Guide for e-Construction & Partnering

Collaborating with Information Technology Authorities to Assess e-Construction Solutions and Determine Future Needs

On-Ramp to Innovation
every day counts

eCP
e-Construction and Partnering

Table of Contents

Cover photos source: FHWA

Note: FHWA is the source for all images in this document unless otherwise noted.

Summary

e-Construction practices are maturing quickly, changing the way and the rate at which technology is being implemented. Information technology (IT) governance models within State government vary. While some State departments of transportation (DOT) still have a dedicated IT Division, most States have consolidated their IT governance and services to support all State agencies. State DOTs may develop collaborative partnerships with their IT authorities (whether in a separate agency or not) to bolster the assessment of current technology and anticipation of future needs.

Audience
The primary audiences for this guide are State DOT construction managers, construction methods development staff, and automation/innovation engineers. The secondary audience includes technical champions at the project level.

Purpose
The purpose of this guide is to offer practices for collaborating with IT authorities on assessing current technology and determining future needs. This guide includes specific suggestions for the following:

- Developing and sustaining a successful partnership.
- Understanding IT business policies for project prioritization.
- Becoming familiar with procurement requirements.
- Creating joint strategy for assessing technology to meet business needs.

Justification
State DOTs are responsible for delivering the State construction program. To do so, construction staff rely on policies, processes, tools, and technologies. While these policies and processes are affected by construction program needs and governed by Federal oversight regulations, the tools and technologies adopted at the DOT level depend heavily on IT resources and policies.

As State DOTs continue to grow their e-Construction programs, some have implemented processes in which a technical champion works with IT authority (internal to State DOT or a separate agency serving all State agencies) to prioritize technology projects and develop business requirements for software development or procurement of commercial off-the-shelf (COTS) solutions. Sometimes business requirements may be defined without a full understanding of the business needs and end users' daily tasks. In those cases, the solutions procured may not be useful for end users, which can lead to the decline of an innovative mindset or to intentional dismissal of technology. Therefore, a collaborative relationship between construction staff and the IT authority, regardless of its organizational location, can provide value to State DOTs.

Construction staff are knowledgeable in the business practice, but translating those needs into precise technical specifications to procure or implement an e-Construction solution can be a challenge. Conversely, IT staff know technology systems and applications, but may not fully understand the requirements or dependencies for specific data being collected or the nuances of field operations. Bringing construction staff together with IT should always be considered for any e-Construction technology project that results in implementing new solutions or improves on existing technologies and practices.

Forming successful partnerships through an agreement or memorandum with the IT authority, whether the IT organization is Statewide or internal to the State DOT, demonstrates a bilateral commitment and is critical to advancing e-Construction technologies and practices. Through a deliberate approach for establishing and sustaining collaborative partnerships, State DOTs can create a strategy for deploying technologies that meet their business needs while complying with IT policies and processes.

Approach

The first step in forming a partnership is recognizing its necessity for achieving business objectives. The key motivation for establishing and maintaining a partnership is to create value for each organization. This guide describes how to build the business case for establishing the partnership and how to perform a technology strategy assessment for continued improvement of e-Construction practices.

This guide contains both effective partnership models and strategies for long-term success. It provides key characteristics of successful partnerships that State DOTs can use to benchmark current and desired partnership levels between Construction and the IT authority by assessing current relationships and identifying gaps to overcome. Once there is clarity on the relationship between these two groups, the guide may be followed to help formalize the partnership and potentially create value for the State DOT.

This guide also outlines specific considerations for implementing e-Construction solutions, including understanding IT business policies, project prioritization practices, and procurement requirements. Further, it offers recommendations for creating a business case to implement e-Construction technologies that aligns with agency-wide priorities and integrates critical strategies that promote sustainable innovation. Lastly, this guide may also be used to create a joint strategy for assessing technology to meet future business needs.

Introduction

"We cannot do any more with less," is a common sentiment observed among State DOT construction programs, stretched thin due to the challenges of a steady decline in staffing and erosion of resident knowledge and experience. Full-time equivalent staff for managing highway transportation systems decreased by more than 37 percent between 2000 and 2010 (1). At the same time, demands related to repairing an aging transportation system with limited budgets for managing construction projects has exacerbated the problem. Adopting e-Construction technologies is one strategy State DOTs can consider for addressing these resource shortages.

Many States adopting e-Construction practices have strong technical champions or dedicated staff to oversee the overall construction technology program (2). These individuals collaborate with IT to pilot and deploy technology.

As agencies increasingly rely on technology, they find themselves investing in software development of back-end systems or COTS solutions for e-Construction. Because IT governance is a vital component of State government operations, annual budgets are established to carry out all technology projects submitted from the business units. As such, IT processes and policies exist to help prioritize projects that add value or heavily influence mission-critical operations. States are also guided by procurement regulations, which may require additional time and steps to plan technology adoption and manage the enterprise applications portfolio.

Creating a partnership between Construction and IT organizations is critical for understanding applicable processes, policies, and regulations and for developing joint strategies to plan and execute e-Construction technology projects.

Components of a Successful Partnership

Most successful partnerships have several key characteristics, including *mutual trust, common values, defined expectations, synergy,* and *effective communication*. Trust originates from a point of mutual respect (knowledge, experience, values, and needs) and is the bedrock of any partnership that grows when stakeholders come together to find solutions that are mutually beneficial, rather than to focus on individual goals (3). Aligning values is important for bridging cultural gaps and orienting the partnership toward a common vision of enhanced IT governance.

Once expectations are defined, a clear understanding of roles and responsibilities can be established. When each side understands the other's needs, they can create an action plan that satisfies both business unit goals and IT policies and procedures. The expected outcome for developing a successful partnership is that both IT and Construction will be able to perform their duties more effectively and efficiently. The cultural enrichment and synergy that comes with bridging organizational gaps and knowledge has the potential to create value for all stakeholders. Finally, the sustainability of a successful partnership benefits from continuous and effective communication not only to collaborate well, but also to resolve any conflicts that inhibit expected outcomes (4).

While many State DOTs have institutionalized a partnering culture for delivering highway and bridge projects, the management of IT projects typically follows a service-oriented model that does not incorporate deliberate pertnering practices (5). In reality, IT and construction project management share similar practices, such as monitoring and managing project schedules, scopes, costs, and budgets. However, IT and construction projects differ in two ways: how projects are identified and prioritized, and how stakeholders communicate and collaborate to solve problems.

e-Construction champions should work with the IT authority to understand how projects are identified and prioritized. For example, is there a call for technology projects every year? How are projects submitted for consideration? Is there a business board that reviews and prioritizes technology projects? Does the process to submit new technology projects require a value proposition statement (e.g., costs and benefits)?

Once the project has been accepted for funds, the IT project manager and e-Construction lead should work together to create a partnering charter to manage the project. Effective and productive partnerships can be implemented and managed using a phased approach, as shown in Figure 1.
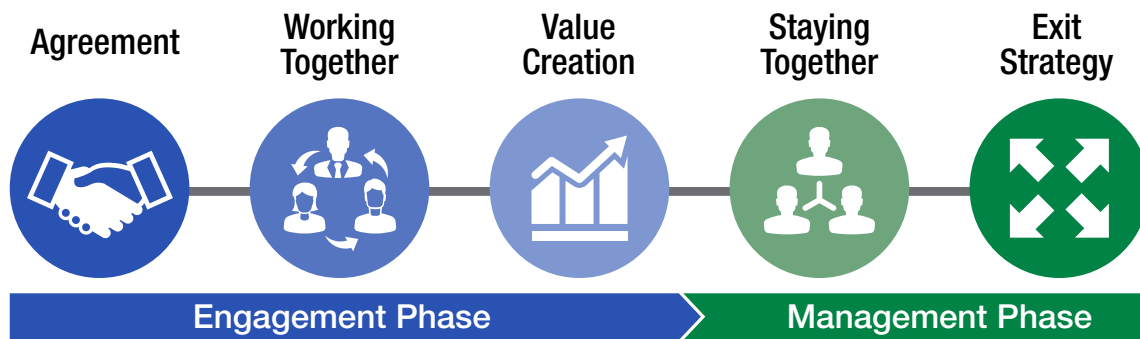

Figure 1. *Process. A phased approach for establishing and managing the partnership.*

In the engagement phase, both sides come together to align their business goals and expectations through some level of agreement; start working together on collaborative opportunities, including technology assessments and strategy development; and create value by identifying mutually beneficial improvement areas, such as jointly analyzing industry trends and forecasting needs and resources (4).

There are several ways to formalize the rules of engagement and for defining expectations. Stakeholders can develop memorandums of understanding to outline broader intentions, rules, and expectations, or they can define formal service-level agreements to include more direct provisions that detail areas of engagement. Regardless of how these rules and expectations are defined, what is important is that both sides of the partnership know who is responsible and accountable for making decisions, as well as how these decisions will be made and monitored. Establishing a charter is also an effective way to organize the partnership governance structure and manage risks.

Partnerships can differ in complexity and scope, but there are certain key features that need to be considered when developing a successful partnership. Table 1 summarizes these key features.

Table 1. *Key features to consider when developing a partnership.*

Key Features	Key Considerations
Goals and Accountability	Have short-term and long-term goals and objectives been clearly defined? Is there a way to track and monitor progress?
Culture	What are the missions and organizational cultures of participating groups? How is the performance of each group measured? Do participating groups share similar terminology/definitions and norms?
Leadership	How will leadership/governance be sustained over the long-term? If leadership/governance is shared, have roles and responsibilities been clearly defined and agreed on?
Roles and Responsibilities	Have participating groups clarified roles and responsibilities? Have all relevant participants been included? Can they commit resources from their respective groups?
Resources	How will the collaborative mechanism be funded and staffed? Have collaboration tools been identified or developed?
Guidance and Agreements	Have participating groups documented their collaboration agreement? Have they developed methods for updating and monitoring the agreement?
Risk Management	What are the risks of the project? How will these risks be managed?

Once the partnership is formalized, it is important that both sides work hard to meet their obligations and maintain open lines of communication (4). Maintaining mutual trust and credibility is a result of displaying an unwavering desire to make the partnership succeed. While IT will have a deep understanding of how IT products and services meet high-level business objectives and requirements, it is important that the State DOT proactively translate its construction requirements and needs so solutions will be effective. Frequent and continued engagement with IT will eventually create value for the agency.

The management phase consists of two distinct areas: sustaining the partnership and ensuring there is an exit strategy in place to address changes in authority and culture. Sustaining the partnership will be one of the more challenging elements in managing the relationship with IT. In order to sustain the partnership for long-term success, proactive communication is paramount to grow trust and credibility. In addition, having a feedback loop and an objective partnership evaluation mechanism in place will allow both sides to monitor the relationship and implement corrective actions quickly. Accountability is important for any partnership, and there are several ways to implement measures that promote transparency between organizations. These include workflow management systems and audit trails for activities.

Finally, all partnerships need an exit strategy to address changes in State government administration, changes in budget priorities, or other situations that may have an impact on the partnership requiring it to dissolve.

Building the Business Case

One of the first steps in carrying out a technology deployment or implementation project is developing a business case that highlights how value will be created for the agency. The purpose of the business case is to show alignment with the State DOT mission and priorities. It presents sufficient context, analysis, and methodology of the deployment or implementation activity to justify chartering a particular technology project.

The context focuses on articulating the problem or opportunity that has been identified and the reasoning for developing the business case. Next, the business and technical leads proposing the business case should collect information to support a benefit-cost analysis. This can be accomplished by looking at expected costs and benefits (quantitative and qualitative) and the impact to current operations (6).

For example, the Pennsylvania Department of Transportation (PennDOT) worked with IT staff to estimate the total cost of developing and deploying three key e-Construction systems (construction management, mobile applications, and document coolaboration) and the estimated benefits due to operational efficiencies (7). These costs were determined based on anticipated labor hours and blended hourly rates for programming and testing. PennDOT also dedicated resources to estimating the quantitative benefits related to elimination and storage of paper documents and to the staff time spent using these paper-based methods. Between 2012 and 2016, PennDOT's cost for developing and deploying their three key e-construction systems were approximately $9.6 million that resulted in an overall savings of approximately $77.1 million. (8)

After creating the business case, the business and technical champions should work closely with IT partners to get the initiative on the list of projects to be considered for funding. Once the project has been approved, it is time to start collaborating to create an implementation plan outlining the project goals, identifying team members, setting timelines and budgets, and creating activities to get the project started.

The implementation plan should also integrate strategies for change management, stakeholder engagement, and communication (6). Most technology deployment and IT projects will affect users by changing processes or practices. Managing this process effectively will ensure the technology's sustainability. Strategies for stakeholder engagement should focus on deliberate, upfront activities that bring understanding to the vision and value for the State DOT. Integrating a robust communication management strategy is one of the more critical aspects of the business case because engaging the end user early in the implementation phase will significantly increase the likelihood of success, as well as sustainability.

Joint Strategy for Assessing Technology

Technology assessment is part of the pre-implementation phase in an IT project. It often results in the following activities:

- Initiating the project.
- Mapping business processes.
- Defining functional requirements.
- Procuring solution and integration services.
- Conducting user training.

Project initiation kicks off the collaboration between IT and the Construction Division. This happens when the project charter, which defines team member roles and responsibilities, is created. The team then moves on to creating a roadmap for specific activities, such as mapping business processes and defining functional requirements.

One of the first activities in defining functional requirements involves the assessment of current IT products and services. This is the first step in understanding the complete landscape of available tools and how they are applied in the context of conducting business. The assessment includes identifying or describing the business requirements that are driving the needs for IT products and services.

First, the implementation team should evaluate the current technology portfolio and requirements for procurement of any new products. It is important to consider how any new tools align with user proficiency levels to determine training needs. Although not necessary, it may be helpful to conduct a Request for Information (RFI) to understand what the market has to offer. Sometimes, it is during the RFI when it is discovered that COTS solutions do not meet the State DOT's business needs and investing in custom development to maintain an existing system or create a new system may be the best solution, and vice versa.

The RFI process is a strategic approach for looking at industry trends to identify potential improvements with e-Construction, for forecasting needs and resources to accommodate potential enhancements, and for developing a detailed implementation plan for integrating new e-Construction technologies and practices. Figure 2 illustrates the technology assessment and strategy development process State DOTs can use to define points of engagement with their IT authority.
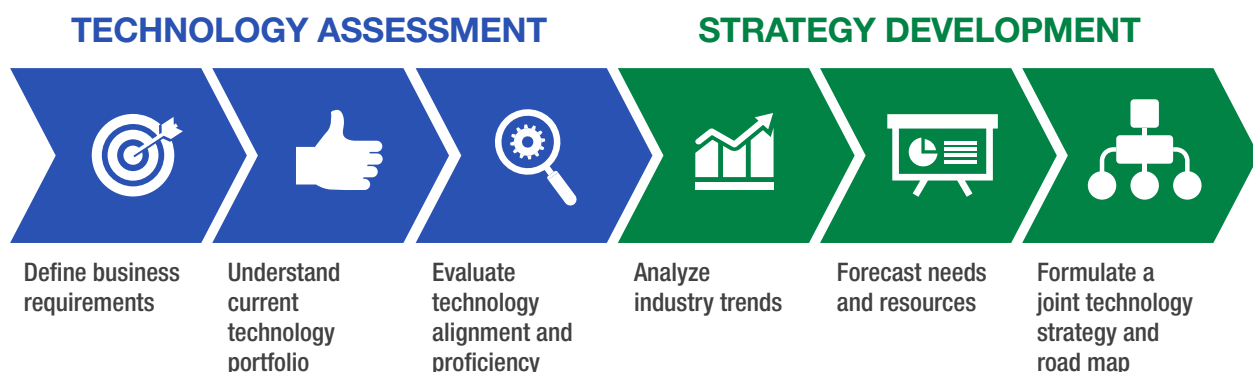
TECHNOLOGY ASSESSMENT   **STRATEGY DEVELOPMENT**

Define business requirements | Understand current technology portfolio | Evaluate technology alignment and proficiency | Analyze industry trends | Forecast needs and resources | Formulate a joint technology strategy and road map

Figure 2. *Process. Technology assessment and strategy development process.*

The process for identifying or defining business requirements is the most critical step in any assessment or strategy development activity to achieve full awareness of redundancies and dependencies between business groups. In partnership with the IT authority, the steps below may be useful in guiding the sourcing and analysis of requirements. Note that none of the four types of requirements discussed in this section are legally binding requirements.

1. Identify key stakeholders who are affected by e-Construction technology and practices. For example, construction and materials inspection field staff, construction project managers or engineers, District or Region executives, asset managers, and data stewards. Some potential stakeholders from IT include developers, support services, product-specific support and infrastructure support staff, etc.

2. Capture functional requirements from stakeholders via interviews, focus groups, or use case analyses. One of the more effective methods is to host a workshop with distinct stakeholder groups and include targeted follow-up conversations.

3. Categorize requirements as functional, operational, technical, or transitional. Functional requirements define how a product or service should function from an end user's perspective. They describe the features and functions end users interact with daily. Operational requirements are those that keep the product or service functioning. Technical requirements define technical issues (e.g., infrastructure improvements, permission levels, cloud computing policies) that are central to successfully implement the technology or practice. Lastly, transitional requirements (e.g., running legacy systems in parallel) are the steps necessary to implement the technology or practice.

4. Analyze and interpret requirements by refining them precisely (without ambiguity and in relation to business needs), prioritizing them, examining the impacts of change, resolving conflicting issues, and evaluating feasibility. Once the requirements have been analyzed, they should be documented and distributed to the stakeholders for review with a realistic deadline for feedback.

The following questions may be helpful when assessing new technology or systems:

- What are the functional requirements? What processes will this system support? Are those processes clearly documented?

- Is there a legacy system the new technology will replace, or will it need to be integrated?

- Does the State DOT have licenses for the new products in other areas of the organization that can be leveraged? How much are these licenses being used? Can these licenses be shared, or will additional licenses be needed?

- What is the maturity level of the technology? Have other State DOTs used this system? What are the industry trends? Will this technology affect other initiatives?

- Does the system being considered require an open procurement, or is the system on an approved list of solutions to purchase?

- What is the funding for procuring the system? Can the system be implemented in multiple-phases?

- Does the State DOT have technical staff who can provide support and expertise during and after the system's implementation?

- What skill sets will need to be developed to use this new system? Who will develop and conduct training?

Conclusions

Formulation of an e-Construction technology strategy and roadmap is an important component of the broader IT strategy. It should consider both internal and external factors, as well as the interdependencies of each. Using available information, the State DOT will need to define the status of not only its technology maturity, but also its process maturity with collecting, processing, sharing, and managing data. This should align with its data governance framework.

After the State DOT staff have a sufficient understanding of the agency's current state, they may find it helpful to conduct visioning and build consensus on key themes to set strategic objectives and directions on where they want the agency to be at the end of the strategy timeframe. Next, by developing strategic options and prioritizing them, they can define how they will achieve the strategic objectives. This also includes establishing a process of continuous strategy development and action planning. Lastly, the technology strategy should include implementation plans and define monitoring and evaluation framework to continually assess progress. This strategy document provides direction and can be flexible. It is important to adjust and modify it as needed to achieve the desired outcome.

State DOTs should evolve their business processes by nurturing a culture of innovation and proactively reaching out to their IT authority to assess current technology and determine future needs. The increasing rate at which the use of digital e-Construction technologies and practices matures will drive the need for significant engagement between IT authorities and State DOTs in working together toward a common vision.

Developing and managing a successful partnership with the IT authority involves the following steps:

1. Formalizing an agreement to outline rules of engagement and expectations.
2. Working together to grow trust between the organizations and understand business drivers and constraints.
3. Creating value will be a byproduct of continued engagement and of the focus on enhancing the capacity of each organization for mutual benefit.
4. Sustaining the partnership will require proactive communication, encourage feedback, and establish accountability.
5. Defining an exit strategy will enable the partnership to be dissolved or pivoted as needed to accommodate changes to factors outside the control of the partnership governance processes.

Leveraging the partnership structure, the State DOTs can assess their current technology and develop a strategy and roadmap that anticipates future technology needs through the following steps:

1. Define business requirements that drive how technology is applied.

2. Understand the current technology portfolio to identify gaps and opportunities for resource optimization.

3. Evaluate technology alignment and proficiency to identify technology gaps and waste.

4. Analyze future trends to grow a culture of innovation.

5. Forecast needs and resources to build strategies that are forward thinking.

6. Formulate a joint technology strategy and roadmap to guide the organization in alignment with the broader IT governance strategy.

7. Formulate and implement strategies for developing training and education of the system(s) for all partners including the IT authority and the construction field staff. This will ensure that knowledge is effectively built, frequently maintained, and consistently shared with relevant partners. Also, active partners will know where to go to for these services in order to maintain their proficiency.

Through a collaborative partnership with its IT authority, a State DOT can implement digital e-Construction technologies and practices more effectively.

References

1. **National Academies of Sciences, Engineering, and Medicine.** NCHRP Synthesis 450: Forecasting Highway Construction Staffing Requirements. [Online] 2013. **https://doi.org/10.17226/22514**.

2. **Federal Highway Administration.** Technology Brief e-Construction and Partnering Peer-to-Peer Exchange: Virginia Department of Transportation and Pennsylvania Department of Transportation. [Online] March 2019. **https://www.fhwa.dot.gov/construction/econstruction/hif19023.pdf**.

3. —. Michigan Stakeholder Partnering Peer Exchange Summary Report. [Online] May 1-2, 2018. **https://www.fhwa.dot.gov/innovation/everydaycounts/edc-3/partnering_library/MDOT-stakeholder-partnering-peer-exchange.pdf**.

4. —. EDC 3 Webinars: Webinar 6 "Prioritizing e-Construction Investments". [Online] January 2017. **https://www.fhwa.dot.gov/construction/econstruction/webinar.cfm**.

5. **AASHTO.** *Partnering Handbook.* Washington, D.C. : s.n., 2018. ISBN: 978-1-56051-709-2.

6. **Federal Highway Administration.** Guide for Determining the Return on Investment for using 3D Engineered Models in Highway Construction. [Online] 2017. **https://www.fhwa.dot.gov/construction/3d/hif17035.pdf**.

7. **Shah, Keyur, et al.** Addressing Challenges and Return on Investment (ROI) for Paperless Project Delivery (e-Construction). [Online] 2016. **https://www.fhwa.dot.gov/construction/econstruction/hif17028.pdf**.

8. **Federal Highway Administration.** EDC-4 e-Construction & Partnering Virtual Summits. [Online] September 2016. **https://www.fhwa.dot.gov/construction/econstruction/edc4/presentations201609.pdf**.

Contacts for more information:

Federal Highway Administration (FHWA)
Office of Infrastructure
Antonio Nieves Torres
antonio.nieves@dot.gov

Office of Technical Services — Resource Center
Kathryn Weisner
kathryn.weisner@dot.gov

e-Construction and Partnering resources:
www.fhwa.dot.gov/construction/econstruction

Distribution
This guide is being distributed according to a standard distribution. Direct distribution is being made to the Divisions and Resource Center.

Key Words
- e-Construction
- Collaboration
- Technology Assessment
- Information Technology
- Construction Technology
- Partnering

Notice
This guide is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document. The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Non-Binding Contents
The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies. This document will not be relied on for enforcement purposes.

Quality Assurance Statement
The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

U.S. Department of Transportation
Federal Highway Administration