

Member Communication Experience

New Research Shows Benefits For Agencies By Transitioning to Digital Delivery in the Transportation Industry

Interview with: Alexa Mitchell, Transportation BIM Program Manager, HDR, and Chris Williges, Economics and Statistics Director, HDR

Building information modeling is increasingly popular in transportation infrastructure. With digital delivery in transportation, also known as BIM for infrastructure, agencies can not only design projects in a 3D platform but also maintain assets digitally rather than with plan sheets. While there is a cost to implementing any new technology, agencies are continually evaluating competing priorities and need to be able to justify their investments.

A new 18-month study, funded by the Federal Highway Administration Turner-Fairbank Highway Research Center through the Transportation Research Board, quantifies those benefits and costs through rigorous economic tools. The team conducted a literature review, identified case studies, and gathered an expert panel to answer the question: What is the return on investment of transitioning to digital delivery in transportation projects?

In this interview, two of the study's authors – HDR's Alexa Mitchell and Chris Williges – share what they found and how agencies can determine their own return on investment.

Q. THERE'S A PERCEPTION THAT MOVING TO DIGITAL DELIVERY IS AN EXPENSIVE TASK. WHAT DID YOUR RESEARCH FIND?

Williges: We found that it's hard for digital delivery not to pay for itself within a few years. We looked at different types of implementation and different levels of maturity for different



sized digital delivery programs. Regardless of the assumptions, the benefits usually outweigh the costs.

Overall, we identified 29 benefits of digital delivery and 13 costs. The biggest benefit was reduced change orders. With digital delivery, designers can clarify their intent and contractors can understand the impacts of the design. In the case studies we examined, with project costs ranging from \$5 million to more than \$200 million, we found that using digital delivery can save roughly 15% on a project in change orders, which is a significant financial benefit.

Our research also determined the cost to agencies was fairly low. When an organization moves to digital delivery, most of its costs come from hardware and software. Often these are costs that the agency would have had to spend anyway. Even

agencies that don't want to invest in digital delivery will find that software will eventually become unsupported and the newer versions will automatically include digital delivery capabilities. Organizations can choose to take advantage of these tools or not, but they're likely to eventually spend this money either way.

Digital delivery-specific investments, costs that wouldn't be incurred otherwise, can also be implemented over multiple projects. Although they will experience upfront costs, agencies will see a return on the hardware and software over multiple projects.

Of course, there are also personnel-related costs, such as employee training, developing new procedure manuals, standards, that sort of thing. But there are also other benefits, ranging from decreased document storage costs to staff time savings. In general, our research determined that these costs were either outweighed or offset by ongoing benefits.

Q. WHY IS THIS RESEARCH IMPORTANT?

Mitchell: In any transportation agency, funds are limited and leaders need to choose where to invest.

The initial setup of the digital delivery environment is quite a significant level of effort. It's a heavy lift. It's perceived that it's time consuming and it is. But more importantly, there's a legitimate question of whether that effort will pay off.

When I was at the Missouri Department of Transportation and I brought a new idea to executives, the first questions would be "How much is that going to cost us?" and "Are we going to get our money's worth?" For digital delivery, I couldn't answer that very well. I didn't have hard numbers – we hadn't consistently determined that value.

It was very important to come up with a consistent way to estimate costs, to estimate benefits, and compare them against each other to come up with that value added. People want guidance on how to document costs and benefits that are specific to their organization.

Most studies have done more of a qualitative analysis. Everyone sees the qualitative value, but we wanted to quantify that value and develop a tool and a strategy to give to technical champions at DOTs and other agencies the backup needed to make their business case.

Q. DIGITAL DELIVERY IS THOUGHT OF AS A TOOL FOR MEGAPROJECTS. IS IT ALSO BENEFICIAL FOR MIDSIZE PROJECTS?

Williges: The short answer is yes.

We grappled with project size during our research. The state DOTs and other agencies overseeing our work were interested in looking at digital delivery, not just for megaprojects, but also for their regular projects. As a result, we researched the benefits of digital delivery for the most typical transportation projects – the middle 85% of projects by size – that agencies deliver. The benefits we found are "typical."

In addition, many benefits cannot be assigned to just one project. Agencies will realize these benefits over many years, particularly as they're able to re-use data, work and training for other projects. As a result, it was hard to quantify benefits for just one project. An agency's overall program benefits from the consistent use of digital delivery on individual projects.

Putting this all together, it's just as important for an agency to use digital delivery on its many small and medium projects as it is to apply digital delivery to the rarer megaprojects.

Q. HOW CAN AGENCIES DETERMINE WHERE THEY ARE ON THE DIGITAL DELIVERY CAPABILITY SCALE, AND HOW CAN THEY ADVANCE THEIR DIGITAL DELIVERY IMPLEMENTATION?

Mitchell: In general, there are four tiers to agency capabilities or maturity with digital delivery:

1. Transitioning from 2D to 3D to produce plans
2. Sharing 3D plans as information only, not as part of the contract
3. Delivering 3D plans contractually, where the 3D model supersedes conventional plans
4. Delivering solely 3D models contractually, with minimal or no plan sheets. This final stage can also include using the model to produce a digital as-built, with information collected in the field during construction for asset management purposes.

After agencies determine where they land on this continuum, they need to decide where they want to be.

Then it's a matter of creating a roadmap, working with stakeholders and vendors, and doing pilot projects.

For some agencies, advancing digital delivery implementation might be a small jump and easy to do. But those further behind their peers will need a longer roadmap.

The Pennsylvania Department of Transportation is working through a five-year roadmap to full digital delivery implementation. We're working with them on that implementation. Over the course of this transformation, they'll complete a series of pilot projects and assess whether they need to shift their approach in order to reach their goals. One of the strategies was to create a safe space for people to experiment. This level of digital transformation is an iterative process – it will take several trials before a process is properly defined and before it can be institutionalized.

Other agencies are also working toward full digital delivery implementation.

Utah has developed a strategic plan, completed over a dozen projects with digital deliverables, and now considers itself institutionalized for digital delivery. The department's next step is to advance the technology's use to asset management, which opens exciting possibilities.

Iowa, too, is looking to follow suit – the DOT will develop its digital delivery roadmap in mid-2022. These states and others recognize the power of digital delivery and the importance of a strategic plan in harnessing the power of the technology.

Another important consideration for any agency is to assign a lead who can take it on as their full-time job. Digital delivery implementation can't be part of someone's "other duties as assigned." Even if an agency has the assistance of a consulting team, it's important to have an agency lead who's accountable for overall implementation.

They will also explore the use of open data standards, such as the Industry Foundation Classes or IFC. Today, software produces proprietary files that are hard to share with people who do not use the same software. This can present real challenges for the user – for example, the recipient can't open the files, the files have to be converted, and only partial information is provided. Soon, we hope to have IFC exports in all digital delivery software so we can share information with one another without worrying whether the recipient can view the file or all the information was translated correctly.

Q. OVERALL, WHAT ARE THE AGENCY BENEFITS OF IMPLEMENTING DIGITAL DELIVERY ACROSS A TRANSPORTATION PROJECT LIFECYCLE?

Williges: I mentioned some of the benefits during project delivery earlier such as reduced change orders.

But agencies don't have to guess what their benefits would be. During our 18-month study, we developed a tool to help entities determine their costs and benefits of digital delivery.

We purposely designed the tool to be easy. If agencies don't have a lot of data, we can give them a general answer. If organizations really want to get into the weeds and want a detailed, customized answer, we can do that too.

Agencies can assess their digital delivery maturity level using the scale Alexa identified earlier. They can then pick the maturity they'd like to achieve and use the tool to identify the benefits of achieving that maturity level.

Agencies can enter limited information to get a general idea of costs and benefits. Or they can input detailed agency information, such as the size of their staff, the average pay per individual, and the average size of project. If they do this, the tool will provide an agency-specific estimate of the costs and benefits. Whether an agency uses simple or detailed inputs, the tool provides costs and benefits for their entire transportation program.

Mitchell: We haven't even yet touched on the benefit of digital delivery for asset management.

Taking digital delivery to that final step, creating an as-built digital model, can really elevate asset management to allow for operations and maintenance work that wouldn't have otherwise been possible.

For example, say your state had a flood and culverts were compromised. Someone would dig for the marked up as-built plans, and extract information to find out what was built or whether they had been moved after previous maintenance. It would be very difficult to even figure out where all those culverts were supposed to be.

Imagine instead that all the relevant information from the designer, the contractor, and operations was stored in an enterprise system. It will be so much easier to find what's needed to address this emergency event and get the system operating again.

When that flood occurs, you input a query in the system and location, type, size and maybe even manufacturer warranty information to help aid in the recovery process.

That is an important benefit of digital delivery and one of the key reasons I think it's so important for agencies to pursue this technology.

Q. HOW DID YOU GET INVOLVED IN DIGITAL DELIVERY?

Mitchell: it was through my work at MoDOT. I was asked to help implement 3D modeling technology for the department. I found out that I really enjoyed teaching people how to use the software and finding ways to optimize the technology.


Q. WHAT ADVICE DO YOU HAVE FOR SOMEONE CONSIDERING A CAREER IN BIM AND DIGITAL DELIVERY?

Mitchell: Digital delivery is very broad, but a good place to start is with model-based design. Once you understand how BIM is used for delivering design projects, then explore other areas you may want to specialize in. For example, 4D modeling is a unique use in which you pair the 3D model with the project schedule to simulate sequences for construction.

Q. HOW DID YOU GET INVOLVED IN TRANSPORTATION AND ECONOMICS?

Williges: I got my undergraduate degree in economics. As I progressed in my career, I got interested in transportation issues and I got master's degrees in city planning and civil engineering. With that background, I enjoy looking at problems that apply economics to transportation decision-making.

Q. WHAT ADVICE DO YOU HAVE FOR SOMEONE CONSIDERING A CAREER IN TRANSPORTATION ECONOMICS?

Williges: If you're really interested in solving transportation issues, then this might be the career for you. One of the things that's interesting about transportation economics is you can apply economic theory to very practical problems. Often when you view a transportation problem through an economic lens, you see different solutions than a planner or engineer would. 



About the Author

Alexa Mitchell, PE, is HDR's transportation BIM program manager and one of the premier industry leaders on BIM for infrastructure. She is active throughout the industry, drawing from her public and private sector experience to help clients with their digital delivery needs, as well as serve on a variety of high-level working groups and committees.

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