



## TECHNICAL SUMMARY

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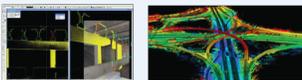
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### LRRB PROJECT COST:

\$146,022



Lidar is a valuable CIM technology for collecting data about built transportation assets that can be used in 3-D models.



DEPARTMENT OF  
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# Moving Local Road Design and Construction into the Digital World: Benefits and Challenges

## What Was the Need?

Documentation needed for bidding on and constructing transportation projects is becoming more complex. Even the simplest projects can require 50 pages of drawings and hundreds of pages of contract documents and specifications. Larger projects can require boxes full of paperwork.

Civil Integrated Management (CIM) is a framework for computerizing the planning, design, construction and maintenance of transportation infrastructure. For example, one CIM technology, 3-D modeling, can make project design and construction more efficient by showing, in a single file, all the design details needed by a contractor and by making conflicts obvious early in the process. Other CIM technologies include electronic document management (EDM), electronic bidding, electronic signatures and automatic machine guidance. CIM has the potential to save time and money in designing projects, reduce design review times, minimize requests for information and field corrections, and reduce office supply costs.

Implementing these technologies effectively, however, is a long-term project that requires a significant initial capital investment and specialized training. Agencies also need to evaluate and mitigate potential risks, such as legal liability if there are errors in the data used to create 3-D models. The Local Road Research Board (LRRB) wanted to begin the process by evaluating which CIM options might be beneficial and feasible for local agencies in Minnesota and how those options might be implemented.

## What Was Our Goal?

This project sought to identify best practices in using digital technology to create road construction plans and documentation, and to provide guidance to local agencies in implementing CIM technologies.

## What Did We Do?

Investigators conducted telephone interviews with engineers from Hennepin, Chisago and Rochester counties, and from MnDOT and Minneapolis-based SRF Consulting. Investigators also reviewed case studies from Norway and the Netherlands, and visited several state departments of transportation as part of National Cooperative Highway Research Program [Domestic Scan Project 13-02](#).

In November 2015, investigators held a brainstorming session with “superusers,” including local engineers, designers, construction managers and inspectors who already were using CIM technologies. This group identified 3-D modeling, EDM and legal issues as priorities for further investigation. They also conducted a strengths, weaknesses, opportunities and threats (SWOT) analysis of 3-D modeling and EDM.

Using the information gathered, investigators developed guidelines to help local agencies incorporate 3-D modeling and EDM into their design, bidding and construction processes.

*Digitizing road construction plans and documents can save transportation agencies significant time and money in design and bidding. Investigators identified 3-D modeling and EDM as technologies with the most potential for state agencies.*

*“A 3-D model provides contractors with all the details they may need, so designers no longer have to anticipate those details and prepare separate drawings of them for the contractors.”*

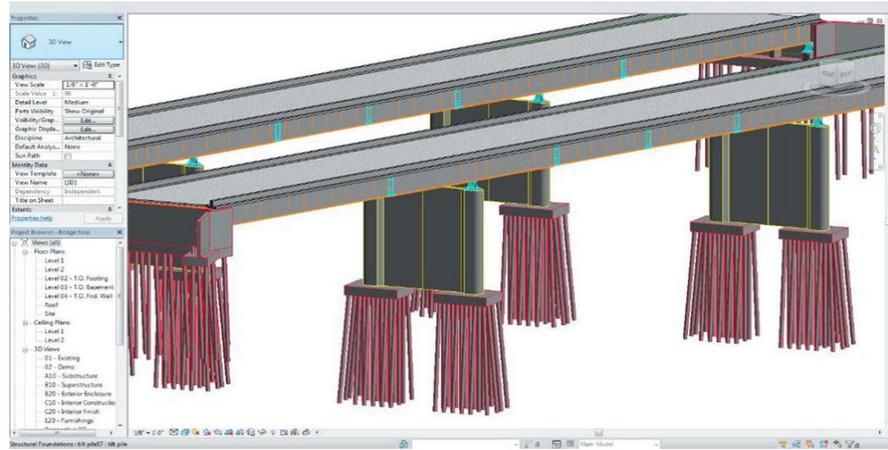
—Jennifer Shane,  
Director, Construction  
Management and  
Technology Program,  
Iowa State University  
Institute for  
Transportation

*“Our ultimate goal is to go from a paper workflow to an electronic workflow. We have to look years ahead to address the challenges involved in this, but the potential benefits justify a long-term commitment.”*

—Lyndon Robjent,  
Engineer, Carver County  
Public Works

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A single 3-D model can provide all the details that contractors may need to bid on a project. This can reduce paperwork, requests for information and construction changes.

### What Did We Learn?

The SWOT analysis identified four benefits of 3-D modeling: the ability to store all project information in a single file, increased efficiency, better visualization and communication, and better long-term decision-making. The opportunity to use advanced technology may also improve job satisfaction and help attract students to the field. Challenges identified included the difficulty of introducing new procedures, the cost of the technology and its steep learning curve, and potential liability.

EDM benefits identified included increased efficiency in sharing data, the opportunity for nearly real-time collaboration, the ability to track design changes, and the ability to electronically archive documents. Challenges again included the cost and learning curve of EDM systems, as well as concerns about security and software updates.

Investigators developed the framework of a process for local agencies to use in implementing both 3-D modeling and EDM. Both technologies require software investments that need to be thoroughly researched, and both call for training and the development of policies to guide their use. In addition, implementation will require extensive collaboration among agency staff, contractors and consultants because the impacts of 3-D modeling and EDM will be felt beyond the agency.

### What's Next?

CIM has high potential benefits, but also high initial costs. Fully incorporating 3-D modeling and EDM into the design and bidding process will likely be a long process, and this project represents the first step in it.

The LRRB is currently evaluating options for the next step, which may involve:

- Collecting feedback from contractors, who will need to collaborate with project owners for any technology implementation to be successful.
- Developing a CIM process using case studies and current design methods and software.
- Identifying deliverables for each phase of a construction project using best practices from contractors, designers, reviewers and inspectors.
- Developing recommendations for implementing a CIM process in a pilot project.
- Identifying shortcomings of current software and suggesting improvements.
- Conducting cost-benefit analyses to quantify potential savings from 3-D modeling and EDM, and to determine how large a project needs to be for these technologies to be cost-effective.

*This Technical Summary pertains to the LRRB-produced Report 2016-29, “Modernizing Road Construction Plans and Documentation,” published September 2016. The full report can be accessed at [mndot.gov/research/TS/2016/201629.pdf](http://mndot.gov/research/TS/2016/201629.pdf).*