

STATE OF CONNECTICUT

**(CTDOT/BUREAU OF ENGINEERING AND
HIGHWAY OPERATIONS)**

FUNCTIONAL REQUIREMENTS DOCUMENT

(ENGINEERING CONTENT MANAGEMENT SYSTEM - ECMS)

FEDERAL SPR (RESEARCH) PROJECT 0093-0164

(6/20/08)

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Project Summary

The overall objective is to develop a digital design environment to utilize and evaluate electronic data systems to improve the efficiency and effectiveness of ConnDOT's project-delivery workflow by streamlining and improving workflow in the design process. This development project will be geared to reduce the time needed to access plan archives; to provide for the submission and review of engineering documents and drawings; and to benchmark current paper workflow processes and the newly installed digital design environment (encompassing electronic document generation, management, signatures, project advertisement and support services). The result will be to demonstrate the cost-effectiveness of a secure, efficient, standardized project design platform that helps reduce project costs, decreases project development times, and provides both accountability and storage for project documents.

Part 1. "As Is" analysis of current system: *document existing work flow and data flow. Include work flow and data flow diagrams as necessary.*

A. Current Process:

Currently, the Connecticut Department of Transportation (ConnDOT) does not have a clear mechanism in place to store and obtain electronic Computer Aided Design (CAD) data and general project data (correspondence and other data) that have been paid for under professional consulting services. Electronic data from large corridor projects have been lost and data are typically not conforming to standards because deliverables are only on paper. Past CAD policies did not address the standardization and delivery of electronic data. Consulting services handles a majority of project designs for ConnDOT. Today's advances in digital technologies offer many opportunities to improve the long-established process used within ConnDOT. Examples of present conditions and issues follow:

- Professional consulting services develop the majority of contracts developed by ConnDOT. In the past, ConnDOT never stressed the importance of standardizing CAD designs, and organizing the electronic data for both internal design and consultant services together. Furthermore, there has never been a cost effective delivery process to obtain the electronic data that the State of Connecticut and Federal Government pays for. Advances in operational efficiency and project delivery are not possible without improvements in these areas;
- The reproduction of engineering drawings and documents is one of ConnDOT's most costly workflow processes. This is required for both design review and delivery of engineering drawings and documents for contractors to prepare project bid proposals. To improve this process and reduce reproduction costs, ConnDOT needs to begin developing the necessary applications that will allow in-house engineers and consultant engineers to deliver a common (standardized) design package (plans, specs and estimates) in electronic format;
- Mylar contract drawings, manually-signed, are not indestructible and can be modified. Mylars can be edited, copied and scanned, and the ConnDOT Mylar

storage area is not under high security. Electronic document technologies (PDF) are available that can foster a more secure environment for contract drawing usage; and

- Digital signatures (currently piloted) are required to accomplish the above and there is a need to reduce operational costs and to improve quality, by providing documents in intelligent (searchable) PDF format throughout the entire design development process. Digital signatures will enable compliance with both Governor Rell's Executive Order #3 and Federal ADA Laws since the documents would be generated from their source applications rather than from scanning processes.
- The existing design development process is heavily dependent on paper. Typically, design submittals (Preliminary Design, Semi-Final, Final etc) require 18 sets of paper plans and corresponding design reports. Furthermore, at times project data and critical correspondence are lost and/or not taken into consideration as a project progresses from design through construction.
- Electronic data for projects are currently stored in "Silos of Data", i.e. multiple discipline divided network drives or on user's local machines. This process leads to a loss of project data confluence and inefficiency throughout the entire project development process and into construction. ConnDOT's Engineering Application's Section has started to migrate to a project container environment using existing network server infrastructure; however, a more robust engineering content management system and network infrastructure is needed.
- There is a need at ConnDOT to keep all project related data together for all disciplines throughout the entire project lifecycle using an integrated engineering content-management system that enables project teams, their information and their tools to work together as one.

A. Current Roles and Responsibilities (Hyperlinks provided to existing CTDOT Webpages):

a. Project Planning

i. [Intermodal and Environmental](#)

b. Infrastructure Design Production and Support

i. [State Design](#)

1. *Project Development*

2. *Highway Design*

3. *Facilities Design*

4. *Structure Design*

ii. [Traffic Engineering](#)

iii. [Consultant Design](#)

iv. [Design Services](#)

1. *Soils and Foundations*

2. *Contract Development*

- 3. *Hydraulics and Drainage*
- 4. *Utilities*
- 5. *Bridge Safety*
- 6. *Environmental*
- v. [*Environmental Planning*](#)
- vi. [*Engineering Applications*](#)
- c. *Infrastructure Construction***
 - i. [*Construction Main Office*](#)
 - ii. *Construction District Offices*
 - 1. [*District 1*](#)
 - 2. [*District 2*](#)
 - 3. [*District 3*](#)
 - 4. [*District 4*](#)
- d. *Office of Information System (Support Function for Both Engineering and Construction)***
 - 1. *OIS Business Systems*
 - 2. *OIS Eng. Support*
 - 3. *OIS PC Support*

B. Current Functions: *The following link provides information as to the existing cursory processes in the project development process:*

[*Existing Process Flow Chart.*](#)

Part 2. “To Be” analysis of current system: *document all desired procedures, roles and responsibilities, and functions. Refer to the SDM manual for additional information.*

A. Required operational functions:

- Usability - *The Department’s Engineering Applications Business Unit has developed an Engineering Business Requirements document that details the intended usability and workflow “by” Engineering Discipline. A link to that document can be found here:*
 - [Engineering Business Requirements](#)
- Audit trail - *Detailed audit trail functions are described in the Engineer Business Requirements Document.*
 - [Engineering Business Requirements - Page 19](#)
- Reliability - *The proposed ECMS must be 100% reliable, since it associated with the design and development of Transportation Infrastructure Improvements. If the system is down, employee productivity is down. The proposed system does not pose any health and safety issues if it goes down and no revenues will be lost.*
- Recoverability - *In the event that the system (database and application) goes down, the system must be up and running in a minimum of two hours after a failure is detected. Preferably, a system design should consider a back-up that will initiate immediately upon system failure notification. If the process site (hardware, data, and onsite backup) is destroyed, the application must be restored within one business day.*
- System availability - *The system must be in operation 7 days a week 24 hours a day.*
- Fault tolerance - *It would be desirable if users can still work locally on documents if the system goes down.*
- Performance –
 - *Response time for queries: Should be within 10 seconds.*
 - *Maximum file size uploads time: should be 1 minute for DOT internal, and 30 minutes for external web access.*
 - *Expected volume of data (See Table 1 Below):*
 - *Expected volume of user activity: [Refer to the Engineering Business Requirements - Appendix D](#)*

Table 1

Engineering Content Management System - Preliminary Capacity Analysis

Potential Active Data (100 Projects Per Year Full Production) Prelim. Calculation:
1,000 Documents Per Project – Max. Ten Years 1,000,000 10 Gigs Per Project Avg. X 100 Projs. X 10 years 10,000 Gigabytes = 10 Terabytes (Can be phased in, since full production of 100 projects/year will not occur until approx. 3 years after the production implementation)
Potential Legacy Data - 600,000 Construction Plans Prelim. Calculation:
100years x 100 Projects Per Year = 10,000 Potential PDF Project Files (documents) 500kb per sheet scanned X 600,000 = 300,000,000kb 300,000,000kb = .3 Terabytes Expansion = .3 Terabytes
Potential Bridge Safety Data - 6000 Bridges Prelim. Calculation:
50 documents per bridge X 6000 = 300,000 potential documents. 300,000 documents X 20mb per file = 6,000,000mb 6,000,000mb = .005 Terabytes Expansion = .005 Terabytes
Potential Traffic Intersection Data - 5000 Intersections Prelim. Calculation:
100 documents per intersection X 5000 = 500,000 potential documents 500,000 documents X 5mb per file = 2,500,000mb 2,500,000mb = .002 Terabytes Expansion = .002 Terabytes
Preliminary Estimate Total : 11 Terabytes

- Capacity – *See Table 1 above.*
- Data retention – *Data must be retained for the life of the infrastructure being constructed specifically for the future uses for maintaining infrastructure. A safe assumption would be for a minimum of 40 years. For those projects that do not get constructed and have gone through a planning stage, a minimum of 15 years of data retention would be acceptable.*
- Work flow – *Detailed workflow and procedural documentation can be found at www.ct.gov/dot/digitaldesign . In the future, the DDE Manual (http://www.ct.gov/dot/lib/dot/documents/deng/CTDOT_DDE_Guide.pdf) will be revised to include more specific uses of the ECMS. Workflow is*

also presented in the following charts:

- [Proposed Process and Flow Chart](#)
- Americans with Disabilities – *Not applicable at this time. The proposed system interfaces will be ADA compliant for both internal and external customers. PDF Engineering Drawings (not presented to the public) are difficult to make ADA Accessible.*
- Security –*DOIT's proposal to have CTDOT's external customers use RSA FOB Keys will not work. The following documents outline the discussion and justification for an alternative solution:*
 - [Engineering Business Requirements – Page 6 \(Design Submissions and Review\)](#)
 - [Engineering Business Requirements – Appendix F](#)

B. Required data functions:

- Data currency - *The proposed Engineering Content Management System must be able to access data of various dates and ages. Data is kept current by end-users updating the database (with files) and is workflow and production dependent. The proposed system's integration with existing department databases must operate in a way that automatically updates attribute data based on changes to the existing databases. (i.e. If the CORE project costing system is updated, the ECMS must have the ability to automatically "read in" the imported data updates). This is a one way scenario. We do not expect to the ECMS to update other existing Department databases. [Please refer to the Engineering Business Requirements – Page 11 for a detailed description of the desired systems integration.](#)*
- Data flow – *Please refer to the following link for information regarding the proposed data flow.*
 - [Proposed Process and Flow Chart](#)
- Interfaces to external system
 - Inbound
 - *Possible Bid Management Information Data – CTDOT Bid Data.*
 - *Contract Assembler – Used to assemble individual construction specifications into a complete word document.*
 - *Bentley IPlot – Used plot MicroStation CAD files to Paper or PDF format.*

- *Bentley MicroStation – CTDOT’s Standard Design Software Package.*
- *Bentley InRoads – CTDOT’s Standard Roadway Design Software*
- *Adobe Acrobat – Standard Application for dealing with PDF’s in the Architectural, Engineering and Construction Field. Also used to apply digital signatures to Engineering Drawings*
- *MicroSoft Office – Standard authoring application.*
- *Bentley STAAD – Structural Analysis Software*
- *Trafficware - Syncro Traffic Analysis – Standard Software for Traffic Analysis*
- *Bentley – StormCAD – Drainage analysis software*
- *Bentley - Storm and Sanitary – Drainage analysis software.*
- *Future AutoCAD*

○ **Outbound**

- *Direct Cost Accounting System.*
 - [Refer to Engineering Business Requirements – Page 4](#)

- **Security Data Perspective** – *The data proposed to be kept in the ECMS is not applicable to HIPAA requirements. CTDOT is aware that certain engineering data sets will be deemed “highly sensitive” in nature and will need to be treated in a sensitive process. Some examples of highly sensitive documents involve Airport engineering plans/drawings, or other major vertical infrastructure. CTDOT intends to plan and document these scenarios, and implement the necessary solutions. (i.e. encryption at the document level during publishing or alternative authentication ECMS solutions). Future electronic data security will be more controlled and adaptable than existing processes.*

C. Desired Roles and Responsibilities:

- *Refer to the following link for the Business Units Roles and Responsibilities:*
 - [Engineering Business Requirements – Appendix B](#)
 - [Project Team Wheel](#)

D. Desired Procedures/workflow:

- *Detailed workflow and procedural documentation can be found at www.ct.gov/dot/digitaldesign . In the future, the DDE Manual (http://www.ct.gov/dot/lib/dot/documents/deng/CTDOT_DDE_Guide.pdf) will be revised to include more specific uses of the ECMS. Workflow is also*

presented in the following charts:

- [*Proposed Process and Flow Chart*](#)

E. Acceptance Requirements – *Engineering Applications will accept the system based on performance and operation of the deployed development system. FHWA needs to evaluate the system based on delivered documentation regarding benchmarks of existing vs. proposed processes.*

F. Documentation required: *Detailed workflow and procedural documentation can be found at www.ct.gov/dot/digitaldesign . In the future, the DDE Manual (http://www.ct.gov/dot/lib/dot/documents/deng/CTDOT_DDE_Guide.pdf) will be revised to include more specific uses of the ECMS. Workflow is also presented in the following charts:*

- [*Proposed Process and Flow Chart*](#)

Part 3. Security: *Examples of items to consider in determining security requirements:*

- *Secure access to the facility housing the hardware/software through use of (but not limited to), individual assigned keycards, security personnel, physically locked and secure buildings/rooms.*
- *Role-based access to the software. No user may access the system that is not directly involved in construction based projects within the State of CT, Department of Transportation. Authorized users include, but not limited to Engineers within DOT, those offices that submit work pertinent to applicable projects, outside consultants assigned to work on specific projects, contractors awarded specific contracts, internal/external auditors, Federal Highway Administration.*
- *Controlled access by data type. Project jobs assigned to outside consultants can be updated and viewed by them only for designated role based folders to be controlled by System Administrators. Department Personnel can view outside Consultants work. Outside consultants may not view/update projects developed by Department. Contractors awarded a project may only view data they are authorized to see within the awarded contract. Non Freedom of Information type data may only be entered/viewed by specific personnel within Contract Development unit.*
- *Controlled access by system function, e.g. system administrator functions. Various area's of the Department/outside Consultants/Awarded contractors will not be allowed to access various portions of system, depending on job requirements. Copying and printing of documents will be controlled, based on individual role types. System administrator functions will allow for configuration of user*

access/initial password. Users will then be allowed to change their own password for additional security. Internal/external auditors will have access to inquire on all aspects of projects. Federal Highway Administration users will have ability to access the system (role based) and inquire on specific federally funded full oversight projects.

Part 4. Requirements Traceability Matrix: *Desirable for larger, complex projects. Traceability should provide the following:*

- *Not applicable at this time.*