Using Electronic Document Management Systems
to Manage Highway Project Files

Prepared for
Bureau of Technical Services

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Request for Report

WisDOT's Bureau of Technical Services is interested in learning about the practices of other state departments of transportation in developing and implementing an electronic document management system to manage highway project files.

Summary

We examined published research and publicly available state DOT documents to gather information about transportation agencies' use of an EDMS. Below we summarize findings in three topic areas:

- State Practices

- Related Research

- Vendor Solutions

State Practices

- Florida DOT's District 5 Construction Office offers a wealth of documents associated with its use of Hummingbird, the department's EDMS.

- IBM's FileNet P8 system is the EDMS in use by Oregon DOT's OTIA III Bridge Program. Benefits for the EDMS, which went online in 2005, have exceeded initial investment costs by more than 6-to-1, yielding a benefit-cost ratio of 6.1.

- A 2003 Arizona DOT report describes the FileNet EDMS used by Pennsylvania DOT. We also provide information about specialized EDMS programs that PennDOT maintains for grade crossing and utility relocation documents and EDMS file naming conventions.

- The TxDocsOnline Web-based program implemented by Texas DOT uses an Internet browser to interact with a FileNet file server. At the time of publication of a 2008 report, TxDOT was completing a statewide implementation of FileNet, with the goal to implement FileNet for each business unit within the agency.

The 2008 report also describes use of a supplemental program—ProjectWise—to manage 2-D drawing composition and 3-D modeling files generated by computer-aided design software.

- Washington State DOT uses Livelink for its electronic file management system. A 2010 procedure manual outlines the processes, rules, roles and responsibilities within Washington State DOT for use of Livelink, including the file structure for construction administration and other processes.

Related Research

- A 2009 survey by the AASHTO Subcommittee on Construction queried state transportation agencies on the use of an EDMS for construction records. Respondents cited costs, staffing and training most often when asked to provide the top five critical concerns, constraints or impediments that must be addressed to initiate, implement and/or expand an EDMS.

- A 2008 conference paper addresses the three critical components of the paper-to-digital process for state DOTs: organization, conversion and access.

Vendor Solutions

- We provide links to vendor websites associated with the EDMS software referenced in this report, including FileNet (Oregon, Pennsylvania and Texas DOTs); Hummingbird (Florida DOT); Livelink (Washington State DOT); and ProjectWise (TxDOT).

State Practices

Below we highlight EDMS programs developed by Florida, Oregon, Pennsylvania, Texas and Washington State DOTs.

Florida

Electronic Document Management System (EDMS) Requirements, Information Systems, Florida Department of Transportation, Policy Topic No. 325-080-003-b, August 8, 2007.
http://www2.dot.state.fl.us/proceduraldocuments/procedures/bin/325080003.pdf
This procedure establishes requirements for electronic records scanned or imported into the department's EDMS to ensure those records are legible, complete and retrievable.

Chapter 2, Hummingbird, Standard Operating Procedures and Example Documents, District 5 Construction Office, Florida Department of Transportation, undated.
http://www.dot.state.fl.us/construction/DistrictOffices/d5web/operating_procedures.shtm (click on "Expand All" and scroll down to "Chapter 2, Office Preparation: Hummingbird")
This website provides links to documents related to District 5 employees' use of Hummingbird, the department's EDMS. In addition to a policies and procedures document available only to internal users, publicly available documents include:

> **District 5 Construction Scanning Procedure**, Electronic Document Management System (EDMS), District 5 Construction Office, Florida Department of Transportation, October 2007.
> http://www.dot.state.fl.us/construction/DistrictOffices/d5web/files/sop/ch2/d5%20Procedure%20for%20Hummingbird.pdf
> This procedure provides direction for scanning personnel.

> **EDMS QA/QC Process**, District 5 Construction Office, Florida Department of Transportation, August 8, 2007.
> http://www.dot.state.fl.us/construction/DistrictOffices/d5web/files/sop/ch2/DISTRICT%205%20CONSTRUCTION%20EDMS%20QA-QC%20PROCESS.pdf
> Among the topics addressed in this document are attribution standards; document tracking; a minimum level of quality assurance and quality control; testing and sampling; problem resolution; destruction of paper originals; and review of documents that have passed their retention period.

Frequently Used Document Groups & Types, District 5 Construction Office, Florida Department of Transportation, undated.
http://www.dot.state.fl.us/construction/DistrictOffices/d5web/files/sop/ch2/Frequently%20Used%20Groups%20and%20types.pdf
This list of documents specifies form numbers, groups and types used in the department's EDMS file structure.

<u>**Oregon**</u>

Information Technology Benefit-Cost Evaluation Report, Oregon Transportation Investment Act III (OTIA III) State Bridge Delivery Program, Oregon Department of Transportation, March 8, 2011.
http://www.oregon.gov/ODOT/HWY/OTIA/docs/OTIAIII_InformationTechnologyBenefitCostEvaluation_Report.pdf?ga=t
An EDMS—IBM's FileNet P8 system—provides a central repository for all documents associated with Oregon's OTIA III Bridge Program. (Oregon DOT's $1.3 billion OTIA III State Bridge Delivery Program is repairing and replacing hundreds of bridges across the state.) The FileNet EDMS went online September 2005 and initially contained 12,460 documents transferred from a previous temporary EDMS. Since 2005, the number of documents stored in FileNet has increased to 210,000. Benefits have exceeded initial investment costs by more than 6-to-1, yielding a benefit-cost ratio of 6.1.

The report describes two areas as holding potential for improving future use of the EDMS, including the use of a records retention feature and user difficulties with search engines, file naming conventions and document templates. Oregon DOT is considering options for continued use of the EDMS after the OTIA III program concludes in 2014.

<u>**Pennsylvania**</u>

Evaluation of Integrated Document Management System (IDMS) Options for the Arizona Department of Transportation, Arizona Department of Transportation, Report No. FHWA-AZ-03-517, February 2003.
http://www.azdot.gov/tpd/atrc/publications/project_reports/pdf/az517.pdf
This report prepared for Arizona DOT includes summaries of other state EDMS programs. Page 224 of the PDF provides a summary of PennDOT's engineering document management solution. While the information is somewhat dated, it provides some insight into the development of PennDOT's EDMS. Highlights include:

- PennDOT employs a powerful engineering document management solution to maintain the originals and versions of source architectural documents.

- The system, which is based on the FileNet Panagon environment, allows PennDOT to maintain and manage road and construction documents and provides easy and efficient access to this information over the desktop while maintaining version control, redlining and edits to the original source files.

- The system employs the electronic file folder concept, in which the electronic folder replaces the manual document jacket and allows end-users to search, retrieve and extract the necessary road and construction documents to the workstation for further research and review.

- PennDOT has invested approximately $12 million in EDMS and supporting technologies. These investments have led to significant increases in task compression, reduction in information float, and greatly increased end-user convenience and access to information.

Design Information Systems, Pennsylvania Department of Transportation.
http://www.dot.state.pa.us/Internet/web.nsf/Secondary?openframeset&Frame=main&src=DesignInfoSystems?readform
This Web page provides links to two of PennDOT's specialized document management systems:

- **GCEDMS.** The Grade Crossing Electronic Document Management System is a state-of-the-art Internet system for maintaining grade crossing inventory information and grade crossing documentation for PennDOT projects involving railroad facilities.

- **UR-EDMS.** The Utility Relocation Electronic Document Management System is a system module within the PennDOT EDMS. Accessible through the Internet for external business partners, UR-EDMS is a Web-based EDMS designed to work with utility relocation documents.

Related Resource:

"Utility Relocation Electronic Document Management System (UREDMS)," Larry Ditty, Chief Utility Relocation Administrator, Pennsylvania Department of Transportation, 2011 Joint AASHTO Right-of-Way and Utilities and Design Subcommittee Meeting, May 12, 2011.
http://modot.org/business/outdoor_advertising/documents/AASHTO%20Presentations%202011/Utility%20Relocation%20Electronic%20Document%20Management%20System.pdf
This presentation describes UR-EDMS as a virtual filing cabinet, with electronic storage and indexing of these documents allowing for easier search, faster retrieval, better revision control and reclamation of valuable office space. Screen shots of the internal and external systems begin on slide 20. A comparison of actual and perceived barriers to adoption of the new technology appears is on slide 26.

Appendix A, PennDOT EDMS Plan Sheet File Naming Convention, Design Manual Part 3, Plans Presentation, Pennsylvania Department of Transportation, Publication 14M (DM-3), undated.
ftp://ftp.dot.state.pa.us/public/bureaus/design/PUB14M/Appendix/Appendix%20A.pdf
This document describes and illustrates the file naming convention for scanned or electronically generated plan sheets. The first section describes the standard format for naming plan sheet files; the second describes two exceptions to the naming standard.

Texas

Engineering Design Data Management—Practices and Framework Development, Texas Department of Transportation, Report No. FHWA/TX-08/0-5246-1, February 2008.
http://tti.tamu.edu/documents/0-5246-1.pdf
This report evaluates engineering design data management practices at TxDOT and includes a discussion of TxDOT's EDMS.

A discussion of FileNet—an enterprise document management system that enables sharing and managing access to files, generates database records to keep track of every document processed, and produces queries and reports based on a number of attributes—begins on page 46 of the PDF. At the time of publication, TxDOT was implementing FileNet statewide and in several divisions, with the goal to implement FileNet separately for each business unit within the organization. Elements of the system include:

- The system stores document-related data in a centrally located Microsoft SQL Server database. The database also contains pointers to files that are physically stored on a dedicated server at every business unit where TxDOT has implemented FileNet.

- Users interact with FileNet through a Web-like interface, with additional functionality such as viewing current file users, assigning file attributes or tags, querying, searching and file versioning.

- TxDOT uses two FileNet configurations:

  o A "thick-client" configuration, which involves the use of a special-purpose client application on user computers

  o A "thin-client" configuration called TxDocsOnline, which is Web-based and uses an Internet Explorer browser to interact with the database and the FileNet file server

- The TxDOT FileNet implementation does not support viewing geographic information systems or computer-aided design documents, although this functionality is possible through third-party programs.

A discussion of ProjectWise begins on page 50 of the PDF. TxDOT is evaluating the effectiveness of ProjectWise, an EDMS that specializes in the management and production of MicroStation files. (MicroStation is a computer-aided design software developed to support 2-D drawing composition and 3-D modeling.) System features include:

- As a client-server application, ProjectWise stores MicroStation files on a main server.

- A user edits a file by "checking out" the file from the server, which in practice means creating a local copy of the file and blocking write-access to the file by other users. After the user finishes editing the file, the system places the edited file back on the server, lifts the write-access block to the file and deletes the local file.

- Like FileNet, ProjectWise manages files and provides querying and reporting capabilities.

- While ProjectWise is an EDMS, TxDOT sees ProjectWise as a special-purpose application to support the project development process, not as an eventual replacement for FileNet. Evaluation of ProjectWise was continuing at the time of report publication.

Page 70 of the PDF presents the benefits of an EDMS implementation, including:

- Decreased time waiting for plan reviews

- Improvements in document production and processing accountability

- Elimination of time-consuming paper document searches, enhanced record security and substantial reduction in physical storage space requirements and costs

- Increased access by internal and external users, particularly using Web-enabled interfaces and procedures

Also on page 70 of the PDF is a description of issues reported by various agencies in connection with implementing an EDMS, including:

- **Data quality and completeness.** In addition to scanning efforts, populating document indexes is a major effort, often performed by consultants. Some agencies have had to assign staff members to clean large amounts of index data and/or work with consultants to ensure the quality of the data.

- **System redesigns and adjustments.** As system implementations progress, some agencies have found it necessary to make adjustments. Examples include revising file naming standards, adding library structures due to limitations on the number of physical documents stored in folders, and reducing the number of document custom properties.

- **Acceptance.** Agencies linked success in implementing an EDMS to the identification of strong project champions, subject matter experts and supportive management and decision-makers. Agencies also mentioned off-site hard copy storage as a strategy to encourage users to start relying on on-site digital copies. Also important is the availability of large-format scanners and large flat-panel monitors to facilitate document viewing by users.

- **Maintenance costs.** In addition to the cost of the original investment, agencies report that the cost to maintain the system can be quite substantial, leading some agencies to consider other strategies for document management such as using a system from a different vendor.

- **Implementation strategy.** Different implementation strategies have met different challenges. For example, one agency focused on scanning documents first but paid little initial attention to the indexing effort. As a result, finding documents quickly became difficult. In another case, two parallel systems were in place (the old one and the new one) at the same time, forcing users to use two systems depending on the date of a project.

"Electronic Document Management at TxDOT," Tim Jennings, Business Solutions Delivery and Support Services, Texas Department of Transportation, AASHTO Subcommittee on Information Systems Annual Meeting, April 2008.
http://www.gomdot.com/Home/events/Conferences/AASHTO/ppt/Tim%20Jennings%20ASIS%20Doc%20Mgmt%20April%202008.ppt
This conference presentation offers lessons learned in implementing an EDMS, including:

- Implementation of an EDMS requires a combined effort of information technology, records management and end-user teams with executive management support.

- Developing enterprise standards can be a long and complex process but is necessary for long-term success.

- Real-world experience is required to understand the challenges and impact of implementation.

- The impact on policies, processes and procedures must be considered, and agencies should be prepared for change.

Washington

Project Electronic Content Management (ECM) Process, Washington State Department of Transportation, January 19, 2010.
http://www.wsdot.wa.gov/publications/fulltext/PMRS/Process_Docs_Maps/ECMProcesses.pdf
This document defines the global project electronic content management processes, rules, roles and responsibilities within Washington State DOT for the use of Livelink, an electronic file management system, for capital transportation project documents. The document establishes and standardizes ECM processes for capturing, storing and retrieving project documents within Washington State DOT's Project Management and Reporting System.

A discussion of the construction management project ECM process begins on page 55 of the PDF. Appendix B, which begins on page 58 of the PDF, provides a list of construction administration document types and typical examples of each document type. Similar tables outline the file structure for ECM processes in other areas, including:

• Agreements	• Hydraulic	• Public involvement
• Bridges and structures	• Landscape architecture	• Real estate
• Buildings	• Materials	• Survey photogrammetry
• Environmental	• Project administration	• Traffic services
• Geotech	• Project design	• Utilities and railroads

Project Management and Reporting System (PMRS), Washington State Department of Transportation, Secretary's Executive Order E 1042.00, July 1, 2008.
http://www.wsdot.wa.gov/NR/rdonlyres/D0752730-4858-4391-B889-D4653FBB3436/0/1042.pdf
This document outlines benefits of PMRS, which includes the project electronic content management system, and lays out plans for implementation.

Related Research
Below we highlight a 2009 AASHTO subcommittee survey that assesses the state of the practice with regard to electronic records within state DOTs and a 2008 conference paper that examines the critical components of a state DOT's conversion from paper to digital.

Electronic Records, AASHTO Subcommittee on Construction, 2009.
http://construction.transportation.org/Documents/SOCSurveyElectronicRecords2009.xls
This survey queried state transportation agencies on the use of an EDMS for construction records. Findings from the survey include:

- Almost two-thirds of respondents require retention of both paper and electronic copies of construction records.

- Respondents were evenly split as to when the agency converts construction-related paper documents into electronic files: at the end of the project or as they are received.

- Most respondents use digital images; some use microfilm.

- Most respondents have no plans to make the digital documents available to the public via the Internet.

- Respondents cited costs, staffing and training most often when asked to provide the top five critical concerns, constraints or impediments that must be addressed to initiate, implement and/or expand an EDMS.

"Optimizing Archived Electronic Transportation Engineering Data," Laith Al-Faqih, Carlos Sanchez, Andrew J. Graettinger, David Hale, *TRB 87th Annual Meeting Compendium of Papers DVD,* Paper #08-1904, 2008. Citation at http://trid.trb.org/view.aspx?id=848265
This conference paper addresses the three critical components of conversion from paper to digital: organization, conversion and access. While this paper-to-digital process was developed for use in a DOT environment, the strategy can be generalized to any firm looking to adopt or optimize an electronic document repository.

Vendor Solutions
Below we provide information about the vendors offering EDMS solutions referenced in this report, including FileNet (Oregon, Pennsylvania and Texas DOTs); Hummingbird (Florida DOT); Livelink (Washington State DOT); and ProjectWise (TxDOT).

FileNet P8 Platform, IBM Corporation.
http://www-01.ibm.com/software/data/content-management/filenet-p8-platform/
This Web page provides links to information about the core of the FileNet P8 platform, including FileNet Content Manager, FileNet Business Process Manager and Enterprise Records.

Hummingbird, OpenText Corporation.
http://www.opentext.com/2/global/products/products-all/hummingbird-landing.htm
On October 2006, OpenText acquired Hummingbird Ltd. Since then, Hummingbird Connectivity has been rebranded, becoming the OpenText Connectivity Solutions Group. This Web page provides links to information about the rebranded Hummingbird products.

Livelink, OpenText Corporation.
http://www.opentext.com/2/global/products/products-all/livelink-landing.htm
In 1996, the product originally called Livelink became OpenText's flagship product. Livelink was the first Web-based collaboration and document management system. In late 2008, OpenText introduced the OpenText ECM Suite as the overall name for the company's portfolio of enterprise content management products and began to market all products under the OpenText brand. The technology component formerly known as Livelink ECM Enterprise Server became known as OpenText Content Server.

ProjectWise, Bentley Systems Inc.
http://www.bentley.com/en-US/Products/projectwise+project+team+collaboration/
ProjectWise is an engineering project collaboration software used to aid in engineering content management, content publishing, design review and asset life-cycle management.