100 YEARS TRB
MOVING IDEAS: ADVANCING SOCIETY

CENTENNIAL PAPERS

Standing Committee on Utilities (AFB70)
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Strategic Research Needs in the Area of Utilities

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INTRODUCTION

It is in the public interest to use the right of way of public roads and streets to accommodate utility facilities (Figure 1) (*1*). This has been a long-standing practice since the early formation of transportation and utility networks, both on local roads and streets and on larger highways serving a combination of local, state, and regional traffic needs. In most cases, public agencies do not charge a fee for the accommodation of utility facilities in the public right of way. In those cases where there is a fee, the amount usually covers a portion of the administrative cost to review and approve the permit or lease. Fees usually ignore the actual cost of accessing and using the right of way.

Public rights of way are becoming increasingly congested. Gone are the days when transportation agencies had to interact with only four or five utility owners during the development and delivery of transportation projects. Today's projects, particularly in urbanized areas, typically involve many utility owners and a large number of increasingly complex utility facilities. The increased proliferation of utility infrastructure within the transportation right of way calls for new, holistic cradle-to-grave approaches to manage the interdependencies between transportation systems and all types of utility facilities.

This management involves many activities including, but not limited to, effective coordination among stakeholders, robust utility investigations, effective utility conflict management, utility design and construction, relocation management and reimbursement, utility as-built data management, and accommodation and permitting post construction. Coordination is not just between transportation agencies and utility owners, but also between relevant transportation agency units. For example, it is common to start preparing utility plan sheets without specific drainage design details. Lack of communication between the highway plan designer and the utility section can lead to drainage ditches or pipes being designed where utility facilities exist or are being proposed.

Figure 1. Accommodation of Duct Bank within the Highway Right of Way.

Historically, the research agenda has focused primarily on utility coordination and reimbursement during the design and construction phases, but relatively little attention has been devoted to utility issues earlier during planning or schematic development, or other issues during or after construction. Many factors must be considered when selecting the preferred alternative, one of which is the cost of utility relocations. Problems arise when the selected alternative creates a conflict with a utility facility that is on its own private right of way or easement. Major utility facilities such as transmission lines may require a significant amount of time to relocate, but they cannot be made whole unless a replacement easement is in place. In many cases, the utility owner must first acquire the replacement easement, sometimes through eminent power, and then request reimbursement by the project owner. However, a delay is likely because this process cannot start until the reimbursable utility agreement is approved and executed.
During the construction phase, a dominant theme has been compliance with damage prevention laws and regulations, but not strategies to eliminate inefficiencies that, in the end, result in unnecessary damage claims, project delays, and change orders. Utility accommodation and permitting after construction as well as overall asset and data management coordination with utility owners have been subject to only a few research initiatives.

Little consideration has been devoted to the quantification and management of utility-related risks during project delivery. This contributes to the common perception that utility risks are not critical in transportation projects (because utility issues rarely block projects from proceeding to development and delivery) versus the reality that utility issues are considered one of the top three reasons that projects incur delays and cost overruns—along with right of way acquisition and environmental issues. A significant risk area is related to uncertainties in the amount and quality of information about existing utility facilities within the project limits. Normally, only about 60-80 percent of the utility infrastructure is known and, of that infrastructure, no more than 90 percent has any potential of being located accurately with current technologies.

A growing challenge is the increasing proliferation of out-of-service utility infrastructure. Most of it is underground, although anecdotal information suggests that this is also a problem with some aboveground installations. Reasons that out-of-service facilities are difficult to manage include, but are not limited to, difficulty to obtain reliable records from utility owners and inefficiencies when contractors find out-of-service facilities during construction. Sometimes, apparently abandoned pipes are in fact operational, including cases where pipes have been repurposed to carry other kinds of utilities, typically communication lines. In oil and gas regions, out-of-service pipelines can pose significant safety and environmental hazards. In other areas, the sheer number of out-of-service utilities that exist under the pavement or within the public right of way generate problems ranging from identifying the actual operational status of existing utility infrastructure to serious design and construction issues for new or relocated infrastructure.

The development of utility records as well as the retention and exchange of those records is a long-standing issue that, according to many practitioners, seems to be getting worse. Most utility installations occupy the public right of way because a public agency has issued a permit authorizing the occupation, but utility owners frequently deny information about the affected installations to the agency that issued the permit. Reasons include data confidentiality and privacy concerns, fear of losing their competitive advantage, and tradition. This reluctance leads to a greater chance of errors and omissions on project plans. Very little research and policy guidance has been forthcoming to address this outstanding issue.

Lastly, very little work has been dedicated to planning for future developments, e.g., what kind of utility services might emerge that could substantially alter how public agencies manage the right of way and their relationship with the utility owners. Examples include small cell towers and other wireless communication technologies, use of the right of way for electric power generation, and strategies to generate revenue and optimize the societal value of the right of way. Also lacking is work devoted to the identification of new strategies to accommodate utilities within the right of way, including utility corridors and structural solutions to rationalize and optimize underground and aboveground spaces.

More investment in utility research is necessary given the increasingly complex demands and costs associated with project delays, utility damage and service disruption, as well as the increasing demands on right of way use. Research to assess the costs and benefits of evolving technologies integrated with more effective coordination among stakeholders and new standards of professional practice (e.g., those related to utility investigations and utility as-builts) would be useful to establish best practice guidance for a diverse group of stakeholders.

Recognizing this need, the TRB Standing Committee on Utilities (AFB70) is stepping up its efforts to identify current, emerging, and cross-cutting issues that affect the interaction between transportation systems and utility networks. The committee is fulfilling this role by establishing relationships with public sector and private sector stakeholders, identifying strategic research needs, developing research need statements, and assisting with the dissemination of research findings.

A LOOK AT THE LAST 100 YEARS

The Federal-Aid Road Act of 1916, today known as the Federal-Aid Highway Act, authorized the federal government to provide aid to the states for the construction of rural post roads, i.e., any public road over which the U.S. mail was transported and outside any place with a population of 2,500 or more (*1*). The term construction included reconstruction and improvement of roads, but not studies, surveys, or right of way acquisition. However, an administrative interpretation considered utility relocation costs to be a highway construction cost, which enabled states to be reimbursed for utility relocation costs.

The Federal-Aid Highway Act of 1944 substantially increased the amount of federal-aid funds available to the states. The act also established a National System of Interstate Highways and modified the definition of construction to include mapping and surveying as well as right of way costs. It also limited the federal contribution to 50 percent of the total construction cost, and it stated that right of way costs could not exceed one-third of the total construction cost.

In 1946, the Public Roads Administration issued General Administrative Memorandum No. 300, which contained detailed working procedures and requirements to implement the 1944 act (*2*). Two of the requirements were the need for a written agreement between a state and a utility owner outlining their respective responsibilities and the need to document actual construction costs, as verified by audit of supporting documentation. Required cost data included labor, materials, transportation, and equipment rental. These required data elements are still in place today.

The Federal-Aid Highway Act of 1956 renamed the National System of Interstate Highways to be the National System of Interstate and Defense Highways and included several provisions to expedite the completion of that system (*3*). The act authorized the reimbursement of utility relocation costs to the states for projects on the federal-aid primary or secondary systems or on the interstate system, including extensions within urban areas, in the same proportion as federal funds were expended on the project as long as those payments did not violate state law.

In 1957, the Bureau of Public Roads issued Policy and Procedure Memorandum 30-4 (PPM 30-4) that superseded the 1946 General Administrative Memorandum No. 300 (*4*). From 1958 to 1973, several revisions modified Policy and Procedure Memorandum 30-4. In 1974, this document was incorporated into FHWA's Federal-Aid Highway Program Manual (*1*).

In 1977, TRB established Technical Committee A2A07 (Utilities) with a mission to focus on the interrelationships between transportation systems and utilities, including the accommodation of utilities in transportation corridors and rights of way. Topics that the committee addressed at the 1978 TRB annual meeting included accommodation of utilities on freeways, combined utility-transportation corridors, computerized mapping and utility data repositories, and field evaluations of pipe locators. TRB changed the A2A07 committee code to AFB70 in 1993.

The 1982 amendment to the 1978 Surface Transportation Assistance Act required competitive bidding for utility relocation work unless a different method was more cost-effective. In 1983, FHWA allowed utility owners to use their own workforce for minor utility relocation projects. Utilities could also use their own workforce for major utility relocation projects, provided FHWA issued a finding of cost-effectiveness. The 1987 amendment to the

Federal-Aid Highway Act expanded the scope of federal participation in utility relocation costs to include projects on any federal-aid system and not just on the federal-aid primary or secondary systems or on the Interstate System as required under the 1956 version of the Federal-Aid Highway Act.

In 1991, FHWA replaced the Federal-Aid Highway Program Manual with the Federal-Aid Policy Guide (*5*). Over the years, FHWA has amended the guide, primarily in response to changes in the Code of Federal Regulations (CFR). For example, the 1995 amendment eliminated the requirement for FHWA to have a pre-award review of preliminary engineering consultant contracts. The amendment required utilities to submit final billings within one year following completion of the utility relocation work, and it eliminated the requirements for the states to certify the completion of utility work and provide evidence of payment prior to reimbursement. The 2000 amendment allowed the use of unit costs for utility relocation reimbursements.

The Telecommunications Act of 1996 was the first major overhaul of telecommunications law in the United States in more than 60 years (*6*). The law enabled utility owners to enter the communications business and to compete in any market against any other. Utility owners that were previously only cable television providers also began to provide telephone and data services. There has also been exponential growth in the demand for broadband high-speed Internet and government-sponsored broadband initiatives to connect "underserved" segments of the population to the Internet.

The 2012 Moving Ahead for Progress in the 21st Century Act included a number of provisions encouraging the use of 3D modeling techniques to accelerate project delivery (*7*). Historically, the project plan of record has been a set of 2D drawings (on paper or digital format) representing plan views, profiles, and cross sections. 2D drawings have multiple limitations, such as the need for multiple views to depict real-world objects in adequate detail and the lack of connectivity between those views, making edits more difficult and increasing the risk of errors and redundancy. 3D modeling techniques are quickly changing the way transportation agencies develop, design, and deliver projects.

The 2018 Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless (MOBILE NOW) Act included provisions to accelerate the deployment of broadband services (*8*). The law made available additional frequencies of federal and non-federal spectrum for wireless broadband use. It also included a 270-day limit for federal agencies to grant or deny applications for leases, rights of way, or easements on federal property for the installation or maintenance of communication facilities. At the state level, it included requirements to facilitate broadband infrastructure right of way efforts, notify broadband infrastructure entities of state transportation improvement programs on an annual basis, and coordinate communication and broadband plans and state and local transportation plans.

HISTORICAL ACCOUNT OF UTILITY RESEARCH

Research to address utility issues during project delivery has generally lagged compared to research in other transportation areas. Utility research has generally focused on coordination and reimbursement topics during design and construction, but less so during planning or preliminary engineering. Relatively little research has been devoted to the development of techniques to improve utility detection, data collection, and data management processes. Research to improve utility detection techniques has been funded primarily by the Pipeline and Hazardous Materials Safety Administration (PHMSA).

As a reference, Table 1 through Table 7 list a few relevant utility-related synthesis, research, and implementation projects at the federal and state levels over the years. Table 1 through Table 7 list both completed and active projects. Table 8 lists a few relevant research projects abroad.

Table 1. Projects Funded by the Second Strategic Highway Research Program (SHRP2).

Project No.	Title	Completed
SHRP2 R15	Strategies for Integrating Utility and Transportation Agency Priorities in Highway Renewal Projects	2008
SHRP2 R15B	Identification of Utility Conflicts and Solutions	2011
SHRP2 R01A	Technologies to Support Storage, Retrieval, and Utilization of 3D Utility Location Data	2013
SHRP2 R01B	Utility Locating Technology Development Utilizing Multi-Sensor Platforms	2013
SHRP2 R01C	Innovation in Location of Deep Utility Pipes and Tunnels	2013
SHRP2 R01	Encouraging Innovation in Locating and Characterizing Underground Utilities	2014
SHRP2 R15C	Pilot Application of Products for the Identification of Utility Conflicts and Solutions	2014

Table 2. Synthesis Projects Funded by Cooperative Research Programs at the Transportation Research Board (TRB).

Project No.	Title	Completed
NCHRP 20-05, Topic 14-03	Reducing Construction Conflicts Between Highway and Utilities	Prior to 1990
NCHRP 20-05, Topic 24-08	Longitudinal Occupancy of Controlled Access Right-of-Way by Utilities – Synthesis 224	1996
NCHRP 20-05, Topic 40-04	Utility Location and Highway Design – Synthesis 405	2010
ACRP 11-03, Topic S09-03	Subsurface Utility Engineering Information Management for Airports – Synthesis 34	2012
NCHRP 20-05, Topic 44-11	Managing Longitudinal Utility Installations on Controlled Access Highway Right-of-Way – Synthesis 462	2014
TCRP J-07, Topic SG-13	Successful Practices for Utility Coordination in Transit Projects	2015
NCHRP 20-05, Topic 47-14	Effective Utility Coordination: Application of Research and Current Practices	2017
NCHRP 20-05, Topic 50-04	Utility Pole Safety and Hazard Evaluation Approaches	Active
NCHRP 20-06, Topic 24-04	The Legal Issues Concerning the Use of Transportation Facilities to Generate Revenue for State DOTs	Active

Table 3. Research Projects Funded by Cooperative Research Programs at TRB.

Project No.	Title	Completed
HRB Special Report 21	Relocation of Public Utilities Due to Highway Improvement – An Analysis of Legal Aspects	1955
NCHRP 20-07, Task 011	Longitudinal Occupancy of Freeways by Utilities	1978
NCHRP 20-24(12)	Avoiding Delays During the Construction Phase of Highway Projects	2001
NCHRP 20-07, Task 248	Guidelines for Utility Encasement Policy for Highway Crossings	2009
NCHRP 20-07, Task 269	Feasibility of Using Incentives to Facilitate Utility Relocations	2009
NCHRP 20-07, Task 312	Successful Practices for Automating Utility Permits	2013
NCHRP 20-84	Improved Right-of-Way Procedures and Business Practices	2014
NCHRP 20-30, IDEA 167	Exploratory Analysis of Augmented Reality Visualization of Right-of-Way Excavation Safety	2016

Project No.	Title	Completed
NCHRP 20-07, Task 373	Utility Coordination Best Practices for Design-Build and Alternative Contracting Projects	2017
NCHRP 20-07, Task 389	Implications of State Departments of Transportation (DOTs) Participation in the One Call Process as an Underground Facility Operator	2018
NCHRP 24-44	Guidelines for Managing Geotechnical Risks in Design-Build Projects	2018
NCHRP 11-08	Improving Rights-of-Way Acquisition and Compensation Practices for Utility Relocation	Active
NCHRP 20-07, Task 407	Utility Coordination Efficiency, Safety, Cost, and Schedule Impacts using various Contracting Methods	Active
NCHRP 20-07, Task 418	An Impact and Value Analysis of Requiring Geo-spatial Locations for Utility Installation As-Builts	Active

Table 4. Projects Funded by FHWA.

Project No.	Title	Completed
N/A	Utility Relocation and Accommodation: A History of Federal Policy Under the Federal-Aid Highway Program, Part I: Utility Relocation and Part II: Utility Accommodation	2003 (Sixth Edition)
FHWA-SA-93-049	Highway/Utility Guide	1993
FHWA-IF-00-014	Cost Savings on Highway Projects Utilizing Subsurface Utility Engineering	2000
FHWA-IF-02-049	Avoiding Utility Relocations	2002
FHWA-PL-02-013	European Right-of-Way and Utilities Best Practices	2002
FHWA-IF-02-64	Manual for Controlling and Reducing the Frequency of Pavement Utility Cuts	2002
FHWA-OP-02-069	Design Guide for Fiber Optic Installation on Freeway Right-of-Way	2002
FHWA-HEP-07-022	Domestic Scan Program: Best Practices in Right-of-Way Acquisition and Utility Relocation	2006
FHWA-PL-09-011	Streamlining and Integrating Right-of-Way and Utility Processes with Planning, Environmental, and Design Processes in Australia and Canada	2009
FHWA-PL-12-025	Developing Multilevel Memorandums of Understanding With Utility Companies	2012
FHWA-PROJ-12-0043	Feasibility of Mapping and Marking Underground Utilities by State Highway Agencies	2018
FHWA-PROJ-14-0015	New Approaches to Utility Cut Pavement Repair	Active
FHWA-PROJ-14-0016	SUP-PRESS – Suppressing Utility Problems – Protection via Robotic Engineering to the Subsurface	Active
SHRP2 Implementation	SHRP2 Implementation Assistance Program – R01A, R01B, and R15B (Rounds 3, 5, 6, and 7)	Active

Table 5. Damage Prevention-Related Projects Funded by PHMSA.

Project No.	Title	Completed
DTRS56-02-T-0005	Digital Mapping of Buried Pipelines with a Dual Array System	2004
DTRS57-04-C-10002	Infrasonic Frequency Seismic Sensor System for Pipeline Integrity Management	2004
DTRS56-02-T-0006	Pipeline Damage Prevention Through the Use of Locatable Magnetic Plastic Pipe and a Universal Locator	2004
DTRS56-04-T-0007	Infrasonic Frequency Seismic Sensor System for Preventing Third Party Damage to Gas Pipelines	2006
DTPH56-08-T-000017	GPS-Based Excavation Encroachment Notification	2011
DTPH56-10-T-000020	Acoustic-based Technology to Detect Buried Pipes	2011

Project No.	Title	Completed
DTPH56-10-T-000019	Advanced Development of PipeGuard Proactive Pipeline Damage Prevention System	2012
DTPH56-08-T-000019	Advanced Development of Proactive Infrasonic Gas Pipeline Evaluation Network	2013
DTPH56-10-T-000021	Advanced Learning Algorithms for the Proactive Infrasonic Pipeline Evaluation Network (PIGPEN) Pipeline Encroachment Warning System	2014
DTPH56-13-T-000001	Subsurface Multi-Utility Asset Location Tool	2014
DTPH56-13-T-000002	Real-Time Multiple Utility Detection During Pipe Installation Using Horizontal Directional Drilling (HDD) System	2016

Table 6. Projects Funded by the Volpe National Transportation Systems Center.

Solicitation No.	Title	Completed
DTRT57-14-R-SBIR1	Robotic Utility Mapping and Installation System (RUMI)	Active
DTRT57-14-R-SBIR1	Integrated Tracking and Guidance (I-TAG) System for Trenchless Utility Relocation	Active

Table 7. Projects Funded by State DOTs.

Project No.	Title	Completed
5-2110-01 (Texas)	GIS-Based Inventory of Utilities	2005
BC353-32 (Florida)	Optimum Placement of Utilities within the Florida Department of Transportation (FDOT) R/W	2005
C-04-04/NYSERDA (New York)	Applications of Ground Penetrating Rader for Highway Pavements	2006
0-4998 (Texas)	Standardization of Special Provisions and Determination of Unit Costs for Utility Installations	2007
510401 WO 8 (Pennsylvania)	Subsurface Utility Engineering Manual	2007
BD544-27 (Florida)	The Efficacy of Utility Database Management	2007
Rowan 10 (New Jersey)	Breakaway Utility Poles	2007
5-2110-03 (Texas)	Internet Based Utility Data Submissions and a GIS Inventory of Utilities	2008
0-5475 (Texas)	Collection, Integration, and Analysis of Utility Data in the Transportation Project Development Process	2008
0-6065 (Texas)	Integrating Utility Conflict Elimination and Environmental Processes	2009
0-6394 (Texas)	Evaluation of Overweight Load Routing on Buried Utility Plant	2011
0-6624 (Texas)	Improving the Response and Participation by Utility Owners in the Project Development Process	2012
0-6631 (Texas)	Best Practices for Utility Investigations in the Texas Department of Transportation (TxDOT) Project Development Process	2012
0-6756 (Texas)	Determine the Cost for TxDOT to Process/Review/Approve Utility and Driveway Permits	2012
UT-11.07 (Utah)	Recommended Protocol and Standards for Utility Data Submittals	2012
BDR74 977-03 (Florida)	Strategic Plan to Optimize the Management of Right-of-Way Parcel and Utility Information at FDOT	2013
55820-00-01 (New York)	Underground Pneumatic Transport of Municipal Solid Waste and Recyclables Using New York City Subway Infrastructure	2013
SPR-07-345 (Kentucky)	Guidelines for Installation of Buried Utilities in Right-of-Way	2013
SPR-460-13-1F (Kentucky)	Methods to Expedite and Streamline Utility Relocations for Road Projects	2014
n/a (Michigan)	Geospatial Utility Infrastructure Data Exchange (GUIDE)	2015
0-6886 (Texas)	Engineering Guidelines for Installing Temporary Lines within the Right-of-Way	2017

Project No.	Title	Completed
SPR-4005 (Indiana)	Warranty Utility Cut Repair (QC/QA of Utility Cut Repair)	2018
55-6IAC002 (Texas)	Utility Conflict Management (UCM) Training & Implementation for TxDOT Districts	Active
P1253 Task 3177 (California)	Solar Power Initiative Using Caltrans Right-of-Way	Active
20-041 (Texas)	Sequencing and Placement of Noise Walls and Retaining Walls on Complex TxDOT Projects	Active
20-104 (Texas)	Quantify the Valuation of Right-of-Way	Active

Table 8. International Research Projects.

Project No.	Title	Completed
GR/R14064/01 (United Kingdom)	Network: Network In Trenchless Technology (Nettwork)	2004
EP/C547365/1 (United Kingdom)	Mapping the Underworld: Buried Asset Location, Identification and Condition Assessment using a Multi-Sensor Approach	2009
EP/F065965/1 (United Kingdom)	Mapping the Underworld: Multi-Sensor Device Creation, Assessment, Protocols	2013
n/a (The Netherlands)	Streamlining Inner City Wastewater Projects	2015
n/a (The Netherlands)	Spying the Underground	2016
n/a (Brazil)	INFRAVIA System – Integration in Urban Design and Infrastructure Networks	2017
n/a (The Netherlands)	ExcaSafeZone	2017
EP/K504191/1 (United Kingdom)	Smart Leak Detection Pipes	2017
n/a (Germany)	Concepts and Methods for Resource-efficient Improvement of Germany's Broadband Infrastructure	2018
EP/R000212/1 (United Kingdom)	Hybrid QT System for Visualisation of Buried Utility Assets (Qvision)	2018
EP/K021699/1 (United Kingdom)	Assessing the Underworld – An Integrated Performance Model of City Infrastructures	2018
82352-509379 (United Kingdom)	Finding Infrastructure with Non-Destructive Imaging Technologies (FINDIT)	2018
n/a (Brazil)	Integrated Management of Urban Planning, Infrastructure, Mobility, and Sustainability	Active
n/a (The Netherlands)	Reduction of Damage to Utilities and Careful Excavation (ZoARG | ReDUCE)	Active
EP/S016813/1 (United Kingdom)	Pervasive Sensing for Buried Pipes	Active

OTHER CURRENT INITIATIVES

A few other initiatives are helping to bring new focus to the management of utility issues during project delivery. Worth noting is the emergence of utility engineering as a recognized engineering specialty and activities by the Committee on Right of Way, Utilities, and Outdoor Advertising Control at the American Association of State Highway and Transportation Officials (AASHTO). The TRB Standing Committee on Utilities plays an important role in these efforts by encouraging and facilitating the participation of committee members and friends in task forces, meetings, and other events; by sharing information about national trends; and by contributing to the development of research ideas and research need statements.

The recognition of utility engineering as an engineering specialty is a major recent development. Utilities are considered a support function at many public agencies, not at the same level as other functions necessary to deliver, operate, and maintain transportation networks.

Within this environment, the field of utility engineering is quickly gaining acceptance as a holistic discipline of practice within the engineering profession in general, and transportation engineering in particular. This paradigm shift is elevating the management of utility issues at transportation agencies to the same level as other recognized engineering specialties, such as traffic, materials and pavements, bridges, environmental, and hydraulics.

The American Society of Civil Engineers (ASCE) has defined utility engineering as a branch of engineering that focuses on the planning, design, construction, operation, maintenance, and asset management of utility systems, as well as the interaction between utility infrastructure and other civil infrastructure (*9*). The second part of the definition is significant because it recognizes that utility facilities do not exist in a vacuum, but rather they exist in a complex environment that includes underground and aboveground elements that constantly interact with other infrastructure within the right of way. It is in this environment that public agencies deliver, operate, and maintain transportation projects. To help promote robust utility engineering practices, ASCE established the Utility Engineering and Surveying Institute (UESI) in 2015. The foundation of utility engineering is six integrated pillars that can be associated with six corresponding areas of expertise (*10*). Figure 2 shows and describes these six pillars.

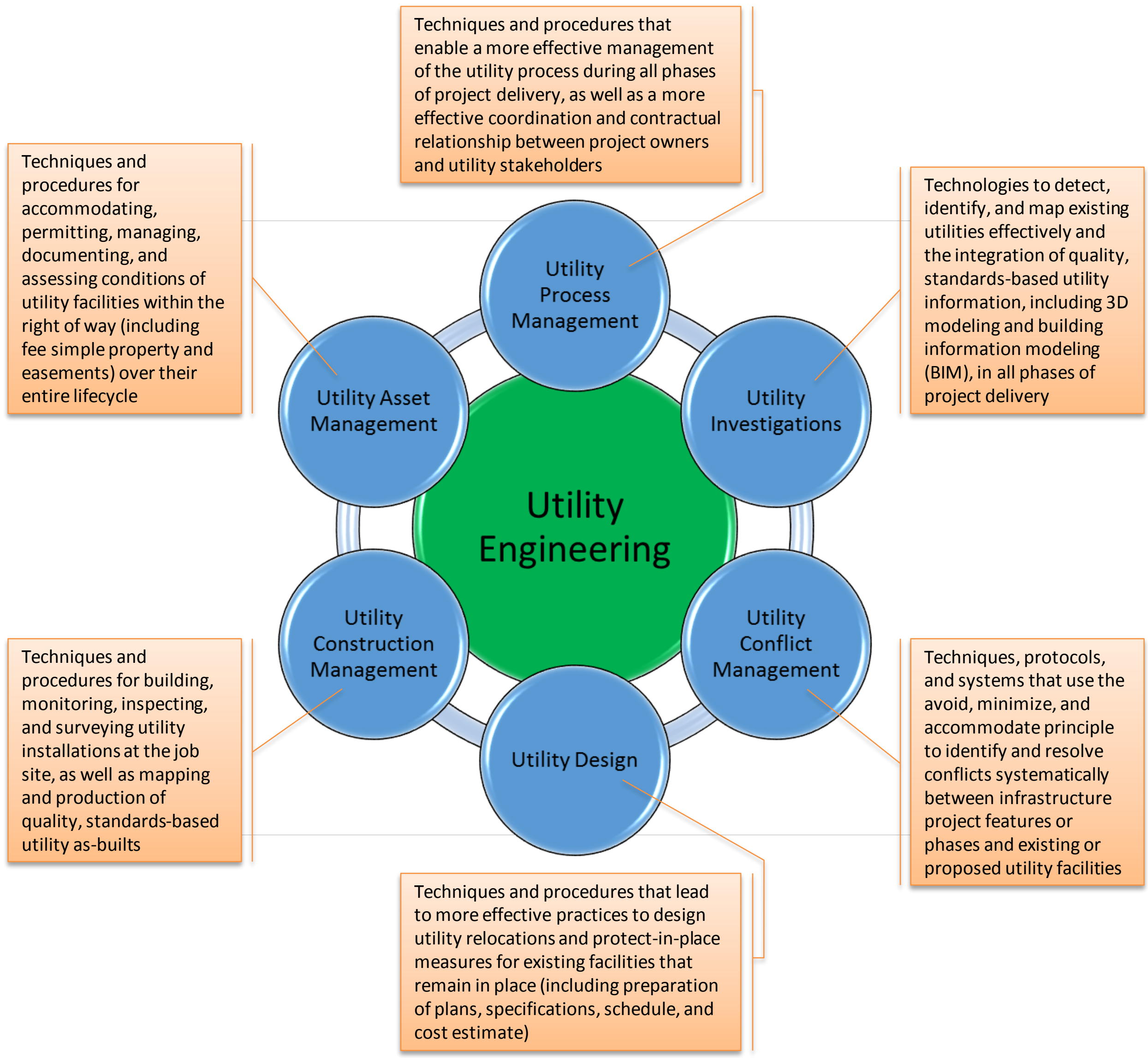

Figure 2. Six Pillars of Utility Engineering.

The AASHTO Committee on Right of Way, Utilities, and Outdoor Advertising Control has several technical subcommittees that identify technical developments, trends, initiatives, issues, and innovations; and prepare an annual report on current issues in each particular area of responsibility. The technical subcommittees were called technical councils when they were established in 2003 (*11*). Technical subcommittee membership and participation include AASHTO members and representatives of local and regional governments, the private sector, and academia.

Three technical subcommittees focus on utility topics:

- Utility Project Scoping and Coordination.
- Utility Accommodation and Safety
- Utility Mapping, Geographic Information Systems (GIS), and Information Management

Many of the synthesis and research projects funded by the cooperative research programs at TRB (see Table 2 and Table 3) have been the result of active participation by technical subcommittee members throughout the entire process. Involvement typically includes identifying a specific need and developing the corresponding need statement, participating as members of the project panel or conducting the synthesis or research project, and assisting with the implementation of successful project products.

Technical subcommittee focus areas change over time as new topics are identified. A small sample of current topics of interest include valuation of permitted communication infrastructure in the public right of way, development of a generalized data flow for managing utility data, training and professional development, utility conflict impacts during construction, and utility coordination effectiveness using various project delivery methods.

A LOOK AT THE FUTURE

A number of critical, emerging, and cross-cutting issues that will influence and shape the transportation community are related to utilities. The following is a partial list of issues and ideas on how to address those issues through research, research implementation, and knowledge transfer.

Strategies to Eliminate Delays and Higher Costs to Transportation Projects Caused by Conflicts with Utilities

Early detection of utility conflicts and a more effective identification of strategies to resolve those conflicts remain relevant. With an ever-increasing volume of utility facilities and owners, it has become vital that a series of steps and strategies be developed to focus utility coordination efforts on those utility issues that can be avoided with minor changes to the project design and more quickly resolve those utility conflicts that cannot be avoided. This is particularly critical for high cost and time-consuming utility conflicts, which are often the most detrimental to project delivery. Research is necessary to document examples where the application of the avoid, minimize, and accommodate principles are applied successfully.

Strategies to Improve the Participation of Utility Owners During Project Delivery

Transportation agencies are not the only party affected by inefficiencies. This problem also affects other stakeholders. Utility owners have a host of challenges of their own, including operating under tight financial conditions. Frequently, utility coordination is a low priority to utility owners because this is not a revenue generating activity. Utility owners also have their own project development process, which affects their ability to coordinate with transportation agencies. Utility owners are the subject matter experts of their facility locations, make, and function. Their infrastructure is an existing and impactful element to the successful delivery of the project to construction. Despite the value their participation may have, they are often not expressly included in the project delivery processes or consulted directly by the awarded contractor charged with the project delivery. As these parties often are working in the same area, sometimes at the same time, it is evident that identifying strategies to facilitate cooperative communication and interaction would help improve both work efforts.

Quantification and Management of Utility-Related Risks During Project Delivery

Risk management involves the identification of uncertain events that can have an impact on a project if they occur. Categories of utility-related risks include, but they are not limited to, uncertainties associated with existing utility locations; structural and operational characteristics of utility facilities; interaction among utilities that occupy a common, confined footprint; utility and project work schedules; inefficiencies and gaps in utility conflict management; traffic control, damage prevention, worker safety, and other construction factors; and cost management. Project managers and designers frequently do not know the level of risk they are assuming. Some tools are beginning to emerge to assist in the process of managing utility risks. However, these tools are generic project management tools and, as such, do not take into account the nuances related to utility data collection, utility accommodation, coordination, costs, and project scheduling. Utility conflict lists are increasingly used throughout project delivery. However, in most cases they focus on risk categories that pertain to locations, but not other dimensions such as schedules or costs. There is a need to develop tools and methodologies that enhance utility conflict management tools, including utility conflict lists, to quantify and manage critical elements of utility risks. The tools and methodologies should be presented in a format that enables project managers and designers to quantify, document, analyze, and make informed decisions about uncertainties and risks in the management of utility issues.

Technologies to Improve the Detection and Documentation of Existing Utility Infrastructure

These technologies are expected to be a combination of geophysical investigative methods combined with positioning techniques. With increased data density and variety will come the need for better interpretation through machine learning and artificial intelligence methods. Available data and utility owner records are usually inadequate to enable a reliable identification and location of utility facilities within project footprints. It is commonplace for One Call marks and field surveys to indicate significantly different locations for the same facilities. The result is confusion, frustration, and extraneous identification of "possible" utility infrastructure on highway project plans. The industry rule of thumb is that only about 60-80 percent of the utility infrastructure within a project footprint is known and, of that infrastructure, no more than 90 percent has any potential of being located accurately with current technologies. Some research has focused on improving the accuracy of utility infrastructure placement and as-built data collection. However, there is a significant need to improve methods locate characterize existing utility infrastructure properly and reliably.

Early Data Management Strategies to Enhance Damage Prevention Practices

Damage prevention should not start 48 hours before excavation. Permitting activities and record keeping will need to produce data that will flow into existing design and construction plans with notifications to users of those plans that there is a change. Opportunities for integration and/or data exchange with state One Call notification centers will need to be explored. As owners and managers of the public right of way, transportation agencies are responsible for issuing occupancy permits and monitoring the placement of all utility infrastructure. The collection and management of utility data is a critical element of agency functions, particularly due to the increasing needs of utility permits, new facility installations, existing utility facility maintenance, road project improvements, and right of way maintenance. The confluence of these driving needs is likely to result in increased risk, damages, and delays if the utility facilities are not well documented and located. There is a good reason that transportation agencies are seeking avenues to document all infrastructure within the right of way.

Technologies and Processes to Improve Utility Data Management Practices Through the Entire Life Cycle of Transportation and Utility Features

There is need to explore strategies such as electronic utility permitting, automated utility conflict detection, radio frequency identification (RFID) markers, and 3D modeling. Effective permitting of utility placement in public right of way is increasing due to the increasing needs of utility consumers. Transportation agencies are seeking technologically savvy means to lend consistency and streamline the permitting of these facilities. Further, since the right of way is first and foremost for the use of the traveling public and not simply a corridor for utilities, the collection of utility location and conflict data is valuable information for future developments of the transportation system. Investigating effective technologies for locating utility infrastructure and conflict identification is essential to support future road development work. A few research projects have reviewed the use of markers for underground utility infrastructure that are accessible from the surface without the need to expose the utility facility. Although the research findings have been generally positive, emphasizing the opportunity of these technologies to improve utility management and safety, adoption of these technologies has been slow. Research could help identify strategies to facilitate the implementation of these technologies.

Curriculum Development and Training for Transportation and Utility Stakeholders

With the growing acceptance of utility engineering as a specialty comes the need for the development of curriculum and training. The six pillars of the utility engineering specialty hold items of interest to both transportation engineer specialists and utility stakeholders. These pieces of valuable information must be defined and shared with transportation engineer specialists and utility stakeholders to relay the value utility engineers impart upon the project and project team. The field of utility engineering is multidisciplinary. Academic and training programs that recognize this reality will have a higher chance of success by building on partnership opportunities across multiple departments and specialty areas.

Strategies to Ensure an Effective Dissemination of Research Results to Users

Most research funded by transportation agencies at the federal and state level is applied research. With few exceptions, e.g., the SHRP2 implementation assistance program, most research products are not effectively translated into transportation practice. There is little systematic knowledge of what research has produced, its potential impact and value, and implementation path. TRB is currently embarking on a research initiative to develop quantitative and qualitative methods for capturing the impacts and value of NCHRP research. It would be helpful if utility needs and topics are properly addressed in this research initiative. At a practical level, it would also be helpful to develop minimum requirements for utility research projects to outline a clear implementation path that includes identification of champions at the federal, state, and local levels to guide the implementation.

Strategies to Generate Revenue and Optimize the Societal Value of The Right of Way

Public agencies around the country manage a huge property asset, the public right of way needed for the transportation infrastructure. A secondary use of the property, as long as it does not interfere with the primary use and safety of the traveling public, is the accommodation of utility facilities. Public agencies typically do not charge a fee for the accommodation of utility facilities in the public right of way as long as the utility serves the public. By comparison, utilities that serve a private or proprietary interest typically pay a fee, often as part of a lease agreement.

Research has synthesized information about potential opportunities where the public right of way could serve alternative uses that would generate revenue for public agencies, such as solar energy generation. Research could generate best practices and lessons learned drawn from past experience to aid public agencies with future alternative right of way projects.

Assessment, Risk Management, and Rehabilitation of Aging Utility Facilities within the Right of Way

The utility infrastructure in the United States is aging. Along with research and procedures to map and document that infrastructure is the need to conduct appropriate risk assessments and identify cost-effective strategies to rehabilitate and upgrade that aging infrastructure. It is not simply a matter of replacing old infrastructure with new infrastructure. Societal values are evolving. At many jurisdictions, residents are beginning to question whether so much aboveground utility infrastructure is sustainable or even desirable. Undergrounding programs are gaining traction. However, there are many unknowns that need to be addressed, including, but not limited to, recommended construction and utility accommodation practices, trade off analysis techniques, and sustainability. At the same time, the utility industry continues to evolve and innovate, but research is necessary to guide these developments.

Strategies to Manage Out-of-Service Utility Infrastructure

The increasing proliferation of out-of-service utility infrastructure is having a detrimental effect on the ability of transportation agencies to deliver projects on time and within budget. Most out-of-service facilities are underground, although anecdotal information suggests that this is also a problem with some aboveground installations. Reasons that out-of-service facilities are difficult to manage include, but are not limited to, difficulty to obtain reliable records from utility owners and inefficiencies when contractors find out-of-service facilities during construction. Sometimes, apparently abandoned pipes are actually operational, including cases where pipes have been repurposed to carry other kinds of utilities, typically communication lines. However, the transportation agencies that were responsible for managing the right of way were not notified of the change in operational status. Research would be beneficial in the development of strategies to manage typical out-of-service facility situations, including removing abandoned facilities to make room for new ones and implementing more effective permitting and inspection procedures for existing out-of-service lines. Standardizing naming conventions would be useful because utility owners and other stakeholders at the local, state, and federal levels use different terminologies that add to the confusion, such as abandoned, out-of-service, inactive, reserved, disabled, and non-attached.

Small Cell Tower and Other Communication Technologies

Small cell communication technologies are being used to extend service coverage of mobile operators and to increase network capacity. Research is currently underway to synthesize legal and regulatory information about public agency obligations to allow access of these technologies to the public right of way, and the public agency's ability to assess reasonable rates for such use. In the case of traditional telecommunication utilities, public agencies have only begun to determine the value of allowing accommodation of these facilities in controlled access right of way. Research would be useful to determine practical methods to determine the value of providing access to the right of way, conditions where such access would be feasible, and potential pitfalls that public agency staff should consider.

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