# E-CONSTRUCTION IN PRACTICE:

## A Peer Exchange w. TxDOT & WSDOT

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SECTION 1:

**e-Construction in Practice: A Peer Exchange with TxDOT & WSDOT**

There's a lot of talk about the potential for paperless e-Construction initiatives to increase productivity, decrease communication delays and improve the day-to-day experience on the part of everyone involved in transportation construction management. But how effective is it, in practice? And why has its implementation proven to be so difficult?

On January 27th, 2016, Dr. Steve Muench, Associate Professor at the University of Washington, Department of Civil and Environmental Engineering, sought to answer this question as he hosted a one-hour virtual peer exchange with professional engineers Roxi Garcia, of TxDOT, and Derek Case, of WSDOT. Both offered revealing perspectives on the challenges associated with undertaking e-Construction initiatives while providing realistic expectations on processes and tool implementations based on first-hand experience.

Following are Dr. Muench's questions and key takeaways from this candid conversation. The audience Q&A is also included.

### QUESTION #1:

**What is the end-game for e-Construction? Where is the industry headed?**

**Derek**: *"Paperless delivery, beginning to end, inception to final records."*

Everything from design and construction; payments, measurements, and change orders; to asphalt records and final records for a contract should become interchangeable and searchable within a well-functioning database to maximize efficiency.

**Roxi**: *"I think at some point we will be 100% paperless. We're just going to automate until we can't get any better."*

While the agency is not there yet, Roxi feels that is where TxDOT is headed. It is a continuous process of implementing new technologies and refining their use. But given the dynamic nature of technology, replacement upgrades over time are inevitable. e-Construction is a constantly evolving process that requires a truly watchful eye.

### QUESTION #2:

**When it comes to paperless initiatives, is transportation construction ahead of or behind other fields?**

**Derek**: Overall, transportation construction is keeping pace with the industry. Yet due to the considerable volume of documentation generated from mega-projects, private industry has led the way in the application of e-Construction for a variety of good reasons:

"*By necessity, they have to. They're the ones that are doing these billion dollar tunnels and five hundred million dollar floating bridges. And the sheer volume of documents that they generate is orders of magnitude larger than the standard contracts we were used to. So it was either swim or drown, literally, in a sea of paper. Design/Builders came in with that expertise and the ability to manage electronic documentation, and they provided us with access to that software and the ability to participate in the process with them.*"

Additionally, public entities have adopted technology at a slower rate because they are the ones responsible for long-term obligations. Once a project is finished, private industry is able to move on, a luxury that owners don't have.

### QUESTION #3:

**What are the biggest opportunities in e-Construction?**

**Roxi**: *"One is file sharing with the likes of the Department of Labor or FHWA."* With this technology, they no longer have to physically come to TxDOT to obtain information in order to conduct an audit.

Another opportunity comes through cost control. For instance, TxDOT has some rather large projects. When these jobs are completed, upwards of forty boxes of records and documentation need to be shipped to a warehouse for storage. Physically storing records in a warehouse, printing these records on paper, ink, the printers themselves, and etc. – these are truthfully unnecessary expenses. *"Part of our analysis in e-Construction is 'How much money are we going to save?'"*

Additionally, data retrieval would be much more streamlined if the number of boxes was cut from forty to five, with the rest stored virtually. The ultimate goal is to reduce the number of boxes to zero.

**Derek**: Public Works Contract Administration, or the ability to collect data once and utilize it many times, is one of the most significant opportunities.

*"Part of Pavia System's next generation potential with HeadLight is that it provides this opportunity. It's not just for inspectors to fill out a form that then only exists in one discrete location, but it populates a database that has tagged information, or metadata, associated with these packets of information that can then be searched and re-used to generate a multitude of other documents required to administer a public works contract."*

### QUESTION #4:

**What E-Construction tools / practices has your agency adopted? What are you planning or working on next?**

**Derek**: In addition to utilizing Building Information Modeling (BIM or 3D modeling) on a select number of projects, WSDOT has also adopted Electronic Bidding, Electronic Distribution of Plans and Manuals, HeadLight inspection devices in 18 offices across the state, the HATS field device program for maintenance, ECM portals for final records, and a variety of document management/workflow programs on mega-projects, including Centric, ProjectWise, Primavera, and others.

*"Next steps are refining HeadLight and expanding its use into other forms. We also plan to expand use of electronic final records and then I'm hopeful we will go into document management workflow."*

**Roxi**: *"For Contract Administration we use SiteManager. For electronic bidding we use a product by Exavision. For Design and Construction as far as archiving or sharing data we use ProjectWise. We use DocuSign and Acrobat Adobe for e-signatures, and we are migrating from a custom software to LCPtracker for electronic payrolls.*

*"HeadLight is one of the applications that we're really looking forward to implementing on tablets in the field. I think that might be one of the next applications that we pick up and start running with."*

According to Roxi, it is likely within the next five years that SiteManager will be upgraded to the web-based version instead of the desktop version. As it is significantly different than the currently used program, TxDOT is still waiting until they "get the kinks out." Automating the system by which bidders are qualified for their bidding capacity is also a priority. The system is currently fairly manual so Roxi and other folks in the industry are really looking for an application that will automate a lot of those tasks, as well as an insurance policy expiration monitoring system.

### QUESTION #5:

**What are the biggest challenges to adopting e-Construction, and why is it so hard?**

**Roxi**: **"***The biggest challenge by far is knowing where to start."*

Texas had a brainstorming session and listed the top priorities to work on, so then it came down to establishing what would be the most efficient and effective undertaking. Through getting more efficient and transitioning to a virtual model, better data was collected, and when information was missing it became more apparent. The real message is to *"Pay for the one that makes most sense today and see how long it takes to implement, and then get rolling on some of the other ones as well. Never go into this thinking 'I've got to fix it all today,' because it's impossible. This is a program that will last you many years."*

**Derek**: *"The human element of the transition into e-Construction is as essential as the technology. Anyone getting started in e-Construction needs to recognize that people are committed to the old way of doing things. So you will be equally engaged in the management of change as you will be in figuring out the technical details."*

While upgrading systems certainly supplies the opportunity to reexamine various workflows, some will remain the same, and in fact they should. The goal is to make the electronic version, as well as the process of moving e-documents, appear as close to the original as possible, which is still quite challenging. "*Often times the agencies are large enough that no single individual actually knows what the workflows are.*"

As far as training is concerned, a big part of the HeadLight pilot was Pavia's support of the units deployed in the field, as individuals need to be prepared and disciplined in working with these new systems. "*When you employ a new technology in the field there is always going to be a need for additional support and one-on-one contact.*"

**Roxi**: "*You really have to have administration not just supporting your cause, but kind of really being the one carrying the ball.*"

In terms of change implementation, more specifically the integration of ProjectWise as an example, many people naturally resist the change, whereas others will take right to it. When ProjectWise was applied to desktops across Texas, administration made sure that it was implemented by setting milestones for employees to accomplish. They also did help checkups to see how progression was going, and set up quarterly meetings with the district engineers.

"*Depending on whether you outsource this or it's in-house, your IT staff has to be really be flexible enough to let you do what you need to do.*"Because of the barrier associated with e-Construction, the administration, IT partners, and contractors all need to be in alignment with the efforts taking place.

For example, LCPtracker has been implemented for payroll and it makes things much easier, but now contractors must have an account online to submit their payrolls, and they've got to make sure whatever payroll system they are using can talk to the new piece of software. For this project to flow smoothly, everyone must be on the same team.

## QUESTION #6:

**Any particular outcomes you can point to?**

**Roxi**: "*I think that the research paper we have with Pavia says it all as far as digitized inspections are concerned. Every time we implement something big... like Electronic Bidding and SiteManager with Contract Administration... things are much faster, data is much better, data sharing, data collection, and the integrity of the data is just astronomical.*"

**Derek**: HeadLight has been deployed in 18 offices across the state, electronic bidding has been in place for several years, and an in-house utility for electronic final records is rolling out.

### QUESTION #7:

**How do you support your e-Construction initiatives from an IT perspective?**

**Derek**: The agency has in-house legacy and mainframe systems that were developed and supported internally. Previously, there have been instances where software packages are purchased from vendors, the agency has gotten fully invested, and the vendor ends up discontinuing that product.

*"Then we have Pavia, a hybrid model, in which we contract with them to develop this software for us and we retain ownership in it. This case seems to have worked out very well because Pavia knows the software. They support it well. It's theirs. But it's ours, too, and we have a right to use it. So we don't get stuck with having someone jerk our license because we don't want to pay their million dollar annual fee or whatever it is. Every software purchase for your e-Construction initiative has those same questions associated with it."*

That's just part of the decision making process that any agency will have to go through.

### QUESTION #8:

**Are you encountering systems integration issues with your e-Construction tools?**

**Roxi:** *"Everyday. There is not one system that works for everything."*

The fact is that various systems are used that are not compatible with one another, and if you can't figure out how to get these programs to talk to each other, no one is getting paid. The integration and testing period to ensure that data is seamlessly crossing over is huge, but the systems are tested on a daily basis. Auditors are regularly studying the systems to make sure that no problems are occurring.

**Derek**: *"System integration is also a big challenge at WSDOT."*

There are various information silos in place that don't always talk to one another, yet each are essential for operations. So while this is a challenging initiative with unique obstacles, the potential is tremendous.

## QUESTION #9:

**Mobile and cloud-based solutions are trending. Have you moved in that direction? This question references ways to take advantage of mobile and cloud-based solutions to help you do your jobs.**

**Derek**: *"Yes. Mobile's first."*

There are currently cellphones, smartphones, and tablets in the field. But cloud-based storage still has its concerns. Right now there are statutory restrictions on where things can be stored and even what can be stored. Additionally, there are security concerns. *"Data security remains a significant element in our reluctance to wholeheartedly embrace cloud-based storage."*

**Roxi**: *"We have tablets in the field, though we're having problems with getting more devices and with connectivity."*

Technology evolves at such high speeds that certain models become outdated at an alarming rate. Additionally, once you have selected a certain device, an Internet carrier must be chosen as well, which in itself poses many difficulties. Texas has three or four preferred networks, but you have to know which one works in your area.

TxDOT implemented cloud-based solutions for a few reasons. The first is cost efficiency. With cloud-based solutions, endless amounts of data can be stored without restrictions versus housing it on internal servers which ultimately can cost a lot of time and money. The second is speed and data accessibility. Information stored through a cloud-based solution can be accessed from anywhere, through virtually any device. If it were to be stored on an internal server, a VPN or Citrix Connection would need to be used, and when working in SiteManager through a Citrix Connection things *"slow to a crawl. So yes, having some web-based solutions speeds up time, you don't get disconnected and the data's right at your fingertips."*

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There's a lot of genuine advances happening in the world of e-Construction, bringing about a very real possibility for a seamless, paperless, and highly efficient construction administration. While core issues like technology innovation, change management and data security are ever-evolving processes, experts like Roxi and Derek are embracing the advances while echoing the challenges that are still hindering productivity.

SECTION 2:

**Audience Q&A**

Several implementation and adoption questions, in particular in the fields of mobile and cloud, were raised by the audience, as well as questions about justifying costs and about HeadLight. We circled back and gathered responses from the panelists:

## IMPLEMENTATION

Q. **David Brown, Parsons Corporation: Would you suggest that SHA look into collecting data and not just filling in forms? The data should be collected only once and in the most efficient way. Many forms require the same data to be entered multiple times – a waste of time and effort.**

A. **Roxi**: *"I think we all are in agreement on that. We'd like to collect the data just one time and unfortunately, we don't have one big master system across, let's just say the United States, that houses all that data. So what you find is different agencies asking for information because they have reporting requirements, and that information looks similar to the last data request. And so no two systems are integrated between state agencies or even our agencies and federal agencies or even local agencies. And so yes, it does feel like we're asking you to give us the same information. I think e-Construction is definitely a tool that can help us to start automating some of these forms so that you are only giving us the data once, but you've got to realize that data is not for one single source. We share that data with multiple agencies and we all feel the pain of collecting the data twice, we do."*

A. **Derek**: *"Well that's exactly what HeadLight aims to solve. Collect once, use many times. Because you're right, we use the same information on a multitude of forms, and that's the whole idea here is that with HeadLight is that we can collect it once and populate multiple forms."*

Q. **Frank, Broen, Teach America: Are 3D plans are part of your e-Construction process?**

A. **Derek**: *"Yes, we have successfully used BIM on a handful of our larger, more complex projects."*

A. **Roxi**: *"In Texas we are. We've being doing 3D designs for many years, I think we're one of the leading states in 3D design right now."*

Q. **Katherine Holtz, TxDOT: When you say you use electronic files, are you saying scanned-in PDF's or are you saying digital live files?**

A. **Derek**: **"***The digital live files are electronic files. We do have some electronic files that exist as PDF's. And that's okay, we're willing to accept. I guess at this point in time we are gonna have a variety of data, some of which will be scanned PDF's of documents, while others, such as the HeadLight documents, will exist as a database.*"

Q. **Brian Deery, AGC of America: Are there compatibility issues with contractor, designer and DOT software?**

A. **Roxi**: *"Yes. So everybody will be on a different version of the software. At times the DOT does not like to force one software application on the contractor, or even on a consultant. So what we will generally say is whatever software application you are running needs to be compatible with our software application. We are not trying to tell contractors - because there are many contractors that work with us once a year, once every two to three years – that you have to buy this one package to work with us. We realize these contractors do work with everybody: the city, the county, TxDOT, and private industries. It is very difficult to tell a contractor to just buy this package for our sole use.*

*"I will tell you that TxDOT in many instances has taken the approach that we pay for the licensing of the application and the contractor reaps the benefits of using that application. Let me give you an example, with LTPtracker, we pay for the licenses. The contractor and his sub-contractors are allowed to use the application for free. I know that the City also uses LTPtracker and they require the contractors to pay for their own license. So I think TxDOT has taken the position that now we're gonna pay for the licenses and they are gonna be required to use our software, but that does not put the burden back on the contractor to support that software just for those one or two jobs that they're doing with us.*"

## MOBILE & CLOUD

**Q.** **Daryoosh Mosleh, MDOT-SHA: What has been challenges of using tablets on the field?**

**A.** **Derek**: *"HeadLight devices are ruggedized and they're in waterproof cases, so that doesn't seem to be a problem. Connectivity has been an issue for some of our outlying offices. That's one of the things that I know Pavia worked through, was making sure that the HeadLight device would continue to function fully even when it was out of range."*

**Q.** **Garret Gladsjo, Alaska DOT & Public Facilities: When implementing certain technologies in the field, did you have to increase the number of field personnel to implement training? Did you just need staff or did you need to insert a specialist into your field staff for support?**

**A.** **Derek**: *"We provided, well, Pavia provided staff to support people in the field, both on the phone with an 800 number and also with the one-on-one, the "visiting nurse" kind-of-thing in the field. Usually there's also a kind of a resident champion among the existing staff who understands how this stuff works and is able to be like a first line of contact for unit fields."*

**Q.** **Soraya Saflicki, Atkins Global: How has the adoption been for the folks doing inspections in the field? What type of challenges have you faced?**

**A.** **Derek**: *"It varies. You get folks that have smartphones and laptops of their own, they're all up in this. You also get the stone-tablet-hammer-and-chisel guys and you get a little more of a challenge. When you deploy a hundred units you're gonna get a broad spectrum of end users."*

**Q.** **Tom Feliz, Pavia Systems: How do you get inspectors and other government officials to fundamentally change the way they work and collect information with the tablet?**

**A.** **Roxi**: *"One day at a time. Again, it's kinda like focusing your efforts. I'll give you an example. I'm a big advocate of e-Construction, I have iPhone, I have an iPad, and I have my personal phone. You can probably reach me electronically pretty easily. My boss loves to still write hand notes and so what I have done with him is, when I visit with him to go to a meeting, I ask him to bring his iPad. I asked him to start bringing the tools we provided so that he starts getting comfortable*

with using them. I sit down with him and one step at a time show him how to do things. I'm trying not to overwhelm him, just showing him what is possible, what can be accomplished.

"So how do we get everyone on board?  With baby steps.  We used to make these huge 3-ring binders for commission meetings, including the Commission Agenda and the documentation at the back. One day the Chair said 'No more, we're getting iPads today and the agenda and supporting documentation are on the iPad, period.' That was the day we went electronic with those things, which was great because it was a huge 3-ring binder. But it's day-by-day, pick a medium in which you are gonna go electronic and start there. So the process is getting everybody to get comfortable with, 'Let me access the agenda today.' And then tomorrow we do something a little more technical, we put the data on our website and then we send you a link to access the information. And then the next day we show you how to input the information yourself. So it's just picking one day to start doing one thing electronically and working from there."

Q. **Jamey Wilhite, Association for High Tech Distribution (AHTD): How have you handled getting through firewalls with mobile devices?**

A. **Derek**:  **"**That's been challenging.  In our pilot project the HeadLight devices existed outside the firewall, and so that was something we had to work around, and we have, but it was significant enough that we are running a secondary pilot. In the second pilot we have some devices that are basically inside the organization, so that we can test how effective they are, hopefully unfettered by the firewall."

Q. **Cibi Pranav, Georgia Tech**: **What are the legal aspects about information storage and how to deal with litigation in case information is lost or misused?**

A. **Derek**: "At WSDOT we have not yet determined whether we can file certain documents electronically in fulfillment of our legal requirements. We are still working through that, as are many other agencies, I would wager. Some things you can store electronically, but not everything, and literally it's a process that most every agency needs to go through with their legal department in order to ascertain whether they are still in compliance with their state laws."

## ADOPTION

Q. **Daryoosh Mosleh, MDOT-SHA: Has changing business processes ever been too challenging to go forward in any specific areas and in what occasions has the process been too challenging**?

A. **Derek**: *"We're not necessarily trying to change the business process, we're trying to emulate it with an electronic document. That was our biggest 'ah-ha' moment. We came to the realization that, just generating this thing that looks like the same document, electronically, is only half the battle. The rest of the challenge is now 'okay, how do we then help this document move through the process just like what we did with the paper document so we've got the same reviews and approvals associated with the electronic document as we had with the paper document?' We are not trying to change that business process."*

## COSTS

Q. **David Brown, Parsons Corporation (Comment): Construction firms are in the business of making money, and some see the paperwork effort imposed by State Highway Agencies as being a cost with no benefit to them.**

A. **Roxi**: *"Wow. That's an interesting perspective. We get something like seven billion dollars of work a year, just from construction and maintenance. This is not designing buildings or any other thing like that. I'm gonna tell you that attached to those dollars is about 50% paperwork. So as a contractor, if your mindset is, 'Well, we do all this needless paperwork that doesn't make money,' I'm gonna tell you it's that paperwork that brings the money, they're one and the same.*

*"The SHA and other industries are not gonna give us money unless we have that documentation to prove to the public, to administration, and everyone else that we have done our due diligence to give you the product that you pay for. All this goes back to public accountability. This is our due diligence to give you the product that you pay for because these are your tax dollars."*

Q **Lee Gallivan, Gallivan Consulting, Inc.: All this support costs money, how do you address managers with the fact this will take money from other areas?**

A. **Roxi**: *"You have to do a cost analysis and a lot of people in IT struggle with that. They see how much it takes to implement something, but they don't see they're saving the money somewhere else. So you do have to realize both what you're spending, and saving. Sometimes the answer is 'I'm still spending more,' no*

*doubt that is the answer sometimes, but you just have to go back to the budget and say, 'What is our focus? Where are we headed?' Technology is not going away, and it will pass you up faster than you can blink. So yes, it will be taken away from other things, but you actually do gain something in that profit, by realizing that this is really what you need to do.*

*"I would say in TxDOT's history that we've implemented quite a few applications. It has never, to my knowledge, hurt any other initiative coming on board. I mean everybody gets paid and everybody's still able to travel and buy supplies for their office. It has never impacted one of those other items."*

A.  **Derek**: *"It has the potential to save labor hours by avoiding the time needed to generate paper documents, or ultimately, to have to handle paper documents when it comes time to close the contract and create the archives. Normally you would box all this up, put it in the truck and haul it to the archives. We've got boxes of the stuff in a warehouse."*

## HEADLIGHT

Q.  **Joshua Cone-Roddy, VHB: Is HeadLight only meant for DOTs?**

A.  **Pavia Systems**: *HeadLight is designed for project owners and CEIs that want higher quality, digitized project inspections data that can be reused across the organization.*

Q.  **Million Weldemariam, Jacobs Engineering: Can Headlight interface with SiteManager? Can it replace SiteManager?**

A.  **Pavia Systems***: Headlight can interface with SiteManager. TxDOT continues to maintain SiteManager as a backend database, and we are building an API to integrate inspection data gathered using HeadLight into it. Headlight could also be used to house all data directly in a cloud-based environment.*

Q.  **Mosleh Daryoosh, MDOT-SHA: Is HeadLight a cloud-based service residing outside the firewall? Or do you host data on your own servers?**

A.  **Pavia Systems**: *HeadLight is delivered as a Software as a Service hosted hosted on a scalable cloud based infrastructure that grows as more data (photos/videos) need to be housed. It resides securely outside of the firewall and can synchronize with systems within the firewall as needed.*

Q. **Trevor Reed, Lochner: When finalizing a project, can you export data from HeadLight to traditional PDF/paper data for long term, reliable record storage?**

A. **Pavia Systems**: *Yes, you can export the data from HeadLight at any point during the construction process in both PDF and raw data formats. This information can be pushed into long-term records in the PDF/paper format required by any organization.*

Q. **Joe Squire, Oregon Department of Transportation: Are you going to walk through a HeadLight demo?**

A. **Pavia Systems**: *You can request a demo here.*

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