancing their combined application and achieving their potential synergies remain.

Benefits

Stakeholders will realize the benefit of practicing e-C&P together in the management and delivery of projects. For e-Construction, benefits include reduced printing costs, increased quantity and quality of electronic

documentation, time savings for inspectors, and greater confidence in a single source of truth for construction contract administration. Construction Partnering improves collaboration and builds trust and stronger relationships across stakeholders. With a renewed interest in partnering and expanded implementation of the e-C&P concepts and tools, agencies and other stakeholders benefit from greater transparency and a more proactive approach to identifying potential conflicts early in the process.

Some specific benefits of e-C&P include:

- Collaboration and communication across the public and private sector, resulting in better documentation for agencies and faster and more accurate payments to contractors;
- Transparency through project collaboration sites with documented correspondence, approvals, and a single source of truth;
- Reduced costs associated with claims and disputes;
- Improved document distribution and workflow processing; and,
- Efficient inspection, documentation, and overall time savings.

In addition, notable success has been achieved when States apply partnering principles to their industry relationships or with local governments. More recently, States are applying Construction Partnering in a less formal way with more emphasis on teamwork and collaboration in lieu of the very structured approach used for so many years. Regardless of whether a formal or informal approach is chosen, technology applications will be important and will play a key role in renewed industry interest in partnering concepts.

Marketing Research

A. General Research Approach

The key focus of marketing and market research for this initiative is to create a branding message that supports the deployment, adoption, and use of e-C&P technologies. The branding message will help increase awareness, understanding, and interest in the offerings and promote best practices for successful construction project management. This activity will include shaping industry perception around how to apply e-Construction tools that also enhance Partnering.

B. Obstacles, Opportunities, Strategies, and Tools/Tactics

To provide a clear path forward, the e-C&P Team evaluated potential obstacles, along with opportunities, strategies, tools, and tactics for mitigating the barriers to deployment and implementation of the innovation. Table 3 summarizes the Team's evaluation, and Table 4 outlines marketing strategies.

Table 3. Opportunities, Obstacles, Strategies, Tools and Tactics

Opportunities/ Obstacles	Strategy	Tools/Tactics
Agencies that have not yet implemented e-Construction might need assistance selling concepts to management.	Develop presentation materials and tools that highlight benefits and ROI to key decision-makers.	■ Presentation slides ■ Self-Assessment Maturity Matrix Tool ■ Calculation and reporting of ROI and key benefits ■ Executive level peer exchanges
Some agencies will have challenges in overcoming past experiences that have created current perceptions of Partnering.	Focus on practical examples from other States that show the benefits of renewed interest in Partnering, including claims avoidance, cost reductions, and schedule improvements.	■ Interviews with States ■ Data collection and analysis of practices ■ Example case studies on risk-based partnering applications

Table 4. Marketing Tools and Tactics

Marketing Tool or Tactic	Activity Description	Level of Priority
Partnering Peer Technical Assistance Program	Set up peer group with listserv or similar communication techniques, regular newsletters, outreach materials, and conference presentations.	1
Posters for Future Conferences	Design and production of handouts, displays, and presentations for FHWA personnel or contractor team members to present or display on e-C&P at AASHTO Meetings, TRB, and others. Recommend including QR code on materials so that users can access additional materials, presentations and reports from the website. Design an e-C&P Logo for use on this and other products.	2

Performance Measures

To ensure the success of deployment goals, measures will be closely tracked. For each goal, State agencies will achieve specific objectives and FHWA will track those activities through input from EDC coordinators in each State and through

observations. FHWA will evaluate the progress of deployment activities and the advancement of States and others in adoption and standard use of the technologies and practices.

Table 5 summarizes the goals and performance measures suggested for evaluating e-C&P implementation across the nation.

Table 5. Goals and Performance Measurement

Goal Category	Monitoring and Measuring Progress	How do we tell if it's working?
Team Goals	Achieve the national goal by performing 10 peer exchanges and publishing at least 8 promotional documents.	■ Number of peer exchanges or pilot projects that result in advancement of State's implementation. ■ Number of products published
National Goals	20 Institutionalized States for e-Construction and 12 institutionalized States for e-C&P. Increase each new and advancing state's maturity level by at least one level.	■ FHWA Center for Accelerating Innovation (CAI) EDC-4 reporting metrics ■ Maturity matrix results ■ TWG member discussions
Innovation (Benefit) Goals	Accelerate deployment of e-Construction and e-C&P nationally and reduce costs, claims, and paper.	■ Requests for peer exchanges ■ Agency engagement levels ■ Enhanced partnering results and improved maturity matrix scores ■ Growing membership in partnering peer technical assistance group

Work Plan

Table 6 highlights the identified activities and anticipated leads to follow up on in implementation. The identified implementation activities reflect feedback received from participants at the fall 2016 Summits held around the country. The feedback from those Summits also has helped in identifying potential audiences for these activities and the type of message that would successfully target those different audiences.

Activities are presented in three separate tracks: e-Construction, Construction Partnering, and e-C&P joined and implemented together. Table 6 is complimentary to Table 1, as it adds responsibility and due dates.

Table 6. Work Plan

Implementation Activity	Audience	Message	Responsible Party	Due	Comments
e-Construction Actions					
1. In-Person Peer Exchanges for non-institutionalized States	State and local agency construction personnel, IT staff, contractors, and vendors	Experience of national leaders shared with neighboring and other agencies accelerates knowledge transfer and adoption.	FHWA, state and local transportation agencies and industry organizations	2017/2018	Gather input directly from States on highest priority needs, SME technical assistance funded directly to States, tailored business case document resulting from peer exchange discussions.
2. e-Construction Technical Topics Webinar Series	State and local agency construction personnel, designers, contractors, and vendors	Experience of national leaders shared with neighboring and other agencies accelerates knowledge transfer and adoption; ROI calculations and state-of-the-art technologies.	FHWA, state and local transportation agencies and industry organizations	2017/2018	Conduct 90-minute webinars with guest speakers on highly technical topics (i.e., Q/A; e-Ticketing; data storage; project collaboration site development; mobile device apps; UAS's).

Implementation Activity	Audience	Message	Responsible Party	Due	Comments
3. Technical documents: Case Studies, Guidelines, and Best Practice Information	State and local agency construction personnel, designers, contractors and vendors	Case studies and guidance documents highlight new technology and innovative practices to educate e-C&P users.	FHWA and Industry organizations	2017/2018	Publications to accompany webinar information – business cases/processes; digitally signed contracts; 3D data integration; disseminate information on state-of-the-practice in e-Construction.
Construction Partnering Actions					
4. National Innovative and Effective Partnering Practices Conference	State DOT construction staff, local agency staff, contractors, consultants, and FHWA	To share Construction Partnering best practices among peers to promote greater use.	FHWA, state and local transportation agencies and industry organizations	4/2017	Nevada DOT hosted in Reno, Nevada, April 4–6, 2017.
5. Construction Partnering Peer Technical Assistance Group and State-of-Practice study	State DOT construction staff, local agency staff, contractors, consultants	How-to guidance for effective and efficient application of Construction Partnering concepts targeting new construction professionals.	FHWA and Industry organizations	2018	Provide help to States by revisiting Construction Partnering policies and procedures and case studies of risk-based and programmatic Construction Partnering.
6. Model Construction Partnering specification development	State DOT construction staff, local agency staff, contractors, consultants, and FHWA	Demonstrate how Construction Partnering adapts to the various alternative contracting methods / scenarios.	FHWA and Industry organizations	2018	Provides updated specification that can be used with a variety of project delivery models.

Implementation Activity	Audience	Message	Responsible Party	Due	Comments
7. Report on the application of Construction Partnering at the programmatic level with industry associations and local governments	State DOT construction staff, local agency staff, contractors, consultants, and FHWA	Case studies, examples, lessons learned, successful applications.	FHWA and Industry organizations	2018	Provides examples and case studies on successful application of Construction Partnering.
e-C&P Synergy Actions					
8. Outreach materials for e-Construction and Construction Partnering applications	DOT IT personnel and construction personnel, local agencies, Tribes, contractors, consultant, venders, industry, and Educational institutions	Inspire a culture of innovation among a new generation of transportation professionals by encouraging them to embrace innovation and technology throughout their careers as a way to advance their chosen profession. Answer - What is e-C&P? How does it affect me?	FHWA	2017	Promote awareness of e-C&P innovations and technology. (YouTube videos, career fairs, tech briefs and to include marketing efforts - logo messaging, and products).
9. Regional e-C&P Demonstration Workshops	State and local agency construction personnel, designers, contractors and vendors	Enhanced technical assistance on specific (AID Grant) projects demonstrating e-C&P technologies and practices with peer-exchange opportunity for each demo.	FHWA, state and local transportation agencies and industry organizations	2018	Two real-world projects at strategic locations for states in the 'Development' and 'Demonstration' implementation stages.
10. e-C&P Community of Practice	State DOT construction staff, local agency staff, FHWA	Website that allows users to exchange information and share ideas	AASHTO	2018	AASHTO contact - Keith Platte.

Implementation Activity	Audience	Message	Responsible Party	Due	Comments
11. Report on applying e-C&P to Alternative Delivery Methods	State DOT management and construction staff, FHWA	How innovative contracting affects the traditional partnering roles by stakeholder group	FHWA, AASHTO and industry organizations	2018	Focus on Design-Build, Construction Manager/General Contractor, and Innovative Financing projects.
12. Research studies in e-C&P to advance the state-of-the-art and continued support for advancement of the subjects	State DOT executive, IT and construction staff, local agency staff, contractors, consultants, and FHWA	Advance state-of-the-art research, understanding, benefits, and best practices. Secure e-Construction data for future use in asset management and life-cycle.	FHWA – TFHRC	2018	e-C&P success stories, disaster recovery study of e-Construction data, archiving of e-Construction data BPs, single source of truth ROI and use, use of e-Construction data after construction in asset mgmt / lifecycle of assets. Methods of e-Construction data archiving, data storage, and data integrity. Research documents; asset management application of e-Construction data; data archiving, storage, and integrity; seamless lifecycle data use case studies.

Summary

This implementation plan provides the first steps toward combining the e-Construction and Construction Partnering practices. Participation by FHWA, agencies, and States is necessary for success. In two years, the combination will maximize the effectiveness of construction programs. The result will be reduced claims, increased efficiencies, increased collaboration and trust, avoided costs, and accelerated project schedules.