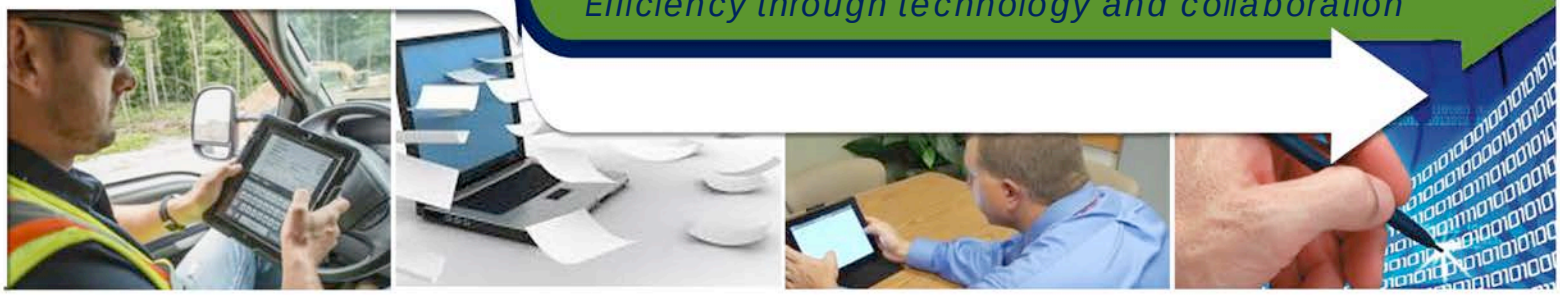
e-Construction

Efficiency through technology and collaboration



Implementation Plan

Every Day Counts 3 | Innovation Initiative

January 2015

AASHTO Innovation Initiative

U.S. Department of Transportation
Federal Highway Administration

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Section I: Overview and Innovation Description

A. Background

A joint FHWA–AASHTO initiative is designed to assist States with implementing a paperless construction administration and delivery process known as e-Construction. e-Construction is a way to reduce the amount of hard copy documentation needed for highway construction projects. The e-Construction process promotes broad but controlled access to a central document management system in which every data element is stored exactly once via modern technologies, including mobile devices, by all key stakeholders at both a project and program level. The e-Construction process includes electronic submission of all construction documentation, electronic document routing and approvals (e-signatures), and digital management of all construction documentation in a secure environment.

Several State departments of transportation (DOT) and industry practitioners are already using or exploring some aspects of e-Construction. Some are even in the process of mainstreaming many of the aforementioned e-Construction practices. The proposed e-Construction concept is supported by many tools and practices that currently exist to improve communication and make construction management practices more efficient. e-Construction has the potential to increase the quality, efficiency, environmental sustainability, and productivity of the construction industry at large while helping agencies to save on printing costs, time, postage, legal involvement, and document storage as well as to introduce communication efficiencies. To date, e-Construction has been proven to be valuable and effective by several agencies. Through enhanced awareness, promotion of benefits, and examples of its application, the highway industry is ready to reap the benefits of program-level implementation.

IMPLEMENTATION PLAN HIGHLIGHTS

A focus on a variety of online and face-to-face informational exchanges tailored to each target audience group

- **An online "community of practice" built from current lead State examples**
- **Cooperation between AASHTO and FHWA on carrying out the plan**
- **Predefined levels of evaluation for target audience implementation status**

The objective of this e-Construction implementation plan is to outline strategies that will market expanded deployment and expanded use of the technology tools and practices available to improve construction project management with the goal of widespread adoption across the industry.

B. Challenges

Developing and implementing an e-Construction plan comes with some challenges. One of those challenges is budgetary restrictions. This challenge applies to all engaged agencies, consultants, contractors, and materials suppliers. All change initiatives require an initial startup capital cost, but the return on investment for e-Construction exceeds the startup costs, as has been proven by our lead State adopters.

- **E-Construction solution compatibility**—one solution doesn't fit all. State and local agencies vary tremendously with regard to the size of their construction programs, sophistication of current technology, and limited funding resources. For States with large construction programs, the benefits of initial investment may be realized more quickly due to application of the technology to a large volume of projects and to the most complex projects. States with smaller programs may have the same initial investment as States with larger programs but with fewer opportunities to capitalize on their investment. However, as subject matter experts (SME) have noted, States can benefit from e-Construction regardless of the size of their construction programs.

  This plan takes into consideration that certain approaches and strategies will need to be tailored and scalable to the situation of the audience.

- **Narrow and focused target audience—**this will require defining a target audience that is in a position of influence with the agency and is motivated and empowered to move forward with solution evaluation, adoption, and deployment.

- **Meaningful measures of progress and success—**the success of the plan will rely on the monitoring of meaningful measures of implementation progress and the analysis of data collected during the two-year period for implementation of this plan. It will be important to establish the

measurements early and monitor them on a regular basis. Based on the results, adjustments in the planned approach and strategies will be required to assure effectiveness in maximizing the national deployment of e-Construction with our limited resources.

- **Dedicated and committed plan implementation participants—**any plan is only as good as the level of interest of those involved. The plan identifies those who will be responsible for managing the plan and those who will be required to develop and carry out the approaches and strategies. This will require a commitment of time and resources to accomplish the objectives of the plan within the 2-year deployment period. For agencies to have time to deploy e-Construction, the activities are front-loaded at the beginning of the 2-year timeframe.

- **Shifting resources—**new costs will be incurred while old costs are reduced (i.e., physical real estate reduced as paper storage is no longer needed, but data storage space increases). In addition, people's roles change (i.e., inspectors spending less time transmitting documentation and more time on their primary function of inspecting the quality of work).

C. Benefits

This initiative will modernize construction document management through elimination of the cumbersome paper-based approach. In addition to saving money by reducing paper use, printing, and document storage needs, this initiative also saves time by decreasing communication delays and transmittal time. The e-Construction process allows faster approvals, increased accuracy, and enhanced document tracking, all while improving transparency. The improvements to communication and the transparency of the process has been shown to reduce questions, claims, and disputes as to when or if a document was submitted. Additionally, all stakeholders can see the name of the document approver along with the exact timing of each step recorded. The process provides a better foundation to help improve communications and partnering. The following is a summary of benefits the

agencies should expect to experience upon successful deployment of e-Construction solutions:

- Reduction or elimination of paper (sustainable solution)
- Operates in a secure environment
- Ease of document access or searchable text
- Real-time document access
- Controlled and improved document distribution and workflow
- Standardization of reports or forms
- Reduced storage and lost paperwork
- Enhanced disaster recovery
- Improved cash flow
- Reduction in claims
- Field staff on the job site for a higher percentage of time
- Easier access to manuals, plans, and project information
- Documents approved faster
- Ability to sign electronic documents remotely
- Faster, more accurate payments to contractors
- Transparency—documents available for viewing by all project partners
- Integrates with other core systems, such as accounting, asset management systems, etc.

The direct benefits the agencies will experience and assets that will be available as a result of deployment of this plan include:

- Access to a national online e-Construction "community of practice." Provides an information portal and central depository of e-Construction information
- Access to SMEs for peer exchanges
- Access to written information, such as blogs, publications, lessons learned, calendars of events, etc.
- Webinars
- Faster problem solving with interactive real-time access to statewide experts and partners

D. Partners

We would like to acknowledge the input and participation from the following Technical Working Group (TWG) members:

Greta Smith AASHTO	Bryan Cawley FHWA Headquarters	Amy Tootle Florida DOT
Rafiq Darji Florida Division Office, FHWA	Greg Mulder Iowa DOT	Jason Clark Michigan DOT
Cliff Farr Michigan DOT	Stuart Laakso Michigan DOT	Mark VanPortFleet Michigan DOT
Robert Fijol Michigan Division Office, FHWA	Richard Beckes Minnesota DOT	Roxana Garcia Texas DOT
John Obr Texas DOT	Richard Duval Turner Fairbank Highway Research Center, FHWA	Rob Wight Utah DOT

E. State of the Practice

Many State DOTs and industry practitioners are already using or testing some aspects of e-Construction. Some are even in the process of mainstreaming many of the aforementioned e-Construction concept practices. The proposed e-Construction concept is supported by many tools and practices that currently exist to improve communication and make construction management practices more efficient. Examples include:

- Transfer of electronic plans supported under EDC-2, 3D engineered models for construction, and electronic contract specifications and special provisions
- Mobile devices, software, and applications for field inspection and data collection
- Data hosting services, such as data clouds, share sites, virtual review rooms
- Electronic review and approval processes (digital signatures and reviews)
- Communications tools (e-mail, text, social media, smart phones)
- Radio frequency identification tags for resource tracking
- Asset management, electronic as-built drawings, and quality assurance records

Michigan DOT has applied e-Construction to all projects, while the Minnesota, Florida, Utah, Texas, Pennsylvania, and North Carolina DOTs have applied this technology to design-build projects. Wisconsin and Iowa DOTs have applied e-Construction to design-bid-build projects. The Michigan DOT, a leader in e-Construction, estimates that its programmatic adoption will result in approximately $12 million in added efficiencies and eliminate 7 million pieces of paper by using electronic document storage for its $1 billion average construction program. In addition, average contract time for complex contract modifications (change orders) is reduced from 30 days to 3 days.

In addition, the following States have implemented procedures that complement their e-Construction applications:

Texas:

- Design (ProjectWise and 3D modeling)
- Pre-letting (advertising, BPRS, pre-bid questions)
- Letting (CDA)
- Contract administration (FieldManager, SiteManager, P6, EPRS, iPads, YouTube)
- Archiving (EDMS)
- Electronic data collection, materials, core custody

Michigan:

- Electronic document management system
- Construction administration software
- Electronic plans and proposals
- Electronic bidding
- Digitally encrypted electronic signatures
- Process workflow
- Mobile devices
- I-books and online manuals
- Fillable forms

Minnesota:

- Letting, award, and approval
- Contract administration—central office
- Contract administration and inspection – Projects

Iowa:

- As-let plans from contracts
- Electronic as-builts in the field
- New electronic shop drawing process (DocExpress)
- Straight-line diagraming for project plans
- 3D project plan vision
- GIS-based smart plans

Florida:

- Project letting
- 3D design models
- Collaborative sharing site
- Mobile devices
- Digital signatures (encrypted)
- Form automation
- Electronic as-builts

Utah:

- Electronic plan sets and documentation (field laptops or digital cameras)
- Budget tracking and projections
- Schedules and projections
- Electronic signatures
- Electronic payroll verification
- 3D design

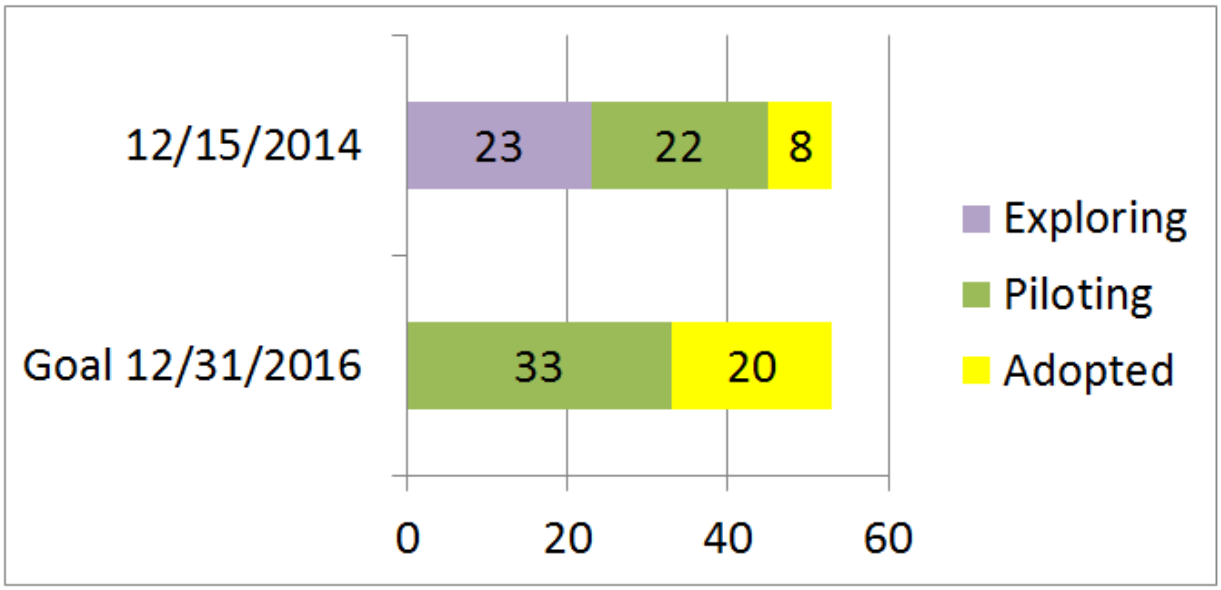
Polling during regional summits engaged participants to define their levels of utilization of e-Construction technology. Participants were provided the following levels of utilization to self-define their rankings:

Adopted: has adopted and implemented e-Construction technology and has constructed two or more projects using e-Construction technology.

Piloting: is investigating or piloting e-Construction technology.

Exploring: is not taking part in national EDC-3 technology initiative.

The following figures highlight the current state-of-the-practice for e-Construction by State.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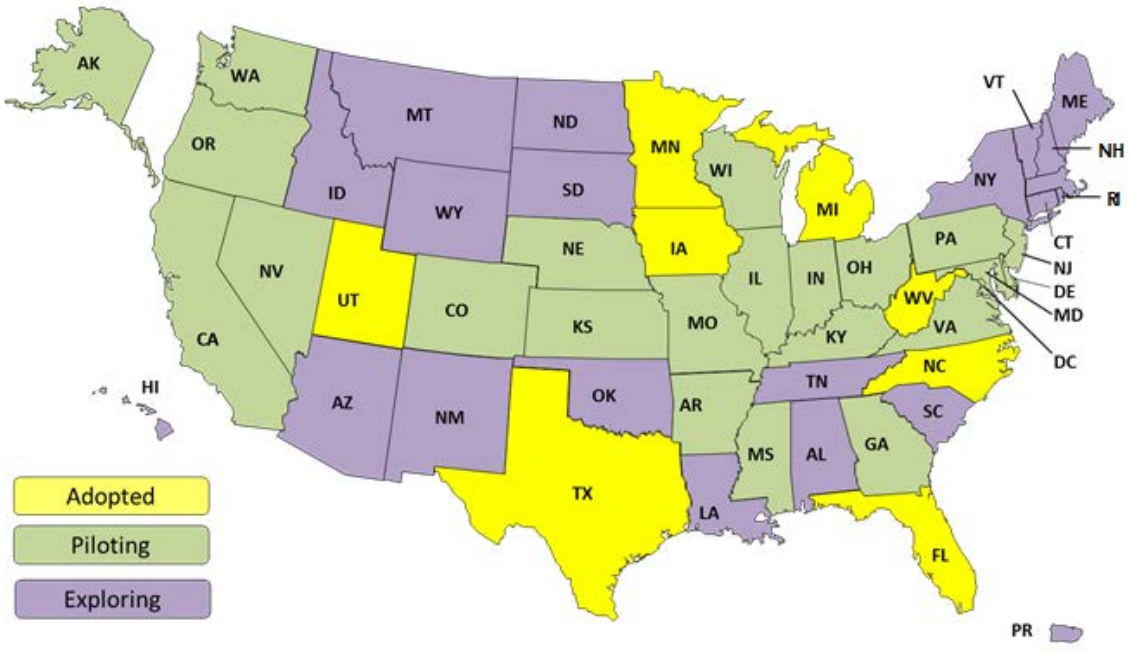
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F. Implementation Team and Key Stakeholders

Implementation Team

Implementation Plan Leader: owns the implementation plan and manages the execution of strategies. FHWA staff.

Implementation Plan Support Staff: directly supports the implementation plan leader. A combination of FHWA, AASHTO, DOT, and consultant personnel.

Advisory Team: reviews the approach and structure of the strategy and measures progress. TWG personnel.

Tools and Tactical Team: executes the strategy and develops the tools. Implementation plan leader and implementation plan support staff will administer and identify tactical team members for individual tasks.

Key Stakeholders

Primary: FHWA, AASHTO, State DOTs (SMEs and States who have adopted e-Construction), contractors, consultants, vendors, and trade associations

Secondary: State DOTs (discussing or exploring). Local agencies, consultants, contractors

Section II: Vision and Mission Statement

The project team has established the following vision and mission statement for this project. They are based on the overall goal of accelerating the implementation and adoption of e-Construction tools for construction in the United States.

VISION:

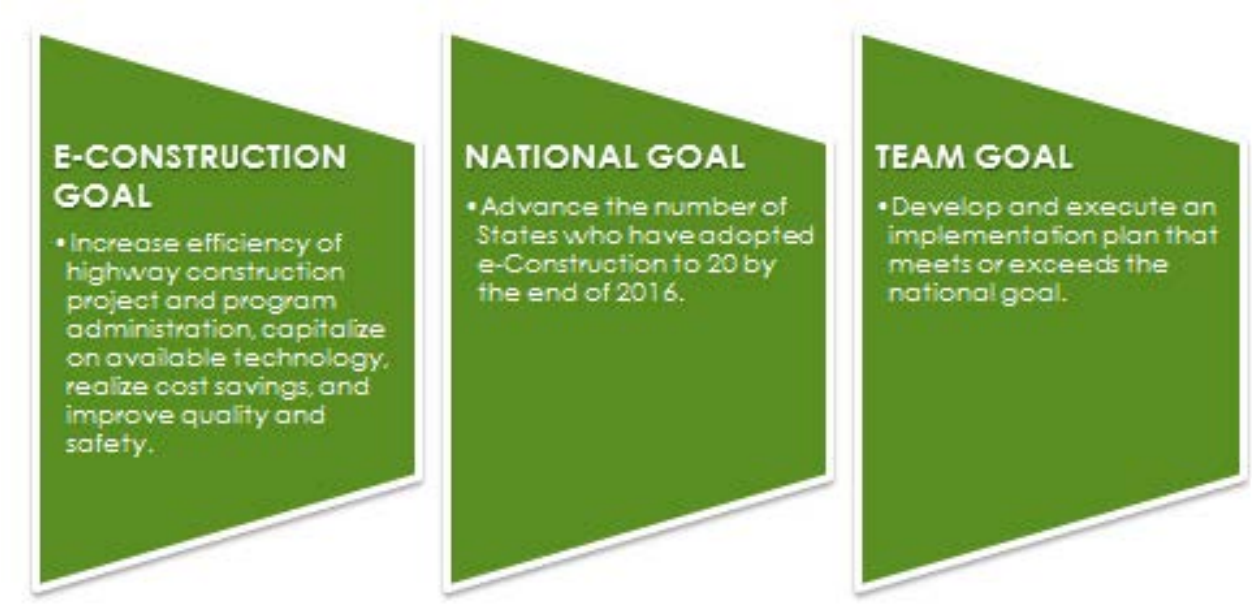
Mainstream the use of e-Construction technology so that agency employees can deliver facilities with speed, efficiency, accuracy, safety, and lower cost using a paperless system to facilitate communications and record keeping on highway construction projects.

MISSION STATEMENT:

Promote knowledge transfer and facilitate implementation of e-Construction to provide users with a secure, efficient, collaborative, paperless, and accessible tool for electronic construction administration data management.

Section III: Goals

The following goals have been established for deploying e-Construction technology:



e-Construction Goal

E-Construction technology works toward the EDC-3 goals of shortening project delivery, enhancing the environment, improving safety, and reducing congestion. Deployment of e-Construction will increase efficiency of highway construction projects and program administration, capitalize on available technology, lead to cost savings, and improve quality and safety. The ultimate goal of e-Construction technology can be summarized as the following:

- Move toward paperless system
- Reduce construction time and cost and increase efficiency
- Improve quality and safety

National Goal

The goal is to have a certain percentage of the target audience develop an e-Construction implementation plan, adopt a technology, and utilize the system with the outcome being that these users experience the benefits of e-Construction technology. Based on the EDC-3 regional summits and the results of target audience polling, it would be reasonable to suggest that by December 31, 2016:

- **20 States will have *adopted*** e-Construction processes. The majority of States will utilize e-Construction technology consistently for highway construction projects.
- **33 States will have *piloted*** implementation of e-Construction technology. Most States will have transitioned from not utilizing the technology into pilot programs for the technology or a primary phase of utilization.
- **0 States will be *exploring*** implementation of e-Construction technology. All States will have plans to implement some form of e-Construction technology.

Team Goal

Develop and execute an implementation plan that facilitates achieving 100 percent of the national goal. To validate this goal, it will be necessary to document 100 percent of State and FHWA Federal lands practices in e-Construction and maximize the success of the recommended activities in meeting or exceeding the national goal. The approach and strategies defined in this plan will engage the target audience and assist it in achieving individual goals and, ultimately, the national goal.

Section IV: Target Audience

Stakeholders who would benefit from using e-Construction technology include system owners, users, and service providers. The target audience for the e-Construction implementation plan is varied, and includes all levels of transportation agency staff, consisting of federal, State, and local agencies, as well as the academic, vendor, consultant, and contractor communities.

The following table provides a summary of the target audience segments and associated characteristics of each group, along with challenges, opportunities, and strategies or products tailored to each.

Table 1: Target Audience Descriptors

Target Audience	Characteristics, Challenges, and Opportunities	Example Strategies, Messages and Messengers
FHWA		
• Headquarters leadership	• Set strategic direction for implementation, fund technical assistance activities, facilitate deployment	• Implementation plan and strategic ideas
• Resource center and division offices	• Assist target audience with implementation	• Webinars; higher-level awareness information
• Federal lands highway divisions	• Implement e-Construction tools—end users of e-Construction tools	• Peer exchanges, marketing materials, training, other specific hands-on information
Management with DOTs		
• Chief executive officers and decision makers, including legislators and external commissions, etc.	• Make funding decisions, set strategic direction for implementation	• High-level sales pitch and marketing other concepts, e.g., ROI, etc.
• Construction engineers, project design	• Make tactical decisions on system utilization, convince	• Peer exchanges, webinars, benefit-cost information, all

Target Audience	Characteristics, Challenges, and Opportunities	Example Strategies, Messages and Messengers
engineers, project managers	decision-makers of benefits	resource documentation
• On-site resident engineers and project engineers, construction managers, construction inspectors	• Day-to-day implementation, system utilization, and continuous improvement—end users of e-Construction tools	• How-to guides, e-Construction standards, resource library, videos
• Owner IT department security and systems administrators	• Allowing adequate access to support all user interface while maintaining records security and accountability	• How-to guides, methods of achieving, listing of hardware and software solutions
Management with Other Agencies		
• Chief executive officers and decision makers	• Make funding decisions, set strategic direction for implementation	• High-level sales pitch and marketing other concepts
• Construction engineers, project design engineers, project managers	• Make tactical decisions on system utilization, convince decision makers of benefits	• Peer exchanges, webinars, benefit-cost information, all resource documentation
Consultants, Contractors, Vendors, other Industry Personnel		
• Construction engineers, project design engineers, project managers • On-site residents and project engineers, construction managers, construction Inspectors	• Users of system requiring special access or permission, as they are key stakeholders but reside outside of the owner-agency	• How-to guides, e-Construction standards, resource library, videos

Section V: Marketing Research

A. General Research Approach

Through the FHWA webinar and seven EDC-3 regional summits, the e-Construction team engaged representatives at varying levels of expertise within each of the target audiences and across multiple States. While we have identified lead States with SMEs, the team recommends additional market research to develop a comprehensive understanding of the target audience's level of utilization of e-Construction technology, especially for the less experienced States. We recommend this market research to prioritize the States that have the most interest in ultimately going paperless so that activities can target those that will best help meet or exceed the goal of 20 States who have adopted e-Construction. To validate the polling performed at the regional summits, we must determine the State of the target audience through direct contact with each to obtain the following information:

- Confirm the target audience—specific personnel within the State
- Identify the outliers—States that may not be interested in deployment
- Confirm the process for how each State assesses its respective level of implementation
- Identify existing technologies being used
- Refine implementation plan goals

In parallel with market research, the team recommends that FHWA develop an e-Construction website to provide a forum for addressing many of the tools or tactics identified below. This could be equivalent to a "community of practice," where practitioners go to find the available information on e-Construction (presentations, sample requests for proposals, system documentation, and anything shared by lead States).

- Communication Portal
  - Website:
    - Document and resource library
      - Recordings of webinars
      - Research documentation or publications
      - Multimedia and videos
      - How-to guide and roadmap

        - Benefit-cost study findings
        - Self-assessment tools
    - Coordination and training tools
        - Webinar transcripts
        - Peer exchange notes
        - Interactive idea exchange or blog
    - Calendar
    - Implementation progress dashboard

To properly gauge the target audience members' level of utilization, the team recommends first developing a directory of contacts that can be used to better understand the needs and challenges. This directory will be used to maintain communication in ascertaining progress in meeting goals. In addition, it will be necessary to perform a high-level cost-benefit assessment that will be shared with the target audience to provide a level of confidence that the e-Construction initiative is meaningful to them. The study currently underway at the Turner Fairbank Highway Research Center may provide the necessary benefit-cost information to fill this need.

B. Obstacles, Opportunities, Strategies, and Tools

To provide a clear pathway forward, the e-Construction team evaluated the potential obstacles, along with opportunities, strategies, and tools, for mitigating the barriers to deployment and implementation of the innovation, many of which can be accomplished through the various links provided on an e-Construction website. The following table provides a detailed summary of the team's evaluation.

Table 2: Opportunities, Obstacles, Strategies, Tools and Tactics

Opportunities / Obstacles	Strategy	Tools / Tactics
FHWA-sponsored e-Construction technology information assembled in one place on the Internet	Develop a website, blog, or social media campaign that will be a portal to e-Construction resources	e-Construction website, blog, social media, etc.

Opportunities / Obstacles	Strategy	Tools / Tactics
Additional centralized forums to share information and lessons learned among expert users and agencies with little or no experience	Create opportunities and provide intermediaries for agencies to communicate and share ideas, successes, and lessons learned	Peer exchanges—exchanging information
Continue FHWA's commitment to providing free educational opportunities to the industry	Create free, accessible learning experiences for interested parties, with specific subject matter for targeted audiences	Webinars providing information to participants
IT communities and end users within agencies can be obstacles to implementation; they are not well-versed in the systems or procedures	Provide strategies to internal IT staff to promote awareness of the benefits and background to the systems, uses, and processes	Develop and make available strategies
Agencies are overwhelmed by the amount of data and information available to research their options	Create a repository, library, and learning center that can be used as a resource for agencies interested in implementing e-Construction	Application and tool roadmap or how-to guide and web-based resource library
Upper-level management staff is not familiar with e-Construction or is reluctant to implement from a cost standpoint	Develop a high-level resource for promoters of e-Construction to use with their managers to get buy-in from decision makers	High-level sales pitch examples
Suspicion of security issues related to cloud-based or electronic data	Educate decision-makers as to the security and safety of the e-Construction concept	Ideas or suggestions for security issues
Agencies are looking for a standard, accepted, out-of-the-box solution	Request AASHTO to develop an enhanced, integrated system and make it available to the target audience or target audience procurers and utilize a proprietary system available in the marketplace	AASHTO-sponsored or proprietary solutions

Opportunities / Obstacles	Strategy	Tools / Tactics
Agencies need to identify funding for the transition and implementation	Develop advice or suggestions for investment strategies	Share investment strategies; STIC Incentive Program funding
Agencies are overwhelmed with the magnitude of the task for full implementation	Break down implementation into smaller, achievable elements	Connect with peers from agencies that are implementing step-by-step e-Construction programs

The following table outlines more specifically the anticipated level of effort and resource requirements for implementation of the proposed tools.

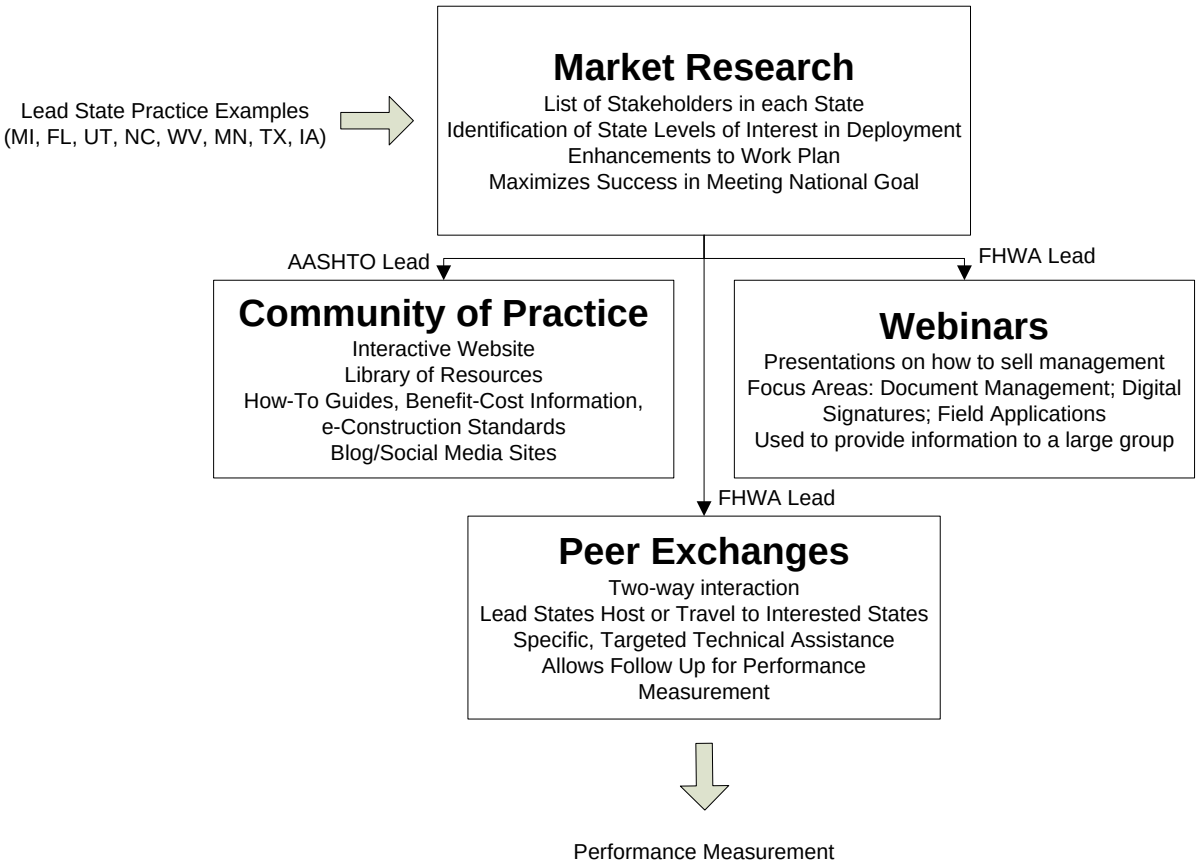
Table 3: Marketing Tools and Tactics

Marketing Tool or Tactic	Level of Effort and Resource Requirements
e-Construction website, blog, social media campaign, etc.	Web hosting. Time and expertise for development, updating, and monitoring.
Peer exchanges	Time for coordination and introductions. Facility costs, travel costs.
Webinars	Web hosting, if required. Time for developing content, delivering webinars, etc.
Develop and make available training programs	Time for research and developing programs.
Application and tool roadmap or how-to guide and web-based resource	Time for research and developing tools.
High-level sales pitch examples	Time for research and developing examples.

Marketing Tool or Tactic	Level of Effort and Resource Requirements
Ideas or suggestions for security issues	Time for research and development.
Share investment strategies; provide access to the high-level benefits of implementation	Time for research and developing examples.
FHWA division and Federal lands office deployment	Division offices: time and research to deploy pilot. Federal lands: time and research to deploy pilot projects.

Section VI: Work Plan

The following diagram prioritizes activities and tools suggested for implementation to meet the national goal. This grouping will allow FHWA to define distinct projects to undertake in 2015.



The following table provides a detailed matrix of the identified activities, cost, audience, and message essential to deploying e-Construction. Responsibility is assigned for each activity and completion dates are identified.

Table 5: Work Plan

Activity	Responsibility	Due
Sharing lessons learned	All	December 2016
Peer exchanges (in-person and virtual) with documentation for sharing	FHWA and all	As soon as possible
Technology webinar series	Michigan DOT, FHWA and all	Fall and winter, 2015 Fall and winter, 2016
How-to guide, with chapter related	Florida DOT,	Summer 2015

Activity	Responsibility	Due
to IT security	Michigan DOT, and FHWA	
High-Level transportation industry presentations	AASHTO and all	Ongoing
Resource website (AASHTO users blog site)	AASHTO and FHWA	Ongoing
AASHTO-sponsored or proprietary solutions	AASHTO	Winter 2016
IT security awareness outreach	AASHTO and all	Spring 2016
e-Construction example specifications	States who have adopted e-Construction	Fall 2015
Application and tool roadmap	FHWA and all	Fall 2015
FHWA federal lands and division office piloting	FHWA	Fall 2015

The total cost for the above activities is to be determined based on final scoping of activities by the responsible parties.

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