



Electronic Construction and Materials Management System (eCAMMS)

Digital Government: Government to Business (G to B)

Contact: Phil Tomassini, CIO

Pennsylvania Department of Transportation

Project Initiation Date: June 2012

Project Completion Date: October 2015

The Pennsylvania Department of Transportation (PennDOT) relies on an extensive network of contractors, material suppliers and producers to support its 763 active highway and bridge projects. In order to ensure that all materials used in these projects are cost-effective and adhere to state and national quality standards, PennDOT administers a comprehensive materials testing and approval process. The scope of this testing and certification effort involves over 5,000 approved material suppliers, 15,000 approved materials and over 6,000 approved recipes for concrete and asphalt. Over 17,000 material samples are tested each year, resulting in over 28,000 test results reports that are sent to contractors, material suppliers and PennDOT staff.

Working effectively with suppliers and contractors is a key component to successful construction projects. Effective business partner relationship management is a high priority for PennDOT and providing suppliers and contractors with the tools they need to help them do their jobs well and get paid in a timely manner is critical to maintaining those relationships.

Previously, PennDOT had an aging, legacy materials lab system that offered only basic functionality and technical capabilities, was not scalable, and had limited remote access. PennDOT envisioned a replacement application to provide secure online access for business partners, public transparency for suppliers and approved materials, expanded automation and greater efficiency.

To achieve these goals, PennDOT developed eCAMMS, the Electronic Construction and Materials Management System. eCAMMS is a web-based, business partner-accessible and publicly searchable system that allows users to track PennDOT's decision on the test results, calculate test results, and report on over 17,000 samples every year. Previously, suppliers submitted test data on paper which was then entered into the legacy system by PennDOT employees and waited to receive their test results by mail. Suppliers can now enter the data online and can quickly access their test results electronically. In addition, eCAMMS includes customizable automated workflows to support the materials review and approval process. PennDOT personnel can also view concrete and bituminous material test information online instead of traveling to the producer locations to review test results. Construction project contractors and the public use the search features available in eCAMMS over 5,000 times each week to find information about products and suppliers approved by PennDOT.

eCAMMS is a highly configurable .NET system that enables PennDOT users to add, modify or delete tests quickly and easily in a matter of minutes. Previously, IT personnel would have to spend days or weeks to make changes to the mainframe system because all test parameters were written in COBOL. This means faster processing, quicker testing, and continuous communication with suppliers.

## **Concept.**

PennDOT is responsible for the construction of new transportation infrastructure and the maintenance of a vast network of over 40,000 miles of roads and 25,000 bridges. As a result of a significant increase in state funding for transportation, this program has grown by 35% to 763 active projects valued at \$6.0 billion. A critical factor in these construction projects is the management of the over 15,000 products approved for project use, the 5,000 approved suppliers who provide them and the 1,100 prequalified construction contractors who use them.

The management and oversight of these materials and products is a multifaceted activity from the initial approval to the final testing and disposition of a sample from an actual project site. Tracking suppliers, materials, and products and managing all of the necessary data is critical to PennDOT and its business partners.

The requirements for products and materials used for transportation projects can vary greatly, adding to the complexity of managing the materials testing program. For example, an interstate highway project may require asphalt of a certain composition, whereas another project for a secondary road may require asphalt with a different recipe. PennDOT specifies the types of approved materials and products that can be used for each project. Suppliers provide materials and products to PennDOT for approval. When prequalified contractors bid, they explicitly list the approved materials and products in the hopes of winning the contract. PennDOT awards contracts based upon the requirement that the quality and specifications of the materials in the bid will actually be used on the construction site. During active construction projects, PennDOT construction inspectors and lab personnel test these materials to ensure contractual compliance. Suppliers and contractors depend on PennDOT's ability to quickly and efficiently approve materials for use in these projects and test materials at project locations to ensure timely payment for work completed.

Working effectively with suppliers and contractors is a key component to successful construction projects. Providing timely updates, keeping data secure, allowing real time access to sample test results, controlling what data is available to each supplier, making material and product approval information accessible to contractors and the public; all of it is important. Effective business partner relationship management is a high priority for PennDOT and providing suppliers and contractors with the tools they need to help them do their jobs well is and get paid in a timely manner is critical to maintaining those relationships.

Previously, PennDOT had an aging, legacy materials lab system that offered only basic functionality and technical capabilities, was not scalable, and had limited remote access. PennDOT envisioned a replacement application to provide secure online access for business partners, public transparency for suppliers and approved materials, expanded automation and greater efficiency. Unable to find a COTS product that would meet its needs, PennDOT leveraged the technology framework built to support the Pennsylvania Department of Agriculture's Lab Information Management System (LIMS).

By leveraging an existing framework, PennDOT reduced its development costs by several million dollars and was able to invest in customizing the framework to meet transportation-specific and construction materials-centric requirements.

The interdisciplinary project team included PennDOT IT staff, a trusted consulting firm that had previously developed the Department of Agriculture LIMS system and materials testing business representatives. Using an agile and iterative approach to project management, the functionality to support supplier and contractor activities was deployed in seven releases. Prior to implementation of each release, business partners were notified by mail and email of the new features. Additionally, PennDOT provided business partner user guides, training materials and videos to assist in using the system. The cost of the system development effort was \$6.43 million.

## **Significance**

For its \$6 billion roadway and bridge construction program, PennDOT must assure the safety of motorists and citizens through proper testing of materials and products. When a specific type of product is required, PennDOT confirms it was actually used. Using the wrong product or an unapproved and/or lesser quality product can result in a road or bridge that doesn't have the required level of reliability, increasing the risk of failures. Additionally, PennDOT wants to ensure citizens are getting the best value for a quality product of the correct composition. Use of a lesser quality product can result in a reduced payment or a requirement that the lesser material be removed and replaced at no cost. Testing materials and products at the Materials Testing Labs in the 11 Engineering Districts and on project sites is critical to PennDOT and this process requires a robust, complex and comprehensive system to meet these business needs.

Because construction materials and products are critical to PennDOT's projects; a vast amount of information must be entered and maintained in eCAMMS; and all of the data must be easily accessed for research, reporting and compliance activities. eCAMMS manages information for over 5,000 unique approved suppliers and over 15,000 unique, approved materials and products for roadway construction.

For PennDOT's 1,100 pre-qualified construction project contractors, access to information regarding approved materials and approved suppliers is essential to the success of their proposals and projects. eCAMMS is internet accessible so it can be used 24x7. Most of eCAMMS is controlled by sophisticated role-based access so only eligible PennDOT personnel and approved supplier business partners can log-in to enter data and view information. Other parts of eCAMMS are publicly available so everyone, including construction contractors and the public, can access important information about approved materials, products and suppliers.

For contractors, approved products and suppliers are listed in four "Bulletins" based upon the type of material or product. Before eCAMMS, contractors would identify approved materials and products by paging through a puzzling assortment of pdf documents or poorly designed web searches that often didn't generate the desired

results. eCAMMS standardizes all of the information across each of the bulletins. The bulletin search pages of eCAMMS are publicly available to contractors and anyone else who is interested in finding approved PennDOT construction materials. Each of the four bulletin search pages is custom designed to make searching for that type of material as easy as possible.

<https://www.ecamms.pa.gov/Public/Pages/Bulletins/BulletinSearch.aspx>

Suppliers can now log into eCAMMS to enter material mixtures for their concrete and asphalt materials for approval by PennDOT for use in roadway construction. Over 17,000 test samples are processed by PennDOT annually and the results of these tests are distributed electronically, greatly speeding up materials acceptance and payments. Over 28,000 reports are distributed to suppliers, contractors and PennDOT staff, and eCAMMS has eliminated the cumbersome mailing process.

To create competitive, high quality materials and products, suppliers develop proprietary formulas for their materials, such as concrete and asphalt. In the past, suppliers had to mail their formula data to PennDOT for approval. With eCAMMS, suppliers now have the ability to enter their own data directly into eCAMMS. No more waiting for the information to arrive at PennDOT and waiting for the data to be entered by a PennDOT employee. Additionally, the well-structured security system ensures that the underlying proprietary information is not disclosed to competitors.

The construction industry is dynamic. Upgrades to materials, more efficient uses of products, upgraded standards, environmental advances and cutting edge development of innovative new products means specifications for, and lists of, materials and products for use on construction projects are constantly changing. Because eCAMMS is highly configurable, PennDOT business users can now quickly and easily make test changes that previously required IT personnel involvement. Many of these changes require only minutes in eCAMMS, not the hours or weeks previously needed for the mainframe COBOL system. Faster changes mean faster benefits to the supplier community. Additionally, a highly flexible and customizable workflow component facilitates key tasks in the system. Interaction with suppliers through the system speeds the time to review and approve.

eCAMMS achieves three of the PennDOT's key goals and objectives. eCAMMS helps create **Effective Partnerships** by providing tools to build and strengthen relationships with outside partners, stakeholders and the public. eCAMMS provides tools for consistent, transparent and open (two-way) communication with the public, employees and transportation stakeholders and achieve **Open Proactive Communication**. Finally, eCAMMS supports an **Innovative, Smart and Diverse Organization** by strengthening and enhancing PennDOT's performance and customer service.

The eCAMMS application also aligns with 8 of 10 of NASCIO's 2016 state CIO priorities.

1. **Security and Risk Management:** eCAMMS uses a two-tiered security approach including PennDOT's SiteMinder solution as well as a sophisticated yet easy to maintain internal security component for group and individual role-based access throughout the application.
3. **Consolidation/Optimization:** eCAMMS consolidated obsolete mainframe systems, manual processes, disjointed web searches, bulletin PDF management, supplier management, product management, sample management and supplier communications into one centralized materials management system.
4. **Business Intelligence and Data Analytics:** eCAMMS has a separate reporting database in addition to the core relational database. The reporting database supports sharing data with other applications and the generation of ad hoc reports to support business and management analysis.
5. **Legacy Modernization:** eCAMMS addresses the need to replace the old system (that was built with COBOL and was running on an old AS400 mainframe that will go out of support later this year) with a modern .NET-based solution that is an easier to maintain, highly configurable, internet-facing web application. At the end of 2016, PennDOT will completely decommission the AS400.
6. **Enterprise Vision and Roadmap for IT:** As stated above, eCAMMS aligns with the PennDOT Strategic Goals and IT vision and roadmap.
7. **Budget and Cost Control:** PennDOT was able to reduce development costs by strategically starting with an existing LIMS framework. PennDOT has also achieved cost savings in other areas including mailing and personnel.
9. **Agile and Incremental Software Delivery:** the eCAMMS project leveraged agile best practices and an iterative development approach with seven releases. Flexibility with the business and their requirements, prototyping new features, and recurring releases are just some of the benefits of agile development.
10. **Disaster Recovery/Business Continuity:** eCAMMS gives PennDOT and external users' access to the system 24/7 wherever they can find an internet connection, making it possible to work off-site when necessary, unlike the previous mainframe system.

## Impact

With the automation and consolidation of supplier management, product management, sample testing management and supplier communications in one system, PennDOT and its materials suppliers and contractors have benefited.

For PennDOT's 5,000 approved materials suppliers, the edits and data validations incorporated in the automation of materials test submissions ensure that all of PennDOT's requirements are met with each submission. The specifications for each materials test are incorporated in the system, ensuring that each sample meets the requirements and thresholds for each individual sample. For most submissions, eCAMMS automatically determines if the individual test results pass or fail by doing a direct comparison between test results and the specifications. With the automated workflow, PennDOT communicates with suppliers throughout the approval process. This has improved the accuracy and efficiency of the submission process, ensuring that authorization of the materials and payments occur quickly.

For PennDOT's 1,100 pre-qualified construction project contractors, the eCAMMS Bulletin Website provides online information about the 15,000 concrete, aggregate, bituminous and other qualified product materials that are approved for use on roadway and bridge construction and maintenance projects. The Bulletins are easily accessible, and a robust search is available including a map-based search for approved suppliers with approved products available in specific geographic areas. For materials where proximity to a construction site is critical, this feature makes it easy for potential project bidders to find approved suppliers within a certain distance. Every week, the bulletin search features are used over 5,000 times.

A robust web interface allows PennDOT personnel to easily update information for approved construction materials and make it immediately available. Additionally, eCAMMS empowers key PennDOT materials management users with over 100 feature-rich maintenance pages where they can quickly modify things such as how the system processes items, validates data and calculates test results. All of this can be done quickly and without involvement of IT professionals. For situations where a formula must be changed and a new test needs to be added, end users now have the ability to make changes and add the new test in minutes.

The processing of samples taken from construction sites and tested at the Materials Lab includes a number of beneficial features. Each sample can be tied to a supplier and a construction project. This provides an automated interface with PennDOT's billing system for charging the project for the lab testing as well as triggering payment for materials delivered to the project. As expressed by PennDOT's Chief Materials Engineer, the system has also significantly enhanced materials oversight.

"With improved sample and test data collection methods, including mobile computing and contractor QC test data which now resides in eCAMMS, in the event of a material failure, we no longer have to search through file cabinets in hopes of finding the results but can quickly extract the information through reporting. This has significantly improved our ability to conduct our forensic investigations on a project but has also allowed us to identify poor performing mix designs to prevent future issues." **Robert Horwhat, P.E., CWI, PennDOT Chief Materials Engineer**

Overall, eCAMMS empowers suppliers by giving them the ability to enter their own data, monitor their testing results, research their sample history, search for information and get feedback quickly. eCAMMS also give contractors the tools to easily identify approved materials and products for use on projects, including the ability to find items within a specific geographic area. Efficiency, transparency and turn-around times are all improved, and costs have been reduced, creating benefits across the board for the supplier and contractor communities as well as PennDOT. All of these improvements also mean better and safer roadways and bridges for Pennsylvania's citizens.