SHRP2 Utilities Solutions Peer Exchange and Retrospective Workshop Report

Report Overview

This report summarizes the Second Strategic Highway Research Program (SHRP2) Utilities Solutions Peer Exchange and Retrospective Workshop, held on July 16-17, 2019 in Washington, DC. The meeting was divided into two days, the first being a face to face Peer Exchange among Implementation Assistance Program (IAP) State participants and other invited states. The second day was a retrospective discussion of state views of the SHRP2 program and vision for the future. This report summarizes the information shared at the meeting through presentations, peer exchange, and group discussions. While this report does not represent official guidance or recommendations, it captures feedback recorded from the participants and is provided as a resource to FHWA and AASHTO to consider for similar programs in the future.

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SHRP2 Background

SHRP2 is recognized as a complex research and implementation program. The research portion of the program included $232 million dollars dedicated across a nine-year endeavor, involving over 100 research projects and more than 300 research contractors. Its inception was in the form of a congressional request from the Transportation Research Board (TRB), who via FHWA funding was ultimately responsible for research oversight. SHRP2 research produced 63 implementable solutions that help solve various transportation challenges identified by state DOTs, in four focus areas of Safety, Reliability, Capacity, and Renewal.

SHRP2 implementation was federally funded and state-supported with a total budget of just over $170 million. Beginning in 2013, the SHRP2 Implementation Assistance Program (IAP) provided implementation assistance through 7 rounds of product offerings, with three levels of engagement (the Proof of Concept Pilot, Lead Adopter

and User Incentives). Transportation agencies have implemented the SHRP2 products on more than 430 projects across the country, in all four focus areas. A total of $155 million has been allocated through the IAP, in the form of financial and technical assistance. States provided dedicated staff to implement the products, attended training and peer exchanges, participated in technical assistance visits, and developed reports. It is estimated that for every $1 invested by a state DOT in SHRP2 implementation, there is an average of a $2 return on their investment in the form of project cost savings, direct funding, and technical assistance. Technical assistance included one-on-one subject matter expert training provided to DOT staff, classroom training, peer exchanges, workshops, webinars, summary reports, and other assistance in the application or implementation of a SHRP2 Solution. Over 300,000 transportation professionals have been engaged in the program. Through more than 12,000 outreach activities, SHRP2 showcased the benefits of implementing new and innovative solutions within the field of transportation. In addition to these outreach activities, over 16,000 hours of technical assistance was provided to transportation agencies, largely in the form of consultant support and subject matter expertise.

Meeting Overview

Appendix A provides the full agenda of this two-day meeting in Washington, DC. The first day's peer exchange gave multiple states the opportunity to present their experiences with the three SHRP2 Utility Bundle products and specific issues that became common themes during implementation. The second day's retrospective discussion provided the states opportunity to comment on the SHRP2 program as a whole, in relation to the specific utility products, and in view of what future steps they would like to see taken to promote these solutions nationally. The meeting evaluation provided as feedback by meeting participants, and a list of the meeting participants can be found in Appendix B and C, respectively.

The SHRP2 Utility Solutions bundle of products provided three tools to help transportation professionals more accurately locate utilities; manage potential conflicts to minimize delays and disruptions to the public; and better organize and ensure data is stored for current and future projects. As a result, state DOTs can better manage their utility program and save lives, money, and time.

- **3D Utility Location Data Repository (R01A)**
  Implementation ranged from developing a 2D standalone geographic database of existing utilities within jurisdictional right of way, to developing an enterprise system architecture to manage utilities in a 3D environment. Additional detail can be found in the R01A white paper, which covers issues with IT (resourcing, standard procedures) and software (compatible platforms, 2D vs. 3D, internal vs. commercial).
- **Utility Location Technologies (R01B)**
  Implementation focused on the use of multi-channel ground penetrating radar (MCGPR) and time-domain electromagnetic induction (TDEMI) technologies to detect underground utilities. Additional detail can be found in the R01B white paper, which covers issues with software (proprietary, compatibility, speed of advances in development), field equipment (availability, procurement, reliability in differing conditions), and utility detection technology procurement (accuracy in differing conditions, advances in technology).
- **Identifying and Managing Utility Conflicts (R15B)**
  Implementation of R15B ranged from using the standalone utility conflict list at a sample of pilot projects, to the development and implementation of enterprise system modules to automate specific utility conflict management features. Additional detail can be found in the R15B white paper, which covers issues with IT (resourcing, standard procedures) and software (design environment, dedicated layers, clash detection, compatibility).

The goals of the Peer Exchange on day one included presentations and discussion from specific IAP participating states regarding utility conflict management standardization, experiences adapting the SHRP2 utility conflict matrix (UCM), utility data repository challenges with both 2D and 3D designs, state experiences coordinating use

of locating technologies for utilities, and relationships with IT resources and strategies for promoting leadership buy-in and agency process change.

The goals of the Retrospective Workshop on day two were to engage agencies involved in SHRP2 implementation activities; to discuss experiences and opinions regarding the SHRP2 Program, Utility Solutions bundle of products, and current disposition of those products; and to identify potential next steps. Although invited participants were familiar with the specific Utility Solutions bundle of products, they were also asked to share their experiences with the SHRP2 Program as a whole. They identified opportunities both programmatically and technology specific for continued improvement, collaboration, and support.

Utilities Solutions Peer Exchange (Day 1)

The first day of the workshop was dedicated to hearing from the states in a peer exchange setting. This was the first in-person Peer Exchange hosted by SHRP2 for utility products, although there have been quarterly conference calls throughout the final round. Alana Spendlove demonstrated Utah's impressive online enterprise software system and how it links data fields with various documents and provides a historical record of project status and events. Chuck Ferguson and Deborah Kukulich discussed Delaware's UCM and their process of reaching consensus with state officials. Nick Lefke explained Michigan DOT's GUIDE (Geospacial Infrastructure Data Exchange) initiative including collecting data from permit applicants, while Chris Pucci shared how Oregon's work implementing a standalone UCM and an enterprise GIS database helped identify other needs the state must address. Bill Owen explained the current status within Caltrans of using location technologies and working towards consistent use and training among all districts. Gabe Priebe shared Montana's work using locating technologies and their goal to tie a data repository to the permit process to ultimately compare it with their SUE data.

Participants then heard David Otte discuss Kentucky's challenges coordinating with their information technology department, issues related to updating software and a need to change department processes to achieve success. Michael Tavani from Pennsylvania described the impact of using the UCM in a daunting public private partnership to replace 558 bridges and the effect on both the project consultants as well as state utilities. The three Texas participants provided an in-depth look at the impact that UCM training, marketing, and education across multiple disciplines has had both for leadership support and the tangible cost savings. Mark Turner then discussed how SHRP2 funds helped gain attention within Caltrans and what more he saw as necessary to change both internal processes and culture.

Each of the sessions during day one provided amble opportunities for the meeting participants to ask additional questions, and discuss implementation experiences with their peers. In that regard, this peer exchange provided the participants a clear understanding of the current status of implementation activities, which then informed the second day of the meeting. The detailed notes from these presentations are in Appendix D and the presentation slides are posted on the AASHTO SHRP2 Utility webpage: http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx.

Utilities Solutions Retrospective Workshop (Day 2)

The second day opened with the SHRP2 Subject Matter Experts (SMEs) presenting their observations of the product implementations. They also provided their insight and perspective about possible next steps to further develop and utilize these products. Following the SME presentations, the meeting participants were led through a series of discussions to evaluate both the SHPR2 program overall and the utilities products within it. The themes listed below capture the comments provided through the discussion.

SHRP2 Program Themes

Overall, the SHRP2 program was perceived successful. SHRP2 provided critical funding and support to address transportation challenges that would not have been addressed otherwise. Participants noted that research might not have happened without the collective funds dedicated to these solutions. The timing of SHRP2 research and implementation was crucial, as it positioned many states well for immediate action to emerging transportation challenges. SHRP2 provided the tools and strategies necessary for transportation agencies to identify, clarify, and in some cases solve these challenges with their partners. Participants stated that the SHRP2 implementation years were well spent to advance use of the products. They stated that the Proof of Concept Pilot, Lead Adopter and User Incentives were all useful forms of implementation.

The national presence of SHRP2 brought important issues to the forefront and provided a framework for discussion. It also provided an opportunity to have productive, higher-level conversations that weren't bogged down by state-specific processes. With national support and funding, state DOT resources were freed up to address other research topics of local interest.

Establishing new and strengthening existing relationships was a key factor to success. SME technical assistance helped state DOTs understand complex concepts and tools. Both the SMEs and FHWA were flexible and adapted project scope and goals based on individual needs. Additionally, SHRP2 provided a platform for information sharing and peer exchange, which proved extremely beneficial, at the national level.

The state DOTs found the application process to receive an IAP award was very straightforward, even for those with less experience in writing grant applications. SHRP2 was well represented across the nation, although it was noted that certain states were leaders in innovation and participants suggested there should be a greater effort going forward to involve other states that may not show strong interest on their own initiative.

States expressed that it was beneficial to have the SMEs available to answer questions, to which they were very responsive. Participants noted that the State Transportation Innovation Council (STIC) also provides funds but not assistance, and the SHRP2 assistance was one of the best aspects of the program. The consultant support was great and made the program more attractive.

FHWA provided state DOTs flexibility in how to use SHRP2 funds, which was extremely beneficial. However, some participants felt FHWA/AASHTO could have better defined how the funds could be used at the onset of the program. While the definition was intentionally left broad to provide states greater flexibility, an established set of uses would have been helpful. In addition, spending the obligated money posed some state DOT challenges. It was easy to get the funds obligated on the Federal side, but states had challenges using SHPR2 funds within their own internal systems. Regardless, the effort required was well worth the money and assistance provided.

Utility Solutions Research/Implementation Themes

Overall themes of the Utility Solutions bundle of products included:

- National impacts of the SHRP2 Utility Solutions bundle of products research provided the state DOT utility engineers:
  - More credibility and a framework for this national discussion.
  - National support and funding freed local resources to be used for other issues of local concern.
  - Opportunity to have conversations that overarched the state lobby due to the SHRP2 national presence.
- It was beneficial to have the SMEs available to answer questions and they were very responsive.
- Education and training provided valuable exposure to ideas and people of various disciplines within the DOTs which would not have occurred without SHRP2 support.
- Relationships are key:

- o Communication with the SMEs was very helpful. Understanding "3D" was frustrating, but the SMEs helped to adapt the scope and goals.
- o When one state decided to shifted gears mid-project, they were able to work with FHWA's Julie Johnston, who understood the nuances between research and implementation, and was comfortable allowing the changes.
- o It was beneficial to learn from others' examples, during the group conference calls, which was the intent of the implementation program.
- Developing an implementation strategy was challenging for some states due to the lack of a central location to pull research literature from.
- Participants perceived that tasks they needed to accomplish took longer than the time allotted for Round 7 and several wished the end date had been clearly communicated at the start. States would have liked a better sense of the full timeline and what had to be accomplished.
- States would have liked more time to carry out the pilots through construction to realize the full benefits of their implementation efforts.
- States liked the R16 Community of Interest approach and suggested this or a "community of practice" for the Utilities Solutions bundle of products would be very beneficial in the future.
- Representatives from utility companies could be included in future workshops to receive their input on the products that states are considering implementing. This would be similar to the R16 implementation efforts, where the railroads were invited to be a part of the Community of Interest. They are also "experts" and have information to share.
- A kickoff Peer Exchange at the beginning of the program would have been helpful.
- Several participants perceived a prominent software vendor became non-responsive and unwilling to fix issues during the implementation phase, although they had been heavily involved in the research. Several states informed this vendor they were considering changing software packages, but the vendor appears to be reproducing the same product in many states with technology that is now outdated by about a decade.

Specific Utility Product Themes

This section describes the themes discussed during the retrospective workshop specific to each of the three Utility products:

- R01A: 3D Utility Location Data Repository
- R01B: Utility Locating Technologies
- R15B: Identifying and Managing Utility Conflicts

Themes of 3D Utility Location Data Repository (R01A)

Knowledge Management
- One of the greatest values of the implementation process for R01A was that it allowed Utah to use funds to visit other states (Michigan, Kentucky, and Colorado) for peer to peer exposure.
- Quarterly IAP peer exchange conference calls were helpful as peer support and information dissemination contributed to achieving some success, but this was not as effective as an in-person meeting might have been.
- It would have been helpful to have a software comparison chart for R01A. While there are good software options available, it was difficult to determine which were most viable for some state applications. States

believed that they would have benefitted from recommendations on what software to use (particularly in relation to the various CAD programs available).

Assessment of Market Readiness for 3D Data

- R01A wasn't as market ready coming out of research as it could have been.
- R01A was premature for some states, even when in the initial steps of 3D design, they were unsure how to proceed and lacked a roadmap for moving forward.
- Initial implementation requires baseline data and accuracy can be improved later with upgrades. States found it is not necessary to focus on 3D and could accept 2D data if available.
- If a DOT isn't ready for 3D data, it's difficult to determine what is needed and what to aim for; working with others helped provide realistic expectations.
- As agencies transition to 3D, future resources should be allocated for transferring utility data.
- States need more testing, in-depth data collection, housing, retracting, and usage in 3D.

Implementation of the Product with Technical Assistance

- Additional training would have benefited the R01A implementation as states found it difficult to understand what they were supposed to achieve.
- Although an Implementation Planning Workshop (IPW) was conducted for all the utilities products, a peer exchange or workshop to kick off the implementation of this product after the IAP awards were made might have helped.
- R01A was perceived as extremely technical and difficult to transfer knowledge. States felt it needed significant IT support.
- Implementation in one state was described as trial and error as the target was unclear.
- R01A will require ongoing funding beyond SHRP2 for successful implementation.
- It is not apparent if there are clear benefits to making a stepped approach to R01A and the overall benefits will be better understood decades from now.
- One state started with a standalone software product for R01A but is now developing an enterprise solution as their understanding of the implementation is clearer.
- There has been industry pushback on the variety of software used among different states. There is a need for compatible systems across the country both from the data repository side, as well as standards for use of data.

Achieving R01A IPW Goals

- States thought the IPW goals could have been better outlined in the application and communicated throughout the effort.
- States considered their work generally in line with IPW goals. Goals were met through self-discovery and evolved throughout the effort as states better understood how much they could accomplish.

R01A Lessons Learned

- Utility companies can be slow to accept states' use of the data.
- There is no immediate return on investment in R01A; it requires a long-term approach to realize benefits (10-20 years).
- Promoting 3D is not helpful when very little 3D information is available to begin with and if a state's 3D data is currently unrealistic and not in sync with the industry.
- Decision-makers need a better technical understanding to clearly understand the product.
- Better communication is needed for the transition of data storage.
- The private sector needs to be involved.
- Limit data access to the utility engineers first, then the designer.
- Data needs to be updated to be more accurate.

Potential Steps Forward

- The ASCE standards should emerge by spring 2020, which should answer many questions. ASCE 38-02 includes an as-built component, which will set the bar. Colorado is using drafts of the ASCE standards to remain consistent with what will be expected.

Themes of Utility Location Technologies (R01B)

Knowledge Management

- A matrix of the geophysical suite of tools and greater understanding of how they apply to quality levels of data would be helpful to states. This would give them a sense of what is available and how each tool works.
- States believe more discussions with service providers and vendors would be beneficial to identify equipment capabilities and match them with state specific requirements for data and results.

Assessment of Market Readiness in the SUE environment

- States that have a SUE program want to continue using R01B.
- Participants questioned why the Subsurface Utility Engineering (SUE) industry isn't providing this service.
- Virginia and Montana have had SUE programs for 20+ years. Based on Virginia's experience, SUE companies do not want to work together, and it is very difficult to get standards established.

Implementation of the Product with Technical Assistance

- Kentucky didn't pursue R01B as they have clay in their soils and the equipment wouldn't work.
- Montana thought R01B could be more customized towards roadway capabilities.
- AASHTO procured a piece of equipment that was utilized for both R06D and R01B work in California. Having AASHTO procure the equipment saved 6 to 12 months in the procurement process.

Achieving R01B IPW Goals

- Oregon met IPW goals and considered the implementation a success. They have now developed a contract and scope of work with help from the SME that includes SUE work.
- California met IPW goals and established a scope of work for their SUE contractor. CA does a mix of in-house and contractor work.

R01B Lessons Learned

- Without SHRP2 funding, it is unlikely states would be deploying this equipment.
- If R01B were relaunched, it should include increased coordination with SUE contractors. States may not buy equipment themselves (with California being the possible exception) but outreach and education may entice contactors to eventually purchase their own equipment
- States would have benefited from research on how much it cost per lane mile, and they don't have the ability to compare costs with vendors without that baseline.
- Standards for hardware and data are needed to provide to all stakeholders.

Potential Steps Forward

- More research regarding costs to states and better understanding of what is commercially available.
- More outreach to Utility locating contractors to encourage their use of this equipment.

Themes on Identifying and Managing Utility Conflicts (R15B)

Knowledge Management
- R15B Round 3 provided Iowa with marketing material that helped sell R15B to the division director. Although the state was slow to incorporate, when they did get started they were able to plug it right into a project. The timing was perfect as was the level of maturity.

Assessment of Market Readiness
- R15B is a tangible plug and play. It's easier to show management staff a tool that is developed, understandable, and easily applied.

Implementation Assistance Program
- R15B materials were critical in getting PennDOT up to speed on the data aspect.
- Vermont hit most of the IPW goals, although they won't see pilot projects move into construction or utilize UCM for a long time.

Implementation of the Product with Technical Assistance
- The one day training was extremely useful, and the SME was often invited back. State districts and utility companies were made aware of the efforts the DOT takes to factor in all the facilities. The Pennsylvania press office recorded Cesar's training for future use.
- One day training was beneficial and consultants who attended shifted to the UCM immediately.
- Vermont started R15B in Round 7 with big goals, but the IT department helped to slow the process and scale back to a standalone product which turned out to be the best place to start. The standalone product showed that there are more effective ways to do the job.
- The R15B conflict matrix proved to be a very effective tool. States are conducting similar research efforts on their own, and collectively, to show conflict resolutions result in time and cost savings.

Achieving R15B IAP Goals
- Texas experienced success, and Oregon felt R15B was straightforward.
- R15B goals remained consistent and achievable throughout the implementation process.
- Vermont's goal is to put the UCM into the designer's hands and teach consultants.
- Colorado, while not an IAP State, used the available internal resources and created a standard UCM plan sheet in Excel that is now being applied to project plan sets statewide.
- DDOT faced setbacks including a staff retirement, challenges with succession planning, and legal delays for the District of Columbia Power Line Undergrounding (DC PLUG) program, which was the program they intended for implementing the SHRP2 UCM. The SHRP2 schedule could not synced with their delays. Now with an established team, they can consider lessons learned from others.

Lessons Learned for R15B
- Timing is critical, and states want to use this tool as soon as possible in the life of the project. It is generally accepted that when the design of a project is at 95%, the application of the utility matrix is too late in the design process.
- Utility coordination doesn't solely involve the DOT utility coordinator but includes designers and project managers who need a basic understanding of the ramifications of their work. Internal conversation and communication must continue to move the dial forward.

- Certain utilities are less diligent than others regarding utility relocation, but the use of the matrix is becoming a standard process for projects with multiple conflicts.
- The Pennsylvania Bridge Replacement project aligned plan view sheets with the UCM to facilitate field meetings. This helped bridge designers, the utility coordinator, project managers and the contractors with any discipline gaps (i.e. utility vs. highway vocabulary) as they progressed through project reviews for all 558 bridges.
- Texas stressed implementation is best when kept simple.
- One project manager in Vermont, who had previously used a conventional paper process, was convinced of the benefits of using the UCM process when they identified that half of the project's anticipated conflicts were not actually conflicts, saving the municipality money and time. Use of the UCM helped eliminate the need to relocate 45 poles.

Potential Steps Forward

- Promote use in more states utilizing peer exchanges to help transfer experience and lessons learned.
- Initiate a Community of Interest across disciplines and including public and private stakeholders.

Overview of Lessons Learned

The workshop participants were asked to consider future efforts to implement a set of technical products coming out of research and what might be done the same or differently in terms of their SHRP2 experience.

Knowledge Management

- Annual peer exchanges where states could learn from other's progress would have been beneficial. States suggested a kick off peer exchange at the beginning of the program that included a variety of disciplines.
- A user platform or interest group, such as a Community of Interest, that includes utilities would have been beneficial.

Implementation Assistance Program

- States were enthusiastic about the ease of application, the amount of funding and the flexibility working with FHWA to adapt their scopes to obtain practical results.
- Clear articulated goals and deadlines would be beneficial.
- Additional training was needed. Demonstrations of software and hardware are necessary for both internal staff and stakeholders.
- The implementation of technical products needs more technical assistance and with SHRP2 the states appreciated what they received.
- Additional IT consultants and support were necessary and should have possibly been made available to support a more robust IT implementation.

Adoption as Routine Practice

- Having FHWA, AASHTO, and TRB promoting this effort gave needed national and local credibility to practitioners
- There is a need to establish clear goals, training, and tangible deliverables in order to improve ease of implementation for all products.

Marketing and Communication

- Marketing the products to executive leaders at the DOT held more weight coming from AASHTO and FHWA rather than internal employees.
- Information about these products is useful to expand awareness but there is more work necessary to standardize processes for consultants and utility agencies.

- Tangible benefits of these tools need to be clearly presented to management, in terms of time and cost savings. This would have been good information to have at the start of implementation.
- It is helpful to emphasize to decision makers the benefit of damage prevention and safety.
- Focusing on asset management is powerful because there is no greater asset than right-of-way. It's important to know what is there.

Roadmap for the Future

FHWA is the lead agency for the Utility Product Bundle moving forward. Additional next steps will be identified at the upcoming FHWA regional meetings. Recommended actions identified by the meeting participants are described for each product below. Additional notes from the meeting are detailed in Appendix E.

3D Utility Location Data Repository (R01A)

Participants recommended the following actions for R01A moving forward:
- Increase marketing and communications.
- Involve division level staff at FHWA.
- Establish a central state repository of data.
- Ensure data is transferable, mailable, searchable and can be used in different formats.
- Involve more states in the AASHTO Committee on Right of Way, Utilities, and Outdoor Advertising Control.
- Identify additional funding sources. Funding sources could be additional monies from FHWA, NCHRP or state DOTs through pooled funds. Topics could include:
  - Utility permitting on highway ROW in locations of upcoming projects.
  - Putting 3D data collection and repository into ROW permitting at the state or local level.
  - Additional case studies of best practices across the country.
  - Proof of concept of available and emerging new tools.
- FHWA to partner with asset management and 3D design folks to market the tool.
- Tie data management and data collection requirements to obtaining permits (MT is tying permits to providing as-builts).
- Establish a Community of Practice.
- Determine what data should be archived and consider opportunities for updating or digitizing data.
- Provide additional testing and clarification for R01A.
- Provide more information on this product and continue work to standardize processes for consultants and utility agencies.

Utility Location Technologies (R01B)

Participants recommended the following actions for R01B moving forward:
- Engage all utility agencies.
- Develop an industry standard.
- Develop an improved scope of work and clearly define contractor expectations.
- Establish Quality Level (QL) standards for users and create an interference bubble. Research what is available to determine what it will require to achieve desired results.
- Consider a broader list of technologies that may provide more precise data and remain current regarding changes in the state of practice.
- Understand the wider realm of SUE technologies available.
- Educate states on ASCE 38.

- Educate states on SUE.
- Provide additional support in the form of peer exchanges and trainings.
- Establish a Community of Practice
- Re-establish the FHWA Transportation Geophysics Conference.
- Identify additional funding sources. Funding sources could be additional monies from FHWA or state DOTs through pooled funds.
- Increase marketing.
- Provide more information on this product and continue work to standardize processes for consultants and utility agencies.

Identifying and Managing Utility Conflicts (R15B)

Participants recommended the following actions for R15B moving forward:

- Stay current on developments in utility conflict resolution software and processes, i.e. the state of the practice.
- Establish a Community of Practice that includes the utility companies.
- Establish a separate conversation with state utility and design staff.
- Identify additional funding sources. Funding sources could be additional monies from FHWA or state DOTs through pooled funds.
- Increase marketing.
- Develop a tool for municipalities and engage them within DOTs.
- Provide more information on this product and continue work to standardize processes for consultants and utility agencies.
- Emphasize to decision makers the benefit of damage prevention and safety.

Conclusion

The workshop successfully engaged state DOTs involved in SHRP2 implementation activities and yielded key takeaways regarding the SHRP2 program; utility products; current disposition of the products; and next steps. While the process of implementing SHRP2 and its success varied across different locations and contexts, the SHRP2 program and utility products were overall successful in helping state DOTs and utility companies address important transportation related challenges.

While the states were generally satisfied with implementation, the success of SHRP2 will in part be measured by the extent that the products, tools, and resources developed during the program continue to be utilized or can be further developed. Although SHRP2 funding is no longer available to support the implementation of the utility products, FHWA will continue to consider ways to support them going forward. FHWA, AASHTO, and TRB successfully collaborated to support SHRP2, and the lessons learned, and recommended actions gathered from this workshop will be used to support and develop future initiatives.

Appendix A – Focus Area Meeting Agenda and Meeting Materials

Photos courtesy: Leif Skoogfors, FEMA; Gas Technology Institute; District DOT; FHWA

SHRP2 Utilities Peer Exchange and Product Wrap Up Meeting Agenda
Tuesday-Wednesday, July 16-17, 2019

AASHTO Meeting Room, Hall of States, 444 North Capitol Street, NW, Meeting Room 333 Washington, DC, 20001

TUESDAY, JULY 16, 2019 – Utilities Peer Exchange

Time	Topic	Speakers
8:30-9:00 am	**Welcome, Introductions & Opening Remarks**	

	• Welcome and Introductions
	• FHWA overview of all the SHRP2 Utility products including:
	   ○ Background
	   ○ Goals of the implementation research
	   ○ Results of the implementation efforts and where we are today
	   ○ Ways FHWA is looking ahead
	   ○ Setting the stage for the future
		Pam Hutton, AASHTO Julie Johnston, FHWA

9:00-10:30 am	**PEER EXCHANGE Utility Conflict Management Standardization (R15B focused)**	

	Two state participants to present their experience or lessons learned regarding standardization (10-15 min) then peer discussion.
	Focus will be on describing and discussing challenges and successes of implementation, including:
	   ○ Development and dissemination of a standard utility conflict list template;
	   ○ Use of the template for information exchange purposes and documentation using the spreadsheet file or a database;
	   ○ Use of dedicated layers or levels to display utility conflict locations in the project design software environment;
	   ○ Conducting utility conflict analysis at project delivery milestones;
	   ○ Any other challenges and/or successes?
		Alana Spendlove, Utah DOT Chuck Ferguson, Delaware DOT

10:30-10:45 am	**BREAK**	
10:45-12:00 pm	**PEER EXCHANGE Transitioning Utility Data Repository from 2D- to 3D-design and construction workflows (R01A focused)**	

	Two state participants to present their experience or lessons learned regarding Utility Data Repository issues (10-15 min) then peer discussion.
	Focus will be on describing and discussing challenges and successes of implementation, including:
	   ○ Utility investigation, timing, scope, quality, and completeness;
	   ○ Mapping and documentation of utility data on project files;
		Nick Lefke, Michigan DOT Chris Pucci, Oregon DOT

	○ Documentation of as-built conditions; ○ Any other challenges and/or successes?	
12:00-1:00 pm	**LUNCH**	
1:00-2:30 pm	**PEER EXCHANGE – Coordination for successful application of utility locating technologies (R01B focused)**	
	Two state participants to present their experience or lessons learned regarding project coordination (10-15 min) then peer discussion. Focus will be on describing and discussing challenges and successes of implementation, including: ○ Engaging multiple DOT departments and their staff including Utility, Right of Way, Surveying, Engineering, Safety, Design; ○ Investment and participation from service providers and contracting with qualified service providers willing and able to integrate standard SUE information; ○ Technical training and information exchange with people covering operations, safety, right of way, surveying, design, and others; ○ Information exchange between districts, other states; ○ Any other challenges and/or successes?	Bill Owen, Caltrans Gabe Priebe, Montana DOT
2:30-2:45 pm	**BREAK**	
2:45-4:00 pm	**PEER EXCHANGE Equipment and IT Resources: Challenges and Successes**	
	Two state participants to present their experience or lessons learned regarding the equipment and technologies they implemented (10-15 min) then peer discussion. Focus on describing and discussing challenges and successes of implementation involving: ○ IT resources ○ Software ○ Field equipment ○ Utility detection technology ○ Any other resources?	David Otte, Kentucky DOT Michael Tavani, Pennsylvania DOT
4:00-4:10 pm	**BREAK**	
4:10-5:30 pm	**PEER EXCHANGE Leadership Buy-in: Procurement and Process Changes**	
	Two state participants to present their experience or lessons learned regarding state process and contract language (10-15 min) then peer discussion. Focus will be on describing and discussing challenges and successes of implementation, including: ○ Leadership buy in of product/processes; ○ Establishing a champion of product/processes; ○ Changing agency process and culture to adapt to new technologies; ○ Adopting product into states processes and policies; ○ Any other challenges and/or successes?	Texas DOT Mark Turner, Caltrans by phone
5:30 pm	**Adjourn, Optional Group Dinner at 6:00 (TBD)**	

SHRP2 Utilities Focus Area Wrap Up Meeting
July 17, 2019

AASHTO Meeting Room, Hall of States, 444 North Capitol Street, NW, Meeting Room 333, Washington, DC, 20001

WEDNESDAY, JULY 17, 2019 – Utilities SHRP2 Wrap-up Meeting

Time	Topic	Speakers
8:30-9:00 am	**Recap of Day 1**	
	• Review yesterday's peer reviews of the utility products • Recommended lessons learned and future potential work to carry forward	
9:00-10:00 am	**Product Panels**	
	• 3D Utility Location Data Repository R01A (15 minutes) • Utility Location Technologies R01B (15 minutes) • Identifying and Manging Utility Conflicts R15B (15 minutes)	Cesar Quiroga Phil Sirles
10:00-10:15 am	**BREAK**	
10:15-11:00 am	**SHRP2 Program Wide Discussion**	
	If we were to ever have another program like SHRP2 we want your thoughts about what worked well and what could be improved. Focusing specifically on the overall SHRP2 **Research phase**: ○ Was the SHRP2 research program successful? If yes, why? If not, why not? ○ Was the timeframe adequate for delivery? ○ If you were going to document the key takeaways from the SHRP2 research program what would they be? Focusing specifically on the SHRP2 **Implementation phase**: ○ What are the key takeaways from the overall SHRP2 implementation efforts? ○ Were you satisfied with the maturity of the products? ○ Was the SHRP2 program easy to implement within your state? How was the application process received? Was it well integrated into DOT planning and decision-making processes? Is it part of the way you do business? ○ If we could launch this research/implementation program over again, what would you do differently? ○ From an implementation perspective, is there a need for any of these products or other products in the SHRP2 program to have greater national penetration? If so, which ones? How would you go about supporting that?	
11:00-11:15 am	**Breakout Report Out (if necessary)**	
11:15-11:30 am	**BREAK**	
11:30-12:15 pm	**Utilities Products Retrospective Discussion**	
	For potential future implementation efforts, we want to document what worked well and what could be improved.	

	Participants may break into groups (likely 6-10 per group) There will be a dedicated note taker at each "product station". Each product will be discussed for 30 minutes each, by each group – then the groups will rotate. Each product station will pose the following questions: • Were the IAP goals for this product accomplished? • Was the implementation of these Utilities product successful? If yes, why? If not, why not? • If you were going to document the key takeaways from the implementation efforts and activities of this Utility product, what would they be? • Was this SHRP2 product easy or was it a challenge to implement within your state? Was it well integrated into your DOT processes? Is it now part of the way you do business? • What lessons did we learn about this technical product implementation? • If we could launch the research for this specific product over again, what would you do differently to prepare for implementation? (Is there a better way forward knowing what we know now?) What activities and events were most successful and why?	
12:14-12:30 pm	**Breakout Report Out (if necessary)**	
12:30 -1:30 pm	**LUNCH**	
1:30-3:00 pm	**Future and Next Steps Discussion**	

	Thinking more about the future -
	• What are the barriers to future implementation?
	• Are there marketing or other activities that would enhance continued implementation of these Utilities Products?
	• Is there a need for further development of any of these products?
	• What future activies are needed for further implementation?
	    ○ AASHTO support
	    ○ FHWA support
	    ○ Agency policy changes
	• What will it take to build these tools into ongoing practice? What else is needed?
	• How do we accomplish this and ensure that the products are relevant?
	• What are the recommended next steps?	

3:00-3:15 pm	**Breakout Report Out (if necessary)**	
3:15-3:30 pm	**Break**	
3:30 – 4:30 pm	**Strategic Roadmap Forward**	

	• What steps should be taken next based on lessons learned?
	• Develop a high-level forward plan for each product:
	• What form should further implementation take?
	    ○ More research? – if so, through what process (NCHRP, TRB, others)
	    ○ More activities? – if so, who would initiate and who would fund?
	    ○ New forms of marketing? – if so, who needs to hear this story and who needs to tell it?	

4:30-5:00 pm	**Report Out and Wrap Up**	

Flash Drive Contents

Please find on this flash drive the following documents listed on charts by product and additionally:

- The SHRP2 2018 End of Year Report
- The SHRP2 IAP Brochure listing all products and participants by state and by product
- The slides from this Utility Focus Workshop
- White papers per product as provided for the workshop
- Utility Bundle Close Out Report
- Generic Chapters for Utilities Manuals
- Case Studies per product
- Lessons Learned per product
- IPW Reports (report outs on initial implementation planning workshop meetings)
- PDF of presentation slides

3D Utility Location Data Repository R01A

Materials	Copies	Website Location
1. Caltrans Case Study	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
2. Lessons Learned Document	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
3. White Paper	Copy on flash drive	
4. Generalize Utility Manual Chapter	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
5. IPW report 2014	Copy on flash drive	

Utility Location Technologies R01B

Materials	Copies	Website Location
1. Case Study Montana	Copy on flash drive	
2. Case Study Oregon	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
3. Lessons Learned	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
4. White Paper	Copy on flash drive	
5. Generalize Utility Manual Chapter	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
6. IPW report 2014	Copy on flash drive	

Identifying and Manging Utility Conflicts R15B

Materials	Copies	Website Location
1. Case Study Delaware	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
2. Case Study Kentucky	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx

3. Case Study Texas	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
4. Case Study Michigan		
5. Lessons Learned	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
6. White Paper	Copy on flash drive	
7. Generalize Utility Manual Chapter	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
8. IPW report 2014	Copy on flash drive	
9. UMC Template	Copy on flash drive	http://shrp2.transportation.org/Pages/UtilityRelatedProducts.aspx
10. Training materials	Copy on flash drive	

Appendix B – Evaluation Results from Utility Workshop Attendees

Rating	Overall Content Effectiveness	Presentation Effectiveness	Expectations Met	Presenters Delivered Clear Information
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	1	1	1	0
9	5	6	6	7
10	9	8	8	8
Strongly Disagree (1-2)	0	0	0	0
Moderately Disagree (3-5)	0	0	0	0
Moderately Agree (6-8)	1	1	1	1
Strongly Agree (9-10)	14	14	14	14
Sum	15	15	15	15
% Strongly Disagree	0%	0%	0%	0%
% Moderately Disagree	0%	0%	0%	0%
% Moderately Agree	7%	7%	7%	7%
% Strongly Agree	93%	93%	93%	93%

What were the most important ideas you will take away from the workshop?
- Best practices from other states.
- Some of the technologies used by the other states.
- Continue follow-up with related state DOTs on their progress.
- Applying lessons learned from other jurisdictions that worked on R01A and how our organization can take advantage of the other SHPR2 products.
- I have a much better understanding of SHPR2 and associated products. I learned a lot from my counterparts and look forward to revisiting the processes in Georgia.
- I got some really good information on the Enterprise products for UCM. It was very interesting to hear the challenges on the utility investigation and technologies. I also learned about new utility investigation technologies and the successful applications and limitations.
- Got some good info on Utah's R15B methods and procedures.
- Utah's utility management tool was awesome to see. We will be implementing a similar tool.
- Use of data collector app
- Got some good info on cheap location data collection -will use in home state.
- Different collection technologies.
- Protect SUE data for future use.
- The importance of emphasizing as-builts on permits.

- Upper management is required to truly implement products. Getting some districts to implement products will get others to commit to them. Contact my peers.
- Big ideas for changing the way we do utility work. Innovative ways to spread the word and get buy in. Road shows -Director/Chief Engineer making statements.
- Use of standards and development of templates and procedures for data collection.
- Enterprise software for utility conflict management
- Legislation requiring SUE notification
- Discussion about moving forward, resources, etc.

Are there questions or issues you wished the workshop had addressed that it didn't?
- Design-build projects
- Utility Owner's perspective of the products.
- No, I obtained a great deal of information that I will relay to my superiors. I only worked on R01A.
- Not really – we covered SO MUCH info!!

What else could the Federal Highway Administration do to support you or your agency in promoting SHRP2 Utilities Products?
- Training on R01A equipment, survey, data management.
- Cover the cost for members to attend AASHTO Subcommittee meetings through AASHTO.
- Money and support to move things forward. Make it a National initiative like an EDC topic.
- More upper management training.
- Help with upper level management to understand the importance of the products. Presentation of savings and time saved.
- Additional training on SUE for state employees (similar to NHI).
- Ensure funding is easily accessed with education of the respective divisions and DOT financial teams.
- Documenting a project from design to construction.
- Field verification during design is critical. This needs to be researched.
- I would like to see research and products for utility verification for utility relocation in the state ROW and for other utility permitted with the ROW.
- Continue to support peer exchanges.
- Continue to make available examples from other DOTs so progress can continue with implementing the SHRP2 products.
- It would be great if FHWA would conduct a webinar directly to state DOT executives. I feel the buy in would happen quicker if the message came from FHWA rather than from a lower level employee within their organization.
- Keep providing updates on implementation and make successes across the Nation available.

How might AASHTO further support you or your agency in promoting SHRP2 Utilities Products?
- I would like to see research and products for utility verification for utility relocation in the state ROW and for other utility permitted with the ROW.
- More upper management training.
- Documents – Executive level info to influence the top.
- Whatever help is available to get information to upper level management concerning the time and money saved with use of these products.
- It would be great if AASHTO would conduct a webinar directly to state DOT executives. I feel the buy in would happen quicker if the message came from FHWA rather than from a lower level employee within their organization.
- Continue supporting utilities and sign conference.
- Provide any opportunities for information sharing to all states interested.
- Continue to promote through various levels at DOTs. Each committee, technical council, etc. should

periodically mention SHRP2 highlighting the program plus purpose and key takeaways.
- Look into future research projects which could support these products.
- Trainings/videos
- Training on R01A equipment, survey, data management.
- Important to show as a national initiative to standardize and improve processes.

Please provide us with additional comments, feedback, or ideas related to this event:
- Peer exchanges/meetings in person would be very helpful. Better guidance on how money can be spent, and more available IT/technical support. Need to invite utility companies to meetings.
- Peer Exchange was very beneficial overall. It would be helpful to have more dialogue about the program (SHRP2) as a whole. I got the sense that people have changed roles throughout the process and knowledge may or may not have been transferred.
- The peer exchange is a great way to share ideas, find the commonality, and understand other's challenges. I was able to get some really good ideas and information.
- Would love additional opportunities to collaborate and continue to build a cohesive national vision for utility accommodations.
- I felt that this meeting was very educational, and I will be taking several ideas home for further review.
- Field verification during design is critical. This needs to be researched.
- Field verification of utility relocations during design is critical – Utility contractors don't always relocate in the correct location. We hire consultants to do this but are not 100% sure if we are using efficient processes.
- Assigning utility corridors in utility congested areas. For example, requiring all telecoms to install their facilities in one duct.
- Standard SUE info and layouts
- Standardize certain processes (e.g. 3D model attributes, SUE info, etc.)
- It was a great workshop and well worth my time. Making connections and hearing other states stories was good.
- Workshop included very robust conversations and dialogue.
- Great program!
- Great session! Very well done. Thank you to everyone who put it together.

Appendix C – Attendee List

Name	Agency	Email
Pam Hutton	AASHTO	phutton@aashto.org
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Jason Harris	Washington DOT	harrijm@wsdot.wa.gov

Appendix D – Peer Exchange Discussion Notes

July 16, 2019

Julie Johnston, the FHWA lead for the SHRP2 program welcomed participants and gave a brief overview of SHRP2. She explained that FHWA is currently developing web-based training based on SHRP2 products with a training coming out in the next year. She challenged the group that over the length of the meeting she hoped to hear specifically from them including: how did you sell your management to get involved; what was their response; how do we help other states sell this; and what are the issues or barriers?

PEER EXCHANGE Utility Conflict Management Standardization (R15B focused)

UTAH

Utah's IAP Goals included the following:

- UDOT R15B (R6): Develop SharePoint-based Utility Tracker. Integrate system into existing business procedures. Conduct implementation at pilot project. Develop training video for designer and utility owners.
- UDOT R01A (R5): Conduct trial implementation of commercial system to handle a wide range of applications at UDOT. Utility data management is one of the modules included in the trial implementation.
- UDOT R15B (R7): Develop a GIS web-based platform to view and manage utility conflicts (initially in 2D, then potentially advancing to 3D). Develop training video for designers and utility owners.

Overall Cost: Total for Rounds 6-7 was about $200,000.

Timeframe for Development: It took about 2 years to develop the agreement tracker and about 1 year for the Conflict Utility Matrix with additional tweaking through the pilot phase. They were the same cost because similar elements were necessary to create the map. In house GIS staff created the map and a consultant created interface.

Future Plans: This is a communication tool for UDOT to present issues to utility companies. They are moving to model-based design as Utility's don't like plot scrolls. They will collect data, store it in the data repository (R01A), and allow designers to pull data into MicroStation, but this is primarily a communication tool.

Presentation (R15B/R01A): Alana Spendlove of Utah DOT presented the UDOT Enterprise software. She explained their work spanned both Round 6 and 7. UDOT's application in Round 6 used a best practice spread sheet but it required 30 different spreadsheets for 30 different products. The designers were not to using it to the maximum capacity but only using it for test holes and not documentation. In Round 6 they created an agreement dashboard with tabs based on Kentucky's KURTS system. The beta system used a spreadsheet with macros which was limited and cumbersome. Now the dashboard sorts by project name, project manager, region, pin number, etc. and is very handy. The data interacts with their Project Management system and can be searched through it and feeds from it. It shows progress "status" with dates, has maps, and the ability to upload documents. The system strives for consistency and customer service across all regions of UDOT. All UDOT regions are using it but they are still working on getting utilities involved as some have firewall issues. The interface was created by a consultant, and the GIS maps were done internally by UDOT.

Utility companies in Utah can access the system, see only their projects (not others), view the maps, and upload their own documents. A utility company must have a current project and an agreement signed for access to the system. If they want to know what is coming, the state has GIS maps with 5 years lookahead plans. UDOT encourages users to be familiar with the map. The system provides project data including contacts and staff

people per position which is then linked to all the documentation created in the system. It also shows agreements that are tracking per product.

Agreements are added by the utility coordinator and conflicts are uploaded by designers in a different portal after conflict analysis. The digital signature is still paper or virtual paper. Utah uses Adobe Sign, but their utility companies usually print and scan documents. Once a project is complete the agreements will be archived. Having rich data linked to each project saves time as dropdowns can be quickly transferred into template fields for project letters, emails, memos, etc. The system allows cost information to be uploaded into the agreement and tracks all correspondence including lists of emails sent from the system (such as notices to proceed with attachments). It provides a great way to record everything sent to a utility even if the conflict does not require an agreement but is mitigated some other way. A running list of comments are recorded that describe status or any issues that arise. This helps record and track non-compliance issues for the state. An example of the process using the system is as follows:

- When a utility is authorized to work on projects, it creates a word document and auto populates data from the database to create letters and contracts from templates. It also creates and records emails for transmitting the produced letters or documents. All emails sent from the system are tracked and kept in the system. Standardized language is already included to save time and provide consistency.
- When including designs and estimates, the system requests to add dates which then populate a projected schedule and can produce automatic reminder emails sent to both the utility and State contacts. Also, it will send past due date notices if the "date approved" is not recorded. It's a non-confrontational record of delays across the board. Once plans and estimates are available, agreements can be created.
- Many Master and Supplemental agreements are available in drop down form and in Word Web form with fields to populate that are added to the system. The program sets up templates for ease of use when creating new agreements with data auto populated when available.
- The system collects signatures, contract numbers, and tracks notices to proceed. All communication is archived when completed.

Utah's Conflict Matrix is a GIS map that shows conflicts. Both resolved (green) and unresolved (red) are shown as the designer puts points in. The map shows all utility lines, conflicts, number of conflicts (from original spreadsheet), types (water line), 11 different layers of GIS, a description, SUE information, test hole data, resolution notes, and it is also able to show the conflict in the table, similar to the original conflict matrix spreadsheet). They did not show proposed utility alignment since it doesn't speak back to MicroStation. Designer needs to put this back into CAD drawings. This is not attached to a data repository but a visual representation of conflict. Currently they are testing on their Moab, Utah, Main Street project using SUDA, which is allowing them to tweak the system and get it ready to train staff statewide. They have created a training video and will also be going out to train face to face.

Alana explained that designers use the FME process in GIS but can also add directly to the system's map. Point or linear conflicts can be added in the system. Designers can continue to add conflicts. The system does not integrate to other project management systems. They are also using PMO with scheduling software, but this is a totally different program. Participants thought Utah has a very impressive system and asked if the data includes as-built. Alana explained that it is SUE data but eventually with R01A they will want designers to take data from the repository to give to SUE for validation and then add to the system. She stressed that without doing SUE, they won't have as many conflicts to work with. Alana emphasized that wherever they identify a conflict it is absolutely shared with contractors on the job, so as not to re-create issues. This system is primarily for information, not necessarily a contractual document. It isn't used for design build although design build is used frequently in Utah. It works for procurement and in the proposal phase but there is no risk to the contractor to use this system.

Alana was asked if they can add the line work in relation to SUE and if the SUE manual is uploaded. The DGN Files are uploaded, and all line styles can be uploaded. There are standards for drainage, edge of curb, roadway, etc. to clean up the system and prevent utilities from getting bogged down.

Participants noted this was a huge undertaking and asked how management had been convinced to support it. Alana said it was an easy sell because the department is innovative and there is already a paperless initiative throughout the state. It was a one and done project thanks to SHRP2 funding.

Utah wanted the Kentucky model with more integration but that is at a standstill till more staff see the value and all the regions implement. She hoped to use this peer exchange to help create a wish list, so management will help with future upgrades. Right now, it's as good as it gets, but needs user acceptance to continue with refinements. Contractors do have similar model-based designs or plan sheets, but they are moving in this direction.

Need an entirely different portal for a contractor to transfer lists to and at least an additional $100K or more.

DELAWARE

Delaware's IAP Goals included the following:

- DelDOT R15B (R6): Implement standalone UCM at three pilot projects. Implement standalone UCM throughout the state. Update utility manual to reflect the UCM approach. Conduct outreach with utility owners. Identify integration requirements with DelDOT systems, including scheduling software and the web-based Utility Permit Application (UPA) system.

Overall Cost: All SHRP2 funds.
Timeframe for Development: Within a few months after the SME presented the product, DelDOT had a draft to the consultants, added several revisions, then presented it to Secretary of Transportation. They worked with designers for a year.

Future Plans: Incorporate the matrix into SUDA. Young designers are coming out of college, so DelDOT seeks to train them in the utility world.

Presentation (R15B): Deborah Kukulich and Chuck Ferguson of Delaware DOT presented their UCM, or Utility Conflict Matrix starting with the statement that conflict matrixes are easy to use and the earlier you catch conflicts the better, even if you still use colored pencils! Delaware wanted one central place to collect conflict data and be able to speak to utility companies more intelligently. This saves time and allows them to be more specific with their requests. They were able to finalize the worksheet and get it up and running customized for DelDOT with added drop downs, and ready to deal with all 60 utility companies and local jurisdictions. The user guides and instruction sheets have also been helpful.

Buy-in came from the top down. Delaware started by pitching potential uses of the project to the Secretary of Transportation along with the Chief Engineer. Both officials were on board early which made it easier for the team. At some point they want to incorporate the matrix into SUDA, but for now it is part of the check list. The construction department has shown interest when they see it used as it identifies if something was missed, helps with depths and comparison of data, and has contributed to creating some design changes. The matrix creates a track record and provides a history of the project.

Delaware's first step was to have the SHPR2 Subject Matter Expert meet with their Management and Directors to sell them based on the Texas experience. Using SHRP2 funds they customized the product to show the Secretary how it worked and the benefits, which got the green light. When seeking buy off at the top, proposing a theory is

okay, but decision makers really want to see the product working. They could see the UCM provides eyes early to call out problems, giving the easy "here it is and here is what's wrong".

Chuck prefers using the terminology "test holes" rather than "pot holes" since DelDOT do not create pot holes (that need repair), they create test holes. When they added test holes into the matrix, the test holes confirmed conflicts. They can also ballpark issues by using the UCM without test holes. By reviewing state law requirements and costs, they sold designers by comparing costs of utilities relocation to costs of catch basin redesigns without utility relocation. In one situation to move catch basins instead of relocating utilities only changed the roadway by an inch or two and had negligible costs but was also able to save $4 million. DelDOT does not require as-builds but is looking for data regarding depths and the need for relocations. They use their crews to measure locations of proposed utility relocations. The utility data is then shared with the utility agencies, local jurisdictions, and contractors. DelDOT's designers have not cared about utilities in the past, seeing them as a nuisance that they try to push back on. Once designers could see what was being done they eventually bought into the ease of this ability to document conflicts and began to value the importance of the matrix. Roadway designers are not always skilled to incorporate utilities into design.

DelDOT has a small utility staff so a designer will have a representative on site to provide as-builds and oversee relocation, so one organization is providing survey and as-build locations. Construction inspection is tasked to contractors and is a small phase of a project, but they still have companies working off microfiche so their expectations of receiving good data are low although some are now sending pdf files.

Chuck and Deborah were asked if they are using their UCM on non-SUE projects, but they are trying not to have non-SUE projects. When asked if there are specific laws to support Delaware's utility work, they explained that there is little legislative coverage, but they can hold utility permits for other work contractors want to do (this is not an ideal resolution). They are trying to get more leverage with lawmakers and create more incentive to meet project deadlines or face financial fees. One utility is 2.5 years behind in a 180-day project. Delaware may have the ear of Verizon management, holding quarterly meetings at the director level but they have not seen any trickle down to this effort so far. There is only one Verizon engineer for the entire state to work with and he can be the bottleneck as a one-man band responsible for permits as well. It is not unlikely DelDOT will receive plans 6 months after a project is completed. Utility agencies don't always care about moving lines, so long as their systems are still working. Landline feeds going thru cell site needs to go thru the state. In one example, there is future work planned to widen a road where a cell tower may have to move but the tower never had permits to begin with for its construction.

PEER EXCHANGE Transitioning Utility Data Repository from 2D- to 3D-design and construction workflows (R01A focused)

MICHIGAN

Michigan's IAP Goals included the following:

- MDOT R15B (R3): Enhance Utility Relocation Tracking System (URTS) to include support for UCM. Implement URTS UCM module in seven pilot projects. Prepare procedure for Utility Coordination Manual.
- MDOT R01A (R7): Use existing consultant to provide knowledge transfer on the use of the Geospatial Utility Infrastructure Data Exchange (GUIDE) system. Conduct data collection at MDOT transportation service centers (22 around the state) that review permits.

Overall Cost: 2 STIC (State Transportation Innovation Council) funds and SHRP2 funds total about $325,000 invested so far.

Timeframe for Development: Phase 1 2013-14; Phase 2 2016; Phase 3 SHRP2 Round 7 2017- July 2019.

Future Plans: Future work will need more resources. They plan to develop personnel resources and work to overcome Utility resistance as a statewide requirement for permits will have pushback. MDOT wants to incorporate the same standard for the state and local municipalities and potentially other states per utility. The goal is to collect permit data once for everyone and make documents available via a public web site.

Presentation (R01A/R15B): Nick Lefke of Michigan DOT presented their product, GUIDE – Geospatial Utility Infrastructure Data Exchange

- *Phase 1* (2013-14) Phase 1 included a piloted collecting standardize data of utilities in a central repository. In cooperation of a Utility Coordination Committee in Michigan (13 years old). Volunteers from utilities to collect data. Michigan staff developed state repository. $50,000 from STIC money and a consultant to evaluate. Needed a statewide standard, stakeholder buy-in, etc. (see slide) Used concrete form tubes. Kept good field records (high pressure gas typically has good data) – used SUE technology to verify after new utility was installed.
- *Phase 2* – Phase 2 used a STIC $100K grant in 2016 with the same consultant to develop a procedural manual, appropriate standards, web portal, and collection app. Surveyors throughout MI will have various levels of expertise. Not every small surveyor firm is tech savvy. One Call loves GUIDE initiative – applying for grants to further enhance GUIDE as they want to reduce contractor calls. Manual has data attributes – committee worked on data attributes. Once a facility has a conflict then we need the details but not generally. Simplified data collection app was created in phase 2 but scrapped in phase 3. Indirect and direct measurements –
- *Phase 3* Round 7 SHRP2 funded independent validation proof of program. The consultant, Spicer, continued from last 2 phases for knowledge transfer then added 2nd consultant to validate and find the issues. Kick off was in May, 2017. Procedural manual has utility doing the data collection themselves. MI has a permit condition regarding data collection on the facility. Took all approved survey companies, sent email and solicited interest to beta test GUIDE. Offered a training kick off and asked for pro-bono data collection to validate the process.

Results included difficulty coordinating data from permit applicants as they were leery of the consultant. The consultant struggled with the utility agencies and some anticipated start dates were logged after the work was finished. Field data was relatively easy, but the collector app was eliminated when it proved to be harder than anticipated; had to be a specific order of data or it had exceptions; and there was not enough GIS support to make it work. The work around was to collect ESRI shape files using a template for data collection.

Going forward, this effort will need more resources! R01A was the toughest product to implement and needs personnel resources to sustain it. The state will also have to overcome resistance from utility companies as any statewide requirement for permits will have pushback. Some agencies may have different standards from the state and local municipalities and will want all of them to incorporate the same standard. Michigan issues 1200 underground permits per year so 6,000 in 5 years and 24,000 in 20 years. They want to collect data once for everyone. Their documents are on a public web site.

Industries in Michigan are asking when this will move forward. A white paper was drafted. Outreach and training are needed for the survey community and this will be an ongoing component due to staff turnover and technology changes. The current GIS team is very small and stretched so dedicated staff resources are needed. The state needs to find ways to help managers understand the benefits of accurately gauging potential costs.

Homeland Security presents other potential issues with their 'you can't share my data card' attitudes. MDOT crew surveying during installation shouldn't be an issue but utility resistance is present. One Call is also working on promoting utility buy-in.

Nick was asked who manages the data once it's collected and who is the keeper of the data. The MDOT vision is the collected data would be in the central repository and those resources would manage it, grant accesses, and take charge. They are currently working on leadership for resources to see this happen. It's always the underground utility data that is the hang up, but Nick thinks it would be fantastic to move forward.

Participants wondered if the state need each utility to provide data then how will they be convinced to participate? Nick explained they must be shown the benefits. AT&T participated in the pilot and thought it was marvelous. As-Built staff at AT&T saw the benefit of having a record of utility locations and really wanted this system. Big company enthusiasm doesn't always trickle down to the actual field staff. When issuing a permit to a utility, the conditions don't always get transferred to the installers and this system hasn't been tested in real life yet. MDOT is working with the contractor association who is supportive of this. Technology is already on many of their machines and equipment. Sometimes the cost of collecting the data is to successfully wrestle with unhelpful utility people. The state will have to handle unmarked, abandoned lines and address them as they are discovered.

Rob Martindale offered the story of the explosion following a Colorado gas line break, that set a series of events in motion including a revision of standards that rolled into a SUE program backed by the legislator who worked with the contractors to beef up pre-construction legislation requiring SUE and standards. New SUE was legislated in August 2018 requiring SUE notification and design standards. This ties into the 3D R01A effort. A good data repository has the potential to be shared with many stakeholders. Even without SHRP2 funding, Colorado saw the need to develop their own system. They bought off the shelf systems and gathered good subject matter experts including those in the GIS world. Colorado can collect survey records (survey stamp for applications) and a history of reliable survey data. Data can be extracted from the repository by funneling it thru the cloud which removed the need for in-house IT and saved 1.5 years of development work. Colorado holistically revamped their entire program using Michigan's GUIDE program to develop a SUE CAD manual, along with lessons from Utah and South Carolina. Survey data and buy-in from utility agencies is challenging because it means they are committing to daily use of the system by the right people. Delaware asked whether the state had the legislation necessary to force the utility agencies hands. Colorado can back charge for delays so when contractors miss dates the state can back charge. Michigan would welcome supportive legislation too!

The Colorado SUE program struggled till this law passed but it is a great benefit for utility coordinators. They created shape files for ROW boundaries in a GIS layer that are sent to a utility's GIS department explaining that they at least owe the state data in the ROW (in an attempt to work around homeland security issues). Colorado is using a mobile app to link to their data repository. One incentive is to provide a license for users. It is a check out/check in system. This helps provide more resources. Off the shelf products include: ProStar and Transparent Earth, which has Google Earth built-in. Legislation called out the ASCE 38 standard but not ASCE 3802.

Texas explained how they took SUE funds from district budgets into a pool that all districts can use totaling 1.3 Billion for utility engineering that includes SUE for everyone to use. Julie mentioned the current national broadband legislation push and wondered if the states would consider leveraging free ROW for data being that it is imperative to know what is in our ROW.

Colorado's intent was to survey within a radio frequency. They use ELMID which has both cellular and radio frequencies. Before that the only system with it all built in was Trimble and was significantly more expensive. Their standards on data collection were relaxed, so now smaller utility companies can use a tablet to provide start and finish data while larger utility firms may request the app and all the data. There is a balance.

OREGON

Oregon's IAP Goals included the following:

- ODOT R15B (R6): Implement standalone UCM at two sample projects. Update policy documents. Develop plan to integrate UCM into design software.

- ODOT R01A (R7): Develop enterprise GIS database to store utility data. Develop module to import CAD data. Develop module to import utility investigation deliverable data. Develop module to import survey data.
- ODOT R01B (R6): Classroom training and field demonstrations completed June 22, 2016. Project selected in February 2017 – SW Canyon Road (SR8). Procurement and contractor award took almost 1 year. Fieldwork carried out week of April 9, 2018. Report delivered January 2019

Overall Cost: $400,000 for all three grants

Timeframe for Development: May 2015 (Start of R15B) – August 2019 (End of Phase 1 R01A)

Future Plans: Oregon would like more time and resources to refine the SHPR2 tool and load all data from 2014 to present. Once the state data and design data are uploaded, they will outfit the utility coordinator with mobile collection for relocation sites to collect newly captured data for database. The plan is to standardize, add to manuals, and customize for the agency. Capturing permit work will be difficult because the state law is confusing, and utilities claim the right to be there by state statute. The plan is to separate permits from right to be there clearly in state law. Oregon is hoping to move toward Colorado and Michigan's legislation at the permit level. They want to fill the database with other sources as there are not enough projects to fill a statewide database.

Presentation (R01B): Chris Pucci presented explaining that the process to implement served to open and identify many unresolved issues in the state. This is a beginning with good potential to go forward. Oregon used their SHRP2 funds to set up a database, capture information they were already collecting, and provide future access. Chris stated that he himself had no influence on decision makers aside from the SHRP2 funds (and that still hasn't helped get their attention) since GIS is funded from general fund and this was not on the priority list. As part of the implementation a SQL Database was set up right away and proved to be easy enough. The plan was to add all the data. There is a statewide advanced GIS platform where utilities could be added using TransGIS, which currently has everything but utility data. There is a possibility the project overdid attributes for utilities in the database which is set up but has no populated data yet.

Oregon processes about 2,000 permits per year that are paper based, district centric, and without coordination. Roughly a quarter of last year's permits are still open with no clarity as to if they were completed. He hopes this work will help in the future. All SUE data per project is put into MicroStation but currently it is lost as soon as project goes to construction. In the current system data can often be hard to find, even somewhat hidden on the server. Oregon is working on standardizing. All active projects are now available statewide and can be applied to GIS very quickly. MicroStation now has everything in it which is almost too much data for GIS applications. Users must use Oregon's specific language in CAD to know what these features are and there is too much information.

The FME (Feature Manipulation Engine) works, but it took plenty of work to be successful. They can now harness and extract what is needed and are about to pull out ROW that was locked in CAD. To process a CAD drawing for ROW into GIS now takes minutes and coordinates are converted on the fly. The state is mandated to work in GIS coordinates. Once the transfer was solved the complicated part became how to work with it. Oregon uses the Trimble business center, a very user friendly off the shelf application. Bill Owens offered that California needs to figure out what is missing as people aren't putting data on the right levels or right lines in FME. For Caltrans, if given a point feature when expecting a line feature the application may crash but if it still runs smoothly the operator won't know if half the data didn't go thru. Oregon's system is so customized it won't upload data if it isn't in the specific code required which minimizes mistakes, but 4-year-old data won't work in the system.

If scripted it correctly, Oregon's system can drill from source data to hand written survey field notes and provide all agency access. There is a great power in this data, but the bugs still need to be worked out. Oregon is not giving up after SHRP2 as they've seen the value and have added data management to their new agency charter and statewide mission statement.

Oregon would like more time and resources to refine the SHPR2 tool and load all data from 2014 to present. Once the state data and design data are uploaded, they will outfit the utility coordinator with mobile collection for relocation sites to collect newly captured data for database. The plan is to standardize, add to manuals, and customize for the agency. Capturing permit work will be difficult because the state law is confusing, and utilities claim the right to be there by state statute. The plan is to separate permits from right to be there clearly in state law. Oregon is hoping to move toward Colorado and Michigan's legislation at the permit level. They want to fill the database with other sources as there are not enough projects to fill a statewide database.

When asked what Oregon used for hand held measurements, Chris explained they are using a previous project's GPS tool. They were looking for a tool that wasn't overkill, but a tablet-based GPS tool that can be submeter for a few centimeters' accuracy with phone and internet and be window's based with big buttons. Oregon is using a DT Research tablet in Windows 10 and a screw-on GPS antenna that requires a half-day training. Subject matter experts can access data and make their own maps. Other states are replacing some GIS tools with tablets, but they must be in cellular range to collect data with a 3-5 ft accuracy provided outside of cellular range. While 80% of Oregon is covered, the 20% of Oregon with no cell reception has no people or projects either.

Colorado uses a Samsung tablet with Bluestar cell only (20% of state has cell coverage) costing about $3500 while the other EMLID unit is $1800 using RTK with radio to provide the line of site. One SUE provider in Oregon put EMLID in each of his trucks. Name brands can be so proprietary they will not apply on a Samsung tablet. There has been an explosion of new hardware products to feed new databases because smaller ones now allow you to talk to your database. The states prefer quality over brand names. So long as the accuracy is the same, the costs of smaller company products is competitive.

Georgia thought it was great that surveyors are leading the conversation and that a good next step will be to see if what is out there now is good enough for these purposes. Kentucky is willing to sacrifice quality of location to get more equipment in the right hands, if they can eventually upgrade.

This project helped destroy barriers between surveyors and designers. Surveyors missed an opportunity 10 years ago when they didn't jump into GIS. Projects that cross the line collecting data and putting it into GIS have been helpful to allow the agency to work better on multiple levels. It is necessary to reach all disciplines and provide the "ah-ha" moments showing that these supplement devices can give amazing accuracy.

PEER EXCHANGE – Coordination for successful application of utility locating technologies (R01B focused)

CALIFORNIA

California's IAP Goals included the following:

- Caltrans R01A (R5): Develop and test a spatial database platform with a standardized set of data attributes to ensure the accurate identification of utility infrastructure during project planning and for conflict resolution during design and construction.
- Caltrans R01B (R6): Classroom training and field demonstrations completed June 17 & 20, 2016, at south & north facilities, respectively. Three field sites (Oakland, Bishop and Colusa) were used to collect TDEMI and single-channel GPR data to validate system performance for SUE. TDEMI system was rented, GPR system was owned by state. In-house geophysics personnel were used for R6--no contractors were involved for acquisition or processing.
- Caltrans R15B (R6): Develop case studies to implement an automated UCM module within the Right of Way Management Information System (ROWMIS). Conduct one-day UCM training course at headquarters and at a district in Southern California. Update utility manuals to include support for UCM. Conduct strategy session with leadership to support further implementation of the UCM approach.

- Caltrans R01B (R7): State completion date April 30, 2019. Caltrans used R01B R6 and R7 funds to purchase additional TDEMI and GPR hardware and related software for data collection and analysis. Geonics EM-61 delivered June 2017. DXG 3D Radar antenna delivered 7/18, an additional GPR tow system was fabricated by Caltrans for data acquisition. (Initial acquisition of DX 3D Radar antenna, controller unit, GNSS hardware, and supporting GPR and GNSS software were acquired using R7 SHRP2 R06D funds, along with additional matching state funds.) GeoSoft license for TDEMI data analysis acquired Spring 2018. R7 training allocation allowed SME to travel to Caltrans and provide 1.5-day software training (between July 18-19, 2018) for TDEMI data acquisition and processing using the co-linear dual-coil Geonics EM61 unit owned by Caltrans. Initial data acquisition with TDEMI and single-channel GPR had already been completed for R6 at three sites. Two of those original field sites (Bishop and Colusa) were selected for demonstration of the new MCGPR unit and TDEMI system to compare earlier SUE information and compare performance metrics between systems. In-house geophysics personnel were used for R7--no contractors were involved for acquisition or processing.

Overall Cost: $320,000 for everything included in Rounds 6-7.

Timeframe for Development: See above.

Future Plans: Going forward they want to incorporate GPR with visual and thermal imaging systems and are initiating a UC Davis project. They are working to ensure contract developments meet workload demand and to develop a scope of work template for district offices to develop their own service contracts.

Presentation (R01B): Bill Owen began his presentation explaining that Caltrans has 20 years' experience with ground penetrating radar. Their challenges with the SHRP2 implementation included dealing with 4 SHRP2 products, short delivery schedules, dual mounting systems, schedule management, and deploying the technology. 3D Radar uses a swept frequency design that can be tailored for shallow or deeper investigation depths depending on survey goals. It's an advanced system, using a single antenna over multiple frequencies and needs a different approach than more commonly-used single-channel systems that require multiple antennas to cover a comparable frequency spread. The 3D Radar air-launched system travels at highway speeds but the ground coupled maximum speed is 13-15 mph, which is still significantly faster than their existing single-channel equipment. They are recording very accurate measurement locations, within an inch under best conditions, without RTK using satellite augmentation and post-processing.

For Caltrans, GPR is a supplemental technology for SUE, not a primary one, due to the poor depth of GPR penetration in the clayey soils present over most of the urbanized portions of the state. In California, GPR works best in the state's desert regions where, unfortunately, subsurface utilities are limited. They have had success with GPR for deep investigations in limited environments. More frequently, TDEMI provides 2D location data while pipe and cable locators give the third dimension. Round 7 worked with 3D Radar and TDEMI. The technologies are also applied to other projects (outside of SUE). They are using Surfer and Oasis Montaj software applications, and plan to still deploy post-SHRP2. In every project where the technologies were applied, something was found that didn't match existing data, either not recorded or not at its recorded location.

Going forward they want to incorporate 3D GPR with visual and thermal imaging systems and are initiating a UC Davis research project. They hope see contract development that can help meet workload demand and a scope of work template developed for district offices to develop their own contracts.

The cost of this project for Round 6-7 was $320,000. AASHTO procured the 3D Radar for Caltrans under R06D, saving 6 months on procurement. The remainder of funds went for additional hardware and software, fabrication, installation, and field work.

Bill was asked about Caltrans' feedback and he explained that California embraces SUE rather reluctantly. It is a big challenge with obtaining executive buy-in—Caltrans currently has no high-level champions for implementing SUE. They are still pushing utility design and relocation into construction. Additionally, staff turnover is a challenge, which has set them back nearly to the same spot they were 3 years ago in developing SUE within the department, as trained staff move on and new people need training. It will be a continual challenge for this work to become self-perpetuating.

Participants asked whether the difficulty lies in putting resources in place or with the challenge to unify process change, but Bill explained the issue is primarily one of size. Money is available, many people agree with the concept, but it's proven difficult to get effective management support and "buy-in" to make SUE a priority in project design. One challenge is that SUE is just not considered as glamourous as other civil engineering disciplines, so it's difficult to attract and retain a capable engineering workforce dedicated to it. Those champions at the lower levels in the organization are fighting inertia as the district offices tend to place too much emphasis on pot holing (QL-A) over a more cost-effectiveness implementation of all SUE quality levels (QL-A through D). That's primarily related to lack of personnel training and experience. Utilities management in California falls under ROW, and although they work under engineers, most ROW agents are not engineers and often lack a technical background, so to win their buy-in they must be taught the SUE process. But it does appear that slowly people are starting to consider that broader approach to SUE. There is a recognition at a fairly high level in Caltrans that the way they do business needs to change, but without a high-level champion it is hard to make that change happen. Grass roots efforts will have some influence at a local level but getting the district offices and executive management to buy into the SUE process will continue to remain their biggest challenge.

In response to a question regarding contract development, Bill stated that the template for the state contract's scope of work mirrors the latest revisions to ASCE 38 and will reference the standard once it is published.

MONTANA

Montana's IAP Goals included the following:

- MDT R01A & R15B (R7): (Includes R01A and R15B) Develop business case for the implementation of commercial off-the-shelf (COTS) software to manage utility permits and utility inventories using cloud-based services. Select consultant for COTS implementation. Customize COTS to address MDT's needs and requirements in three areas: Notification module, permitting module, and utility location data repository.
- MDT R01B (R7): Classroom training and field demonstrations completed July 20, 2017. Project selected is Custer Avenue, Helena, MT. Vendor for data collection is UMS. MT GPR data capture held in August 2018 – they have set the bar for use of equipment & data collection (along with TDEMI). They collected 60-line miles over two nights and were very efficient – within 30 minutes of safety briefing were collecting data. Traffic control was good. Hoping for a quick turnaround on data – they have been doing this for 20+ years on UXO. TDEMI was for full lane width, GPR was not.

Overall Cost: The cost is $150,000 or $100,000 more than the state spends already.

Timeframe for Development:

Future Plans: Tie the data repository to the state permitting process to compare with SUE data. Depending on the project they may use all these technologies, but with an already strong SUE program, this would primarily be used in high risk work. They have two on-call SUE consultants, and existing paper permits are going away in October this year.

Presentation (R01B, R01A, R15B): Gabe Priebe began his presentation explaining that while Montana is 1/35 the population of California it has almost the same land mass. Montana cares about utility data because they need to

coordinate with utility agencies and provide certification to FHWA. They reimburse around 75% of utility costs per Montana law.

With from 100-200 activities present from project nomination to construction, utility data facilitates utility coordination. Montana invests in $100-200,000 worth of SUE per year. The goal of this work is to minimize data rediscovery!

The goal is to have the data repository tied in with the permitting process and then compare it with SUE data. Depending on the project they may use all these technologies, but with an already strong SUE program, this would primarily be used in high risk work. The cost is expected to be $150,000 or $100,000 more than they already spend. They have two on-call SUE consultants, and existing paper permits are going away in October this year. Colorado SUE laws will provide a useful reference for Montana. They are just starting to investigate how SPAR compared with others like RDA 100.

Montana piloted R01B technologies on a Custer Avenue project in Helena. They knew that the Yellowstone pipeline was in the project area but wanted to confirm location to avoid relocation. TDEMI identified new point features and detected linear anomalies. TDEMI has been successful identifying 'blob' and SUE is used to differentiate different utilities and/or provide confirmation. Overall, 78 new features were found on the project and 64 linear anomalies (around 18% of detected features). The cost savings of the R01B products has still to be quantified as the project is still developing, but the likelihood is that is that the pipeline will not need to be relocated saving around 6 million dollars.

PEER EXCHANGE Equipment and IT Resources: Challenges and Successes

KENTUCKY

Kentucky's IAP Goals included the following:

- KYTC R15B (R3): Enhance Kentucky Utilities and Rail Tracking System (KURTS) to accommodate utility data collected in the field, include a cost estimating engine, and provide support for an online version of the utility conflict list to manage utility conflicts. Integrate existing spatial utility information into system. Provide training to users.
- KYTC R01A (R5): Design structure of spatial database to store utility data. Populate database with sample data. Provide training in collection and use of the data. Evaluate future implementation activities.

Overall Cost: When Kentucky had a change in administration, it immediately killed one project. There is one person in the permits area interested and some others that David will tap for support, but legislation must back them up.

Timeframe for Development: Rounds 3-7.

Future Plans: Need legislation to support future progress.

Presentation (R01A): David Otte described this project as offering half a million dollars to spend but no one cares. Without a team in place, the project stalled so this last year has been frantic but good for moving forward. He told participants they need to hire someone to manage this. Kentucky would like to use the collector app on phones for sub-contractors, to give them location of what is in the ROW. This might require legislation. They recognize overhead costs now, but the money will be saved eventually.

Technical challenges:

- Collector released Aurora (new version) in the middle of this project. This forced the team to switch gears from android to IOS and necessitated the purchase of iPads. IOS doesn't sync with Trimble R10 but R10-2 which is what they were waiting for.

- There were elevation issues locating things 100s of feet below where they should be.
- ESRI didn't get it resolved with Trimble, so the solution was to move storage of field collection data to ArcGIS online and their cloud servers. Anything vendor submits goes to SME, but Aurora was natively collecting in other projections. There was trouble with conversion, so the state let them host it and it resolved itself.
- Company data submissions were a challenge as they went higher up the corporation ran into issues. Field workers understand the value but higher up they protect the data. Companies are hesitant to share. The state is also requiring them to do the automating so it's a bit of a lift for them.

Kentucky is trying to break down silos in their state and is not focused on multi state use. Under SHRP2's R16 product, a community of interest was formed where both rail agencies and DOT's meet to discuss master agreements and that model could be useful for utilities. Colorado did a roadshow with their utilities around the state. The goal was to get utility buy-in which requires exposure among stakeholders and even beta testing. Local utilities have seen the benefit of the system but there has been some resistance from larger utilities (some have provided information but with a 10ft "buffer"). Politicians want consistency over state lines. Regarding requiring different software across state lines, David believes Ohio has a system they like but neighboring states may use different software systems.

When Kentucky had a change in administration, one project was immediately killed. There is a person in permits interested and some others that David will tap for support, but legislation must back them up.

David was asked if they faced internal IT security issues due to moving data issues, but Kentucky has progressive IT people who offered to host the portal and have taught him a lot. These IT people are contracted to work for the state.

PENNSYLVANIA

Pennsylvania's IAP Goals included the following:

- PennDOT R01A (R7): Develop an IT business case and system requirement plan to develop a spatial database to store utility data. Data sources include final design plans, utility permit data, and as-built data.
- PennDOT R15B (R7): Conduct one-day UCM training course at two locations for designers and utility coordinators around the state. Implement standalone UCM at 24 pilot projects. Identify lessons learned from the UCM implementation at seven pilot projects. Develop system requirements and develop IT system to include UCM in PennDOT's utility management system.

Overall Cost: The costs came to $4 million but included the need to re-create several other areas of application.

Timeframe for Development: 4.5 years Project start: Aug. 2016; Application Development started Nov. 2017; Release 1 – Feb. 2020; Release 2 – Jan. 2021; Release 3 – Sept. 2021

Future Plans: A searchable Utility Conflict Matrix for the future.

Presentation (R15B): Michael Tavani presented Pennsylvania's URMS or Utility Relocation Management System that is tracking utility involvement on projects, particularly using their conflict matrix. The project is a collaboration platform built to manage highway and bridge project utility involvement and utility conflicts. Training sessions with the SHRP2 subject matter expert helped to get initial leadership buy-in. It was recognized that UCMs were being used, but not standardized throughout the state. They fell short when it came to internal processes. Management saw value in standardizing the UCM and thus supported the pilot.

Michael described the recent Pennsylvania Public Private Partnership Rapid Bridge Replacement Project as an insanely large multi-asset rehabilitation of 558 state bridges under one contract over 3 years which required

coordination between utility and environmental departments with ROW to be provided to the contractor. To succeed the project needed PennDOT to help the partner get organized and succeed. A small team met with the 'partner' PWPP with their 3 Utility coordinators (among them they were expected to cover the entire state). When asked for data, each had individual spreadsheets. DOT acted quickly with SHRP2 help to set up makeshift databases and spreadsheets that would quantify the problems and figure out needed resources. The project actually took 4.5 years and included 1300 individual utility relocations. Strengths and weaknesses within the state system became clear. The ability to manage data and communicate state needs (both short term and long term) needed help. They sat down early with utility management staff (presenting a road show) to show them problems and needs, and to ask what they could do to help. The utility management staff went to bat with PennDOT to identify the data they needed to plan out the upcoming 3 years and what they needed to get everything done.

Looking back, PennDOT now understands what data is needed to manage utilities in their ROW (as the focus had been short term till now). Each district traditionally managed utility issues on their own, so the needs of the "entire" state were missed although districts are often vying for the same resources. The need to re-write the application created a list of IT requirements. By end of this SHRP2 project application they knew the UCM would be a universal language to build out from. The costs came to $4 million but included the need to re-create several other areas of application.

Key project objectives of the new portal included the need to increase usership, so they provided an easy to use system on multiple platforms, that includes an EPS (electronic permitting system) and a "one stop shop" GIS One Map tool.

Other objectives included the need for tracking and visibility in tracking a project lifestyle. The system provides audit history, email chains, due dates for tasks managed at district level, process predictability, and project timelines specific to projects. It needed to show where utilities fall within a project (location, conflict resolutions, preconstruction/construction, project close out) show full understanding of where the process is at, and what has been done to date. Utilities were being bombarded (DOTs, contractors, design build contractors, PPP, etc.) and valued consolidating these requests because the platform was expandable. The latest information should always be on this platform.

Conflict matrix integration data includes: conflict level documents, SUE results, utility as-builts, processes whether reimbursable or not, reimbursement prorated for private, and cost sharing options for municipalities. The UCM will be searchable for future use. Utility companies will only be able to see their own data and conflicts.

Challenges included getting the old policy from the 60's and 70's to align process with an "on Screen" approach. It forced them to stop thinking "forms" but think "information" instead. By the time this is completed about 60% of the current utility staff will have retired. Foreseeing significant changes coming due to this turnover made this a timely project.

PEER EXCHANGE Leadership Buy-in: Procurement and Process Changes

Texas's IAP Goals included the following:

- TxDOT R15B (R3): Provide the one-day UCM training course at all 25 districts and headquarters. Monitor the implementation of the standalone UCM approach at pilot projects in the five metro areas. Update policy documents to support the use of the UCM approach.
- TxDOT R01A (R5): Develop 3D model of utilities for one of the R15B pilot projects. The model includes existing utilities and design of utility relocations. Develop library of 3D objects for transition from 2D to 3D design and construction.

Overall Cost: Training and outreach so far has $860,000 invested with over 2000 participants trained. Statewide implementation will cost just over $500,000. Cost savings as of April 2018, include a 95% decrease in costs due to utility delays and a 76% decrease in estimated utility delay days.

Timeframe for Development:

Future Plans: More training, more coordination, district wide implementation, and working with universities to develop Utility Engineering curriculum.

Presentation (R15B): Charon Williams, Anna Pulido, and Gregg Granato jointly presented the enthusiastic experience of TXDOT's campaign for statewide acceptance and support. The gears moving this process include the initial memo received from their Chief Engineer, the development of their implementation plan, and continual training and execution of that implementation plan.

The initial memo from the Chief Engineer changed the state definition on "ready to let" and helped create a statewide initiative to avoid, minimize, and accommodate.

Text from the memo states the following:

Delivering transportation improvements drives our business and will continue to be measured. It is essential that our performance standard for 'ready to let' projects be elevated and defined to ensure consistency in project letting preparation to meet our goal. Therefore, through detailed workshops attended by district and division offices the 'Ready to Let' definition as outlined below was developed and will be implemented on all construction projects effective immediately.

> ➢ ENV cleared and ENV mitigation complete (cleared sufficiently to proceed into construction without delays)
> ➢ ENV permits secured (cleared sufficiently to proceed into construction without delays)
> ➢ ROW cleared (cleared sufficiently to proceed into construction without delays)
> ➢ 100% PS&E (includes completed and approved schematic)
> ➢ Project agreements in place (includes local funding being received or an amount sufficiently received to proceed into construction without delays)
> ➢ Railroad coordination complete and agreement in place
> ➢ Utility agreements in place and relocations in progress (cleared sufficiently to proceed into construction without delays)
> ➢ The above and any other remaining issues to be cleared in < 3 months

Once training started in Texas, it snowballed, and everyone started requesting courses. The forward message of "here's where we will be" has resonated and now this course is also delivered to specific utility companies. Texas has trained over 2000 participants and to date has provided $860,000 in investments.

The new processes have shifted responsibility from the Utility Coordinator to the Project Manager. But to achieve this, the agency needed buy-in from all disciplines understanding how they fit in the process and how utilities fit into what other disciplines do. To achieve this Texas is including utility coordinators, transportation engineers, designers, and more. Training and execution started with Metro district and is now heading to 20 other districts. TXDOT has 25 districts who had the opportunity to customize the utility conflict matrix, but the state is now working on an RFP to standardize the utility management system.

With this application Texas has realized a savings of $10 million and up to 38 months over 5 pilot projects. They have identified an additional $13 million from projects not in the pilot. The program is about to go statewide with implementation. Investment attached to statewide deployment will be over $500,000. Policy changes are happening from the top down. With more training and workshops, they are increasing their industry partnerships. The effort has effectively created a statewide buzz and a desire to partner with TXDOT regarding design. TXDOT stated that improved relationships with utility owners cannot be quantified, it is priceless.

The benefit of leadership buy-in is that it provides the opportunity for culture change. All senior leaders need to be invested, which was achieved by stressing the benefits of time and cost savings. In October 2018, the TXDOT Chief Engineer decided they would will implement the UCM. This meant identifying conflicts as early as possible, tracking conflicts, determining what is avoidable, what can be minimized, or what must be adjusted/accommodated. Beginning with the project development process, staring at the schematic phase and approaching partners with the message, "Give us your information so we can avoid relocating you".

When TXDOT initially applied for the SHRP2 R15B grant, not all leadership was on board because they could not see the benefits and wanted to compare this approach with what was already done. This directive gave TXDOT the opportunity to collect the data and in fact strengthened their case for UCM. When TXDOT presented just how much money was being wasted on utility delay claims it changed the conversation. The turning point happened during the 2015 legislative session discussion on utility delay costs when millions of dollars in utility delay claims were exposed. Now, cost savings due to coordination with UCM has shown as of April 2018, a 95% decrease in costs due to utility delays and a 76% decrease in days for the average number of estimated utility delay days.

Once leadership was on board, the biggest obstacle became senior design people who believed they already did this and were resistant to adding extra work with the UCM spreadsheet. Not being involved in everyday utility work and not understanding the impacts created a silo mentality. Everyone needs to be aware of the process. The designer wants control, but there must be a spirit of collaboration. Turnover in staff means some of the institutional knowledge is leaving so now is time to persuade designers to use this process. TXDOT made and distributed stickers to everyone with the message "Avoid, Minimize, Accommodate".

TXDOT stressed coordination early and often, explaining that 90 days after a project is let there needs to be agreement at the very least, but ideally utilities should already be adjusted, with some allowance for construction management plans. In Texas, District, Utility Portfolio, Right of Way, Design, Finance, and Environmental representatives sit down together and walk thru each project in a 4 year look ahead for districts, and a 4 month look ahead for state view. This allows them to identify routine delays and make decisions to delay lets or accelerate projects on both the district level and state level.

Participants asked how many projects get pushed back now, but as the culture has shifted, the mindset is now to bring projects as close to ready as possible. In the monthly state meetings, they may push back or accelerate 2-3 projects a month. On the district level they update the schedule as soon as they know there will be a delay but that takes early coordination. Montana had always tried to get their utility in place 3 months before a let but now it's a full year ahead which can be painful but helpful. In some cases, funding allocation forces letting even if the project is unprepared.

CALIFORNIA

California's IAP Goals included the following:

- Caltrans R01A (R5): Develop and test a spatial database platform with a standardized set of data attributes to ensure the accurate identification of utility infrastructure during project planning and for conflict resolution during design and construction.
- Caltrans R01B (R6): Classroom training and field demonstrations completed June 17 & 20, 2016, at south & north facilities, respectively. GeoSoft License acquired Spring 2018, and SME provided (1.5 day) software training July 18-19, 2018 for TDEMI data processing (for single EM61 unit with top and bottom coils owned by Caltrans). Purchased DXG 3D Radar instrument and controller unit, then fabricated tow system for data acquisition. Selected two field sites (Bishop and Calusa) for demonstration of new

MCGPR unit and TDEMI system to verify SUE information and calibrate hardware. Because state owns both MCGPR and TDEMI systems, no contractors are involved for acquisition or processing.

- Caltrans R15B (R6): Develop case studies to implement an automated UCM module within the Right of Way Management Information System (ROWMIS). Conduct one-day UCM training course at headquarters and at a district in Southern California. Update utility manuals to include support for UCM. Conduct strategy session with leadership to support further implementation of the UCM approach.
- Caltrans R01B (R7): State anticipated completion date to be confirmed. Implementation already underway from R6, so used training allocation for SME to travel to Caltrans and provide demonstration on use of software - GeoSoft. Caltrans purchased hardware for data collection. Caltrans got their DXG 3D Radar unit delivered 7/12. GeoSoft (TDEMI Processing) training provided 7/18. Caltrans expects 'radar van' set with DXG for fall field work 2019.

Overall Cost: $375,000 from SHRP2 funds.

Timeframe for Development: Caltrans has put in 3 years of implementation with research as far back as 2003.

Future Plans: Looking forward Caltrans will need a utility manager focal point to focus all things related to utilities and a group responsible for coordinating. Multidisciplinary roles would be very cross functional. They need to capture data better and coordinate with districts and national efforts. They need to identify real costs and ask as an agency why such a dependence on pot hole testing. The state needs training for more than just new hire college recruits.

Presentation: Mark Turner (by phone) the Caltrans 'shepherd' for SHRP2 presented by phone and shared that Caltrans is doing well with implementation of $375,000 from SHRP2. With 12 Districts statewide, the R15B effort provided the opportunity to standardize. The IAP funds helped gain attention within the department. This is the end of the beginning. Proof of leadership buy-in is shown in that 2 people were granted out of state travel to attend this event from California. Caltrans has tried to build momentum with utility research projects as far back as 2003 and 2006 that showed lack of shared information leading to inefficiencies. Utility conflict is significant cause of project delays and cost overruns.

Caltrans had good management support to pursue multiple SHRP2 grants, but then they were handled independently. They have trained several hundred people in UCM best practices but have not been successful with the utility companies.

Champions have been the 3 SHRP2 leads themselves. No champions have emerged in state leadership or even the CA Division Office of FHWA. The Chief Engineer attended an AASHTO meeting about e-Construction, which then rose to the top of the priority list, showing how critical their push can be. Someone needs to own the process as in Caltrans, the SUE program is dedicated for utility investigation, and the state still heavily relies on pot hole testing using capital dollars which is not funded like SUE (support dollars). SUE consultants are very aware of what is going on in California, but the state is not viewed as a leader in this area. Mark expressed his gratitude for the national leaders who have come to California over the years and acknowledged that occasionally the state can send someone to AASHTO ROW committee.

Regarding changing process and culture to include virtual design, 3D modeling, and new technology tools, this is just one more tool. The pace has been slower than hoped as somehow this topic gets lost, but it is on the critical path. It was discovered that UCM wasn't being used in the construction process. Half the Caltrans workforce is over 50 and they hadn't hired anyone in 10 years until last year. There is a need to understand the magnitude of problems, with FHWA program analysis and risk assessment tools. Caltrans has a long way to go but some pieces (thanks to SHRP2) are in place now.

GROUP DISCUSSION

Regarding training and education, the participants discussed secession planning and developing people for roles. Texas has talked to 3 universities regarding supporting a utilities engineering curriculum for current students as well as other engineers within the DOT who are now interested in utilities to train them on coordination. There was a conversation regarding the debate is on who coordinates utilities and who engineers utilities. Individual activities for coordination are not engineering but the collective discipline is utilities engineering although it was stated that perhaps 20% of engineer work is actual hard-core engineering so position does not necessarily need to be filled by an engineer. With 5 surveyors participating in the room, this is a very important consideration. Georgia is considering a certificate program.

A Utility Coordinator role is at the nexus of everything a DOT does. Colorado is mixing NHI and a program developed in Indiana to offer to all disciplines. The first 30 participants will be taking it in August 2019 and the plan is to roll out to consultants and internal staff as well.

Utility accommodation – Montana is struggling using design build needing major utility coordination involvement and wondered if there are good practices building requirement into RFP. Design build does get issues up front, but they asked the group how best to bring the consulting community on board. Some contractors don't know what is done before the letting, so they asked how the best should be chosen. Julie suggested this as a topic for the FHWA utilities peer exchange in New Mexico.

Pennsylvania offered not to be specific on expectations but to identify the size team needed to involve utility management on projects and not to underestimate the work involved. Manage design build into the RFP. Run SUE and develop 30% package, then have the agency own the SUE package after it's left the RFP, and anything forward shifted to the contractor.

Georgia requests Level B data before an RFP goes out. Their prequalified Utility Coordinator has to be on the team, and they educate utility owners through a workshop held prior to the RFP. Innovative delivery means they pay for utility relocation costs. The design build team has complete control over utility and they encourage redesign to avoid utilities.

Design build over CMGC (Construction Manager General Contractor) often depends on the complexity of utilities present and the size of project. CMGC is more effective in Colorado.

Texas is doing a little of everything. Fairly recent is design build as they acquire ROW and utility coordination prior to execution of design build but adding anything outstanding goes to the design build contract.

DC PLUG is an initiative with Pepco that started after the 2012 storm surge. It is a partnership with Pepco and DDOT to relocate primary feeders underground while identifying utility work and capital improvements leading up to this relocation, so our designs would be coordinated. Legal challenges delayed DDOT several years. There is a need to make sure expectations of restoration are identified. Roadways are Portland cement with asphalt overlay. The gas company assumed DDOT was coming in right behind them, but that wasn't the case and this created additional disruption to the neighborhoods. DDOT needs to identify future work ahead of time with this 3-part process using DDOT capital funds, District fees to Pepco, and 250 million of Pepco's budget.

Texas is undertaking a $1.2 Billion design build project of elevated lanes along I-35 that includes, 40 distribution lines going underground, ROW acquisitions, and relocations for AT&T. They need to coordinate transmission lines, consider Buy America stipulations, and coordinate relocating a lift station and an AT&T unit.

There was a question regarding FHWA's participation in SUE and when reimbursement of SUE with federal money can this occur to minimize the budget for a DOT. State DOT's are responsible for providing utility clearances so the project when let will not be impacted (or it will be moved with construction). FHWA expects the work to be done by the state upfront and thus won't reimburse. While it seems pointless to keep throwing money at a

complex problem, the participants recognized it is time to change the state of practice. FHWA can reimburse for SUE investigation in the 30% upfront, but this depends on how a state codes the investigations. Georgia added it would be helpful if there was an opportunity for an interim certification to authorize funds earlier from FHWA. Right now, there is no way to do early utility investigation funds, based on statutes currently (ROW has the law on its side). The problem lies in where utilities get coded and where you pull your costs. The participants were also interested in what level of federal funds would be authorized for cost over runs and delays and who would capture that information.

In Utah, all design build is state funded. The high-risk utility portion is pulled out, so that portion is predetermined, and the design builder is told if they touch that it's on them. They provide master utility agreements with program management teams, host workshop for utilities to meet with design builders. As-build may have a provision for developers.

PEER EXCHANGE WRAP UP DISCUSSION

R15B – Identifying and Managing Utility Conflicts

- The peer exchanged identified two successful approaches and as states are tailoring products, it can quickly change the way design and utility conduct business.
- Standardization and consistency among regions will provide better customer service using web-based products allows all stakeholders to see the same forms.
- These developments have been positively received and quickly show tangible benefits.

R01A – 3D Utility Location Data Repository

- Just talking within the agency and educating within is one of the biggest hurdles overcome.
- Bringing the repository in the open to discuss and letting people know what is going on will be the longest lasting impact.
- SHRP2 funds provided opportunity for state to match the Michigan GUIDE initiative – without it they wouldn't have had a proof of program phase, so SHRP2 funds took the program to the next level, allowing them to validate the draft manual and provide changes.
- California now has Oracle with 2D/3D tables and although many project engineers don't take on the conflict matrix, many utility engineers like the repository so they can pull it out and provide engineers with utility information.
- Engineers don't understand the differences in state plains – not mixing portals together. Just slow getting them to adapt the CM.
- Virginia would like to see a national database
- Even without SHRP2 funds allocated, Colorado wouldn't have what they needed from others to do what they are doing today. They've been able to work through these issues watching the work of the IAP states.
- Colorado and Georgia attended the workshop although they did not participate in the IAP.

R01B – Utility Location Technologies

- Montana received all three products. Increasing exposure within utility and design disciplines was a huge help.
- Staff turnover is a real issue.
- These products allow implementation of the product to evolve as more people get on board (and adapt features such as automated emails vs. traditional email)
- Interesting to compare MT to CA in size.

- California will be faced with having to develop R01A/B products from the ground up. Without a strong champion executive level, it will become more difficult going forward. Some districts will adopt faster than others. Without R01B funding highly unlikely we would have ever adopted the technology.
- Key findings showed how difficult it is to change organizations from within.
- In Texas, Anna sees at the district level while Charon views the state level, and both worked to bring the districts together. Districts complain together but if you bring them for a summit you can peer exchange within districts on solutions and good outcomes. Charon has really helped spread goodwill throughout the state.

Equipment and IT Resources –

- Pennsylvania needed to revamp the entire IT system statewide, so R15B provided a good starting point or universal language to build around. They had good support from the top. The deputy secretary was approached a few years ago when all districts were complaining about utility delays costing money. He was willing to go to talk to legislators into passing something like Colorado requested proof to show the benefits. The lack of being able to substantiate the claims showed PennDOT what they lacked and how to move forward to provide bargaining tools for new legislation.
- This tool is the most important thing a state can use! Texas thought it was the utility's fault till they analyzed the data and found real holes in the State processes. They uncovered internal issues and stakeholder issues.
- Kentucky was able to upgrade their Matrix to the Collector app and begin to add data from mobile phones. Eastern Kentucky has high elevation mountains and wanted to adapt the technology to locate gravesites which apparently works very well so now they will be presenting this as a powerful technology with multiple applications.

Leadership Buy In –

- Political will in Texas and the major P3 project in Pennsylvania helped these initiatives tremendously.
- Texas built their process from the top down. This started at the top, went down tier by tier, from executives to senior engineers on down.
- California's issues are not unique as many states face the factor of priorities and individual culture within organizations. This is a reality that must be acknowledged. Sometimes the issue is recognized but it's getting people to take a next step.
- Delay claims add up and people do take notice. For example, San Diego, District 11 is very excited and invited more training with utilities which may influence other districts since sometimes a big district can make waves with smaller ones.

Appendix E – Retrospective Discussion Notes

July 17, 2019

Utility Solutions Retrospective Workshop Notes
SUBJECT MATTER EXPERT PRODUCT PANELS

Phil Sirles, SME Utility Location Technologies (R01B)

Phil presented the R01B Research Goals from 2012 and their outcomes:

Goal	Outcomes
1. **Educate industry and agencies** about benefits and limitations of subsurface utility engineering (SUE) investigation technologies, when it may be advantageous to incorporate multi-channel utility designation into business practices, and 2. How to **implement these systems**.	• Increased understanding of reliability of 3D data and quality levels. • Determination of depth and 3D data, which allows Quality Level B data to be identified earlier in the design process. • Multi-channel utility designation is accepted as another tool for facilitating subsurface utility investigations. • Implementation integrated with other SHRP2 utility products and coordinated with American Society of Civil Engineers' committees' standards for utilities.
3. **Establish standard processes** to incorporate SUE across agency departments.	• Scope the work needed for subsurface utility detection and provide data that can be used for measuring the performance of the outcomes.
4. Develop ability of agencies to incorporate SUE in total cost of facility ownership to **improve return on investment**.	• SUE integrated into agency asset management plans. • Proactively collected data on utility location as it is installed (using database developed under R01A).

- This is advanced technology but only for transportation applications. Department of Defense has been investing significant money for many years. The Army Corp of Engineers has been heavy working on QA/QC.
- These are proven technologies, but they aren't silver bullets. They augment existing SUE technologies.
- Hardware and Software are used for visualization of the data and what we make of it.
- MCGPR & TDEMI are reliable as another SUE QL-B tools
- MCGPR helps build 3D models, with good site conditions
- TDEMI is a metallic utility detector in any soil type
- TDEMI is a 2D digital mapping
- TDEMI does not discriminate buried and above-ground metallic objects (i.e., vehicles)
- Integration and interpretation with SUE information is KEY!
- Making sense of 2D SUE and 2D TDEMI
- GPR and EM are reliable to QL-B.
- Training is needed to integrate more into the utility world.

SME R01B Lessons Learned:

- Coordination and Planning are Key Elements
- Multiple Departments in the DOT
- Contractor(s) for advanced geophysical technologies
- Not all SUE providers are qualified for advanced geophysics
- Consequences if 2D SUE and advanced methods are not reconciled and integrated carefully
- Understand site conditions prior to deployment (either method)
- Good depth (Z) estimates from MCGPR and geometry in 3D
- One 'shift' of data collection yield weeks of analysis & reporting
- Work at night for TDEMI (vehicles cause interference with data)

SME R01B IAP Summary
- VDOT – Pleased MCGPR worked in 'clayey' soils
- MTD – Pleased Yellow Stone pipeline was detected
- OR-DOT – Pleased with ties between SUE and MCGPR/TDEMI and developed / matured their SUE statewide program
- OH-DOT – Learned site conditions play a major role
- ARDOT – Learned the contractors may not be as prepared as planned, and contracting can take a long time
- Caltrans – Created in-house ability; and, TDEMI primary method

SME Suggested R01B Future Steps
- NCHRP Synthesis including:
  - o What would increase your level of comfort using geophysics for utilities?
  - o Experience will lead the way.
  - o Database of qualified vendors.
  - o Training and knowledge.
  - o Standards and software that may come out of industry.
- Spend time learning how EACH product gives value to the DOT and utility owners for product delivery but not as independent products.
- Too early for any IAP state to provide performance metrics, but when return on investment is measurable it will help push acceptance.
- Track pilot products for a few years particularly through construction.
- It's all about reducing risk! Optimize the next step – to QL-A.

Cesar Quiroga, SME, Identifying and Managing Utility Conflicts (R15B)
SHRP2 R15B Tools
- Product 1: Compact, standalone utility conflict list
- Product 2: Utility conflict data model and database
- Product 3: One-day UCM training course

Cesar's comments:
- UCM training is critical. Training is the most valuable exercise bring more stakeholders to the table.
- Different states chose different implementations.
- States didn't always have IT support or as much leadership support as they thought so the standalone product was then more favorable. Enterprise implementation was more complicated than expected.

Lessons Learned
- Obtain and maintain buy-in from the administration. San Antonio was so successful because of leadership support.

- When in doubt, pursue a standalone UCM implementation
- Follow standard IT phases for enterprise UCM system
- Substantial economic benefits of UCM
- Upfront costs are real, but consider them as an investment
- Other related utility process components are also critical
- UCM training is critical
- Satisfaction with one-day UCM training course
- UCM training should target project managers and designers
- Increased awareness of the project delivery process
- Need to improve utility data management practices
- UCM standardization is critical

SME R15B Benefits –
- Standardized method and form for tracking utility conflicts and resolutions conveys a unified message to Utilities who may have national presence.
- Significant economic and project delivery time savings
- More positive working relationship with the industry
- Better understanding of utility issues that can affect project delivery

SME Suggested R15B Next Steps
- Educate Leadership – but how?
- AASHTO and FHWA help educate leadership and be sure to mention Claims Avoidance!
- UCM is about changing business processes first. If IT seems too complicate – start with a standalone implementation. If you don't know the business process well – you won't be able to document. Standalone will get you there.
- Utility Engineering – (see description on slide 13) Understand it is an all-encompassing description.
- Connect UCM to specialty of utility engineering.
- Training must include all stakeholders – everyone benefits.
- You need good utility data – recommendations on collecting utility data and how it's provided to the rest of the processes.

Cesar Quiroga SME 3D Utility Location Data Repository (R01A)
Goals
- Conduct a pilot utility data repository implementation
- Implementation framework:
- Results of other federal and state research and research implementation efforts
- Industry-developed utility data models and standards
- State DOT-driven data programs and initiatives
- Technical assistance focus:
- Present available options to each state DOT
- Outline advantages and disadvantages of each approach
- Provide information to state DOTs as questions emerged as to what approach to consider
- When you populate a database, people start to believe it. So, if you have indeterminate levels you need to say so. Know your accuracy and note it for archiving later. Accuracy depends on what you are doing and the circumstances.
- ASCE provides framework but states will customize.

SME R01A Lessons Learned

- Obtain and maintain buy-in from the administration
- Understand short-term and long-term needs and objectives
- Focus on low-hanging fruit to begin a utility data repository
- Follow standard IT phases for enterprise utility data repository
- Address challenges for developing robust 3D models

SME R01A Benefits
- Availability of depth and elevation of utility facilities throughout the project
- Integration with aboveground 3D project data
- Capability to generate cross sections at any desired location
- 3D representation of subsurface environments with a high concentration of utility installations within a limited space
- 3D design and analysis of utility conflicts
- Acceleration of project delivery and fewer delays
- Increased safety, less risk, and less damage to utilities
- Less utility exposures because of proof of utility installation existence, location, and attributes
- Availability of depth and elevation of utility facilities throughout the project
- Integration with aboveground 3D project data
- Capability to generate cross sections at any desired location
- 3D representation of subsurface environments with a high concentration of utility installations within a limited space
- 3D design and analysis of utility conflicts
- Acceleration of project delivery and fewer delays
- Increased safety, less risk, and less damage to utilities
- Less utility exposures because of proof of utility installation existence, location, and attributes

SME Suggested R01A Next Steps
- Availability of depth and elevation of utility facilities throughout the project
- Integration with aboveground 3D project data
- Capability to generate cross sections at any desired location
- 3D representation of subsurface environments with a high concentration of utility installations within a limited space
- 3D design and analysis of utility conflicts
- Acceleration of project delivery and fewer delays
- Increased safety, less risk, and less damage to utilities
- Less utility exposures because of proof of utility installation existence, location, and attributes
- Know your limitations
- Focus on low hanging fruit
- Develop libraries -but it's expensive.
  - Can you share among state DOTs? TX and CO are working on it.
  - CO's library is in SUDA – now syncing into software.
  - Testing in process.
- Availability of depth and elevation of utility facilities throughout the project
- Integration with aboveground 3D project data
- Capability to generate cross sections at any desired location
- 3D representation of subsurface environments with a high concentration of utility installations within a limited space

- 3D design and analysis of utility conflicts
- Acceleration of project delivery and fewer delays
- Increased safety, less risk, and less damage to utilities
- Less utility exposures because of proof of utility installation existence, location, and attributes
- Connect utility data management to the increasingly accepted specialty of utility engineering.
- Chattanooga presentation showed research needs more discussion. Out of 11 needs – 5 have to do with finding utilities, managing conflicts and data.
- Review TRB paper

SME R01A Vision
- R01A: Document and manage the location and characteristics of all utility facilities that exist within the right of way

- R15B: Identify and resolve utility conflicts as early as possible during project delivery to avoid unnecessary utility relocations, utility-related delays, and higher project costs

- Consider the utility process as an integral component that covers all phases of project delivery—starting as early as planning and continuing through preliminary engineering, design, and construction

Discussion:
- Were we able to document a project from design to construction in the IAP? No but partly. Most work was in the pre-construction phase and now TX is looking at benefits. Time will tell. KY is a few months out on R01A for storm sewer # of savings.
- Planning is always way out ahead.
- EM systems under R01B were the most available at the time but 4 are now available and working to get better depth.

SHRP2 Program Overall Discussion
Research Phase:
- If SHRP2 is considered all research – then yes, we did that.
- Bentley wasn't particularly responsive in the implementation phase although they were very involved in the research. Several participants felt Bentley was not invested in their implementation being non-responsive and unwilling to fix issues. One state had a high-level person reach out to Bentley threatening to switch to ArcGIS or AutoCAD and several others suggested this work around. Bentley appears to be reproducing the same product to every state, but the technology is now 10 years behind AutoCAD on a 32-bit process.
- One non-IAP state had difficulty finding final reports on R01A and wondered if everyone else had the information on the research that they needed. This made it difficult to work through what the consultants were trying to do.
- The process seemed a little haphazard when trying to pull literature and research together from various resources.
- With R01B, the Round 5 research had identified a prototype which was supposed to be available to the proof of concept users. Prototype was inadvertently destroyed… This caused us to scramble and re-invent the work plan as they went. Company that developed the prototype went out of business. Similar issues with NDT equipment. This is the nature of a one of a kind machine.

Implementation Phase:

- Round 7 seemed too short at the end. Would have liked better communication on the full timeline and what had to be accomplished.
- Round 3 had plenty of time, but the end date wasn't clear going into Round 7.
- It was great to have SME's available to answer questions and they were very responsive.
- States would have liked more time to carry out the pilots all the way to construction to realize the full impacts. Texas has already budgeted state money to continue use through construction.
- R01A benefits will be better understood decades from now.
- While there is good software out there, it wasn't easy to figure out which ones were viable, but luckily one state's IT was willing to help so long as they worked with Oracle. Having to change versions several times, it would have been helpful to have a software comparison for R01A available. There is so much out there, states wanted suggestions on what to use (particularly in relation to the various CAD programs available).

National Impact
- It's a better sell when utility products are pushed at the national level. It lends more credibility but also provides a framework for discussion.
- The SHRP2 'national' level gave an opportunity to have a conversation with utility that overarched the state lobby. During the Montana rollout tour a participating lobbyist gave a bit of pushback, but the national presence of SHRP2 helped quiet him down.
- National support frees other local resources to be used on other aspects of solutions.

Did we hit enough states? Are your peers looking for this information?
- SHRP2 was well represented; some states push the envelope more than others. Some states you never hear from so from a program level you must force feed some. They may just not show up.
- States liked R16 approach. A Community of Interest for Utility Stakeholders would be very beneficial.
- FHWA Regional Peer Exchanges are coming up and the intent is to try to hit every state.
- Include the utility industry in the workshops and get their input on products we are thinking of implementing. They are the "experts" and have information to share.

Key Takeaways:
- Relationships are key:
    - Being able to talk to the SME was very helpful. Hearing "3D" was frustrating, but the SME helped to adapt the scope and goals.
    - When one state shifted gears mid-project, they were able to work with Julie and she understood the nuances between research and implementation and was comfortable allowing the changes.
    - It was good to learn from others' examples. This is what was intended.
- Pilots were available to help move from research to implementation.
- A Peer Exchange at the start would have been helpful.
- The education and training on these topics were valuable and provided exposure to ideas and people of various disciplines that would never have discussed these topics otherwise.

Did the 3 forms of SHRP2 Implementation work for you?
- Proof of Concept Pilot, Lead Adopter and User Incentives were all useful forms of implementation.

SHRP2 Implementation Application Process
- The application was so easy that one state got ahead of themselves and missed their internal sign off hoops which causes some trouble and needed a special legislative meeting to approve the approval of free money.
- The process was super easy for people who don't do grants well.

- Spending the obligated money posed some challenges. In one case, it was easy to get it obligated on the Federal side but hard to get it into the state's internal system to be able to charge to it. It was necessary for the state to issue this activity with a project number, but the money came through a channel the DOT wasn't used to and the accounting culture had hiccups.
- SHRP2 could do better indicating what the money was good for. States didn't know enough about money to know what it was for. It was left broad and open, so states would have flexibility to use it for anything but perhaps a big bubble would have helped define it.

Key Takeaways:
- Without this money and resources states wouldn't have done this.
- This program provided seeds toward solving a problem states are dealing with. This could not have been timed any more perfect because so many states are in the position that something has to be done now.
- R15B materials were critical in getting PennDOT up to speed on the data aspect. They would have been scrambling to put them together on the fly. It took weeks to get the information together.
- DDOT faced setbacks including a strong IT lead who left the agency, poor succession planning, and legal delays for the DC Plug program. The SHRP2 schedule was not synced with their delays. Now with an established team they can take into account lessons learned from others.
- R15B Round 3 provided Iowa with advertisements that really helped sell this to the division director without having to develop their own materials. Although the state was slow to incorporate, when they did get started they were able to plug it right into the project. The timing was perfect as was the level of maturity.
- With R01B, without the funding it is unlikely Caltrans would be deploying the 3D Radar system they have now. Their work with AASHTO on R06D equipment facilitated the procurement of the hardware and saved the state 6 months -1 year of procurement, even with AASHTO's own hiccups.
- FHWA gave AASHTO a remarkable way to provide flexibility to utilize the funding in many ways.

Utility Bundle Specific Feedback
Maturity of Products
- R01A was not mature.
- R01B commercial products and the SHRP2 products were available at the same time. One state was able to test what was just coming on the market and are now implementing GPR on one of their biggest projects going forward. This state would never have tested it or otherwise contracted for it. Getting the service from a consultant they knew to ask for the service they wanted. This success varies depending on the product.
- R15B was adaptable and ready to use.

What should have been done differently?
- Formalize the kick off with the end clearly articulated for what is in mind and provide clear deadlines.
- Provide more peer exchanges annually to learn from other's progress. Earlier on would have been beneficial with a variety of disciplines included. Utah brought Paul, a Surveyor who could speak the language, but the GIS people need to attend too.
- Provide IT Consultants Send an IT team in for support. Donna had to train herself in Oracle.
- Provide more boots on the ground, technical assistance.
- Prepare an overall summary or condensed version to bring new staff quickly up to speed.
- This meeting has been exceptional.

Perception of funding amounts? Useful?
- Michigan – STIC grants are matching funds without assistance but the SHRP2 assistance was one of the best things in the program. The Jacobs support was great and made the program more attractive.

- Money can always be increased. One R01A estimate was $250,000 but the state ended up spending $360,000
- Well worth the effort to go for the money.
- We could buy what we wanted with no strings attached. So long as the State kept SHRP2 informed, the state could spend it as they chose although sometimes the IT department didn't want to take it.

If you had more money what would you spend it on?
- Training and software to support it.
- More hardware and experimenting.
- Internal staff and stakeholder training.

State Discussion Comments:
- R01A was premature for Pennsylvania and they were unsure where to go with it although it helped to clarify that they are still in the first steps of 3D design and exposed the issue that nobody knew what they needed from each other and the state lacked a road map for moving forward.
- In California 50% of data from utilities is 2D or even pdfs. Stressing 3D was not helpful since very little 3D information is accessible to begin with. Stressing 3D turned off several districts. It was good to scale it to future 3D but not realistic now and not in sync with where the industry is at.
- The Kentucky implementation was trial and error for a while with R01A as the target was unclear.
- The most value in learning R01A from FHWA for Utah was that it provided visits to other states for peer exposure. Alana attended Nick's training in Michigan, sat with David for a day in Kentucky and met with Rob and his consultants in Colorado. Phone calls were good but not as effective as being in person. If a DOT isn't ready for 3D they won't actually know what to ask for. It's hard to determine what was needed and what to shoot for so working with others helped provide realistic expectations.
- R01A wasn't as market ready coming out of research as it could have been, but peer support helped to find some success.
- R01B was difficult to scope for Oregon. They would have benefited from research on how much will it cost per lane mile but didn't have ability to compare costs with the vendors without that baseline.
- Vermont started R15B in Round 7, somewhat late to the game. The product was a pipe dream going in, but IT slowed them and made them scale back. They shifted to a standalone product which was the best place to start after all. The standalone showed there are better ways to do the job. One day training was beneficial and consultants who attended shifted to the UCM immediately. **Takeaway:** The utility coordination piece isn't just the utility coordinator's job. Drafters plotting lines with conflicts present shouldn't just fall back on utility coordinator and designers need basic understanding of the ramifications of their designs. Internal conversation and communication continue to move the dial forward.
- Texas experienced both sides of SHRP2 as R15B was very successful but R01A not successful at all. They could have benefited from some training on R01A (they weren't provided as much information on R01A as with R15B, so it was hard to understand what they were supposed to be getting from R01A. A workshop to kick off the SHRP2 program might have helped. Success was only through peer exchange.
- Oregon felt the R15B product was straightforward. R01B had tons of research. R01A struggled and never kicked off and was like inventing their own wheel. Although they googled other's work, saw demos from Kentucky, it still felt like they were on their own and years behind.
- The R15B conflict matrix research was priceless. A lot of states are doing similar things with collective research to show differences and it was easy to pull what would work best for Pennsylvania. They continue to use that material in application development.

R01A Implementation Goals
- Data is crucial regardless of quality. It can always be upgraded. No need to focus on 3D. Take 2D if it is available.
- States had not seen goals from IPW. Could have been better included in the application and throughout the effort.

- States generally felt work was in line with IPW goals. Oregon and Texas were clear on their goals, but their goals changed once they realized they couldn't accomplish as much. Goals were met through self-discovery. These goals were national goals, and we expected some of them to be tweaked.
- California started with a standalone product for R01A but now heading to enterprise as implementation became clearer.

R01A Issues Identified:
- Maturity
- Inherently difficult
- Needs IT support
- Requires ongoing funding beyond SHRP2.
- Utilities can be slow to accepting use of the data by States.
- Understanding it's a long term to realize benefits. It's going to take a while to populate
- No immediate return on investment. (10-20 years)
- Decision makers need some technical understanding
- Transition of data storage – need better communication.
- Needs to ride on coattails of interagency change to 3D. Your agency is moving to 3D design but without utility data you miss a huge benefit. Resources provided for moving the entire agency should allocate funds for utilities.
- Not ready for prime time but needs more testing, in-depth data collection, housing, retracting, using in 3D. It's proven to works but needs more development. It takes work to keep the data accurate and "clean" and there is a need to determine all the steps and add them to the work flow. R01A lacks the detailed pieces to finish.
- Private sector needs to come along
- Limiting access to the data – utility engineers first, send data to designer
- Updating accurate data.
- Not apparent if there are clear benefits to making a stepped approach to R01A.
- Based on a question about different states doing different solutions, FHWA might package the solution and provide to states in some standardized form. They might consider providing a National data format standard to get states up and running.
- States are watching the ASCE standards emerge hopefully by next Spring which should answer many questions. An as-built standard will set the bar. Colorado is working with drafts of the ASCE standards to stay in line with what is expected. ASCE 38-20 includes an as-built component.
- There has been industry pushback regarding the variety of software used among different states. There is a challenge to get as close as possible to compatible systems across the country both from the data repository side as well as standards for use of data.

R01B Implementation Goals
- Initial impressions questioned why the SUE industry isn't providing this service. States would just buy equipment and store it.
- Virginia and Montana have had SUE programs, using vendors, for 20+ years.
- Virginia found that SUE companies do not want to work together, and it was very difficult to get standards established. Had to be forced. They don't appear to want to work together to move industry ahead.
- States that have SUE program in place want to keep using R01B.
- Kentucky didn't pursue R01B as they have clayey soils, so equipment wouldn't work.
- Montana thought it could be more customized towards roadway capabilities.
- Oregon met all the IPW goals and consider it a success. Set up contract work and scope to now get SUE work done.

- CA met IPW goals. Established scope for SUE contractor. Performs a mix of in-house and contractor work.
- If we were to relaunch this, it should include SUE contractors. States will not buy equipment themselves (except perhaps California). Don't focus so heavily on two technologies – states won't buy MCGPR (some do have single channel). Need to make sure vendors are at on-site training (One vendor purchased the technology after attending on-site training).

Should FHWA look at best practice for contracting, standards instead of specific technology – or maybe a Turner Fairbanks road show?
- There needs to be a blend of hardware and data standards to push out to the utilities in a standard format.
- A geophysical suite of tools and greater understanding of what applies to what quality level data would be helpful including what's out there, what works, etc.
- Not specifying specific vendor equipment is valuable but it is necessary to expose more of what's available. Let the states tell vendors what quality and what results are expected with performance-based specifications. States have to stick to budgets, so they must determine what is necessary to get their specifications with what's available.
- The scope did not specify to "use geophysics" so we might not have gotten what we wanted.

R15B Implementation Goals
- One day training was extremely useful, and the SME was often invited back. State districts and utility companies were made aware of the efforts the DOT takes to factor them in and include all the facilities. The Pennsylvania press office recorded Cesar's training for future use.
- Vermont hit most of the IPW goals well. They won't see pilot projects move into construction and utilizing UCM for a long time. One non-pilot project using UCM converted a paper-based manager by identifying half the expected conflicts were in fact not conflicts at all, which saved the municipality a lot of money and time. This UCM eliminated the need to relocate 45 poles. Certain utilities are less diligent than others regarding moves, but this is becoming standard process for projects with multiple conflicts. Vermont's goal is to put the UCM into designer's hands and teach consultants to consider everything in the ground including their interests.
- Colorado utilized what was going on in the research and created a standard UCM plan sheet that is now going into all plan sets. The review team had buy in on the plan sheet developed from the R15B experience. The UCM in excel is now required for every plan sheet and is part of the contractual documents for information only, tied to the 102 spec for information only to make a standard plan sheet so nothing is missed.
- The Pennsylvania Bridge Replacement project took Planview sheets and aligned them with the UCM numbered and referenced on Planview sheets to facilitate field meetings. This helped bridge discipline gaps (utility vs. highway speak) on all 558 bridges.
- Texas stressed to keep it simple, check all goals.
- R15B goals stood the test of time. UCM was plug and play.
- Timing is critical, and states want to use this as soon as possible in projects since at 95% design it's too late.

Lesson Learned:
- R01A is extremely technical and hard to transfer knowledge.
- R15B is easier to implement than the other two because the goals were clearer, it includes training, it has more tangible deliverables, and during implementation the communication, focus and engagement were different.
- R15B is a tangible plug and play – easier to show management that something is developed to apply.

- Even if you don't resolve issues applying the UCM will brings awareness of issues to the forefront earlier for better coordination.
- While the UCM is in full implementation each district in California made their own versions so standardizing is the big need now.
- When you compare to other products you see benefits right away.
- The UCM didn't involve other resources as there was no big IT resource required and no consultant needed.
- The state of practice was ready for this.

Appendix F – Roadmap for the Future

Overall Program Future Steps

- Market executive leaders from DOT. Holds more weight coming from AASHTO and FHWA than internal employees.
- Communicate it is an effort to standardize for consultants as well as utility companies.
- Show tangible benefits, time savings, cost savings, funds that can be used elsewhere.
- There is value here, projects can be delivered earlier, progressed into a product we were working towards.
- PA -focus is on asset management – no greater asset than ROW – we are managing your greatest asset – you need to know what's there.
- We need this information, so we can design around you – we can avoid you.
- Emphasize damage prevention and safety.

R01A Future Steps

- If FHWA emphasized R01A the same way they emphasize 3D design, then everyone would have heard about it by now and states want that same message, marketing, and push for utility data repositories. Paul Scott was a big advocate for SUE at the FHWA level. The same push would be beneficial both at the division level and headquarters level. (Julie wants division offices to come up to speed acknowledging that few have any knowledge of utilities but they've all done risk assessment. Need to provide funding for division offices to attend peer exchanges and share these activities with division administrators across the country.
- The timing was just right bringing the solution to the current problem and there is no better marketing.
- 3D Design and Paperless is not complete without these Utility Products.
- There is a concern regarding varying standards throughout a state and the consequence of silos of GIS data within a state. Michigan can envision One Call as a central state repository of data. The Michigan One Call director loves R01A. Stats are up 30%. In the long run states have to have one central repository where they have ownership. If this stopped at the state level it could be under the 50 different One Call organizations.
- One Call operations can often distribute the cost of maintaining a system to their users (Michigan has 1000 members of One Call).
- Whatever format the data is in, it needs to be transferable and mailable to be used in different formats. States have different laws with different needs.
- The AASHTO technical committee will continue the R01A technical conversation and are happy to invite more people to discuss. (Rob Martindale, Chair)
- Future work must be supplemented by FHWA and research partnerships.
- FHWA might partner with asset management and 3D design folks to message these tools.
- Further research/development is needed including the following:
  - Getting data in the repository
  - Using it in a project (project data in some states may not be used for another 10 years)
  - Having designers pull, use, manipulate, put in 3D design, add to as-built, and repopulate. Need one more step to be done.
  - Perhaps research funding could incentivize a research project such as Utility Permitting on Highway ROW in locations of upcoming projects. This is an 800 lb. gorilla.
  - Research around products that get it to a certain level of affordable accuracy with or without supplements. It's not a product driven solution, but long term.

- In some states, holding permits doesn't motivate compliance. Without enforcement the data will not be provided. Research a database everyone can all implement. (matching state formats with a national universal format standard) How to change one format to another – FME is complicated and need research to simplify FME generic scripts which are so complicated. Research solution for existing data.
- Show Proof of Concept but putting it out there to use it. Fill in the gaps that are missing. Create smaller projects coming out of this big project.
- Technical committees could propose NCHRP or Pooled Fund – topics could include:
  - Putting 3D collection and repository into ROW permitting at state or local level
  - Best standards
  - Producing a deliverable that provides best standards
  - Testing products – proof of concept of available tools.
- States/ AASHTO might propose other research problems.
- Provide funding to upload data into a repository on state or local level. A data manager
- Data management and data collection for permits (MT tying permits to providing as-builts)
- Research funds to support whatever DOTs need to support data repository.
- Community of Practice imperative.
- Federal Aid Eligibility – flesh out for deliverables
- Things in the ground are hundreds of years old yet 80% of utilities are still recorded on paper. It must be decided what is useful for archiving or if getting new data is better. What's the balance? When using data from the past 5-7 years even CAD has changed.

R01B Future Steps

- Need more industry buy-in and pressure put on them to better implement SUE technologies and process.
- Need industry standards.
- Come up with better scope of work and sharing on what is expected from the contractor.
- If DOT's don't demand the technology most people won't move. They aren't willing to go out on a limb for 3D. Set standards for QLs to what users can live with and create an interference bubble. Research what is available to determine what it will take to get what is wanted.
- Broaden the quantity of technologies considered to provide better accuracy. Technologies are established. There are limitations of the technology intended to provide the 3rd dimension "Z" to populate the R01A database. It is only able to provide 3rd dimension in limited circumstances in QL-B. Many states don't know what ASCE 38 really is (it defines SUE practice). Consider SUE engineering as a whole from QL A-D. QL-A pot holing to expose utility where Z is needed for places where R01B doesn't work.
- Bring available SUE courses (such as the LSU -3 Day locator course) to a national level to bring more states on board on what to do with your QLs and how to get them. Even if they don't have a SUE program they still need to understand the process.
- Broaden SUE technology to include more of the tools being used. (ask Bill) Look at the whole process. A-B-C-D levels need to be done to complete SUE. Don't focus on one technology and miss the bigger SUE picture.
- Most states don't have a SUE program, but states would benefit from training.
- Either try to go back and study those specific technologies till they are useful. (no)
- Or shift course and focus on understanding wider realm of SUE technologies available to help us accomplish better what we need. (industry doesn't want the 3D liability) Appropriate in certain levels of accuracy. SUE providers who understand the process – now bring states up to speed to understanding and will give a broader understanding at a national level and more acceptance of the practice.

- FHWA has example SUE scope. MI just revised their SUE scope but will need to be revised discussing A-D QL and we will need to add ASCE 38-20 reporting data.
- Determine how to make SUE more accurate.
- Training, education, promotion, dispelling myths from 10 years ago. Develop understanding of state of practice. NCHRP synthesis into a training process – (2-year process). Show- tell people what is actually happening. How do you move it forward to training?
- CO -partnered with SUE companies for a 1-day workshop training with a project life cycle on how to deliver a CDOT project from 0% to construction. SUE company came in for 2 hours to explain how they "do their thing" and deliver their product. Did 13 statewide trainings with DOT, consultants, - very helpful in educating on current SUE. Starting to see local data with correct SUE data. PPT training and tied into One Call data.
- California– MCGPR in general… Additional states are acquiring these systems. Need for additional state Peer to Peer discussions to see what people are doing across the board with these technologies. MN is ahead in pavement evaluation. 3D Radar is being purchase in KY and (possibly) TX. Develop a Community of Practice – possibly resurrect FHWA Transportation Geophysics Conference

R15B Future Steps

- Figure out the evolving state of the practice. Everyone monitors utilities in some form or fashion, but what is the state of the practice and how might we asses if it is worth diving into? What has been the progress over the last 7 years? Is money better spent evolving the practice?
- AASHTO Committee is reflecting on certain aspects. 7 years ago, that wasn't the case.
- How do we support that?
- A community of practice needs to include the utility stakeholders.
- Pooled Fund or FHWA
- AASHTO Pooled Fund
- Gabe's technical committee Project Scope Utility Coordination. Committee on ROW – determine state of practice with a survey.
- Separate conversations with utility and design staff.
- Pooled fund study on technical support similar to SHRP2.
- Marketing
- Municipalities – show what states are doing to local entities. FHWA Local Programs? Federal Aid Local Program Assistance Training Class to include UCM.
- States reach out to Local Government Agencies with what they have. Is it to our advantage to bring them along? MI tried this 10 years ago with a committee of contractors, utilities, and One Call. They recognized there is no effort from the local level and developed a Utility Coordination Check List for locals to provide only the bare bones as their consultants aren't paid to collect and explored requiring this to receive funding. Locals pay for all PE, when they apply for Federal Money it's for the construction phase. Julie suggested it goes back to Federal dollars can push a bit of a hammer if there are problems with utility they could be fined. They need a bare boned scaled down version.
- GA thinks Municipalities are a priority. There are ways to engage them within our DOTs.
- PA -have a tool for municipalities.
- How do we sell this?