Mobile Highway Construction App

Improving State Operations

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Executive Summary

The Pennsylvania Department of Transportation (PennDOT) supports a vast network of over 40,500 miles of roadways and 25,000 bridges. With a $2.5 billion annual roadway construction budget, this network is constantly expanding and construction inspectors are an integral part of the stewardship of these dollars. In 2014, PennDOT had 832 active highway construction projects, a significant increase from 566 projects in 2013. Balancing the need for increased demand in roadway project delivery with fiscal stewardship requires innovative solutions to allow construction crews to work faster and more efficiently. To meet this expectation, PennDOT has been utilizing mobile computing technologies as the solution.

The primary responsibility of PennDOT's 1,580 employee and consultant construction inspectors is to oversee and verify all project site activities each day. This includes verifying all materials delivered (e.g. bituminous, concrete, steel beams, guiderails, etc.), verifying work completed by contractors, documenting the testing of materials and other quality assurance and inspection activities. Previously, these activities were completed through labor-intensive, manual paper-based processes. Site activities and testing were captured on paper throughout the day. Only when the inspector arrived at a construction trailer could he/she enter the data into the electronic contract management system to allow payment. Additionally, reference material and documentation, such as engineering drawings, contracts, amendments and design requirements were frequently maintained at the trailer, which typically is a 10- 40 minute drive from the construction site. Overall, administrative tasks consumed 25% of the inspector's day.

In alignment with PennDOT's strategic goal to increase efficiency through modernization of assets and streamlining processes, development of the Mobile Highway Construction App was initiated in July 2013. Using an agile development methodology, the project team developed user-friendly automated processes that integrate with PennDOT's legacy back-end systems for payment and materials testing. Additionally, all project documentation is available through the app, and engineering designs can be electronically annotated at the construction site. The agile project development methodology ensured that the development team delivered valuable functionality to the user community on a regular basis, quickly realizing significant savings.

This mobile solution now enables construction inspectors to complete their daily work from the field on their iPads and the impact from using the mobile app has been impressive. Last year, PennDOT's inspectors saved 62,700 hours by leveraging this solution, which resulted in a savings of $2,298,582. In 2015, PennDOT will roll the app out to its 1,200 consultant inspectors through its B2B App Store with Apple. The combination of PennDOT and consultant inspectors using this app in 2015 will save over 379,200 person hours per year (1.5 hours/daily/person) yielding an efficiency gain of more than $17,500,000 as well as improving the quality of data collected each day. Inspectors are spending more of their time on value-added quality assurance and project oversight.
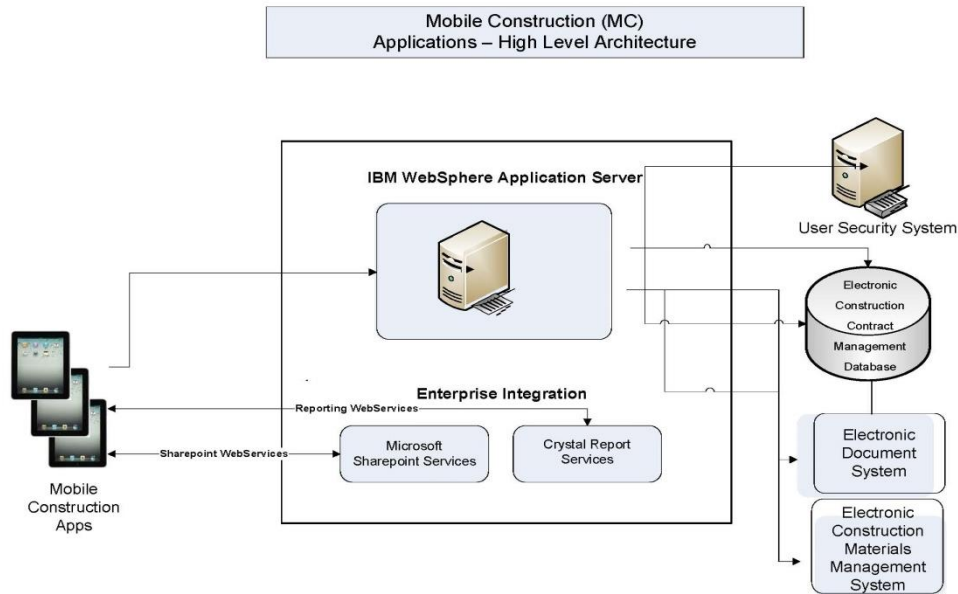
Business Problem and Solution Description

PennDOT is responsible for over 40,500 miles of roadways and 25,000 bridges. As a result of recent state transportation funding legislation, PennDOT's highway construction program has grown more than 25% over two years to $2.5 billion in construction contracts. When projects reach the construction stage, materials management, adherence to schedule, quality control and safety are paramount as delays and defects can result in millions of wasted dollars.

Roadway construction is essentially a manufacturing operation where the factory floor is on Pennsylvania's roadways. The construction inspectors provide project oversight and are responsible for monitoring the contractor's work for compliance with the contract, observing and documenting quality control testing, recording information including completed work and documenting material quantities for completed work. They play a key role in ensuring that projects are completed on time and within budget. Inspectors must have access to project-specific engineering designs, contracts, and approved materials suppliers. They must also be able to perform complex payment calculations so that contractors and suppliers are paid accurately and on time.

Prior to development of the mobile app, all of these activities were completed through labor-intensive, manual paper processes. During the course of each day, inspectors would complete their paperwork, and then travel to construction trailers where they could access PennDOT systems that support these activities. Inspectors ended up using 25% of their day on administrative tasks. Mobile computing offered a unique solution to this problem.

PennDOT decided to leverage the Apple iOS platform on the iPad because of its closed architecture and advanced technologies that provide end-to-end control and security for devices, data, and apps. It was further determined that a native iOS app would not only automate the process but provide the high level of operational performance required to meet business needs. Additionally, this solution provides a mobile storefront for deployment of apps via PennDOT's private app store for over 380 employees or the Apple B2B app store for over 1,200 consultant inspectors.

Fully deployed in September 2014, the Mobile Construction App now provide inspectors with seamless access, on a single device, to a SharePoint-based workflow system, the most recent job site project plans, technical drawings and all necessary construction project documents from multiple legacy back end systems. (See Diagram Below)

Mobile Construction (MC)
Applications – High Level Architecture

Construction trailers are located on average 10-40 minutes away from the work site. The Mobile Construction App eliminates the need to carry and maintain heavy paper manuals as well as travel time if a needed document is not physically onsite.

The vital daily Project Site Activity (PSA) report captures inspection activities, materials and equipment used and work completed on the project, which ultimately drives contractor payments. Prior to the mobile solution, manual complex calculations on the work done that day were also recorded on this report. By automating the PSA process, complex and data-intensive calculations are performed automatically, ensuring timely payment to contractors and material providers. PSAs have been replaced with a user-friendly interface and data are directly synced with the server-based estimation process. Once through the approval workflow, these estimates generate payments to the contractor.

Construction inspectors can complete their daily PSAs from the field on their iPad even when used in an off-line mode since activity can still be entered in real-time. Once a network connection is available, inspectors can upload the finalized PSA data through a secure connection into PennDOT's Engineering and Construction Management System (ECMS). Vital project-specific documents are also downloaded to the iPad for use off-line (e.g. engineering plans).

With mobile devices, inspectors can take, store and email photos of inspection results and electronically capture and save up-to-the-minute progression of "as built" drawings. If a pipe cannot be laid in the original planned engineering designs, the design can be annotated to note the obstacle immediately instead of at the end of the day.

As with all of PennDOT's mobile projects, agile methodology was utilized, allowing the development team to work closely with the business area and ensure that their evolving

requirements would be satisfied with regular releases of functional software capabilities, addressing the highest priority needs.

Both central office and district staff were engaged on the core project team to ensure that the right stakeholders were represented. Regional meetings were held on a regular basis to keep the user community informed on the project status. This was also used as an opportunity to conduct demos of completed functionality so that the feedback could be incorporated into future development sprints.

A group of 38 construction inspectors, representing all 11 of PennDOT's engineering districts, were identified as power users. These power users were heavily engaged in the design of the mobile app and were given in-depth training on the use of the app so that they could go out and conduct regional training sessions for the rest of the construction inspectors across the state.

Additionally, PennDOT produced step-by-step instructional videos for the users that can be launched, on-demand, from within the app whenever needed.

In summary, the in-house developed app on the iPad provided the best solution for the security, functionality and performance needed to increase the efficiency of construction inspectors. Now more time is spent on inspecting and less on time-consuming administrative tasks and travel.

Significance

The mobile solution developed has returned significant cost savings and efficiencies in roadway construction operations for the Commonwealth of Pennsylvania, benefiting all residents and increasing public safety. This technology could also be applied nationally as the condition of roads and bridges impacts the entire population. There is an understanding that the country can no longer ignore the deterioration of its transportation infrastructure. As a result, transportation funding legislation has been in the spotlight at both the state and federal level over the past few years. It is a critical enough issue in the commonwealth that the legislature passed Act 89 in 2014 which increased the highway construction budget by $220 million in FY 14-15 and by $324 million in FY 15-16. The introduction of the latest mobile technology to a construction process in dire need of automation efficiencies has resulted in increased productivity for our inspectors, which is needed to support increasing construction activity.

The Mobile Highway Construction App aligns with the following NASCIO 2015 state CIO priorities.

1. Security – PennDOT designed and built a comprehensive mobile security framework that is integrated with its identity management services. Use of the iPad also provides greater security of data and apps through the Apple Business to Business (B2B) store.

PennDOT's Mobile Device Management (MDM) strategy has been so effective that the commonwealth's CIO designated PennDOT as a statewide Center of Excellence. PennDOT now provides MDM services for 29 other state agencies.

3. Consolidation/Optimization: This solution established a consistent and efficient way to collect site activities data and provided a uniform method to access the most recent versions of all relevant construction documents across the 11 engineering districts of Pennsylvania.

5. Budget and Cost Control: With $18,015,912 in operational efficiencies gained per year, this solution ensures that savings can be used to expand value-added inspection activities, supporting the rapid growth of the roadway construction program.

6. Human Resources/Talent Management: Highly skilled and motivated employees are the key to any successful project. PennDOT made significant investments in its human resources/talent by providing iOS development and UX Design training to its mobile development team. Agile and SCRUM training was provided to PennDOT's project managers and development teams as well to ensure iterative development could be used for this activity. Committing to employee development, improving our business processes and modernizing our technology provides the potential to attract and retain the next generation of employees to the public sector.

7. Strategic IT Planning: PennDOT utilizes a business-driven IT strategic planning process to ensure projects align with the commonwealth's strategic direction. This project aligns with Governor Wolf's Executive Order establishing the Governor's Office of Transformation, Innovation, Management, and Efficiency (GO-TIME) initiative, which focuses on cost savings, modernization of state government operations, enhancing services and citizen engagement, and fostering greater collaboration among state agencies and local communities, non-profits and the private sector. It also supports PennDOT's strategic goals to increase efficiency through modernization of assets and streamlining processes; and continuous improvement and innovation in delivery of projects and department-wide operations focusing on mobility.

8. Mobile Services/Mobility: The customized mobile app provides automated processes and instant and continuous access to all the functionality needed by the inspectors in the field. This improves efficiencies in performing document research and preparing daily reports. The time spent traveling back and forth between the work site and construction trailers due to unavailability of appropriate documentation has been eliminated.

Benefits of the Project

With the deployment of a customized and integrated mobile app, inspectors are now spending 92% of their time on inspection activities, compared with 75% before mobile technology. The savings associated with this significant efficiency improvement equate to 1.5 hours per inspector each day. For PennDOT employees alone in 2014, this

reflects overall efficiency gains of 62,700 employee hours with savings of $2,298,582. The full deployment of the mobile technology in 2015 to PennDOT's 1,200 consultant inspectors is resulting in another 288,000 hours in annual operational efficiencies. This reflects an additional $14,160,960 in yearly savings. Overall for 2015, this equates to $17,504,352 in time savings.

Additional cost savings have been documented in the amount of $150 per person per year by reducing the amount of hard copy documentation. This documentation consisted of related publications and relevant project-specific documents. For PennDOT inspectors, this is a savings of $57,000 and $180,000 for consultant inspectors.

Additionally, project-specific plans and specifications are typically updated as requests for information are submitted by the contractor or changes are made to the design. The average cost of purchasing and/or printing and shipping reference documents is approximately $330 per construction job. These plans are now routed electronically. With PennDOT awarding 832 projects in 2014, this is resulting in savings of $274,560.

Overall, the documented operational efficiencies equate to $18,015,912 in savings each year.

At the same time, for PennDOT and consultant inspectors, the deployment of integrated mobile technology has automated what had been extremely cumbersome manual processes to measure work completion, quality assurance testing and complex payment calculations. This automation has significantly improved overall data quality and overall efficiency.

For PennDOT's IT team, this project provided an opportunity to leverage new technologies in innovative and integrated ways, resulting in tangible benefits to the transportation construction community as well as the taxpayers we serve.