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The New Mexico Department of Transportation was interested in determining the feasibility of adopting a CADD Content Management System (CMS) to improve engineering workflow efficiency, data integrity, engineering data re-usability, and increase data collaboration throughout the NMDOT and extended Consultant Community.

These slides provide an overview of the project. Additional data and details of the project can be obtained in the Final Report submitted to the NMDOT.
Objectives

- Determine the feasibility of utilizing a Content Management System to assist in managing CADD data throughout the NMDOT and interactively with its Consultant Design Community

- Identify human and technical obstacles and solutions to implementing such a system

- Identify the strengths and weaknesses, usability, and costs of systems for NMDOT to consider

- Identify the cost of user training, site licenses, implementation, and expected annual maintenance costs thereafter
Project Tasks

- Task 1 – Needs Assessment and Software/Equipment Survey
- Task 2 – Accepted/State-of-the-Art Practices Survey
- Task 3 – Feasibility Study: Technical
- Task 4 – Feasibility Study: Cultural
- Task 5 – Market Study of CMS Software
- Task 6 – Recommendation of Best Software Fit for NMDOT
- Task 7 – Cost-Benefit Analysis of Implementing CADD/CS
- Task 8 – Implementation Plan
Needs Assessment and Software/Equipment Survey

New Mexico Tech requested from the NMDOT design teams and IT groups information regarding current servers available, as well as current CADD and file management systems in use.

To determine current needs, the New Mexico Tech research team also obtained information on how often CADD files needed to be shared.
Task 1 – Main Findings

- **NMDOT** currently uses the following CADD programs:
  - Bentley Microstation Version V8i Select Series 1 (8.11.07.180)
  - Autodesk AutoCAD Versions 2004 and 2012

- All current design projects require file access/modification from different district/design centers.

- Most copies of CADD files are stored on servers. Accepted rules for naming the files are used by design teams to recognize the most recent version of a file.
  - The risk of making a mistake in determining the most current version or owner of a file is very high as this is a manual system. Good communication between users is essential, as is consistent use of the file naming rules.
  - This system will fail if two persons work on the same file at the same time. However, a software that locks the file while it is being used would solve this issue.

- **Server speed and bandwidth affect the efficiency of the design process.**
  - An advanced file management/sharing program that transfers only the changed bytes would reduce the unnecessary network traffic as well as server load.
Task 2 - Description

Accepted/State-of-the-Art Practices Survey

To determine the state-of-the-art practices for the use of Content Management Systems for CADD in transportation design projects, the New Mexico Tech research team conducted surveys with two groups:

1. **NMDOT employees**

2. **Other DOT offices around the country**
Task 2 – Main Findings of Part I

Part I – NMDOT Employee Survey

- Most respondents are proficient in AutoCAD, MicroStation, Windows XP, and AutoCAD Xref, and blocks.
- Most individuals are not familiar with Windows Server 2008, Linux, or Mac OS.
- Most individuals have some experience with the use of shared files.
- Not all employees have a consensus on how to name shared files.
- Some users wait until they finish their portion of the work to save files to the server. In the meantime, other users may be using outdated files.
- Employees are satisfied with the amount of time it takes for documents to be saved or opened.
- Most individuals would like to gain more information about file management.

![Percent of Individuals Familiar with a System to Track of Different Versions of a File]
Task 2 – Main Findings of Part II

Part II – Other DOT Offices Survey

- File sharing/management programs used in DOT offices are MS-Windows based, user friendly and easy to learn.

- At the administration level, good computer knowledge of networking and MS-Windows server is required.

- At the user level, only basic computer knowledge is sufficient.

- Respondents believe these programs increase efficiency and reduce the chance of mistakes.

- Most of these programs need monthly maintenance and yearly update/upgrade.
Task 2 – Main Findings of Part II (cont.)

- ProjectWise is the most popular file sharing/management programs used by DOT offices around the US.
- In general, use of an automated file sharing/management program is recommended by the different DOT office personnel.
Task 3 - Description

Feasibility Study: Technical

In this task, the New Mexico Tech research requested from the Technical Panel and the NMDTO IT group information on the current resources and future plans for upgrades.
Task 3 – Main Findings

- There are currently 6 Dell Blade servers at the NMDOT, one in each Districts:
  - Deming (District 1)
  - Roswell (District 2)
  - Albuquerque (District 3)
  - Las Vegas (District 4)
  - Santa Fe (District 5)
  - Milan (District 6).

- Three 500 GB file servers are dedicated to CADD files in the following locations:
  - Santa Fe (EABRN 1) - serves the Northern Region and stores all software licenses
  - Albuquerque (EABRC 1) - serves the Central Region
  - Deming (EABRS 1) - serves the Southern Region of the state

- Connections available to the six District Offices are 100Mb, with exception of Grants (District 6) and Deming (District 1) that have 5Mb connections. According to Eric Roybal, Network Manager for the NMDOT, each location is utilizing no more than 60% of the bandwidth available during working hours.

- Although NMT was informed that several upgrades were underway and others were planned for the near future, no details were available.
Task 4 - Description

Feasibility Study: Cultural

This task investigates the attitudes NMDOT IT and design personnel have towards CADD/CMS.
Task 4 – Main Findings

- Major strengths of using rules for naming different versions of file:
  - no additional cost to the Agency
  - availability of previous versions of the file

- Main weaknesses of using rules for naming different versions of file:
  - it is a manual system and therefore inherently susceptible to errors
  - it relies on all users being familiar with and consistently using the pre-determined naming convention
  - it requires the transfer of entire files from and to the server
  - it does not provide locking of files (two users could simultaneously update the same file)

- Survey results:
  - Sharing of project files, including CADD files, are a necessity at the NMDOT.
  - Approximately 70% of the respondents used shared files, however, only half of them are familiar with the agreed-upon file naming system to identify the latest version of a file.
  - More than 40% of the respondents access shared files on a daily basis.
  - While approximately 90% of the respondents saved files (including CADD files) on the server, only 30% of these individuals created backup files.
  - Approximately 90% of the respondents are interested in learning a file management program.
  - More than 50% of the respondents prefer classes as a method of learning a new system, a little over 20% prefer reading manuals and online training/webinar is the choice of approximately another 20%.
Task 5 - Description

Market Survey of CMS Software

In this task, currently available CADD Management System software were evaluated by the New Mexico Tech research team based on present and future needs of the NMDOT.

Part I – General Evaluation of CMS Software
Part II – Evaluation of CMS Software with Secure/Managed File Transfer Solutions
Task 5 – Main Findings of Part I

Part I – General Evaluation of CMS Software

- Available CMS programs may be divided into two major groups:
  - open-source programs
    - almost free
    - source files are available to the users
    - no customer service
    - user is responsible for fixing and maintaining the program him- or herself
    - examples: Mercurial, Bazaar, and Fosil
  - closed-source programs
    - distributed without the corresponding source codes
    - full versions are not free.
    - user pays for both the cost of ownership and support as well as maintenance
    - examples: ProjectWise, Buzzsaw, and GlobalSCAPE

- Features of nine closed-source and three open-source file sharing/management programs were investigated based on phone/email interviews.
- Performance and user friendliness of these programs was evaluated. A summary of the top two is presented in the next slides (complete results are presented on the Final Report)
### Summary of Interview with Buzzsaw Representative

<table>
<thead>
<tr>
<th>Buzzsaw</th>
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<tbody>
<tr>
<td><strong>Platform</strong></td>
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<tr>
<td><strong>How It Works</strong></td>
</tr>
<tr>
<td><strong>File Locking</strong></td>
</tr>
<tr>
<td><strong>Transfer of the Entire Files or Only Changed Bytes</strong></td>
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<tr>
<td><strong>Supported File Types</strong></td>
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<tr>
<td><strong>Computer Knowledge Needed to Install the Program</strong></td>
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<tr>
<td><strong>Learning Curve</strong></td>
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<tr>
<td><strong>Years Being in Business</strong></td>
</tr>
<tr>
<td><strong>Customers Who Can Share Their Experience</strong></td>
</tr>
<tr>
<td><strong>Total Cost (upgrade, update, maintenance, support, and number of licenses)</strong></td>
</tr>
<tr>
<td><strong>Video Presentation (planned or available)</strong></td>
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## Summary of Interview with ProjectWise Representative

<table>
<thead>
<tr>
<th><strong>ProjectWise</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Platform</strong></td>
</tr>
<tr>
<td>Windows Server 2008 and Windows for desktop</td>
</tr>
<tr>
<td><strong>How It Works</strong></td>
</tr>
<tr>
<td>ProjectWise is a project collaboration and engineering information management solution developed for architecture, engineering, construction, and operations (AECO) of infrastructure projects. Unlike traditional document management and collaboration software, ProjectWise is a system of collaboration servers &amp; services for AECO.</td>
</tr>
<tr>
<td><strong>File Locking</strong></td>
</tr>
<tr>
<td>Yes. It only allows one person to edit a file at a time.</td>
</tr>
<tr>
<td><strong>Transfer of the Entire Files or Only Changed Bytes</strong></td>
</tr>
<tr>
<td>Yes. ProjectWise utilizes Delta File Transfer technology that transfers only changed bytes, which works on all file types.</td>
</tr>
<tr>
<td><strong>Supported File Types</strong></td>
</tr>
<tr>
<td>Any type</td>
</tr>
<tr>
<td><strong>Computer Knowledge Needed to Install the Program</strong></td>
</tr>
<tr>
<td>ProjectWise client applications are simple to install. ProjectWise server applications require Bentley Professional Services to deploy.</td>
</tr>
<tr>
<td><strong>Learning Curve</strong></td>
</tr>
<tr>
<td>ProjectWise has an interface that is very similar to Windows Explorer, so the learning curve is relatively short for someone who is accustomed to using Windows.</td>
</tr>
<tr>
<td><strong>Years Being in Business</strong></td>
</tr>
<tr>
<td>28 years</td>
</tr>
<tr>
<td><strong>Customers Who Can Share Their Experience</strong></td>
</tr>
<tr>
<td>44 of the ENR Top 50 engineering firms and nearly half of all US DOTs use ProjectWise</td>
</tr>
<tr>
<td><strong>Total Cost (upgrade, update, maintenance, support, and number of licenses)</strong></td>
</tr>
<tr>
<td>Depends on the number of users and servers</td>
</tr>
<tr>
<td><strong>Video Presentation (planned or available)</strong></td>
</tr>
<tr>
<td>Yes</td>
</tr>
</tbody>
</table>


Part II – Evaluation of CMS Software with Secure/Managed File Transfer Solutions

- Nine companies who provide secure/managed file transfer solutions were contacted
- Five companies responded and provided information about their file transfer/management programs
- Although these programs transfer files securely, most parts of the file sharing/management process is done manually
- These programs transfer entire files, not only the changed bytes of an edited file
- Therefore, these programs will not speed up the file sharing/management process
- Nevertheless, NMDOT may need to consider these programs for secure file transferring.
Task 6 - Description

Recommendation of Best Software Fit for NMDOT

This task compares the two software packages selected by the New Mexico Tech research team as the best candidates for fulfilling the needs of the NMDOT.

Recommendations are made to the NMDOT.
## Task 6 – Main Findings: Top Two Programs

Based on surveys, features and limitations of the available file sharing/management programs, and NMDOT needs, two programs were selected: Buzzsaw and ProjectWise.

<table>
<thead>
<tr>
<th>Description</th>
<th>Buzzsaw (Autodesk)</th>
<th>ProjectWise (Bentley)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program to support Building Information Modeling workflows. It provides a secure access to information from personal desktop, mobile device, or the web. Compatible with Autodesk products but cannot support all versions of other companies’ products in older versions (Buzzsaw Users’ Guide).</td>
<td>Information management and project collaboration software. Microsoft Windows based program. Full compatibility with MicroStation and other Bentley’s products but its integration compatibility with Autodesk’s products is not fully guaranteed. (ProjectWise Users’ Guide).</td>
<td></td>
</tr>
<tr>
<td>Supports Mac OS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Updates</td>
<td>Automatic, several times a year</td>
<td>Manual</td>
</tr>
<tr>
<td>Requires NMDOT IT support</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Customer service</td>
<td>Web-based pre-sale customer support. Technical questions not answered by phone.</td>
<td>PIs are satisfied with support provided by customer service.</td>
</tr>
<tr>
<td>Large files</td>
<td>Not possible to partially load files or to save changes on certain parts or layers.</td>
<td>Delta file transfer – only sends changes needed to update the file.</td>
</tr>
<tr>
<td>Reported problems</td>
<td>Problems opening DWF in mobile version. Reported synchronization issues. To batch plot, use batch plot capability of AutoCAD. Latest version cannot search words based on attribute in files containing text – troublesome when working with dozens of files.</td>
<td>Compatibility issues with older versions of AutoCAD Civil 3D.</td>
</tr>
</tbody>
</table>
Task 6 – Main Findings: Web Forums

The following observations were obtained from discussions on web forums about the top two programs selected by the research team: Buzzsaw and ProjectWise

- Approximately two third of the users recommend Buzzsaw
  - Trial version provided at no cost has an important role in the popularity of Buzzsaw
  - Free collaborating site of Autodesk is user-friendly and attractive
  - Users on web forums believe Buzzsaw to be more convenient for external users

- Autodesk seems to be keeping its “old way” without any real innovation while Bentley is enhancing its product, and as a mature company, it has much more facilities for users such as better customer service (Autodesk Discussion Group)
Task 6 – Recommendations

- Capabilities and features of programs improve with time and for this reason this conclusion might need to be revised in the future.

- Two file sharing/management computer programs were found to better meet the NMDOT needs and requirements:
  - Buzzsaw by Autodesk
  - ProjectWise by Bentley.

- Both Buzzsaw and ProjectWise meet most of NMDOT’s requirements.

- Since it may be more convenient for the NMDOT not to dedicate a server for file sharing/management, Buzzsaw is the recommended choice for immediate implementation.

- However, Bentley products have been used by the NMDOT design teams for quite a long time. Therefore, switching to ProjectWise, a more complete file management system, might be unavoidable after some time.
Task 7 - Description

Cost-Benefit Analysis of Implementing CADD/CMS in NMDOT

This task explores the costs and benefits associated with the implementation of a file sharing/management software.
Cost of implementing CADD/CMS in NMDOT includes:

- Initial cost of each license ($L$) depends on the number of required licenses ($n$)
- Cost of hardware upgrade to meet the system requirements of the software ($H$)
- Training cost ($T$)
- Cost of change in schedule of NMDOT personnel and working procedure ($S$)
- Annual maintenance/upgrade cost considered as a percentage of licenses’ prices ($M$).
- Unforeseen costs ($U$)

Assuming CADD/CMS software will be used for 10 years, total cost ($C$) is:

$$C = nL + H + T + S + 10M + U$$

Since the margin of error for the unforeseen costs ($U$) is relatively large, $U$ is estimated to be a percentage ($\lambda$) of the rest of the costs ($nL + H + T + S + M$):

$$C = (\lambda \% / 100 + 1) (nL + H + T + S + 10M)$$

Monthly cost is:

$$C = (\lambda \% / 12000 + 1/120) (nL + H + T + S + M)$$
Benefits of implementing CADD/CMS include:

- Reduced risk of mistakes
- Reduced labor costs
- Savings in time
- Increased productivity

The benefits associated with implementing CADD/CMS in NMDOT would easily justify the costs.
Task 8 - Description

Implementation Plan

Task 8 investigates the attitudes NMDOT IT and design personnel have towards CADD/CMS.
Task 8 – Main Findings

- Due to recent developments at the NMDOT, including the replacement of Bentley Design and Survey Software by Autodesk products, the implementation of a full file management system does not seem feasible at this time.

- However, the file sharing system Autodesk Buzzsaw is recommended for immediate use, to increase data collaboration throughout the NMDOT and extended Consultant Community.

- Should NMDOT decide to adopt Buzzsaw:
  - Cloud storage site would be hosted by Autodesk
  - Training would be provided by Autodesk
  - NMDOT would be responsible for providing Autodesk information on:
    - the number of internal users and the types of permissions required for such users
    - the number of external users and the types and duration of permissions for these users
  - NMDOT would be responsible for scheduling the training sessions

- Since a method will still be required to track the latest version of shared files, NMT recommends widespread distribution of naming rules to be employed
  - this could be done via an internal memo to supervisors
  - supervisors would be responsible for assuring that all users consistently use the rules

- Should the NMDOT decide to adopt a file management system in the near future, the research team recommends ProjectWise.
Conclusions

- To maximize work flow, the New Mexico Department of Transportation has recognized the need for an efficient file management software system.

- To select the software that would best meet the needs of the NMDOT, several file sharing software packages were researched while the requirements of the NMDOT and its employees were assessed using interviews and surveys.

- The top two file sharing/management computer programs selected were:
  - Buzzsaw by Autodesk
  - ProjectWise by Bentley.

- Due to recent developments at the NMDOT, including the replacement of Bentley Design and Survey Software by Autodesk products, the implementation of a full file management system does not seem feasible at this time.

- However, the file sharing system Autodesk Buzzsaw is recommended for immediate use, to increase data collaboration throughout the NMDOT and extended Consultant Community.

- Should the NMDOT decide to adopt a file management system in the near future, the research team recommends ProjectWise.
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