



Construction Documentation System (CDS V3)

Improving State Operations

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Pennsylvania Department of Transportation

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The Pennsylvania Department of Transportation (PennDOT) is responsible for the construction of new transportation infrastructure, and the maintenance of a vast network of approximately 40,000 miles of roads and 25,000 bridges. In the past several years, there has been an increase in transportation funding to address the country's outdated and deteriorating transportation infrastructure of roads and bridges. More funding equates to a 35% increase in construction projects between 2013 and 2016. As of March 2016, PennDOT had a total of 763 active projects totaling \$6.0 billion.

Construction contractors and suppliers partner with PennDOT in meeting the increasing demands in roadway project delivery for the citizens of the Commonwealth, and PennDOT project inspectors have an enormous responsibility to ensure that large and complex construction projects are running efficiently. Daily project site activities must be tracked and verified so that payments are made to contractors and suppliers in a timely manner; driving the need for a robust and effective construction management and documentation system to allow PennDOT inspectors to effectively manage active construction projects.

Prior to the implementation of the new Construction Documentation System (CDS V3), data resided in a standalone, disconnected application installed on individual personal computers (PCs) at each construction site and construction documents were stored as paper records in file cabinets, with no remote access to the paper documentation or the data. Approvals were done in the Engineering and Construction Management System (ECMS), but there was no direct linkage between the two systems. To make inspectors more efficient and effective, a new CDS system needed to be developed to transition to a more paperless process and provide electronic access to construction site data, project forms and approval workflows.

The CDS V3 is a web-based system that is closely integrated with ECMS and resolves the remote access issues with the previous PC-based system. Business partners and construction staff now have both direct and remote access to information provided by the new system. Integration with ECMS enables CDS V3 to leverage existing data and payment functions and there is no need for an ad-hoc reporting database. Multiple, manual data entry points have been eliminated, as have hard copies of documentation. There is new functionality for auditing and more robust and automated data backups. Completed in March 2015, CDS V3 has resulted in savings of \$5.13 million in 2015 and \$5.9 million in 2016; becoming the "one-stop shop" for accessing construction documentation.

CDS V3 aligns with the Federal Highway Administration (FHWA) initiative known as "Every Day Counts" (EDC), which encourages transportation agencies to find innovative ways to speed up the delivery of highway projects, facilitate greater efficiency at the state and local levels, address the challenges of limited human and financial resources, and deliver more projects for the same money. EDC promotes knowledge transfer, technology transfer, and innovation across the nation by sharing best practices and lessons learned among the states. As a result, PennDOT is working with FHWA to share its experience with CDS V3 and the overall approach to e-Construction.

Concept:

The previous construction documentation system was technologically limited, inhibited business efficiencies and was out of compliance with the Commonwealth's technology guidelines. Pain points for the users included limited access to construction data, one-at-a-time user access and no web presence.

PennDOT created the new CDS application due to the increase in active highway construction projects and the necessity to improve efficiency. The project initiation process started in May 2012 when PennDOT completed a study eliciting prioritized stakeholder requirements, surveying potential CDS vendors and polling other DOTs regarding their experiences with CDS applications. Based on this research, PennDOT selected its existing ECMS framework technology platform to leverage already-built security, identity/access management, workflow and data services.

To gather formal requirements, business analysts went into the field to directly observe how construction projects were managed. One example of the insights gained from these observations is the Project Site Activity (PSA) report, Payment to contractors is done only after capturing inspection activities, materials and equipment used, and how much work is completed daily. Prior to CDS V3, this information was recorded by inspectors in paper diaries. Business analysts observed these processes and worked with the business to determine how they could be made more efficient. By automating the PSA process, complex payment calculations that had been performed manually are now performed automatically in the system, reducing the number of potential errors and ensuring timely payment to contractors and suppliers. Business analysts also noted that the majority of the forms required the same project information (name of project, location, etc.) which was hand-written over and over again. These screens are now pre-populated with the project information, automating and streamlining the process.

New functionality in CDS V3 provides a comprehensive picture of each construction project through documentation that can be viewed by construction personnel throughout the department. Users are now able to create documents in the system and have version control and check-in/check-out functionality for collaboration. With new workflows, reviews and approvals can be done easier and faster. Non-document files such as images (jpeg), CADD diagrams and Visio drawings can be uploaded into CDS V3. Now, inspectors have a system that is easy to use, accurate, reduces input errors, eliminates paperwork and increases efficiency.

The previous construction documentation system did not provide easy, remote access to documents since every document was printed out and stored in boxes. At project completion, these documents were shipped to a central storage area. Integration with ECMS now provides inspectors and other personnel with direct access to construction documentation. Reports can be easily produced, project data can be shared and data collection and transfer is more efficient. In addition, the required final audit for all construction projects can be performed quickly and efficiently with the centralized and accessible data repository.

Maintenance and support for the previous system was extremely time-consuming. IT personnel had to travel out to the construction offices to install software upgrades on each PC. Upgrades are now pushed out from Central Office, eliminating trips to the districts for associated support. CDS V3 offers more reliable and automated data backups. The system is significantly more robust, flexible and maintainable.

PennDOT used an iterative development methodology with this project to allow business users to be fully engaged throughout the project. As part of each iteration, the development team allowed the users to see working software and provide valuable feedback so that changes could be made based upon that feedback loop. This reduced risk by helping ensure that the final product would ultimately meet the business needs. The developers were able to stay within scope, schedule and budget while delivering the system that the users wanted.

To educate the users on CDS V3, the Train-the-Trainer concept was utilized and each of the eleven PennDOT engineering districts throughout the Commonwealth sent two representatives to be trained. These representatives were responsible to train the appropriate district personnel. Webinars were also valuable training tools and eliminated the cost of additional personnel traveling to PennDOT's Central Office in Harrisburg.

The cost to build CDS V3 was \$2.74 million dollars, representing 24,973 labor hours required for the development and support of the project.

Significance:

Over the past decade, the country's roads and bridges have been viewed with intense scrutiny and an increase in transportation funding has been a priority at both the state and federal levels. Ensuring construction operations are as efficient as possible increases public safety and benefits the citizens of the Commonwealth of Pennsylvania.

As part of the EDC initiative, the FHWA initiated a research project to assess how transportation agencies are transitioning to a more electronic and paperless project delivery system. PennDOT is considered a national leader in e-Construction with CDS V3 playing a major role in the transition. Inspectors save numerous hours and can be more effective in doing their jobs through automation. With the central electronic repository, all construction personnel can access data on active and closed construction projects.

Investing in IT and upgrading systems ensures PennDOT is enhancing the efficiency of the organization and supports the Department's strategic goal of investing in sustainable infrastructure. CDS V3 also aligns with the Enterprise IT Strategic Focus Areas of innovation and efficiency and transforming the workforce through technology.

CDS V3 aligns with the following NASCIO 2016 state CIO priorities.

1. Security and Risk Management: Leveraging the existing ECMS system enabled CDS V3 to use the same security technology platform. Role-Based Access Control functionality was implemented for needed authentications and authorizations.

3. Consolidation/Optimization: This solution creates a more efficient way to collect construction information and provides a consistent method to access all relevant construction documents across the 11 engineering districts of Pennsylvania.

5. Legacy Modernization: By replacing the previous system, CDS V3 has significantly improved business efficiency for construction project inspection staff and IT efficiencies by enabling real-time access to resolve any issue or problems.

6. Enterprise Vision and Roadmap for IT: PennDOT utilizes a business-driven IT strategic planning process to ensure alignment 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), 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. The CDS V3 also supports PennDOT's strategic goal of sustainable infrastructure investment by proactively and innovatively managing resources and implementing technology to ensure efficiency of the organization. In addition, CDS V3 aligns with the Enterprise IT strategic focus areas of innovation and efficiency and transforming the workforce through technology.

7. Budget and Cost Control: CDS V3 has resulted in savings of \$5.13 million in 2015 and \$5.9 million in 2016 and will continue to produce operational and employee time savings in the years to come.

9. Agile and Incremental Software Delivery: CDS V3 was developed using an iterative software development approach to reduce the time to deliver functionality to the users and minimize project risk.

Impact:

The previous construction documentation system was an obsolete and inefficient system. Numerous cumbersome, labor-intensive processes revolved around essential construction project tasks. The creation of CDS V3 as a robust web-based field documentation system has transformed the way project inspection staff do their jobs.

Benefits include the following:

- Elimination of multiple manual data inputs
- Web access for PSAs, Audits, Estimates, and Work Orders
- Report functionality by pulling data from ECMS
- A central document repository for construction project documentation

- Elimination of hard copy documentation
- More robust and automated data backups

With full implementation of CDS V3, construction forms and processes have been automated and paper-based methods have been eliminated, providing annual operational savings of \$5.13 million in 2015 and \$5.9 million in 2016 and beyond. Based upon a development cost of \$2.74 million, the projected Return on Investment (ROI) is \$8.29 million through the end of 2016.

Employee inspectors saved costs by reducing the amount of driving back and forth between project sites to the office. They also saved time on the activities associated with paper documentation such as entering data from the field diaries into the system, auditing, and searching for paper documents.

CDS V3 saves time for both PennDOT and consultant inspectors with entering project staff documentation. Time savings can also be found for the construction inspectors in charge and their travel time to construction sites to process PSAs, estimates and work orders. Less time is spent on organizing and scanning project documentation since this information is now in an electronic format.

Based upon business priorities, additional modules and functionality have been identified and will be developed for future releases of CDS V3. Examples of future functionality to be released are Consultant Hours and Mileage Log, Source of Supply and Force Accounts.

Business users throughout PennDOT's engineering districts have been greatly impacted by CDS V3. District 11 is located in the Pittsburgh area and has a high volume of construction projects. Daniel Cessna, the District Executive of District 11, had the following to say about CDS V3:

“CDS V3 is transforming our construction business model; affording increased efficiency, automation and simplification of work processes, transparency, and improved data integrity. This technology upgrade integrates our business systems, allowing us to be more responsive to our business partners, while increasing the overall efficiency of our work.”

CDS V3 enables business users to efficiently manage large and complex construction projects, complete all documentation required for compliance and trigger timely payments to contractors and suppliers. It has eliminated manual, labor-intensive tasks, enabling inspectors to be more efficient with their time, reduced travel costs and reduced delivery times for roads and bridges to the benefit of the citizens of the Commonwealth.