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BEST MANAGEMENT PRACTICES AND INCENTIVES TO EXPEDITE UTILITY RELOCATION

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16. Abstract

The relocation of utilities often causes delays to the completion of highway projects in Illinois and other states. These delays often result in delayed project completion and reopening of closed roads, and increased design and construction costs. This report presents the findings of a research project funded by the Illinois Center for Transportation (ICT) to investigate, identify, and recommend best management practices (BMPs) and incentives that can be used by the Illinois Department of Transportation (IDOT) to expedite utility relocation and minimize its related work delays. The objectives of this project were to (1) conduct a comprehensive literature review to gather and analyze the most current resource material on BMPs and incentives, (2) analyze the conformance of utility-relocation practices in selected IDOT district offices with related IDOT policies and laws, (3) conduct surveys of other state DOT officials and Illinois utility company representatives to collect and analyze their experiences in utilizing BMPs to expedite utility relocation, (4) evaluate the compliance of the identified BMPs and incentives with federal and Illinois state laws, regulations, and guidelines governing utility relocation, (5) quantify the costs and benefits of all the identified compliant utility-relocation BMPs, and (6) develop a dynamic decision-support tool that enables IDOT to rank the compliant utility-relocation BMPs and incentives based on their district-specific criteria.

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EXECUTIVE SUMMARY

The relocation of utilities is often reported as a major cause of delays to highway projects in Illinois and other states. Utility relocation often results in delayed project completion and reopening of closed roads, and increased design and construction costs. To mitigate these negative impacts of utility-relocation projects, a research project funded by the Illinois Center for Transportation (ICT) was conducted to investigate, identify, and recommend BMPs and incentives that can be used by IDOT to expedite utility relocation and minimize its related work delays. This report presents the findings of this research project. The objectives of this project were as follow:

- Conduct a comprehensive literature review to gather and analyze the most current resource materials and best management practices from other agencies and organizations on the use of incentives to expedite utility relocation. The literature review conducted focused on identifying and categorizing current best management practices and incentives to expedite utility relocation, and analyze the extent and frequency of using these BMPs by all state DOTs.
- Analyze the conformance of utility-relocation practices in selected IDOT district offices with related IDOT policies and laws. This analysis was executed in four steps that focused on (1) performing a comprehensive review of all IDOT policies and laws related to utility relocation; (2) conducting interviews with IDOT officials from a representative sample of IDOT district offices and collecting data from these offices to analyze the conformance of their utility-relocation practices with related IDOT laws and policies; (3) generating a list of recommendations to expedite utility relocations; and (4) identifying the causes and impacts of utility-relocation delays based on the feedback received from the IDOT officials interviewed.
- Conduct two surveys to gather feedback from other state departments of transportation (DOTs) and Illinois utility companies on (1) their use of BMPs and incentives to expedite utility relocation; (2) the overall effectiveness of these BMPs and incentives; (3) their experienced reductions in the duration of utility relocations that were achieved as a result of these BMPs and incentives; (4) additional state DOT implementation costs; (5) the challenges encountered as a result of implementing these BMPs and incentives; (6) the causes and impacts of utility-relocation delays; and (7) the scheduling of IDOT projects by Illinois utility companies.
- Evaluate the compliance of the identified BMPs and incentives with federal and Illinois state laws, regulations, and guidelines governing utility relocation. This analysis provides a list of compliant BMPs and incentives that can be implemented on IDOT utility-relocation projects.
- Quantify the costs and benefits of all the identified compliant utility-relocation BMPs and rank them based on their cost-benefit score.
- Develop a dynamic decision-support tool that enables IDOT to rank the compliant utility-relocation BMPs and incentives based on five criteria: (1) utilization rate; (2) effectiveness rating; (3) project-reduction percentage; (4) implementation cost; and (5) problems and challenges experienced. This interactive support tool provides IDOT districts with the flexibility to rank compliant utility-relocation BMPs based on their specific ranking criteria.

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CHAPTER 1: INTRODUCTION

1.1 PROBLEM STATEMENT

The relocation of utilities often causes delays to the completion of highway projects in Illinois and other states. The United States General Accounting Office (USGAO) conducted a survey to identify the extent and reasons of delays in highway and bridge projects from utility relocation in all states (USGAO 1999). In this survey, utility relocation was reported by 42 states to cause delays on their federal-aid highway and bridge projects. The percentage of delayed federal-aid projects involving utility relocations was reported to be 0–10% in 20 states, 11–20% in 8 states, 21–30% in 6 states, and above 30% in 8 states, as shown in Figure 1. The survey results also identified the most frequent reasons for delays in relocating utilities, as shown in Table 1.

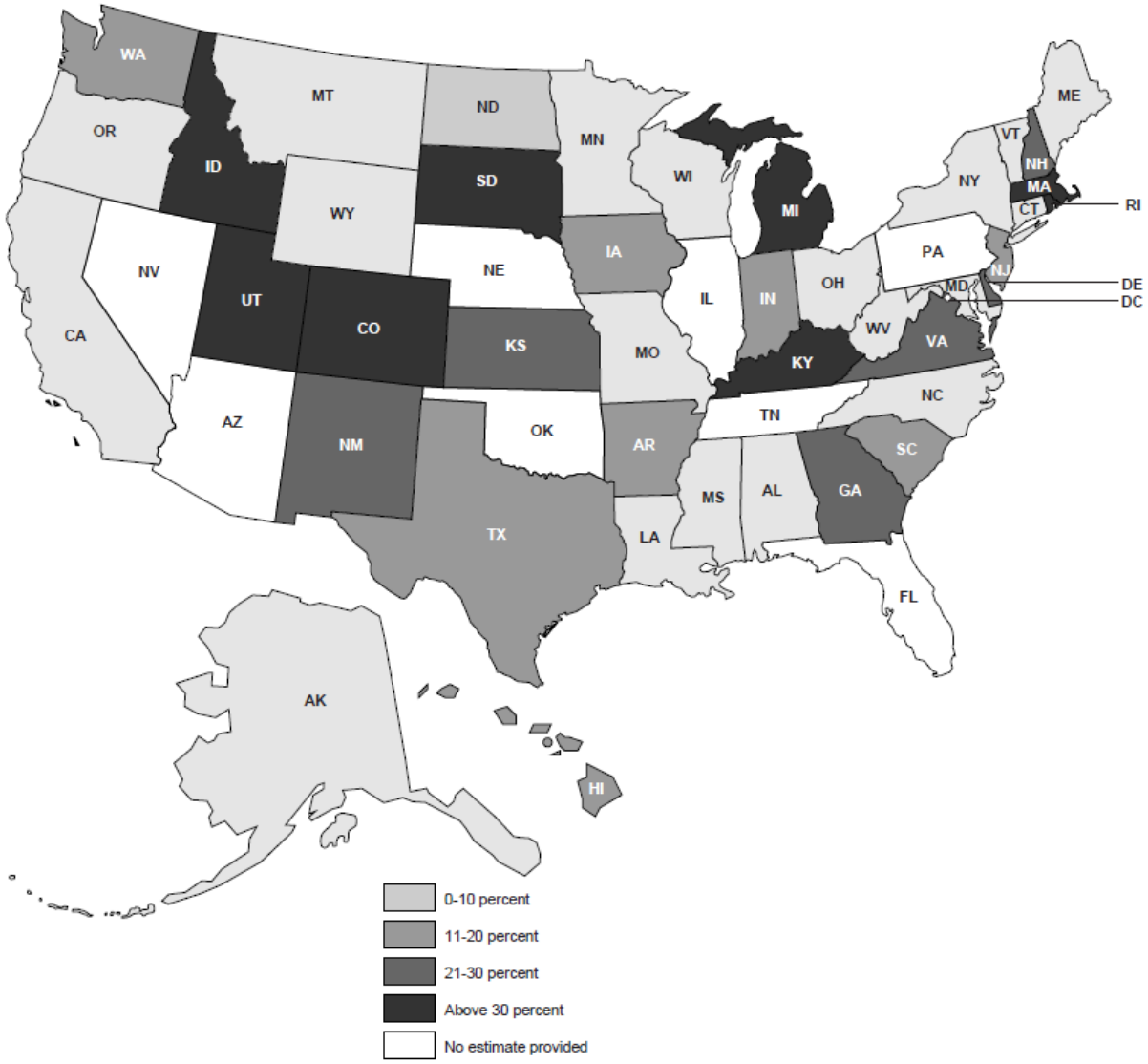

Figure 1. Reported percentages of delayed projects involving utility relocations (USGAO 1999).

Table 1. Reported Reasons for Delays in Relocating Utilities (USGAO 1999)

Reason for delay	Number of States
Utility lacked resources	34
Short time frame for state to plan and design project	33
Utilities gave low priority to relocations	28
Increased workload on utility-relocation crews because highway/bridge construction had increased	28
Delays in starting utility-relocation work: some utilities would not start until construction contract was advertised or let	28
Phasing of construction and utility-relocation work out of sequence	26
Inaccurate locating and marking of existing utility facilities	23
Delays in obtaining right-of-way for utilities	23
Shortages of labor and equipment for utility contractor	19
Project-design changes required changes to utility-relocation	19
Utilities were slow in responding to contractors' requests to locate and mark underground utilities	16
Inadequate coordination or sequencing among utilities using common poles/ducts	13

The reasons in Table 1 for delays in relocating utilities, as reported by USGAO, can be addressed and minimized by identifying and implementing best management practices (BMPs) and incentives to expedite utility relocations. Accordingly, IDOT needs more information on BMPs that (a) have been successfully used by other state DOTs; (b) are compliant with state and federal laws; and (c) provide the best benefit-to-cost ratio.

1.2 RESEARCH OBJECTIVES AND METHODOLOGY

The main goal of this research project was to investigate, identify, and recommend BMPs and incentives that can be used by IDOT to expedite utility relocation and minimize its related work delays. To accomplish this goal, the research objectives of these project were to

1. Conduct a comprehensive literature review to gather and analyze the latest research studies on BMPs and incentives to accelerate utility relocation and minimize its related work delays.
2. Review IDOT practices and policies on utility relocation.
3. Conduct surveys of DOT officials in other states and representatives of utility companies in Illinois to identify their BMPs to expedite utility relocation.
4. Evaluate the compliance of the identified BMPs with state and federal laws.
5. Study and quantify the costs and benefits of implementing the identified BMPs in Illinois.
6. Develop recommendations that can be used by IDOT to expedite utility relocation and minimize its related work delays.

1.2.1 Proposed Techniques and Methodology

The research team accomplished the project objectives by adopting a rigorous research methodology. The methodology broke down the research work into six major tasks (see Figure 2) that are described in more detail in the following chapters and appendices.

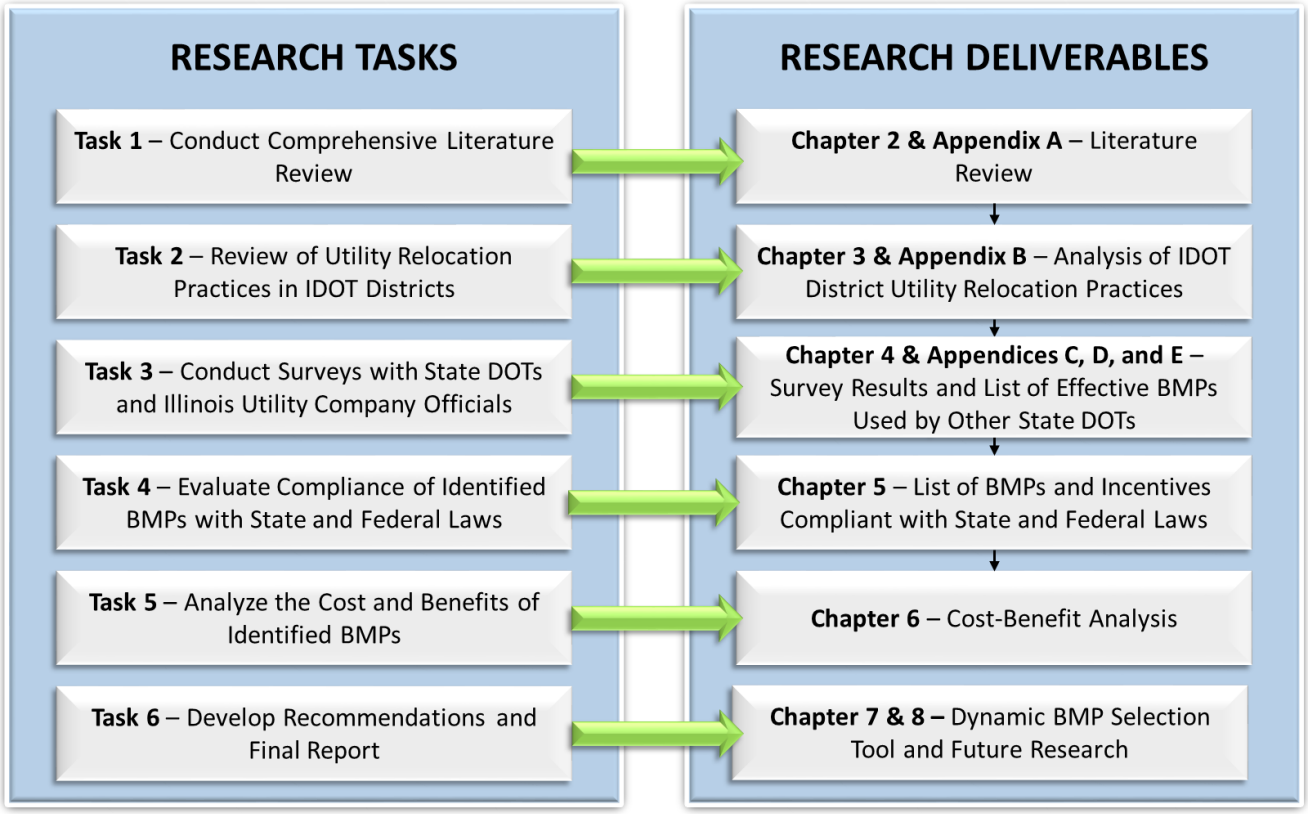

Figure 2. Research tasks and deliverables.

CHAPTER 2: LITERATURE REVIEW

This chapter summarizes the findings of the literature review conducted on best management practices (BMPs) and incentives that were recently used or suggested by DOTs in other states and by utility companies. The objective of this literature review was to identify and analyze all BMPs and incentives that were reported by all state DOTs and federal agencies, including the Transportation Research Board, American Association of State Highway and Transportation Officials, National Cooperative Highway Research Program, and Strategic Highway Research Program (Ellis and Herbsman 1991, Scott 2011 and 2013, AASHTO 2005, Anspach 2010, Quiroga et al. 2012, Ellis et al. 2009, Bell et al. 2014, and FHWA 2003 and 2004). A total of 45 BMPs were identified in this literature review. These 45 identified BMPs and incentives were organized and grouped in four main categories: (1) coordination practices; (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices, as seen in Figure 3. The following sections provide a concise description of the identified BMPs and incentives in each of these four categories. Additional detailed descriptions of these BMPs and incentives are included in Appendix A.

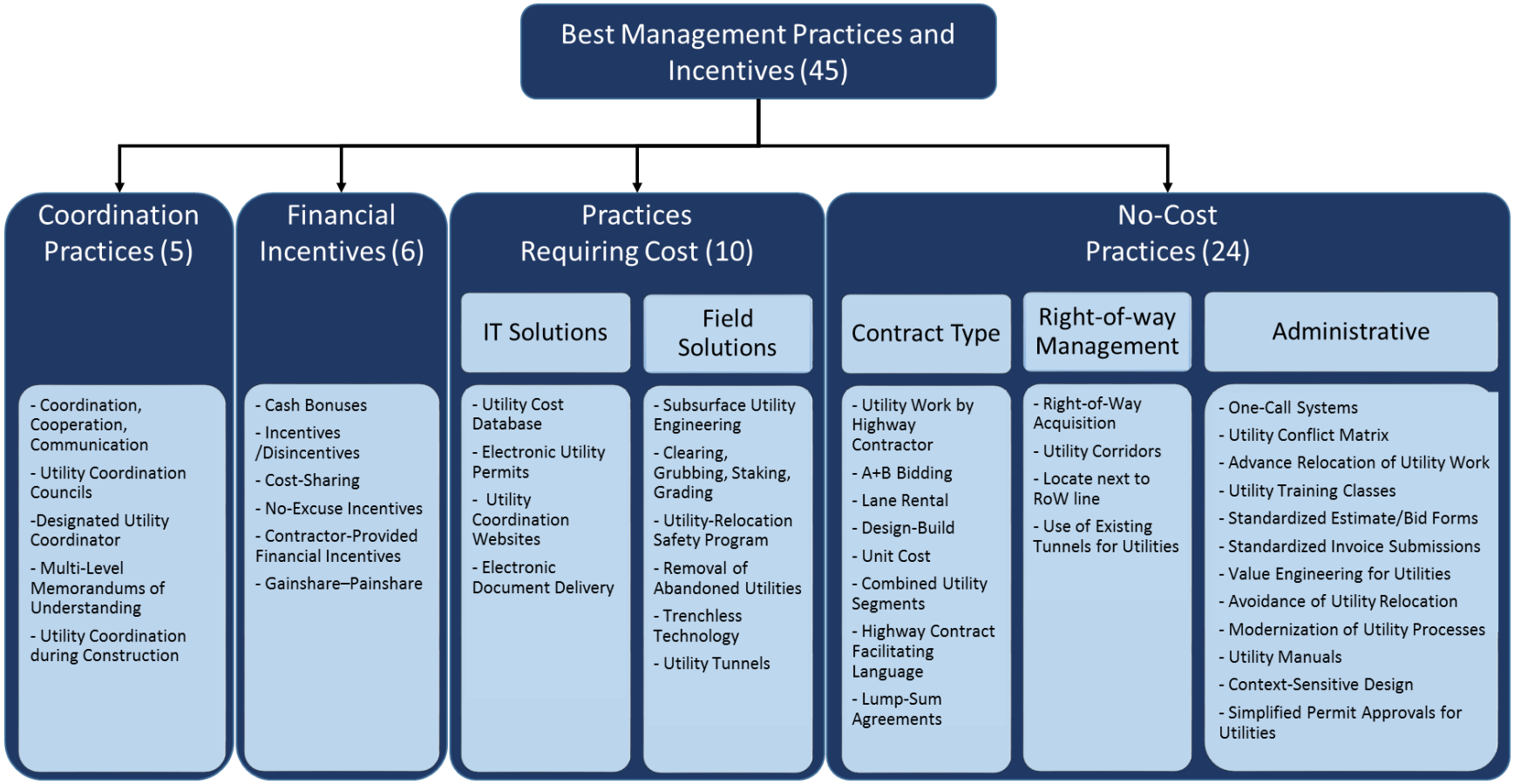

Figure 3. Organization of utility-relocation best management practices and incentives.

2.1 COORDINATION PRACTICES

These best management practices were identified as effective to expedite utility relocation by promoting coordination between the state DOT and utility companies. They minimize delays by implementing plans and procedures for communication and addressing utility conflicts and project issues. This category includes (1) coordination, cooperation, and communication; (2) utility coordination councils; (3) designated utility coordinators; (4) multi-level memorandums of understanding; and (5) utility coordination during construction, as shown in Figure 4 (FHWA 2002a, FHWA 2002b, FHWA 2002c, Scott 2011, Wilde et al. 2002, Ellis et al. 2009, and Quiroga et al. 2012). The following provides concise description of these five coordination practices:

1. Coordination, cooperation, and communication: A collaborative effort in which project members share and request information to reduce utility-related issues.
2. Utility coordination councils (UCC): Councils formed of utility companies, government agencies, contractors, and support companies that meet regularly to discuss utility issues.
3. Designated utility coordinators: A state-designated or -required individual responsible for coordinating utility issues on a project.
4. Multi-level memorandums of understanding (MOU): MOUs summarize the objectives, obligations, and terms of agreement between a state DOT and a utility company.
5. Utility coordination during construction: Extending utility coordination during roadway construction to assist with unexpected utility issues.

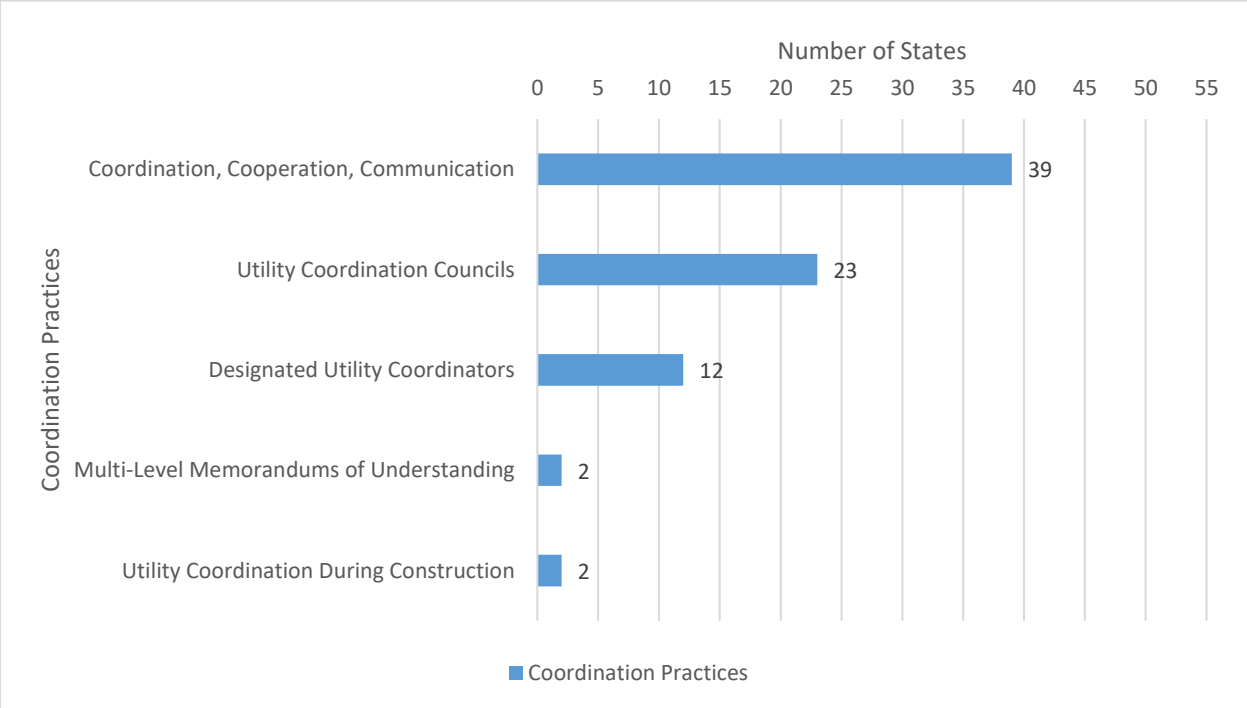

Figure 4. Reported use of coordination best management practices.

2.2 FINANCIAL INCENTIVES

In this category, the state DOT provides utility companies or contractors with financial incentives to expedite utility relocation. These practices include (1) cash bonuses, (2) incentives/disincentives, (3) cost-sharing, (4) no-excuse incentives, (5) contractor-provided financial incentives, and (6) gainshare–painshare, as shown in Figure 5 (FHWA 2002c and 2004, Ellis et al. 2009, Scott 2011, and Hosseinian and Carmichael 2013). The following provides a concise description of these six financial incentives:

1. Cash bonuses: Monetary bonuses paid directly to utility companies or contractors for on-time or accelerated utility relocations.
2. Incentives/Disincentives (I/D): A contract structure that compensates the contractor for each day that identified milestones are completed ahead of schedule and assesses a deduction for each day the contractor overruns.
3. Cost-sharing: The first type of cost-sharing requires a utility company to pay a specified share of any additional cost over an agreed upon target price. The second type assigns the majority of utility-relocation costs not covered by federal funding to the utility company.
4. No-excuse incentives: A monetary bonus awarded to the utility company/contractor if milestone tasks are achieved by specified contract dates, regardless of any delays normally granted on construction projects.
5. Contractor-provided financial incentives: An agreement that places full responsibility for all utility relocations on the contractor instead of the state DOT. The contractor coordinates utility issues and provides incentives to utility companies for early completion.
6. Gainshare–painshare: A cooperative contractual relationship where all parties share benefits and risks.

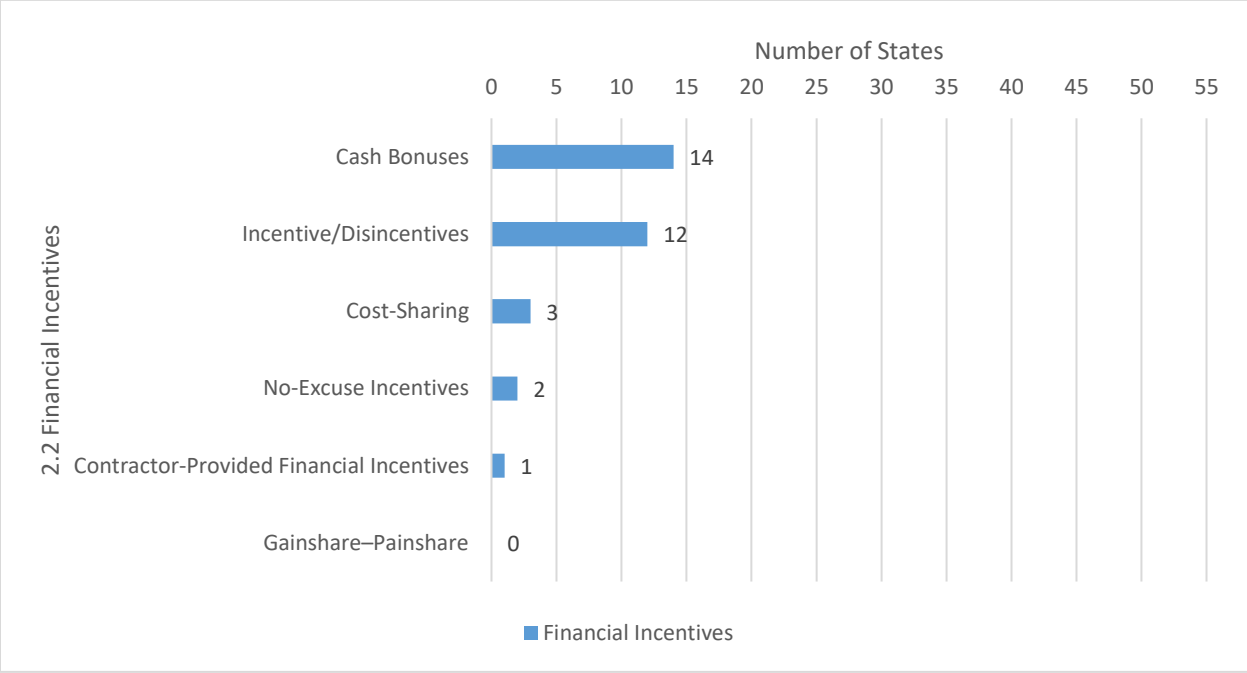

Figure 5. Reported use of financial-incentive best management practices.

2.3 PRACTICES REQUIRING COST

This category includes all identified BMPs that may require additional cost from the state DOT to implement. The identified BMPs in this category can be grouped and organized in two subcategories: (1) IT solutions and (2) field solutions, which are discussed in the following subsections.

2.3.1 IT Solutions

This subcategory includes all BMPs that require the implementation of an IT solution to improve the efficiency and effectiveness of utility relocation. The BMPs identified in this subcategory include (1) utility-cost database, (2) electronic utility permits, (3) utility coordination websites, and (4) electronic document delivery, as shown in Figure 6. The maintenance costs of these BMPs were reported to be minor, but the IT solutions produced consistent benefits throughout the life of the system (FHWA 2002c, Ellis et al. 2009, Bell et al. 2014, and Scott 2013). The following provides a concise description of these four IT-solution practices requiring cost:

1. Utility-cost database: A DOT database used to track and analyze utility-relocation costs.
2. Electronic utility permits: Electronic utility-permitting systems follow the same procedures as traditional permitting but save time by removing the need to mail in or physically deliver forms.
3. Utility coordination websites: Utility coordination websites improve communication among state DOTs, contractors, and utility companies.
4. Electronic document delivery: Electronic document delivery (EDD) or file transfer protocol (FTP) sites have the potential to expedite utility relocation by increasing communication between project members.

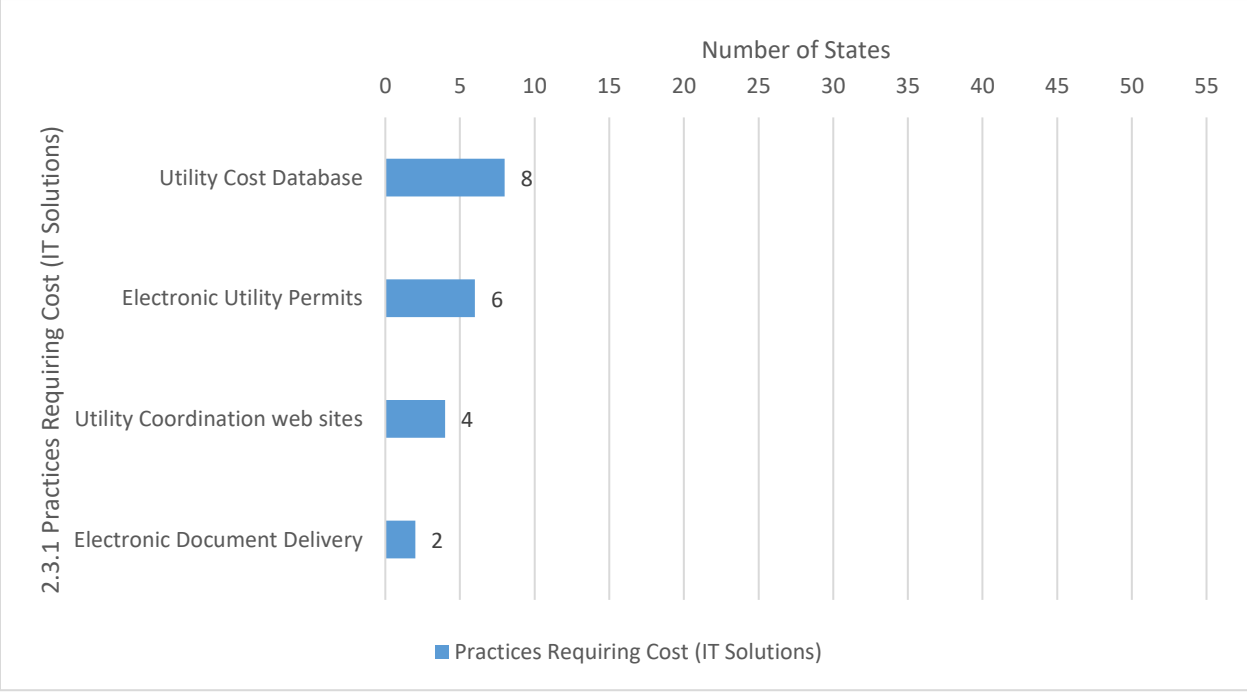

Figure 6. Reported use of IT-solution best management practices.

2.3.2 Field Solutions

This subcategory includes all BMPs that require the implementation of field solutions to improve the efficiency and effectiveness of utility relocation. The BMPs identified in this subcategory include (1) subsurface-utility engineering; (2) clearing, grubbing, staking, grading; (3) utility-relocation safety programs; (4) removal of abandoned lines; (5) trenchless technology; and (6) utility tunnels, as shown in Figure 7. These field solutions require a cost to implement but have been reported to improve coordination, minimize risk of unknown utilities, and increase safety (Scott 2011, Ellis et al. 2009, FHWA 2002 and 2003, Bell et al. 2014, and USGAO 1999). The following provides a concise description of these six field solution practices requiring cost:

1. Subsurface-utility engineering: Subsurface-utility engineering involves the use of technology to map and manage underground utility data.
2. Clearing, grubbing, staking, grading: State DOTs employ the highway contractor or a subcontractor to prepare the utility-relocation area prior to the utility company/contractor performing work.
3. Utility-relocation safety programs: A safety program implemented to relocate utility poles that experience high accident rates.
4. Removal of abandoned utilities: The complete removal of abandoned utility lines to avoid future conflicts and delays.
5. Trenchless technology: Trenchless technologies, such as utility tunneling and directional drilling, utilized to reduce the need for surface work.
6. Utility tunnels: A designated longitudinal space for utility lines, constructed of large-diameter pipes and manholes to access, maintain, and repair utilities if necessary.

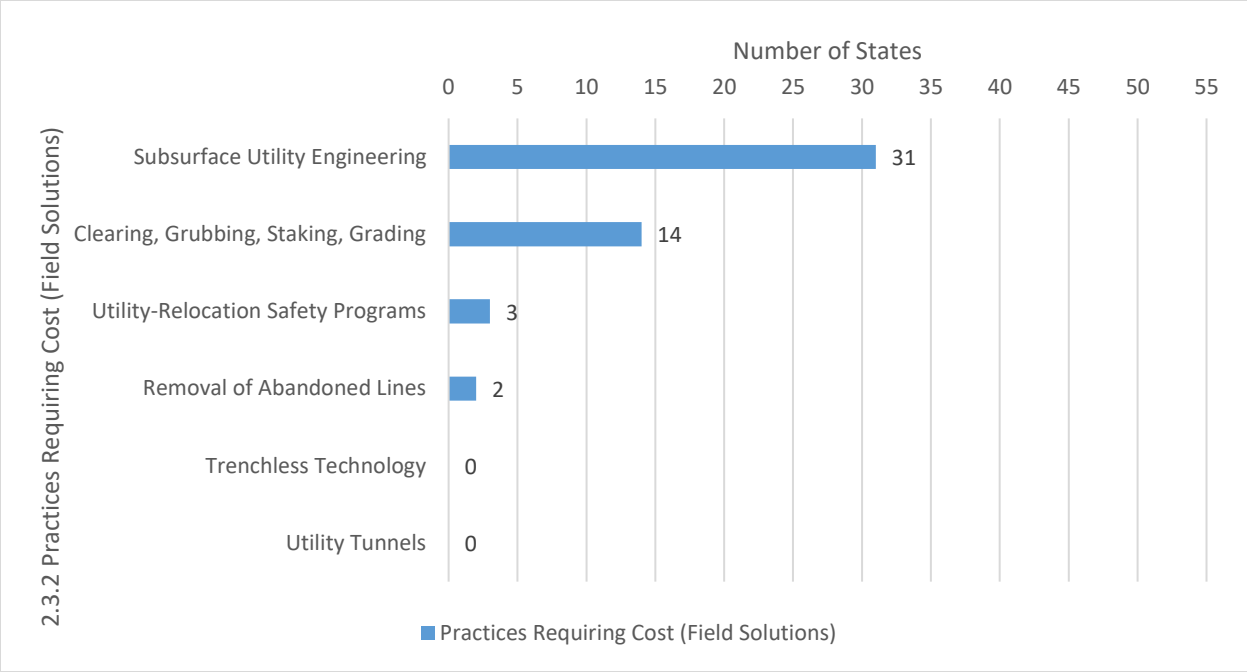

Figure 7. Reported use of field-solution best management practices.

2.4 NO-COST PRACTICES

This category includes all identified BMPs that do not require additional cost from the state DOT to implement. The BMPs identified in this category can be grouped and organized into three subcategories: (1) contract type, (2) right-of-way management, and (3) administrative, which are discussed in the following subsections.

2.4.1 Contract Type

This subcategory includes all contract-related BMPs and incentives to expedite utility relocation. The BMPs identified in this subcategory include (1) utility work by highway contractors, (2) A + B bidding, (3) lane rental, (4) design–build for utilities, (5) unit costs, (6) combined utility segments, (7) highway-contract-facilitating language, and (8) lump-sum agreements, as shown in Figure 8. These BMPs were reported to benefit highway construction projects, but they have not been widely applied to utility-relocation projects (Scott 2011, FHWA 2002, Herbsman et al. 1995, and Ellis et al. 2009). The following provides a concise description of these eight contract-type no-cost practices:

1. Utility work by highway contractors: An agreement that assigns utility relocation to the roadwork contractor.
2. A + B bidding: A competitive bid-evaluation method that encourages contractors to minimize their bid for both the project time and cost.
3. Lane rental: A contracting technique that requires utility companies or contractors to pay the DOT an agreed upon fee for renting and closing a lane.

4. Design–build for utilities: A contracting method that utilizes a single firm for both design and construction. This method has the potential to expedite the overall project duration by allowing an overlap of the design and construction phases.
5. Unit costs: DOTs utilize predetermined unit costs to reimburse utility companies/contractors for utility relocation instead of reimbursing them based on the actual costs incurred.
6. Combined utility segments: Combining utility segments from multiple highway projects to reduce the number of potential errors on drawings and other contract forms.
7. Highway-contract-facilitating language: The use of contract language that encourages highway contractors to aggressively minimize delays.
8. Lump-sum agreements: A contract agreement that allows the utility company/contractor to be reimbursed for a total amount instead of a per unit basis.

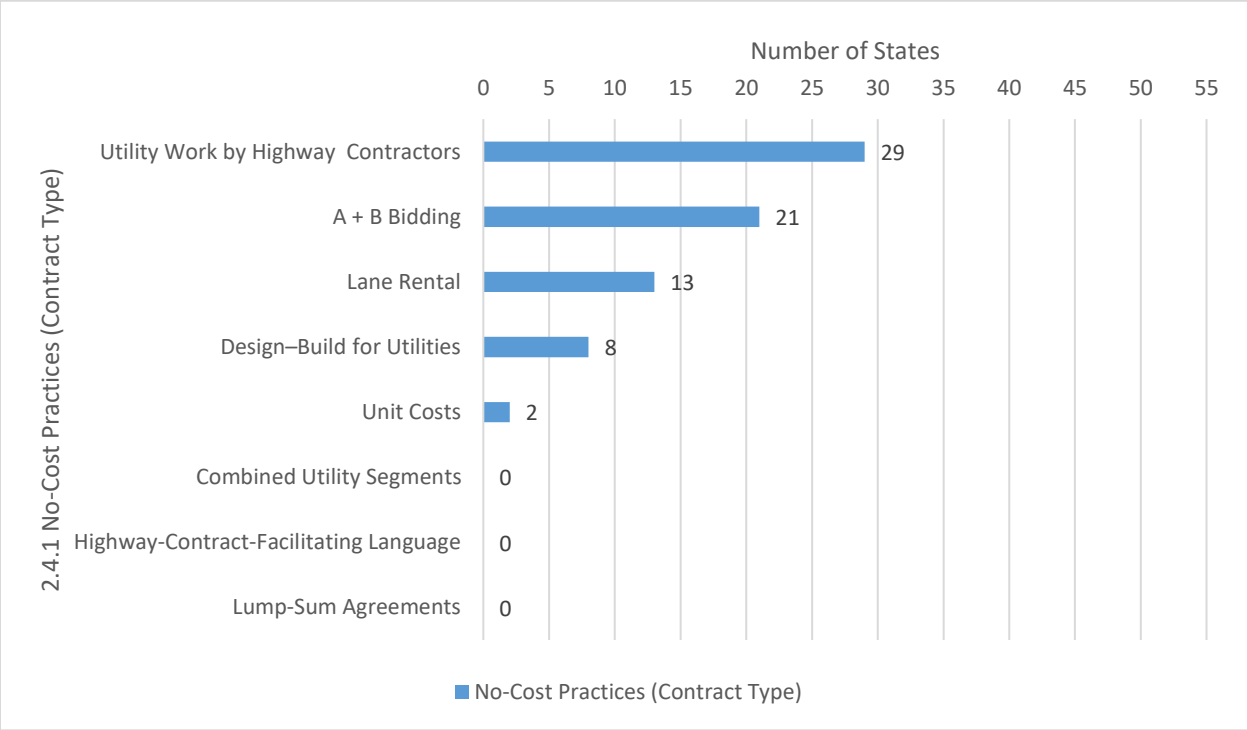

Figure 8. Reported use of contract-type best management practices.

2.4.2 Right-of-Way Management

In this subcategory of BMPs, the state DOT utilizes right-of-way management techniques to expedite utility relocation. The BMPs identified in this subcategory include (1) right-of-way (RoW) acquisition, (2) utility corridors, (3) locating next to RoW line, and (4) use of existing tunnels for utilities, as shown in Figure 9. These right-of-way management practices expedite utility relocation through simplifying the right-of-way acquisition and utility-installation site (Scott 2011, Quiroga et al. 2012, Ellis et al.

2009, FHWA 2002, Krause 2014, and USGAO 1999). The following provides a concise description of these four right-of-way no-cost practices:

1. Right-of-way acquisition: State DOTs acquire right-of-way for both roadway and utility use.
2. Utility corridor: A narrow strip of right-of-way that is adjacent to highways and used exclusively for utilities.
3. Locating next to RoW line: A federal requirement for aboveground utilities that must be located as close as possible to the right-of-way line to ensure that they are at the farthest location from the highway.
4. Use of existing tunnels for utilities: Utilizing existing or abandoned tunnels as passageways for utility installation.

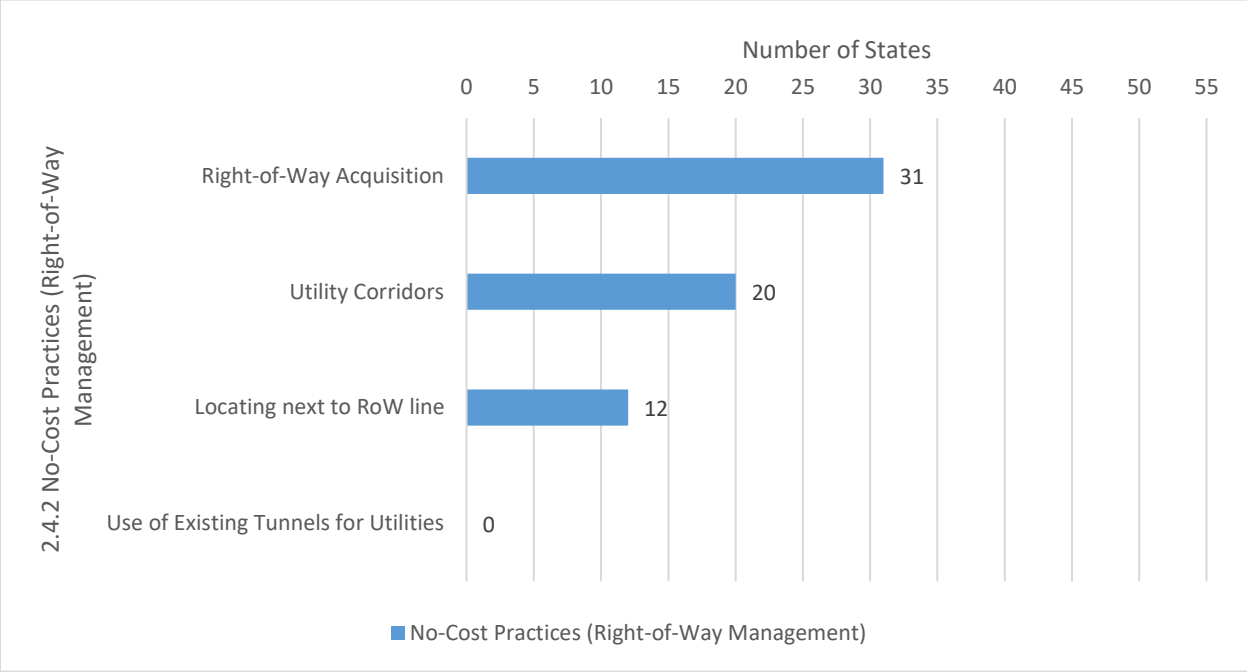

Figure 9. Reported use of right-of-way best management practices.

2.4.3 Administrative

This subcategory includes administrative BMPs and incentives that improve the efficiency and effectiveness of utility relocation. The five most used no-cost administrative BMPs are (1) one-call systems, (2) utility conflict matrix, (3) advance relocation of utility work, (4) utility training classes, and (5) standardized estimate/bid forms, as shown in Figure 10. These administrative practices include solutions to avoid conflicts, simplify administrative processing, reduce costs, and streamline procedures. These practices expedite utility relocation by reducing conflicts and issues between the state DOT and the utility company (Scott 2011, Ellis et al. 2009, Quiroga et al. 2013, FHWA 2002, and Bell et al. 2014). The following provides a concise description of these twelve no-cost administrative practices:

1. One-call systems: Nationwide programs that require contractors to contact utility companies prior to excavation to prevent damaging of utilities.
2. Utility conflict matrix: Project teams identify, organize, and track utility conflicts, potential utility conflicts, and construction obstacles to give team members ample time to resolve conflicts.
3. Advance relocation of utility work: A requirement for utility relocation to be performed before highway construction begins, to minimize contractor–utility coordination and potential conflicts.
4. Utility training classes: State-developed utility training classes offered to familiarize personnel working on utility projects with procedures and situations they may encounter.
5. Standardized estimate/bid form: A standardized estimate/bid form is utilized to improve the efficiency of reviewing submitted bids.
6. Standardized invoice submissions: A standardized invoice facilitates the review of billing requests and enables the state DOT to expedite payment to utility companies/contractors.
7. Value-engineering for utilities: A practice in which a qualified team of contractors, consultants, and design personnel review and improve the design and construction of a project to maximize value for the DOT and to minimize the project cost.
8. Avoidance of utility relocation: A coordination practice used during the design process to minimize or avoid utility relocation altogether.
9. Modernization of the utility procedures: An internal review and update of DOT utility manuals and procedures to ensure that documentation is kept up-to-date.
10. Utility manuals: A utility manual that highlights the roles and responsibilities of DOT employees and utility companies.
11. Context-sensitive design: A collaborative effort between the state DOT, utility companies, and contractors with community leaders to design a project plan that does not harm the environment, physical setting, scenery, or historic sites but still allows for the installation and maintenance of utilities.
12. Simplified permit approvals for utilities: A simplified utility-permitting process for utility companies/contractors to expedite the administrative work of utility relocations.

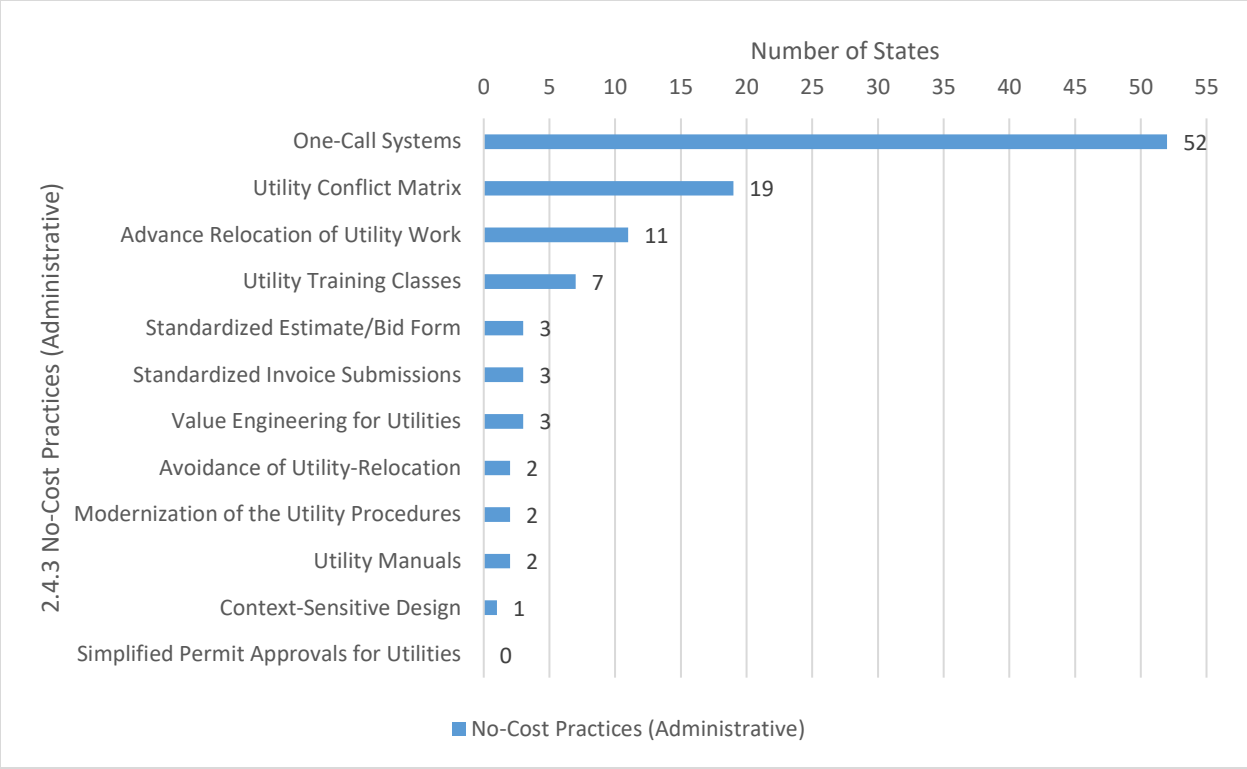

Figure 10. Reported use of administrative best management practices.

2.5 USE OF UTILITY-RELOCATION BMPS BY STATE DOTS

This section analyzes the use of the aforementioned 45 best management practices by all 50 state DOTs, as well as Washington, DC, and Puerto Rico. This analysis was based on the findings of the literature review of recent surveys and/or research studies (Scott 2011, USGAO 1999, Ellis et al. 2009, Bell et al. 2014, Quiroga 2012, and Krause 2014). Accordingly, the findings of this analysis might not accurately represent the current use of these BMPs by all state DOTs because it is possible that the use of these BMPs and incentives has changed in recent months or years after the publication of these reports. The findings of this analysis are summarized in Figure 11 and Table 2. The results in these figures show that the BMPs that were used by more than 25 state DOTs are (a) one-call system; (b) coordination, cooperation, and communication; (c) subsurface-utility engineering; (d) right-of-way acquisition; and (e) utility work by highway contractors. Table 2 summarizes the number of BMPs and incentives used by each state. The average number of BMPs and incentives used by each state was calculated to be eight practices.

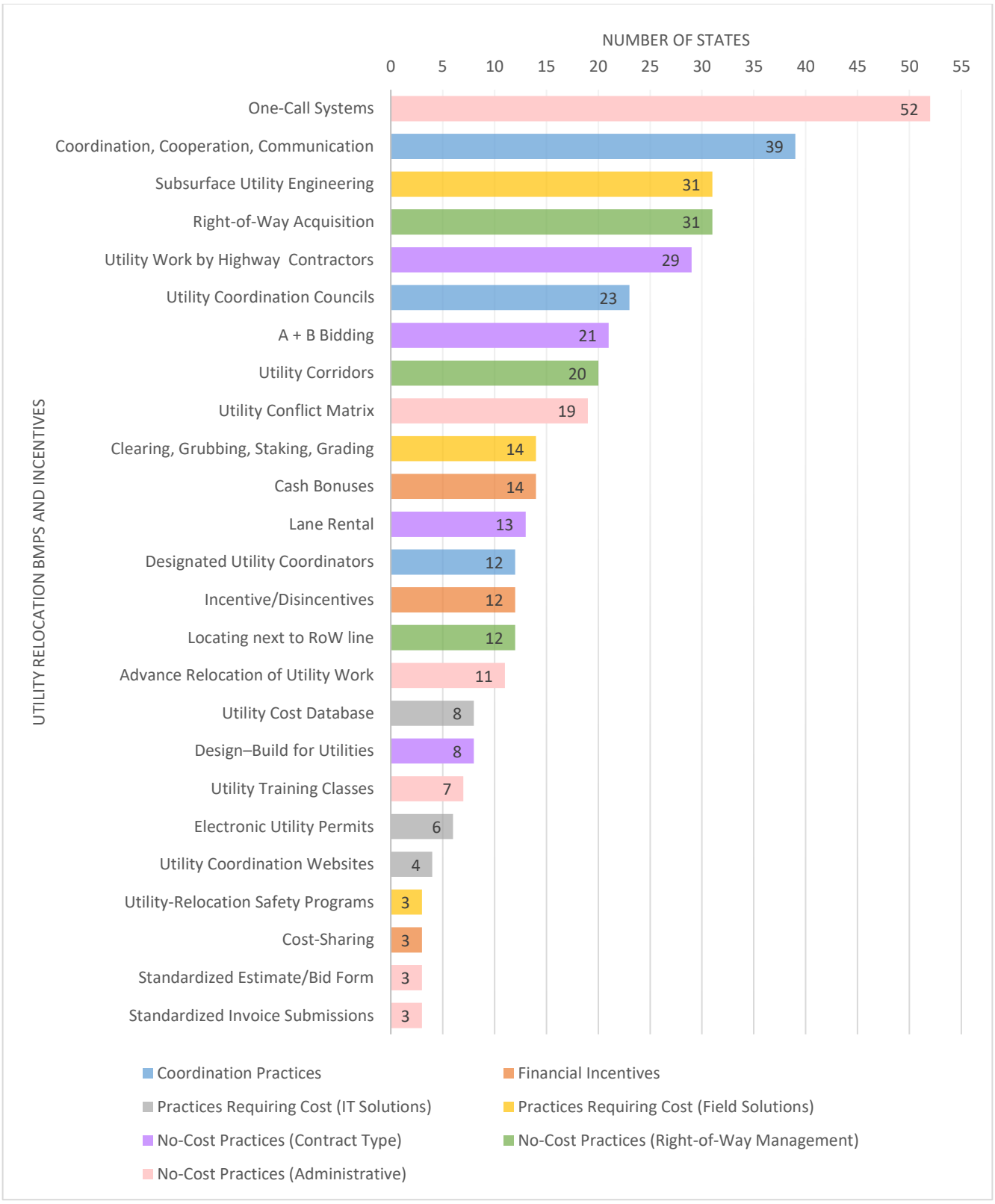

Figure 11. Top 25 utility-relocation BMPs and incentives in use.

Table 2. Number of Utility-Relocation BMPs and Incentives Used by Each State

State	Total	Reference
AL	8	ALDOT 2015
AK	4	DOT&PF 2015
AZ	10	ADOT 2015
AR	6	AHTD 2015
CA	10	Caltrans 2015
CO	7	CDOT 2015
CT	3	ConnDOT 2015
DE	9	DelDOT 2015
FL	16	FDOT 2015
GA	14	GDOT 2015
HI	2	HDOT 2015
ID	8	ITD 2015
IL	8	IDOT 2015
IN	9	INDOT 2015
IA	5	DOT 2015
KS	8	KDOT 2015
KY	8	KYTC 2015
LA	6	DOTD 2015
ME	8	MaineDOT 2015
MD	12	MDDOT 2015
MA	5	MADOT 2015
MI	13	MIDOT 2015
MN	11	MnDOT 2015
MS	6	MSDOT 2015
MO	8	MoDOT 2015
MT	10	MDT 2015

State	Total	Reference
NE	3	NDOR 2015
NV	6	NDOT 2015
NH	6	NHDOT 2015
NJ	4	NJDOT 2015
NM	4	NMDOT 2015
NY	8	NYSDOT 2015
NC	13	NCDOT 2015
ND	4	NDDOT 2015
OH	13	OhioDOT 2015
OK	5	OklahomaDOT 2015
OR	9	OregonDOT 2015
PA	13	PennDOT 2015
PR	5	DTOP 2015
RI	8	RIDOT 2015
SC	10	SCDOT 2015
SD	6	SDDOT 2015
TN	12	TDOT 2015
TX	16	TxDOT 2015
UT	10	UDOT 2015
VT	5	VTrans 2015
VA	12	VDOT 2015
WA	8	WSDOT 2015
WV	7	WVDOT 2015
WI	12	WisDOT 2015
WY	6	WYDOT 2015
DC	2	DDOT 2015

CHAPTER 3: REVIEW OF UTILITY-RELOCATION PRACTICES IN IDOT DISTRICTS

This chapter describes the analysis conducted to study the conformance with IDOT laws and policies of utility-relocation practices in a representative sample of IDOT district offices. This conformance analysis was conducted in four steps that are designed to (1) perform a comprehensive review of all IDOT policies and laws related to utility relocation, (2) identify a representative sample of IDOT districts and IDOT officials who were interviewed as part of this analysis, (3) develop a preliminary questionnaire that was emailed to IDOT officials before the interviews to maximize the efficiency and effectiveness of the interviews conducted, and (4) conduct interviews and report their findings on the degree of conformance between utility-relocation practices and IDOT policies. These four steps and their outcomes are discussed in the following sections of this chapter.

3.1 UTILITY-RELOCATION LAWS AND IDOT POLICIES

In this step, a comprehensive review was conducted to identify and study all related federal regulations and guides, state laws, and IDOT policies that govern utility relocation/adjustment in Illinois. The findings of this review are organized into three main sections that focus on (1) related federal laws and regulations, (2) related state laws, and (3) IDOT policies governing utility relocation. These main findings are described in detail in Chapter 5.

3.2 IDENTIFYING A REPRESENTATIVE SAMPLE OF IDOT DISTRICTS AND OFFICIALS

To identify a representative sample of the IDOT districts and officials that would be interviewed, the research team obtained feedback and guidance from the Technical Review Panel (TRP). The TRP provided a representative sample of IDOT district offices that consisted of five district offices, as well as the IDOT Bureau of Land Acquisition, as shown in Table 3 and Figure 12. These five districts range from urban to rural and cover varying population densities, providing a representative sample of the state of Illinois. In addition, for each of the districts identified, the TRP provided contact information for IDOT officials who administer utility-relocation projects, as well as for land-acquisition personnel in Springfield. Names of the IDOT personnel who were interviewed in this study and their titles are listed in Table 3.

Table 3. IDOT Personnel Interviewed

Location	Name	Title
District 1 - Schaumburg	Jose Dominguez	Project Support Engineer
District 1 – Schaumburg	Tim House Jr	Area Utility Coordinator
District 3 – Ottawa	Amy Reed	Project Support Engineer
District 5 – Paris	Dan Magee	Utilities Coordinator
District 5 – Paris	Kevin Knoepfel	Project Support Engineer
District 5 – Paris	Josh Lowry	Permits Technician
District 7 – Effingham	Theresa Petersen	Project Support Engineer
District 7 – Effingham	Ken Grove	Railroad/Utilities Coordinator
District 7 – Effingham	Greg Jamerson	Interim Program Development Engineer
District 9 – Carbondale	Greg McLaughlin	Project Support Engineer
District 9 – Carbondale	David Barger	Railroads Coordinator
Land Acquisition – Springfield	Steven Warren	Program Management Section Chief

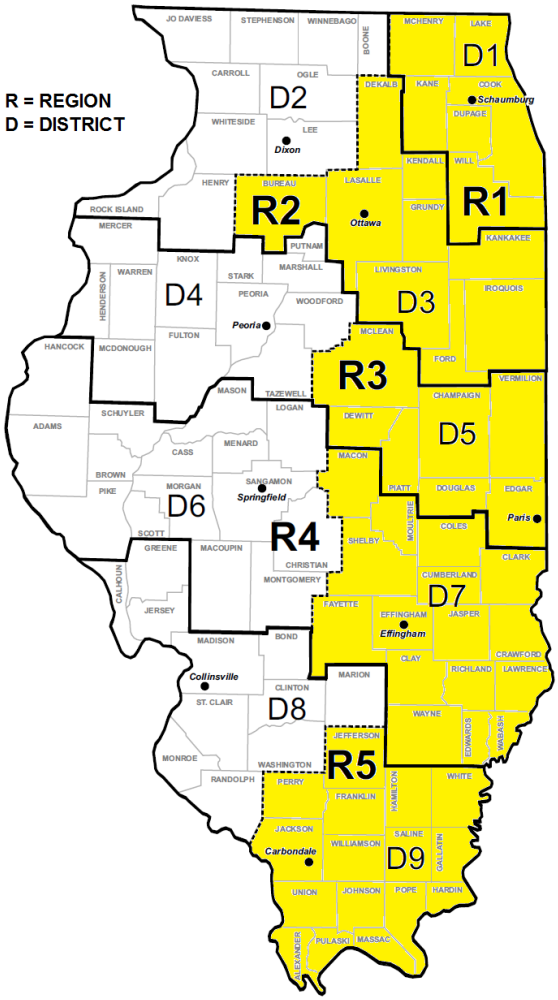

Figure 12. IDOT districts selected for review.

3.3 DEVELOPING A PRELIMINARY QUESTIONNAIRE

To maximize the efficiency and effectiveness of the interviews, a preliminary questionnaire was developed and prior to the meeting emailed to each IDOT office that participated in the interviews. The questionnaire was designed to collect data on utility-relocation practices in IDOT district offices and their conformance to IDOT policies. The questionnaire was developed by the research team and was reviewed and approved by the Technical Review Panel (TRP) of this project.

The utility-relocation questionnaire included six questions (see Table 4) to collect feedback from the interviewed IDOT officials on (1) the conformance of utility-relocation practices in their districts with the aforementioned IDOT policies and laws; (2) the use of best management practices (BMPs) and incentives to expedite utility relocation in their districts; (3) the benefits and drawbacks of implementing these BMPs in their districts; (4) their recommendations on additional BMPs and incentives that have the potential to expedite utility relocations; (5) the utility-relocation delays experienced in their districts; and (6) specific schedule and cost data on recent utility-relocation projects in their districts. In addition to these six questions, each IDOT official interviewed was provided a list of best management practices and incentives, as shown in Table 5. This list was provided to aid in identifying current BMPs; for questions 2, 3, and 4; and to provide a comprehensive list of BMPs and incentives that are used by other state DOTs to expedite utility-relocation projects.

It should be noted that the feedback collected during the interviews is organized into three sections, as shown in Table 4. The feedback collected on question 1 is summarized in section 3.4, and questions 2 and 3 are described in section 3.5. The feedback on the remaining questions (4 through 6) is discussed in Appendix B.

Table 4. Interview Questions for IDOT Personnel

Question	Interview Questions for IDOT Personnel	Feedback Summary
1	Please indicate if the district policy for utility relocation conforms to the IDOT utility-relocation/adjustment process. Please indicate what differences, if any, exist; and any steps that are unnecessary, need to be added or adjusted.	Section 3.4
2	Please list any current or past best management practices or incentives utilized by your district for utility relocation (i.e., clearing, grubbing, staking; designated utility coordinators; utility coordination councils; CCC; lane rental, etc.).	Section 3.5
3	Can you suggest any BMPs or Incentives currently not used that may be more beneficial?	
4	Have you experienced any benefits or drawbacks from the use of these BMPS? If so, which have been the most beneficial/advantageous, and similarly which have been the most problematic?	Appendix B
5	Are there any specific types or phases of utility work that consistently experience delays? (such as a particular utility or utility company, right-of-way acquisition, work on specific highways or near specific cities, etc.)	
6	Can you provide any project cost (invoice/manpower reports) and schedule (original and as built) data on recent utility-relocation projects in your district? This will assist us in comparing how similar projects across different districts in Illinois compare to each other.	

Table 5. List of Best Management Practices (BMPs) and Incentives

Coordination Practices	
Coordination, Cooperation, Communication (CCC)	Multi-Level Memoranda of Understanding (MOU)
Utility Coordination Councils (UCC)	Utility Coordination during Construction
Designated Utility Coordinators	

Financial Incentives	
Cash Bonuses	No-Excuses Incentives
Incentives/Disincentives (I/D)	Contractor-Provided Financial Incentives
Cost-Sharing	Gainshare–Painshare

Practices Requiring Cost	
IT Solutions	
Utility-Cost Database	Utility Coordination Websites
Electronic Utility Permits	Electronic Document Delivery (EDD)
Field Solutions	
Subsurface-Utility Engineering (SUE)	Removal of Abandoned Lines
Clearing, Grubbing, Staking, Grading	Trenchless Technology
Utility-Relocation Safety Programs	Utility Tunnels

No-Cost Practices	
Contract Type	
Utility Work by Highway Contractors	Unit Costs
A + B Bidding	Combined Utility Segments
Lane Rental	Highway-Contract-Facilitating Language
Design–Build for Utilities	Lump-Sum Agreements
Right-of-Way Management	
Right-of-Way (RoW) Acquisition	Locating next to RoW line
Utility Corridors	Use of Existing Tunnels for Utilities
Administrative	
One-Call Systems	Value-Engineering for Utilities
Utility Conflict Matrix	Avoidance of Utility Relocation
Advance Relocation of Utility Work	Modernization of Utility Procedures
Utility Training Classes	Utility Manuals
Standardized Estimate/Bid Form	Context-Sensitive Design
Standardized Invoice Submissions	Simplified Permit Approvals for Utilities

3.4 CONDUCTING INTERVIEWS

The research team conducted face-to-face meetings to interview each of the IDOT officials listed in Table 3. These meetings were conducted from August 20 to September 3, 2015. The interviews were conducted with each IDOT district separately to ensure that the reported practices of each district would not be influenced by the practices of another district. District officials were asked to invite additional IDOT officials, if any, with experience on utility-relocation delays and potential solutions to mitigate them. In each of these interview meetings, minutes were taken and were emailed to the interviewed official to verify their accuracy. The following sections provide a concise description of the interview procedure and its findings on the degree of conformance between utility-relocation practices and IDOT policies in each of the five interviewed IDOT districts and the IDOT Bureau of Land Acquisition. This degree of conformance was identified, based on the feedback provided by the officials interviewed to the first question in Table 4.

3.4.1 District 1–Schaumburg

IDOT District 1 is located in northeastern Illinois and serves one of the most populated urban areas in the nation, including the city of Chicago. The district contains 28,060 centerline miles of roads and consists of six counties: Cook, Lake, McHenry, Kane, DuPage, and Will (IDOT 2015b and 2015c), as shown in Figure 13. The interview with District 1 officials was on August 27, 2015, from 10:30 a.m. to 1:00 p.m., at the IDOT office in Schaumburg. The IDOT officials who participated in this interview were Project Support Engineer Jose Dominguez and Area Utility Coordinator Tim House, Jr.

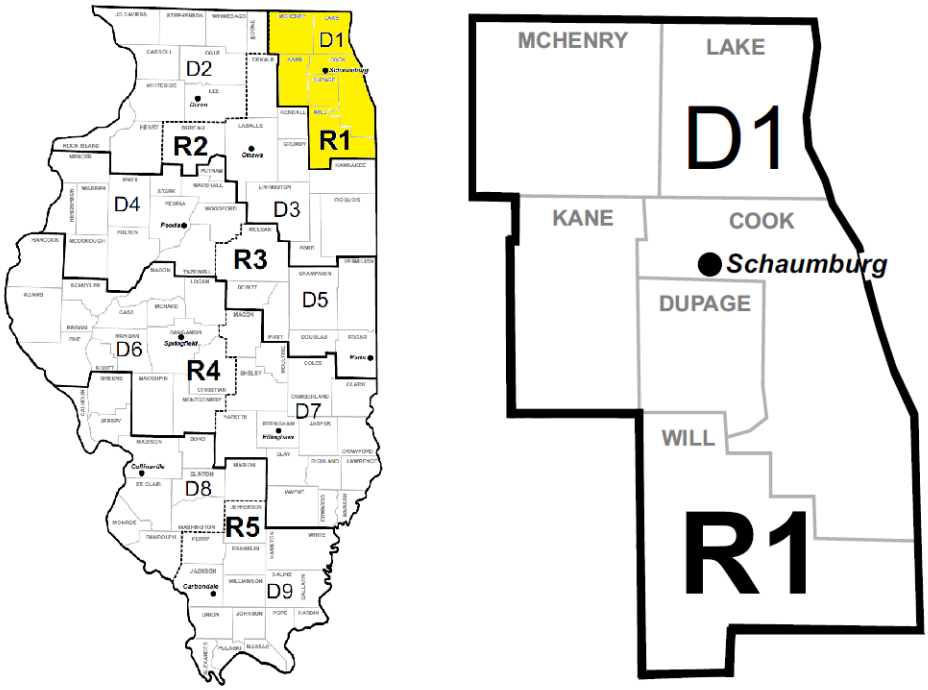

Figure 13. Map of District 1 with county boundaries.

In this interview, IDOT officials were asked to provide their feedback on the first question in the aforementioned questionnaire (see Table 4) to study the degree of compliance between the utility-relocation practices in their district and IDOT policies. District 1 officials discussed the utility-adjustment process in their district, focusing on programming, design, land acquisition, permitting, plans and specifications, letting dates, field operations, and coordination with utilities. In this interview, District 1 officials stated that utility-relocation practices in their district fully comply with the "Utility Adjustment Process Flowchart" in the Bureau of Design and Environment (BDE) manual and with all other IDOT policies and procedures. They noted that this full compliance is necessary because of the large number, size, and complexity of projects in their district.

3.4.2 District 3–Ottawa

IDOT District 3 is located just south of District 1, along the eastern Illinois border. The district consists of nine counties: DeKalb, Bureau, LaSalle, Kendall, Grundy, Livingston, Kankakee, Ford, and Iroquois (IDOT 2015b and 2015d), as shown in Figure 14. The interview conducted with the District 3 official was on August 20, 2015, from 10:00 a.m. to 1:00 p.m., at the IDOT office in Ottawa. The IDOT official who participated in this interview was Project Support Engineer Amy Reed.

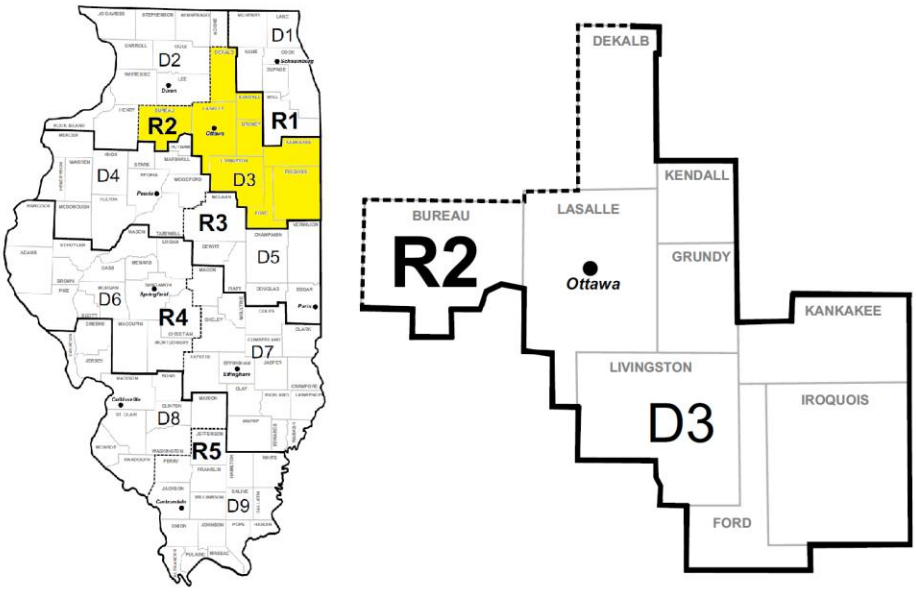

Figure 14. Map of District 3 with county boundaries.

In this interview, the IDOT official discussed utility-relocation practices in District 3, including programming, Phase I plans and specifications, land acquisition, permitting, letting dates, field operations, and coordination with utilities. The District 3 official interviewed also reported that utility-relocation practices in her district comply with all IDOT policies and procedures, with one minor exception for few small projects. For these few small projects, Phase I and Phase II were reported to occasionally overlap or be performed out of sequence to expedite the overall utility-adjustment process. Although this practice may vary slightly from IDOT procedures that specify that Phase I and Phase II are sequential, the IDOT official reported that these minor deviations from IDOT

procedures do not cause utility-relocation delays. In addition, the interviewed official reported specific utility-relocation issues in District 3, including (1) population growth, (2) the impact of project complexity on delays, and (3) coordination with utility companies and its impact on delays.

First, the IDOT official reported that District 3 has experienced significant population growth in recent years. According to the 2010 Census, the population of Kendall County more than doubled in ten years, increasing from 54,544 in 2000 to 114,736 in 2010. This 110.4% population increase made Kendall County the fastest-growing county in the United States from 2000 to 2010, based on the percentage increase in population (USCB 2011). The IDOT official also reported that the number of road-improvement projects in this district has increased to meet the demand of the growing population. According to the IDOT 2016–2021 Multi-Year Plan (MYP), Kendall County will have another sixteen projects in the next five years (IDOT 2015a). The District 3 official has reported that this amount of work will cause considerable strain on local utility companies and municipalities that must meet the demands of a rapidly expanding community. The official also reported that utility companies do not have crews available to complete this many projects in such a short period of time. The lack of manpower is causing delays and increased costs as roadway contractors must either wait for utility crews or deviate from their construction plans, perform work out of sequence, or perform costly remobilizations. Kendall and Kankakee counties have had several complex roadway-reconstruction projects in the past few years to deal with the population growth; all projects experienced major utility delays.

Second, the IDOT official reported that project delays vary depending on the level of project complexity. Complex projects were reported to experience more delays due to the length of project, number of improvements, special conditions, and number of entities involved; while less complex and smaller projects were reported to experience minor deviations from IDOT procedures without causing project delays.

Third, the official interviewed reported that coordination with utility companies and its impact on delays vary from one utility company to another. It was reported that a number of utility companies in District 3 did not provide timely coordination and communication. For example, it was reported that District 3 received little to no communication from cable providers on a number of projects after the district sent them multiple plans; however, this lack of communication did not cause delays, as these cable providers were able to complete the required utility-adjustment work as scheduled. By contrast, the lack of timely communication and coordination by utility companies was reported to cause delays on other projects. For example, it was reported that delays were encountered on all projects involving railroad companies in District 3. On one $50M project, it took nearly two years to obtain a signed agreement, which significantly delayed the roadway contractor, who was forced to perform work out of sequence to adjust for this delay. The delay in railroad work in this project resulted in increased costs and delayed project delivery.

3.4.3 District 5–Paris

IDOT District 5 is located in eastern central Illinois and contains seven counties: McLean, DeWitt, Piatt, Champaign, Vermilion, Douglas, and Edgar (IDOT 2015b and 2015e), as shown in Figure 15. The interview with District 5 officials was on August 25, 2015, from 10:00 a.m. to 12:00 p.m., at the IDOT

office in Paris. The IDOT officials who participated in this interview were Utility Coordinator Daniel Magee, Project Support Engineer Kevin Knoepfel, and Permits Technician Josh Lowry.

In this interview, the three IDOT officials discussed utility-relocation practices in District 5, including programming, design, land acquisition, permitting, plans and specifications, letting dates, field operations, and coordination with utilities. The three officials reported that utility-relocation practices in District 5 fully comply with the "Utility Adjustment Process Flowchart" in the BDE manual and with all other IDOT policies and procedures. In addition, the interviewed officials reported specific utility-relocation issues in District 5, including (1) the impact of reprogramming projects on utility coordination, (2) availability of coordinators in utility companies, and (3) utility-coordination personnel and responsibilities.

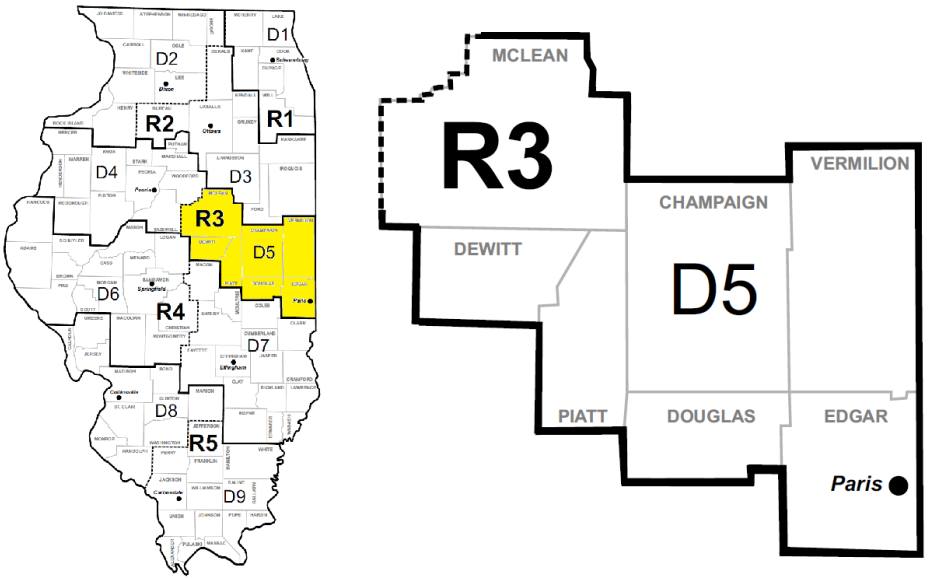

Figure 15. Map of District 5 with county boundaries.

First, the interviewed officials reported that a number of delays can be attributed to programming changes. Reorganization of the program or delaying a proposed project often leads to moving other projects to start earlier than their planned start date in the original program to utilize available funding for the fiscal year. IDOT officials reported that this reorganization of projects often creates difficulties in coordinating with utility companies that planned their projects and resource utilization based on the original program.

Second, District 5 officials reported that utility companies servicing their district do not have sufficient staff to coordinate utility relocations. Some utility companies have as few as two individuals in their utility-adjustment department that are responsible for coordinating utility relocations in the entire central Illinois region. Interviewed IDOT officials reported that the lack of utility coordinators within the local AT&T makes coordination difficult and causes delays in this district.

Third, District 5 reported that they divide the responsibilities of utility and railroad projects between two coordinators. Two of the five interviewed districts reported that they have a single coordinator who is responsible for both utility and railroad projects, and they reported requesting an additional coordinator to enable one to work only on utilities while the other focuses on railroads. District 5 reported that having separate, designated utility and railroad coordinators is beneficial and enables the district to provide more oversight on utility and railroad projects.

3.4.4 District 7–Effingham

IDOT District 7 is located in central Illinois and contains sixteen counties: Macon, Shelby, Moultrie, Coles, Cumberland, Clark, Fayette, Effingham, Jasper, Crawford, Clay, Richland, Lawrence, Wayne, Edwards, and Wabash (IDOT 2015b and 2015f), as shown in Figure 16. The interview with District 7 officials was on September 3, 2015, from 10:00 a.m. to 12:00 p.m., at the IDOT office in Effingham. The IDOT officials who participated in this interview were Project Support Engineer Theresa Petersen, Railroad/Utilities Coordinator Ken Grove, and Interim Program Development Engineer Greg Jamerson.

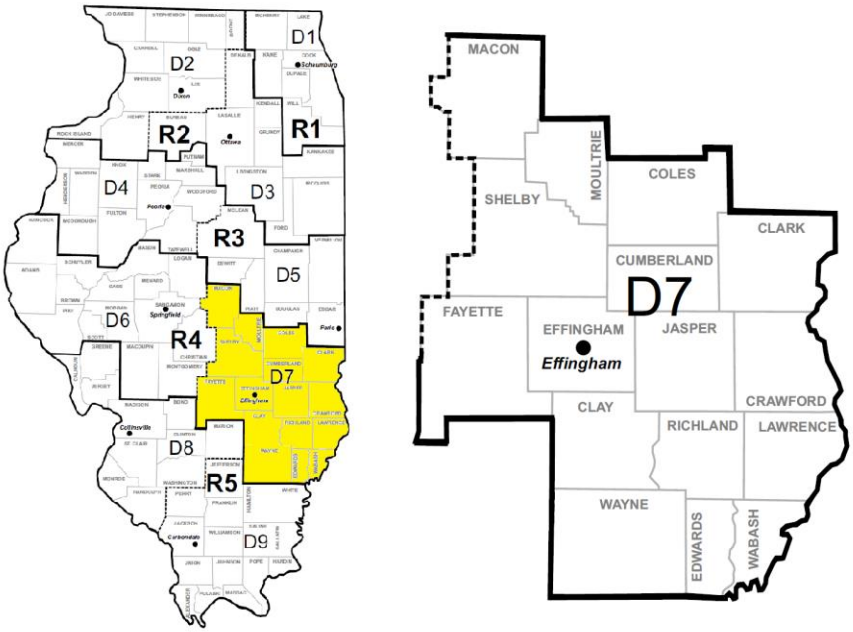

Figure 16. Map of District 7 with county boundaries.

In this interview, the IDOT officials discussed utility-relocation practices in District 7, including design, programming, land acquisition, permitting, letting dates, field operations, and coordination with utilities. District 7 officials reported that utility-relocation practices in their district are in full compliance with IDOT policies and procedures. In addition to compliance with IDOT policies, the interviewed IDOT officials reported on the annual project-support meeting organized to discuss what difficulties each district is experiencing and their solutions. Representatives from project support in all nine IDOT districts are reported to attend these sessions. The main topics include permitting discussions, utility-relocation delays, and agreements and coordination with railroad companies.

3.4.5 District 9–Carbondale

Encompassing the southernmost part of Illinois, IDOT District 9 provides freight movement to the eastern, western, and southern United States. This district contains sixteen counties: Jefferson, Perry, Franklin, Hamilton, White, Jackson, Williamson, Saline, Gallatin, Union, Johnson, Pope, Hardin, Alexander, Pulaski, and Massac (IDOT 2015b and 2015g), as shown in Figure 17. The interview with District 1 officials was on August 26, 2015, from 10:00 a.m. to 12:00 p.m., at the IDOT office in Carbondale. The IDOT officials who participated in this interview were Project Support Engineer Greg McLaughlin and Railroads Coordinator David Barger.

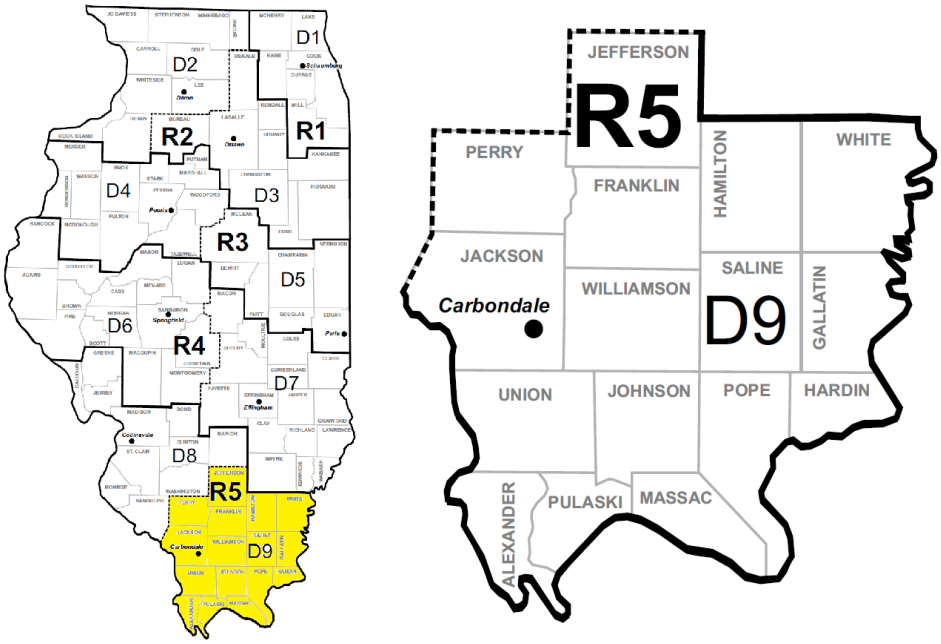

Figure 17. Map of District 9 with county boundaries.

In this interview, the District 9 officials discussed the utility-adjustment process in District 9, focusing on programming, design, land acquisition, permitting, plans and specifications, letting dates, field operations, and coordination with utilities. The interviewed District 9 officials reported that utility-relocation practices in their district comply with all IDOT policies and procedures with one exception on permitting of reimbursable utility work. The interviewed officials reported that District 9 occasionally does not require utility companies to acquire permits for reimbursable utility relocations so as to expedite the start and completion of utility-relocation work. This practice in not in line with section 4-209 of 605 ILCS 5 that states: "No person shall willfully cut, excavate or otherwise damage that portion of any highway under the jurisdiction and control of the Department, including the hard-surfaced slab, shoulders and drainage ditches, either within or without the corporate limits of a municipality without a permit so to do from the Department" (605 ILCS 5/4-209). District 9 officials reported that this practice was used to expedite utility-relocation work and did not cause other issues or delays.

In addition, District 9 officials discussed the utility-coordination issues on the IL-Route 13 project that was currently experiencing utility-relocation delays. It is a complex construction project spanning several miles along IL-Route 13 and has been separated into multiple contracts—undergoing widening, intersection reconfigurations, and overall safety improvements. The officials reported that the project required the relocation of multiple utilities (electric, phone, and gas lines) that were located in a limited space in a number of intersections and interchanges. IDOT officials reported that the concentration of utilities in a limited space and the lack of timely coordination from utility companies caused project delays. District officials reported that they expect this issue to be encountered in a number of the remaining locations of the ongoing IL-Route 13 project (IDOT 2015i).

3.4.6 Bureau of Land Acquisition–Springfield

The Bureau of Land Acquisition is responsible for acquiring and clearing right-of-way for state highway construction (IDOT 2014). The interview conducted with the Bureau of Land Acquisition official was on September 3, 2015, from 1:30 p.m. to 3:00 p.m., at the IDOT office in Springfield. The IDOT official who participated in this interview was Program Management Section Chief Steven Warren.

The Bureau of Land Acquisition reported that one of their main responsibilities is to ensure that IDOT districts are conforming to state and federal land-acquisition laws and policies. The Bureau of Land Acquisition, in conjunction with the Federal Highway Administration, visits each IDOT district annually and inspects documentation to verify that the appropriate processes are being followed. By performing yearly audits, the land-acquisition department confirms that each district is in full compliance with the applicable federal and state land-acquisition laws and guidelines, to maintain funding eligibility. Failure to comply with these laws could result in loss of federal funding for the district.

3.5 IMPLEMENTED AND RECOMMENDED BEST MANAGEMENT PRACTICES AND INCENTIVES IN IDOT DISTRICTS

This section summarizes the feedback collected during the interviews on the use of best management practices (BMPs) and incentives in a representative sample IDOT districts. Interviewed district officials were asked to (1) identify BMPs utilized in their district, (2) recommend any additional BMPs and incentives that have the potential to expedite utility relocations, and (3) describe the benefits and drawbacks of the utilized BMPs. The feedback collected on the first two questions about the utilized and recommended BMPs is summarized in the following two sections, respectively. The feedback collected on the third question, about the benefits and drawbacks of the BMPs utilized, is summarized in Appendix B.

3.5.1 Utilized BMPs and Incentives in Selected IDOT Districts

As part of the questionnaire, each interviewed IDOT official was provided the list of best management practices and incentives compiled from the literature review (see Table 5). This list was provided to aid in identifying current BMPs used by each district, as requested in question 2 of the questionnaire, which stated: “Please list any current or past best management practices or incentives utilized by your district for utility relocation (i.e., clearing, grubbing, staking; designated utility coordinators;

utility coordination councils; CCC; lane rental, etc.)." During the conducted interviews, IDOT officials reported the use of sixteen BMPs and incentives in their districts, as shown in Table 6. A detailed performance analysis of these BMPs and incentives utilized by IDOT officials is summarized in Appendix B.

Table 6. BMPs and Incentives Utilized by Selected IDOT Districts

COORDINATION PRACTICES
1. Coordination, Cooperation, Communication (CCC)
2. Utility Coordination Councils (UCC)
3. Designated Utility Coordinators
4. Utility Coordination during Construction
FINANCIAL INCENTIVES
None selected
PRACTICES REQUIRING COST
IT Solutions
5. Electronic Utility Permits
6. Utility Coordination Websites
7. Electronic Document Delivery (EDD)
Field Solutions
8. Subsurface-Utility Engineering (SUE)
9. Clearing, Grubbing, Staking, Grading
10. Trenchless Technology
NO-COST PRACTICES
Contract Type
11. Highway-Contract-Facilitating Language
Right-of-Way Management
12. Right-of-Way (RoW) Acquisition
13. Locating Next to RoW Line
Administrative
14. One-Call Systems
15. Avoidance of Utility Relocation
16. Standardized Invoice Submissions

3.5.2 District-Recommended BMPs and Incentives

In addition to the aforementioned BMPs that were reported to be used in IDOT districts, the interviewed officials were asked to recommend any additional practices that have the potential to expedite utility relocation, as shown in question 4 in Table 4, which stated: "Can you suggest any BMPs or incentives currently not used that may be more beneficial?" The feedback on this question provided a total of 18 BMPs not currently used by the districts interviewed. These 18 BMPs consist of (a) eight BMPs that were included in the provided list of BMPs that was compiled in Table 5; and (b) ten new BMPs that were suggested by the interviewed IDOT officials, as shown in Table 7. These eighteen recommended BMPs are organized in four categories: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices, as shown in Table 7 and Figure 18. The detailed descriptions of these recommended BMPs and incentives by IDOT officials are summarized in Appendix B.

Table 7. BMPs Recommended by Interviewed IDOT Districts

RECOMMENDED BMPS	(# of Recommending Districts /# of Interviewed Districts)	Percentage (%)
COORDINATION PRACTICES		
Utility Coordination by Roadway Contractor*	5/5	100%
Assign Utility Relocation to IDOT Resident Engineer	1/3	33%
FINANCIAL INCENTIVES		
Penalty/Back Charge to Utility Company for Delays	4/4	100%
PRACTICES REQUIRING COST		
IT Solutions		
Statewide Utility-Permit Database*	2/2	100%
Updated IDOT Website	2/2	100%
Updated Land-Acquisition System	1/1	100%
Field Solutions		
Clearing, Grubbing, Staking, Grading*	5/5	100%
Removal of Abandoned Utilities*	4/4	100%
Advance Building/Tree-Removal	5/5	100%
NO-COST PRACTICES		
Contract Type		
Requirement that Roadway Contractor Track Utility-Relocation Delays	2/4	50%
Right-of-Way Management		
Right-of-Way Utility Coordination	1/5	20%
Administrative		
Utility Training Classes*	3/4	75%
Avoidance of Utility Relocation*	3/3	100%
Modernization of Utility Processes*	3/3	100%
Simplified Permit Approvals for Utilities*	1/3	33%
Additional Utility Personnel	5/6	83%
Schedule Changes for Project Support Engineering (PSE) and Letting Dates	6/6	100%
Phase I Plan Extensions	1/1	100%

* = Selected from original 45 BMPs in chapter 2 (see Table 5)

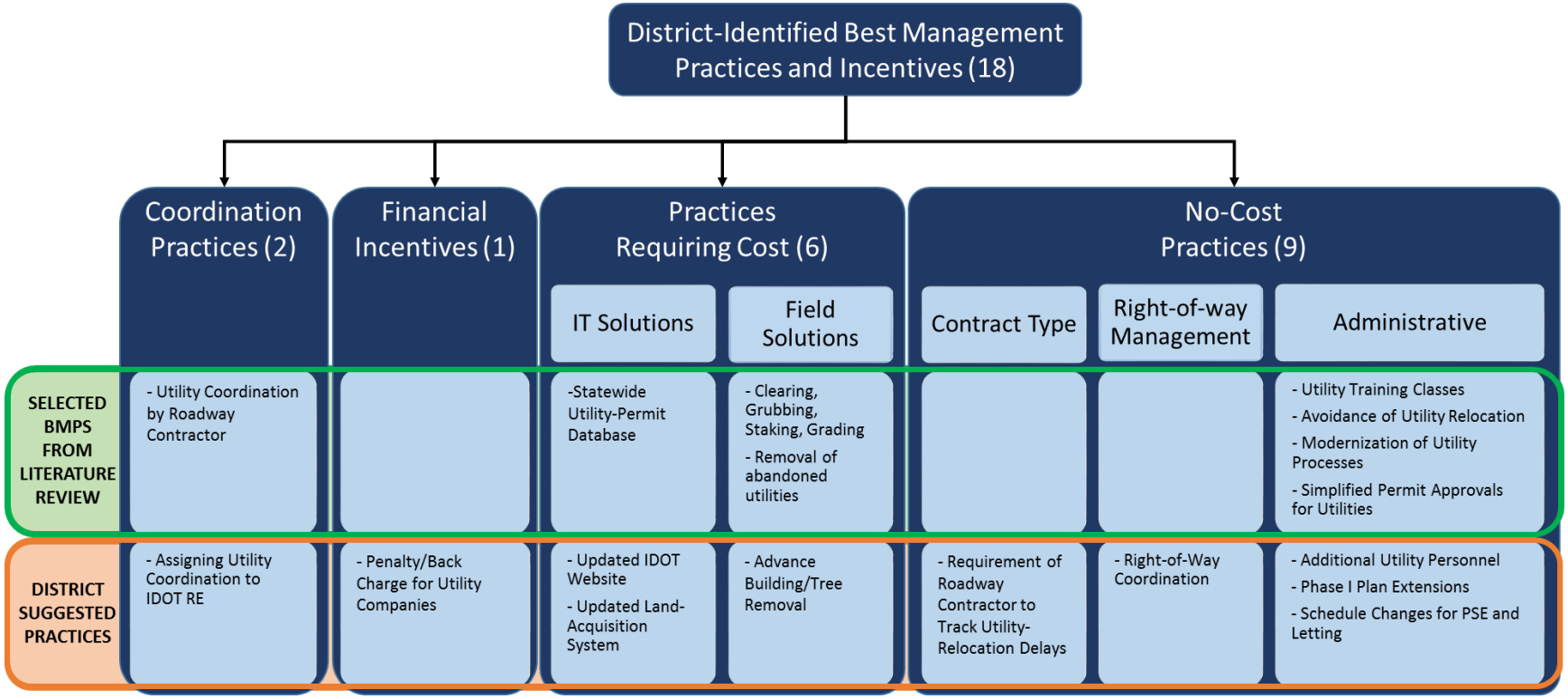

Figure 18. Organization of BMPs recommended by interviewed IDOT districts.

CHAPTER 4: SURVEYS OF STATE DOTS AND ILLINOIS UTILITY COMPANIES

This chapter presents the findings of two online surveys conducted to gather and analyze feedback from state DOT officials and utility company representatives on their experiences in implementing BMPs and incentives to expedite utility relocations on highway projects. The two surveys were designed to collect data on (1) the use of utility-relocation BMPs and incentives by state DOTs and Illinois utility companies on their previous projects; (2) effectiveness of these BMPs and incentives, using a categorical scale that ranges from "not effective" to "very effective"; (3) reductions in duration of utility-relocation projects achieved as a result of these BMPs and incentives; (4) state DOT costs, if any, resulting from implementing these BMPs and incentives; (5) problems and/or challenges encountered during the implementation of these BMPs and incentives; (6) causes and impacts of utility-relocation delays; and (7) durations, timeline, and sequencing of IDOT projects by Illinois utility companies.

The two surveys were developed following the best practices guidelines of the American Association for Public Opinion Research (AAPOR 2015). Each survey was designed to take less than 15 minutes to complete. The surveys were designed in collaboration with the Technical Review Panel of this project to collect feedback and data from survey respondents on their prior experiences with utility-relocation BMPs and incentives.

The state DOT survey included 18 questions that were organized and grouped into eight sections, as shown in Table 8. The survey was designed to collect feedback and data from DOT officials on (1) their background; (2) their use of utility-relocation BMPs and incentives in their states; (3) effectiveness of these BMPs in expediting utility relocation; (4) reduction in project duration resulting from the use of BMPs; (5) estimated DOT cost to implement these BMPs; (6) problems and/or challenges encountered as a result of these BMPs and incentives; (7) causes and impacts of utility-relocation delays on DOT projects; and (8) additional feedback. A complete copy of the state DOT online survey and its questions is included in Appendix C.

The Illinois utility company survey included 23 questions that were grouped in seven sections, as shown in Table 9. The survey gathered feedback and data from Illinois utility company representatives on (a) their background; (b) their use of utility-relocation BMPs and incentives on IDOT projects; (c) effectiveness of these BMPs in expediting utility relocation; (d) problems and/or challenges encountered as a result of these BMPs and incentives; (e) scheduling of IDOT projects; (f) causes and impacts of utility-relocation delays on IDOT projects; and (g) additional feedback. A complete copy of the Illinois utility company online survey and its questions is included in Appendix D.

Table 8. Organization of State DOT Survey Questions

Section	Question
S1. Background information	Q1. What is your name?
	Q2. What state do you represent?
	Q3. What is your current job title?
S2. Use of utility-relocation BMPs and incentives on DOT projects	Q4. Which Coordination Practices have been utilized on DOT utility-relocation projects in your state?
	Q5. Which Financial Incentives have been utilized on DOT utility relocation projects in your state?
	Q6. Which Practices Requiring Cost have been utilized on DOT utility-relocation projects in your state?
	Q7. Which No-Cost Practices have been utilized on DOT utility-relocation projects in your state?
S3. Effectiveness of BMPs in expediting utility relocation	Q8. Please rank the effectiveness of each BMP in expediting utility relocation on a scale from 1 to 5.
S4. Reduction in project duration resulting from the use of BMPs	Q9. Please estimate the effectiveness in reducing project duration (in percentage of total project time) attributed to the use of each utility relocation BMP.
S5. Estimated DOT cost to implement BMPs	Q10. Please estimate the cost required to implement these utility-relocation BMPs on your projects.
S6. Problems and challenges	Q11. Please list any problems or challenges encountered as a result of implementing these BMPs and incentives
S7. Causes and impacts of utility-relocation delays on DOT projects	Q12. Please list any causes of utility-relocation delays experienced on DOT projects and estimate the percentage of projects affected by these types of causes.
	Q13. Please list the impacts resulting from utility-relocation delays on DOT projects, if any, and estimate the percentage of projects affected.
S8. Additional feedback	Q14. For State-owned facilities, (i.e., underground conduits for traffic signals, lighting, etc.), does the State require the utility company to locate the State-owned facilities or does the State locate their own facilities?
	Q15. Can you suggest any BMPs or incentives that were not listed and could have the potential to expedite utility relocation?
	Q16. Please list any additional comments regarding BMPs and incentives for utility relocation
	Q17. Would you be willing to provide more information, if needed?
	Q18. Are you interested in receiving the main findings of this survey upon completion?

Table 9 Organization of Illinois Utility Company Survey Questions

Section	Question
S1. Background information	Q1. What is your name?
	Q2. What is your current job title?
	Q3. What utility company do you represent?
	Q4. What type of utility company do you represent?
S2. Use of utility-relocation BMPs and incentives on IDOT projects	Q5. Which Coordination Practices have been used on your DOT utility-relocation projects?
	Q6. Which Financial Incentives have been used on your DOT utility-relocation projects?
	Q7. Which Practices Requiring Cost have been used on your DOT utility-relocation projects?
	Q8. Which No-Cost Practices have been used on your DOT utility-relocation projects?
S3. Effectiveness of BMPs in expediting utility relocation	Q9. Please rank the effectiveness of each BMP in expediting utility relocation on a scale from 1 to 5.
S4. Problems and challenges	Q10. Please list any problems or challenges that were encountered as a result of these BMPs and incentives
S5. Scheduling of IDOT projects	Q11. For state-reimbursable projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and receipt of permit, if required?
	Q12. For nonreimbursable projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and receipt of permit, if required?
	Q13. For state-reimbursable projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and start of utility adjustment/relocation work?
	Q14. For nonreimbursable projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and start of utility adjustment/relocation work?
	Q15. What is the average duration of utility-adjustment/relocation on your IDOT projects once your relocation work begins?
	Q16. How far in advance does your utility company schedule DOT utility-relocation projects before work starts?
	Q17. Do you have any additional comments regarding your experiences with the duration, timeline or sequencing of IDOT utility-relocation projects?
S6. Causes and impacts of utility-relocation delays on IDOT projects	Q18. Please list any causes of utility-relocation delays experienced on DOT projects and estimate the percentage of projects affected by these types of causes.
	Q19. Please list the types of impacts resulting from utility-relocation delays on DOT projects and estimate the percentage of projects affected.
S7. Additional feedback	Q20. Can you suggest any BMPs or incentives that were not listed and could have the potential to expedite utility relocation on DOT projects?
	Q21. Please list any additional comments regarding BMPs and incentives for utility relocation
	Q22. Would you be willing to provide more information, if needed?
	Q23. Are you interested in receiving the main findings of this survey upon completion?

The two surveys were developed using an online surveying website (SurveyGizmo, https://www.surveygizmo.com/) to facilitate distribution and collection of survey data. A list of contacts was obtained from the Technical Review Panel for each of the two surveys. The list of contacts for state DOT officials consisted of members of the subcommittee on construction of the American Association of State Highway and Transportation (AASHTO SOC). The list of contacts for Illinois utility companies consisted of representatives from all major utility companies in the state of Illinois. A link to the online survey was then e-mailed to each of the identified contacts on these two lists. A complete copy of the of the online surveys for the state DOT officials and Illinois utility company representatives is presented in Appendix C and Appendix D, respectively.

A total of 143 complete responses were received from the two online surveys, including 53 from state DOT officials and 90 from Illinois utility company representatives. The 53 responses completed by state DOT officials in the national survey represented 37 different states and the District of Columbia. Three responses were received from Nebraska, Utah, and Virginia; two responses from Colorado, Florida, Georgia, Kansas, Kentucky, Louisiana, Montana, Rhode Island, and Wisconsin; and one response from Alabama, Arkansas, Arizona, Connecticut, District of Columbia, Delaware, Iowa, Massachusetts, Maine, Missouri, North Carolina, New Hampshire, Ohio, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Vermont, West Virginia, and Wyoming. Table 10 summarizes the number of completed responses from each participating state DOT.

Table 10. Number of State DOT Responses

State	Number of Responses
Alabama	1
Arkansas	1
Arizona	1
Colorado	2
Connecticut	1
District of Columbia	1
Delaware	1
Florida	2
Georgia	2
Iowa	1
Kansas	2
Kentucky	2
Louisiana	2
Massachusetts	1
Maine	1
Michigan	1
Minnesota	1
Missouri	1
Montana	2

State	Number of Responses
North Carolina	1
North Dakota	1
Nebraska	3
New Hampshire	1
Ohio	1
Oklahoma	1
Oregon	1
Pennsylvania	1
Rhode Island	2
South Carolina	1
South Dakota	1
Tennessee	1
Texas	1
Utah	3
Virginia	3
Vermont	1
Wisconsin	2
West Virginia	1
Wyoming	1
Total	**53**

The 90 responses received for the Illinois utility company survey represented all types of utilities, including water, gas, electricity, telecommunications, cable television, sewer (sanitary, storm, or both), pipeline-related (petroleum, high-pressure, hazardous liquids, etc.), fiber optic, government

entities, and an Internet service provider. These 90 unique responses included many responses from utility company representatives who reported that their company performs multiple types of utility work. Accordingly, these 90 unique responses represented a total of 130 responses from different types of utilities, as shown in Table 11 and Figure 19.

Table 11. Number of Illinois Utility Company Responses

Utility Type	Number of Responses
Water	40
Gas	13
Electric	11
Telecommunications	12
Cable Television	3
Sewer	32
Pipeline (Hazardous Liquids, Petroleum, High-Pressure, etc.)	10
Fiber Optic	2
Government	6
Internet Service Provider	1
Total	**130**

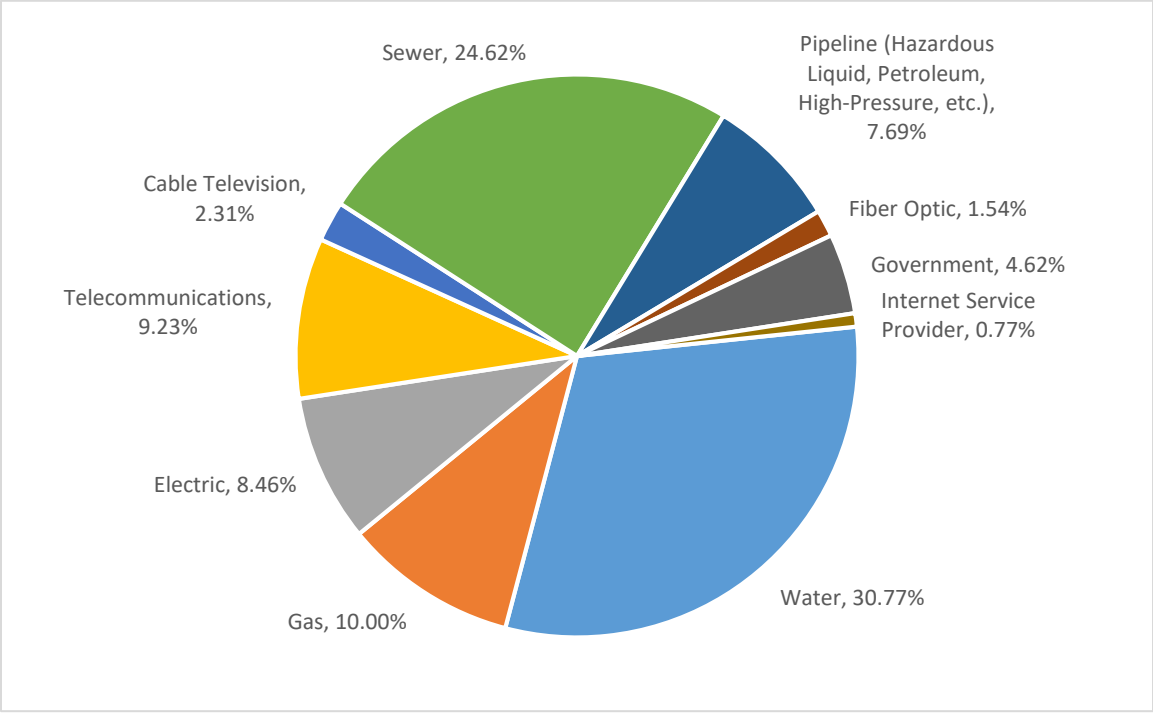

Figure 19. Distribution of Illinois utility company responses by utility type.

The analysis of the survey responses is summarized in the following three sections and in Appendix E. First, the following three sections provide a concise analysis of the survey responses that focused on (1) use of BMPs and incentives on DOT utility-relocation projects; (2) effectiveness of the BMPs and incentives; and (3) average reductions in project duration resulting from the use of BMPs and

incentives. Second, Appendix E provides a detailed analysis of the survey responses to the remaining five sections of the survey that focused on (4) implementation costs of the BMPs and incentives incurred by state DOTs, if any; (5) problems and challenges experienced as a result of utilizing these BMPs and incentives; (6) causes and impacts of utility-relocation delays; (7) durations, timeline, and sequencing of IDOT projects, as reported by Illinois utility company representatives; and (8) additional feedback and comments.

4.1 USE OF BMPS AND INCENTIVES ON DOT PROJECTS

The state DOT officials and Illinois utility company representatives were asked to identify the BMPs and incentives that have been utilized on their DOT utility-relocation projects. Each respondent was provided a list of 61 BMPs and incentives, along with a brief description of each BMP. The feedback on the use of these 61 BMPs and incentives was analyzed and grouped in the following four main categories of BMPs: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices. The top 25 BMPs and incentives used by participating state DOTs and Illinois utility companies are shown in Figure 20 and Figure 21, respectively. The use of the remaining BMPs and incentives by state DOTs and Illinois utility company representatives is summarized in Appendix E.

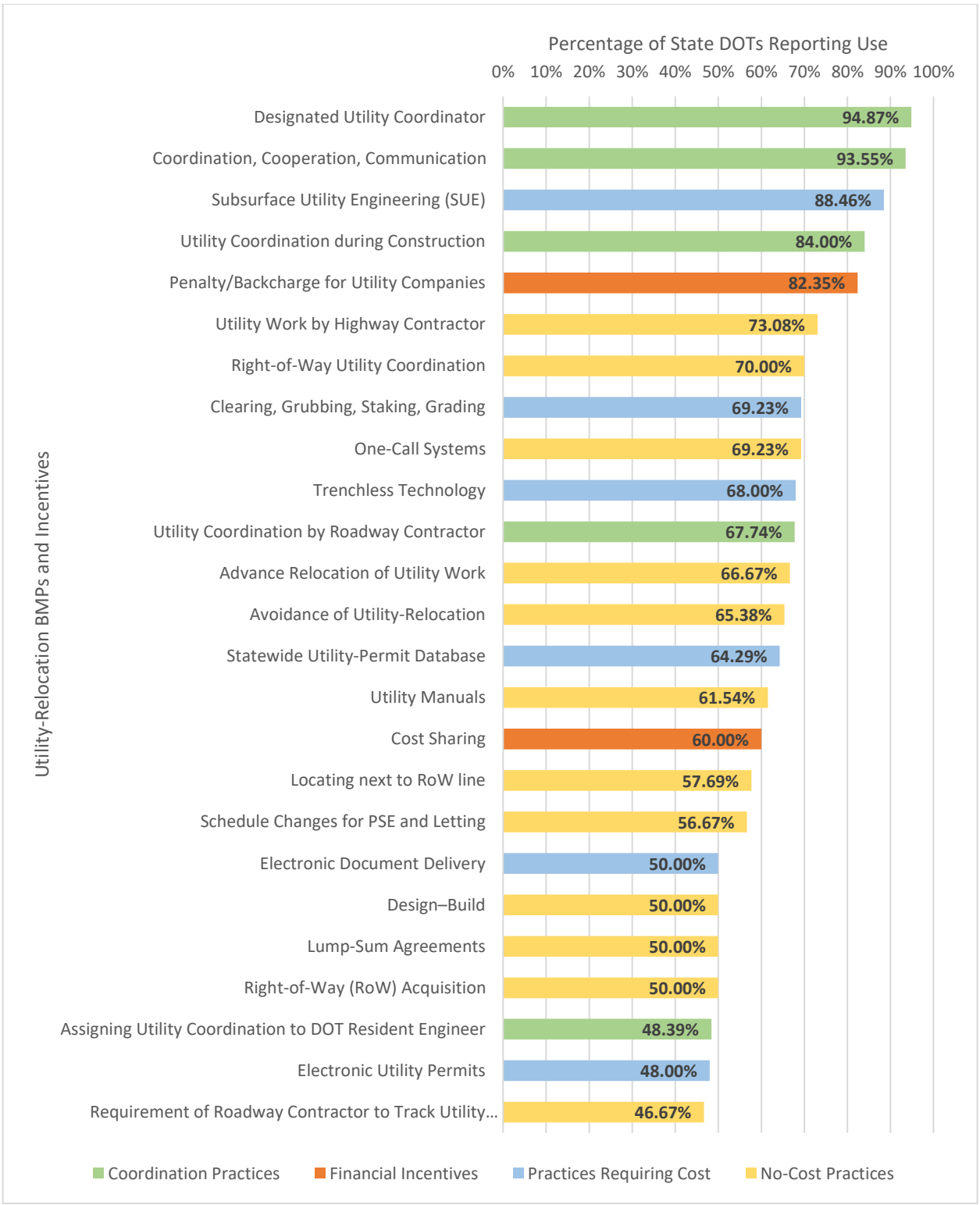

Figure 20. Top 25 BMPs and incentives most utilized by state DOTs.

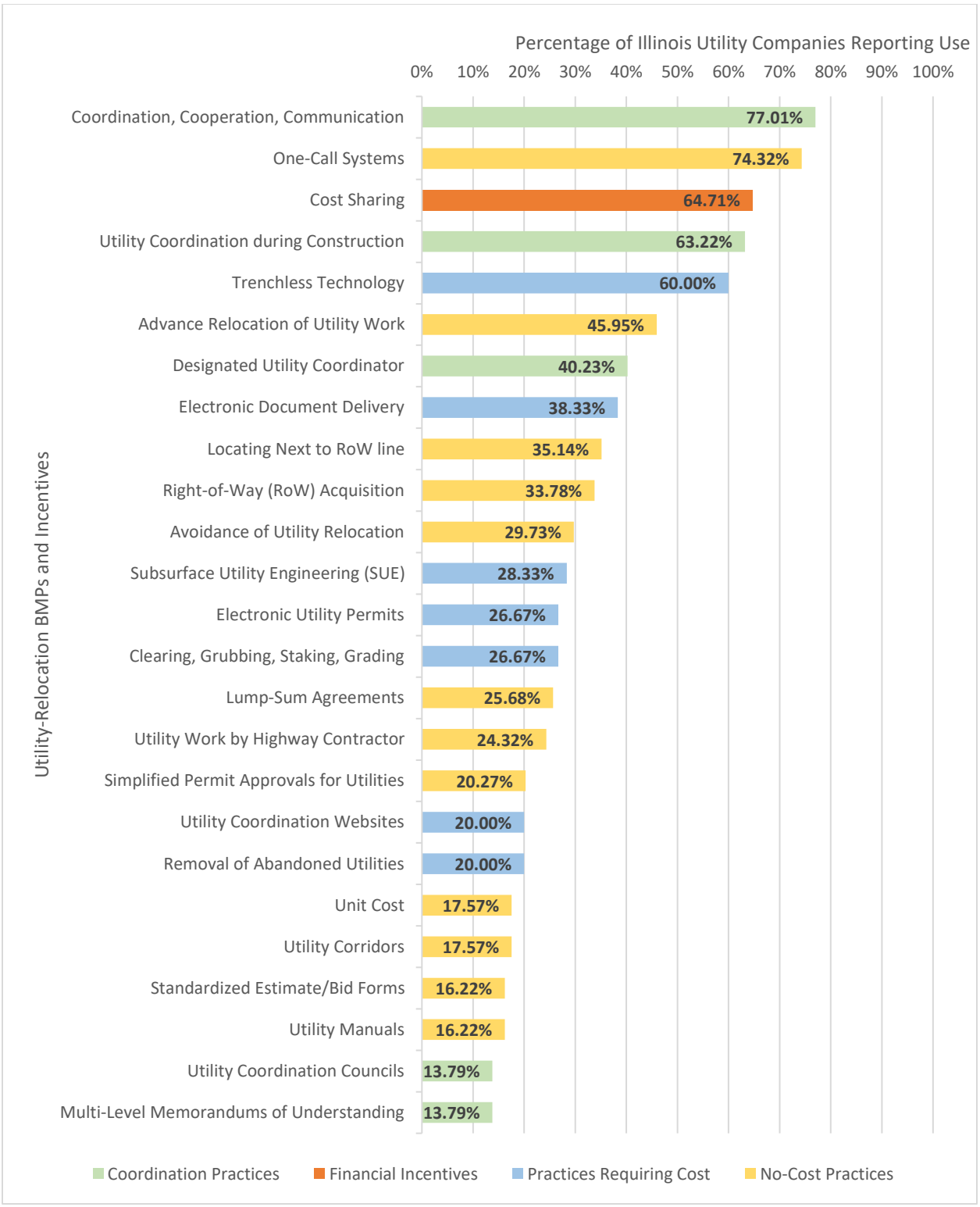

Figure 21. Top 25 BMPs and incentives most utilized by Illinois utility companies.

4.2 EFFECTIVENESS OF BMPS AND INCENTIVES

Survey respondents were asked to rank the effectiveness of the 61 utility-relocation BMPs and incentives identified in the previous section. A total of 117 respondents—42 state DOT officials and 75 Illinois utility company representatives—reported the effectiveness of these 61 BMPs, using a five-point scale: not effective, slightly effective, moderately effective, effective, and very effective. For identifying the average effectiveness for each BMP, the categories are represented numerically using a scale from 1 to 5, where 1 represents “not effective” and 5 represents “very effective.” A weighted average effectiveness of each BMP was calculated separately for the state DOT and the Illinois utility company responses. The effectiveness and weighted averages of these BMPs were analyzed and grouped into four categories: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices. The top 25 most effective BMPs and incentives by participating state DOTs and Illinois utility companies are ranked based on their weighted-average effectiveness, as shown in Figure 22 and Figure 23, respectively. The effectiveness ratings of each BMP by state DOTs and Illinois utility company representatives are summarized in Appendix E.

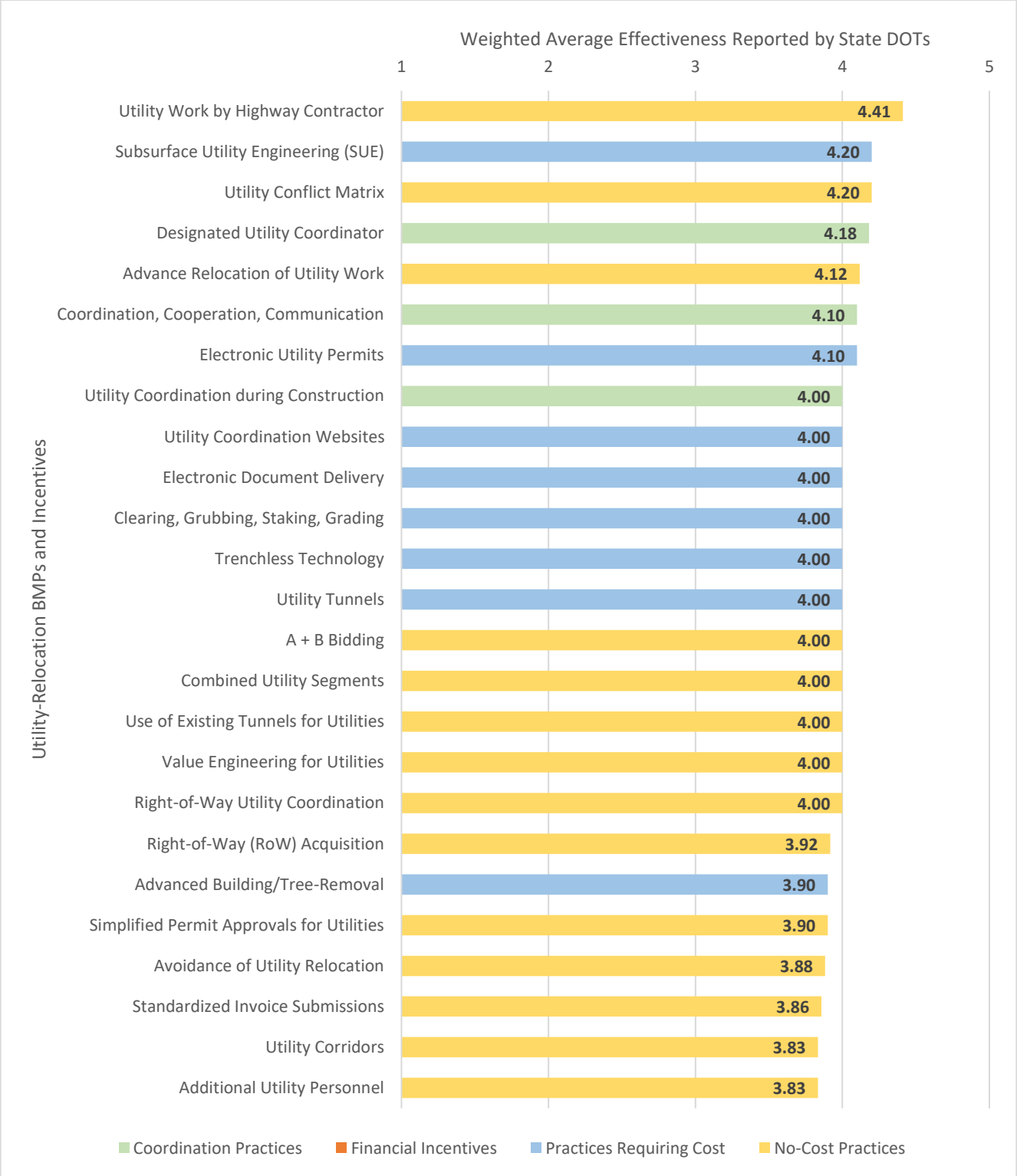

Figure 22. Top 25 most effective BMPs and incentives, per participating state DOTs.

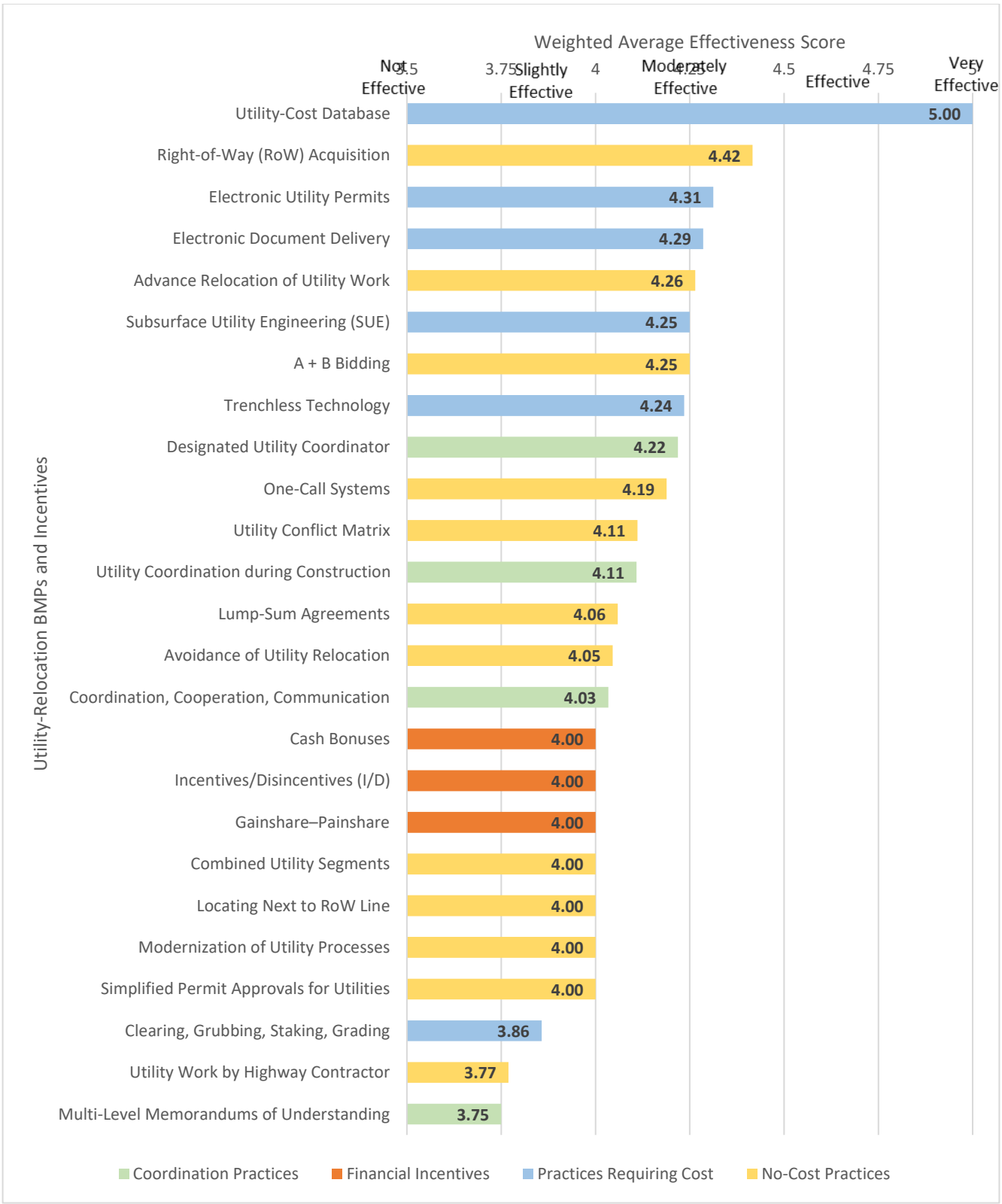

Figure 23. Top 25 most effective BMPs and incentives, per participating Illinois utility companies.

4.3 IMPACT OF BMPS AND INCENTIVES ON REDUCING PROJECT DURATION

State DOT officials were asked to estimate the reduction in project duration resulting from implementing each of the aforementioned BMPs and incentives in terms of percent of project duration. If the percentage reduction was unknown, respondents were asked to provide the time reduction in months or input "unknown." The feedback on the impact of each BMP and incentive on reducing the project duration was analyzed and grouped into the following four main categories of BMPs: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices. The top 25 most effective BMPs and incentives were ranked based on their average percent project-duration reduction reported by participating state DOTs, as shown in Figure 24. The impact of reducing project duration for the remaining BMPs and incentives by state DOTs is summarized in Appendix E.

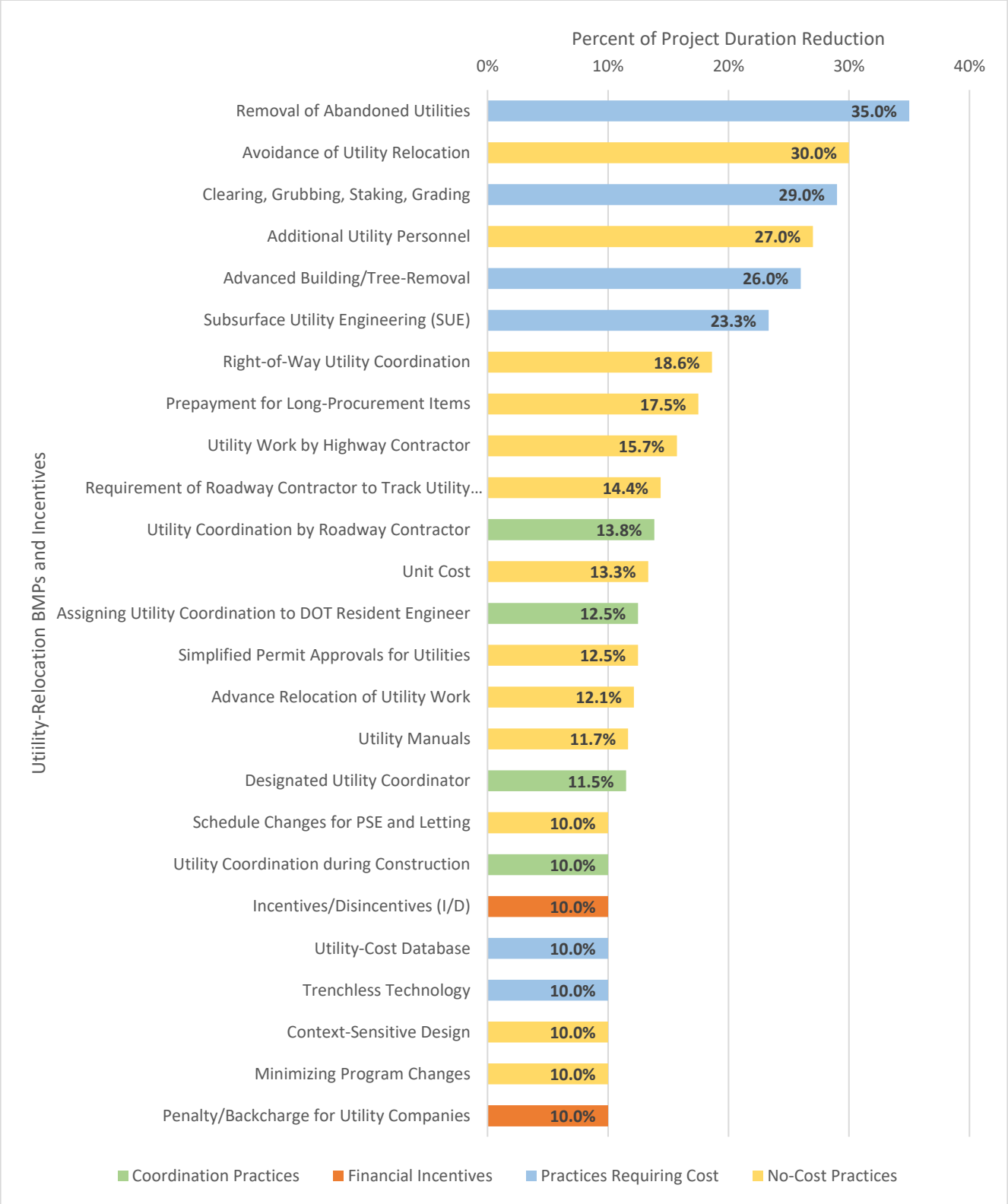

Figure 24. Top 25 BMPs and incentives based on their reported project-reduction effectiveness by state DOTs.

CHAPTER 5: EVALUATE COMPLIANCE OF IDENTIFIED BMPS WITH STATE AND FEDERAL LAWS

This chapter provides a concise review of the compliance evaluation performed of 61 best management practices (BMPs) and incentives with federal and Illinois state laws, regulations, and guides governing utility relocation. These 61 BMPs were previously identified in chapters 2, 3, and 4 of this report, which present a comprehensive literature review, a review of IDOT practices, and surveys of state DOTs and Illinois utility companies, respectively. The compliance of these 61 BMPs with related federal and Illinois laws, regulations, and guides was analyzed based on the assumption that any BMP or incentive that is not expressly prohibited by these laws is considered compliant. The following two sections in this chapter describe the federal and state laws, regulations, and guides governing utility relocation, and the compliance evaluation of utility-relocation BMPs and incentives with these laws.

5.1 FEDERAL AND STATE UTILITY-RELOCATION LAWS, REGULATIONS, AND GUIDES

This section provides a concise review of federal and state laws, regulations, and guides that govern utility relocation/adjustments in Illinois. These laws, regulations, and guides cover the specified requirements for utility placement, relocation, and adjustment within the highway right-of-way, as well as funding for utility projects. The following two subsections provide summarized descriptions of (1) related federal laws, regulations, and guides; and (2) related state laws, as shown in Figure 25.

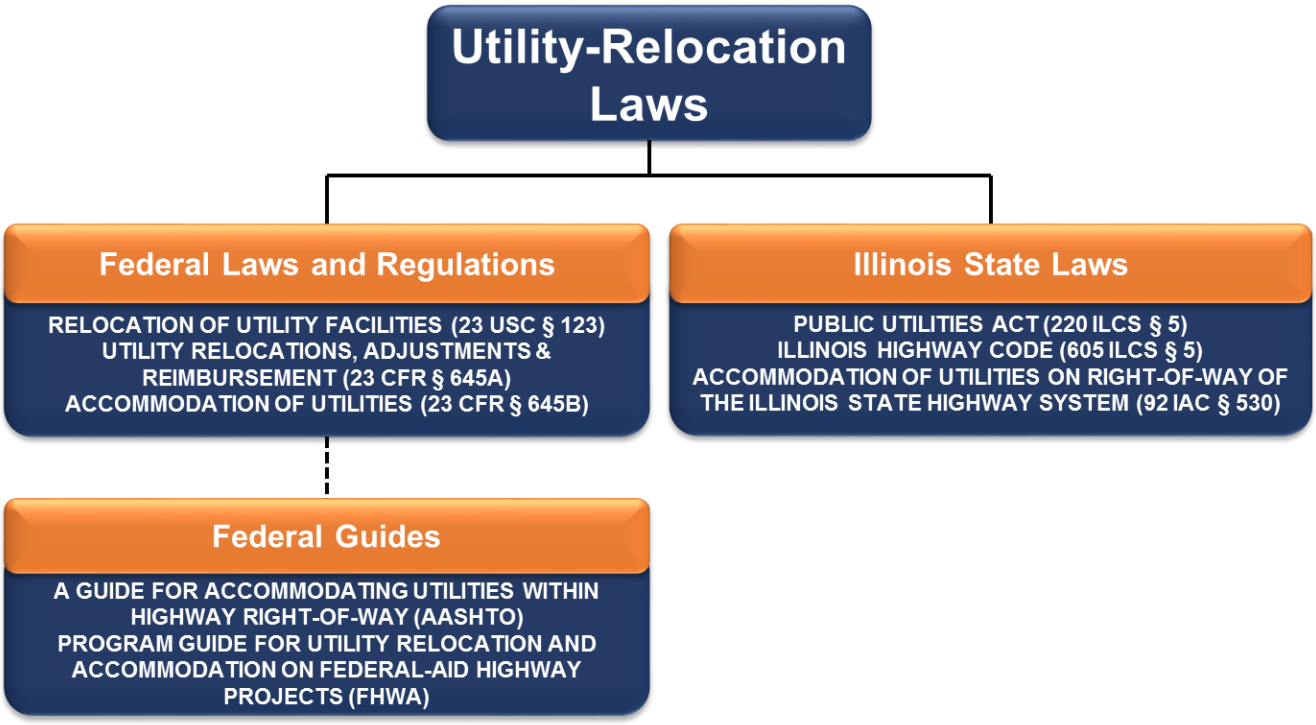

Figure 25. Laws, regulations, and guides governing utility relocation.

5.1.1 Federal Laws, Regulations, and Guides Governing Utility Relocation

This section focuses on federal laws, regulations, and guides governing utility relocation, including (1) relocation of utility facilities (23 USC § 123 et seq.), (2) utility relocations, adjustments, and reimbursement (23 CFR § 645.101 et seq.), (3) accommodation of utilities (23 CFR § 645.201 et seq.), (4) guide for accommodating utilities within highway right-of-way (AASHTO 2005), and (5) utility relocation and accommodation on federal-aid highway projects (FHWA 2003). These five federal laws, regulations, and guides were evaluated to identify compliant BMPs on federally funded projects. The outcomes of this analysis are discussed in section 5.2 of this report.

5.1.1.1 "Relocation of Utility Facilities" (23 USC § 123)

Section 123 of title 23 of the United States Code, "Relocation of Utility Facilities" (23 USC § 123) details the requirements for reimbursement of federal funds to the state for the cost of relocation of utility facilities. This section is organized into three subsections defining the (1) requirements for reimbursement, (2) the term "utility," and (3) the term "cost of relocation" (23 USC § 123).

5.1.1.2 Utility Relocations, Adjustments, and Reimbursement (23 CFR § 645 Subpart A)

Utility relocations, adjustments, and reimbursement, subpart A of title 23 of the *Code of Federal Regulations*, section 645, describes the policies, procedures, and reimbursement provisions for the adjustment and relocation of utility facilities on federal-aid and direct federal projects. This subpart is organized into ten sections, describing (1) the purpose of the statute, (2) applicability of reimbursement for utility work conducted by state DOTs on federal-aid highways, (3) definitions related to the subpart, (4) eligibility requirements for federal funding, (5) preliminary engineering requirements associated with utility-relocation work, (6) right-of-way procedures for utilities occupying the state right-of-way, (7) agreements and authorizations requirements, (8) construction procedures, (9) cost-development recording and reimbursement requirements, and (10) alternate procedures describing the processing of utility relocations by the FHWA (23 CFR § 645.101 et seq.). Subpart A defines the requirements for reimbursement on federal utility-relocation projects and does not dictate the utility-relocation procedures conducted in the field.

5.1.1.3 "Accommodation of Utilities" (23 CFR § 645 Subpart B)

"Accommodation of Utilities" (23 CFR § 645 Subpart B) describes policies and procedures for accommodating utility facilities and private lines on the right-of-way of federal-aid or direct federal highway projects. This subpart is organized into eight sections: (1) the purpose of the statute; (2) applicability to both new utility installations and utility adjustments within the right-of-way; (3) cooperation policies between the utility company and DOT; (4) definitions related to the subpart; (5) general requirements, such as safety, aboveground installations, and installations within freeways; (6) state DOT accommodation policies; (7) use and occupancy agreements; and (8) FHWA approval for utilities to occupy right-of-way (23 CFR § 645.201 et seq.).

5.1.1.4 *A Guide for Accommodating Utilities within Highway Right-of-Way*

The American Association of State Highway and Transportation Officials (AASHTO) developed *A Guide for Accommodating Utilities within Highway Right-of-Way* to evaluate the adequacy of state utility-accommodation policies. This guide is incorporated by reference into the previously discussed 23 CFR

§ 645.211. This guide regulates the use and occupancy of highway right-of-way by utilities and is organized into six sections: (1) introduction and purpose of the guide; (2) general conditions for safety, design, location, and restoration; (3) underground-facility requirements; (4) pipeline requirements; (5) overhead-facility requirements; and (6) ditch and canal requirements (AASHTO 2005). The guide provides the minimum requirements for utility installation and relocation on highway right-of-way.

5.1.1.5 *Utility Relocation and Accommodation on Federal-Aid Highway Projects*

In 2003, the Federal Highway Administration developed a detailed program guide titled *Utility Relocation and Accommodation on Federal-Aid Highway Projects* (FHWA 2003). This guide is organized into two chapters: "Utility relocations, adjustments, and reimbursements" and "Utility accommodation." The program guide directly references sections in the aforementioned 23 CFR 645A and 645B. The program guide describes the applicability and eligibility of federal aid on highway projects, policies, general requirements, necessary engineering reviews, right-of-way acquisition, types of agreements, construction, cost development, alternate procedures, and approvals.

The program guide includes in its first chapter a section titled "alternate procedures" that lists a number of best management practices (BMPs) and incentives to minimize delays related to utility relocation. This program guide reported that the costs of implementing these BMPs are eligible for partial or full federal funding on federal-aid projects (FHWA 2003).

5.1.2 Illinois Laws Governing Utility Relocation

This section focuses on Illinois state laws governing utility relocation, including (1) Public Utilities Act (220 ILCS 5 et seq.), (2) Roads and Bridges (605 ILCS 5 et seq.), and (3) Accommodation of Utilities on Right-of-Way (92 IAC 530 et seq.). These three Illinois state laws were evaluated to identify compliant utility-relocation BMPs that can be utilized in the state of Illinois. The outcomes of this analysis are discussed in Section 5.2 of this report.

5.1.2.1 Public Utilities Act (Chapter 220 ILCS 5)

The Public Utilities Act in the Illinois Compiled Statutes (ILCS) is organized into twenty-three articles describing the regulations for public utilities to operate in the state of Illinois. The law requires public utilities to provide adequate, efficient, reliable, environmentally safe, and least-cost utility services (220 ILCS 5). The act focuses primarily on providing public utilities to Illinois citizens, and it includes two articles that are directly related to utility installation and relocation. Articles 8 and 21 describe requirements for installing overhead high-voltage lines within right-of-ways.

5.1.2.2 Illinois Highway Code (Chapter 605 ILCS 5)

The Illinois Highway Code is the governing law for all public highways in the state of Illinois. The code is organized into eleven articles and details the administration, planning, construction, maintenance, and operation processes of all Illinois state highways. Article 9 in this code, "General Highway Provisions," section 113, describes the minimum requirements of utility-coordination procedures within highway right-of-ways. Subsection (b) of section 113 in article 9 focuses on establishing and implementing effective communication between IDOT and utility companies on planned highway

projects. It discusses the establishment of a coordination council composed of state DOT and utility participants (605 ILCS 5/113b).

5.1.2.3 Accommodation of Utilities on Right-of-Way of the Illinois State Highway System (Title 92 IAC 530)

Part 530 of the Illinois Administrative Code (IAC) establishes the policies and procedures for accommodating utilities on right-of-way of the Illinois State Highway System. This part is organized into nine subparts, describing (a) general provisions; (b) permit-application requirements; (c) general permit conditions; (d) specific permit conditions; (e) construction methods and maintenance work on utilities; (f) vegetation control; (g) utility attachments to bridge or traffic structures; (h) application denial, revocation, and sanctions; and (i) administrative remedies.

5.1.3 IDOT Policies Governing Utility Relocation and Roadway Construction

This section highlights IDOT policies that are directly related to utility installation and relocation in the following five IDOT manuals and specifications: (1) *Bureau of Design and Environment Manual,* (2) *Accommodation of Utilities on Right-of-Way of the Illinois Highway System,* (3) Standard Specifications for Road and Bridge Construction, (4) Supplemental Specifications and Recurring Special Provisions, and (5) *Land Acquisition Policies and Procedures Manual.*

5.1.3.1 *Bureau of Design and Environment (BDE) Manual*

The *Bureau of Design and Environment (BDE) Manual* provides IDOT personnel with procedures and practices for the development of roadway projects (IDOT 2010). Chapter 6 of the BDE manual, titled "Utility Coordination," includes utility-adjustment policies and procedures for projects with and without federal funding. These policies in chapter 6 serve as the standard processes and procedures for administering utility projects, starting from the preliminary design phase through final contract payment. They define (1) general guidelines, (2) procedures, (3) preparation of utility plans, (4) utility coordination, (5) estimates, (6) agreement processing, and (7) adjustment procedures. Chapter 6 provides detailed descriptions of utility-adjustment tasks, types of contract agreements between the state and utility companies, procedures for review, project finances, change-order procedures, and final payment (IDOT 2010).

5.1.3.2 *Accommodation of Utilities on Right-of-Way of the Illinois Highway System*

This manual serves as the standard policies and procedures for accommodating utilities on right-of-way of the Illinois state highway system. The manual includes nine subparts that focus on (1) general provisions; (2) permit-application requirements; (3) general permit conditions; (4) specific permit conditions; (5) construction methods and maintenance work on utilities; (6) vegetation control; (7) utility attachments to bridges or traffic structures; (8) application denial, revocation, and sanctions; and (9) administrative remedies (IDOT 1992).

In 2008–2009, a committee was formed to update the 1992 version of this manual. The committee included several IDOT personnel who were interviewed in developing this report. The committee developed an updated draft of the manual that included (a) revisions to safety protocol; (b) revisions for new technologies that did not exist in 1992, specifically trenchless installation, directional boring,

and fiber optic wiring; (c) revised guidelines for as-built plans and records retention; (d) detailed requirements for notification of the removing, relocating, or modification of utility facilities; and (e) clarifications on previously conflicting information contained in the accommodation manual.

5.1.3.3 Standard Specifications for Road and Bridge Construction

The Standard Specifications for Road and Bridge Construction outlines the general requirements and covenants applicable to all highway-construction improvements, as well as provisions relating to materials, equipment, and construction requirements for individual items of work on road and bridge construction projects (IDOT 2012). These specifications include ten divisions that focus on (1) general requirements and covenants; (2) earthwork, landscaping, and erosion control; (3) subgrades, subbases, and base courses; (4) surface courses, pavements, rehabilitation, and shoulders; (5) structures; (6) incidental construction; (7) work-zone traffic-control protection, signing, and pavement marking; (8) electrical requirements; (9) materials; and (10) equipment.

For example, the first division in these standards (division 100) describes the general requirements, including work processes for roadway contractors and roadway contractor's responsibilities with utility coordination, delays, and compensation. Section 105.07 in division 100 is titled "Cooperation with Utilities," and it specifies that utility-relocation operations can be performed concurrently with roadway-construction work if it cannot be completed prior to the start of construction. Subpart a of section 105.07 states: "arrangements for adjusting known utilities will be made by the Department (of Transportation) prior to project construction; however utilities will not necessarily be adjusted in advance of project construction and, in some cases, utilities will not be removed from the proposed construction limits" (IDOT 2012). In the event that utility relocation is performed concurrently with roadway construction, subpart a of section 105.07 specifies the responsibilities of the roadway contractor in accommodating the utility company. It states "The contractor shall coordinate with any planned utility adjustment or new installation and the contractor shall take all precautions to prevent disturbance or damage to utility facilities" (IDOT 2012). This subpart concludes: "No additional compensation will be allowed for any delays, inconveniences, or damages sustained by the Contractor due to the presence of or any claimed interference from the said known utility facilities or any adjustment of them" (IDOT 2012).

5.1.3.4 Supplemental Specifications and Recurring Special Provisions

The Supplemental Specifications and Recurring Special Provisions accompanies the previously described Standard Specifications for Road and Bridge Construction (IDOT 2015h). Any addendum to the standard specifications is contained in the supplemental specifications, which are updated yearly, whereas the standard specifications are updated every five to ten years.

For example, section 105.07, "Cooperation with Utilities," was revised in the Supplemental Specifications and Special Provisions to clarify the accommodation of utility companies. The section states: "The Department reserves the right at any time to allow work by utilities on or near the work covered by the contract. The Contractor shall conduct his/her work so as not to interfere with or hinder the progress or completion of the work being performed by utilities." This section also states: "The Contractor shall coordinate with any planned utility adjustment or new installation and the

Contractor shall take all precautions to prevent disturbance or damage to utility facilities" (IDOT 2015h).

Another related section in these provisions is section 107.37, titled "Locations of Utilities within the Project Limits," that provides specifications on compensating contractors for delays due to utilities. It states: "No additional compensation will be allowed for any delays, inconveniences, or damages sustained by the Contractor due to the presence of or any claimed interference from known utility facilities or any adjustment of them" (IDOT 2015h).

5.1.3.5 *Land Acquisition Policies and Procedures Manual*

The *Land Acquisition Policies and Procedures Manual* provides uniform practices for the acquisition of property required for highway improvements. The manual was developed by the Bureau of Land Acquisition with assistance from all IDOT districts. The manual is divided into ten chapters: (1) overview, federal programming, and qualifications; (2) right-of-way engineering; (3) appraisal and appraisal review; (4) negotiation and acquisition; (5) relocation assistance and payments program; (6) property management; (7) accounting for land-acquisition services; (8) contracting for land-acquisition services; (9) outdoor advertising; and (10) special wastes (IDOT 2014).

An example of a related section in this manual is section 1.2 in chapter 1, titled "Land Acquisition Process—Overview." This section describes the main steps for land acquisition, including surveying, ownership determination, environmental assessment, appraisals, negotiations, and relocations (IDOT 2014).

5.2 COMPLIANCE OF BEST MANAGEMENT PRACTICES AND INCENTIVES

This section analyzes the compliance of 61 best management practices (BMPs) and incentives with federal and Illinois state laws, regulations, and guides governing utility relocation. These 61 BMPs were identified based on the outcomes of a comprehensive literature review, interviews with IDOT personnel, and two surveys conducted of state DOTs and Illinois utility companies, as discussed in chapters 2, 3, and 4 of this report, respectively (see Figure 26). These 61 BMPs identified were organized into four main categories: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices, as shown in Figure 26. The compliance of all the BMPs and incentives in these four categories with federal and state laws, regulations, and guides is described in the following sections.

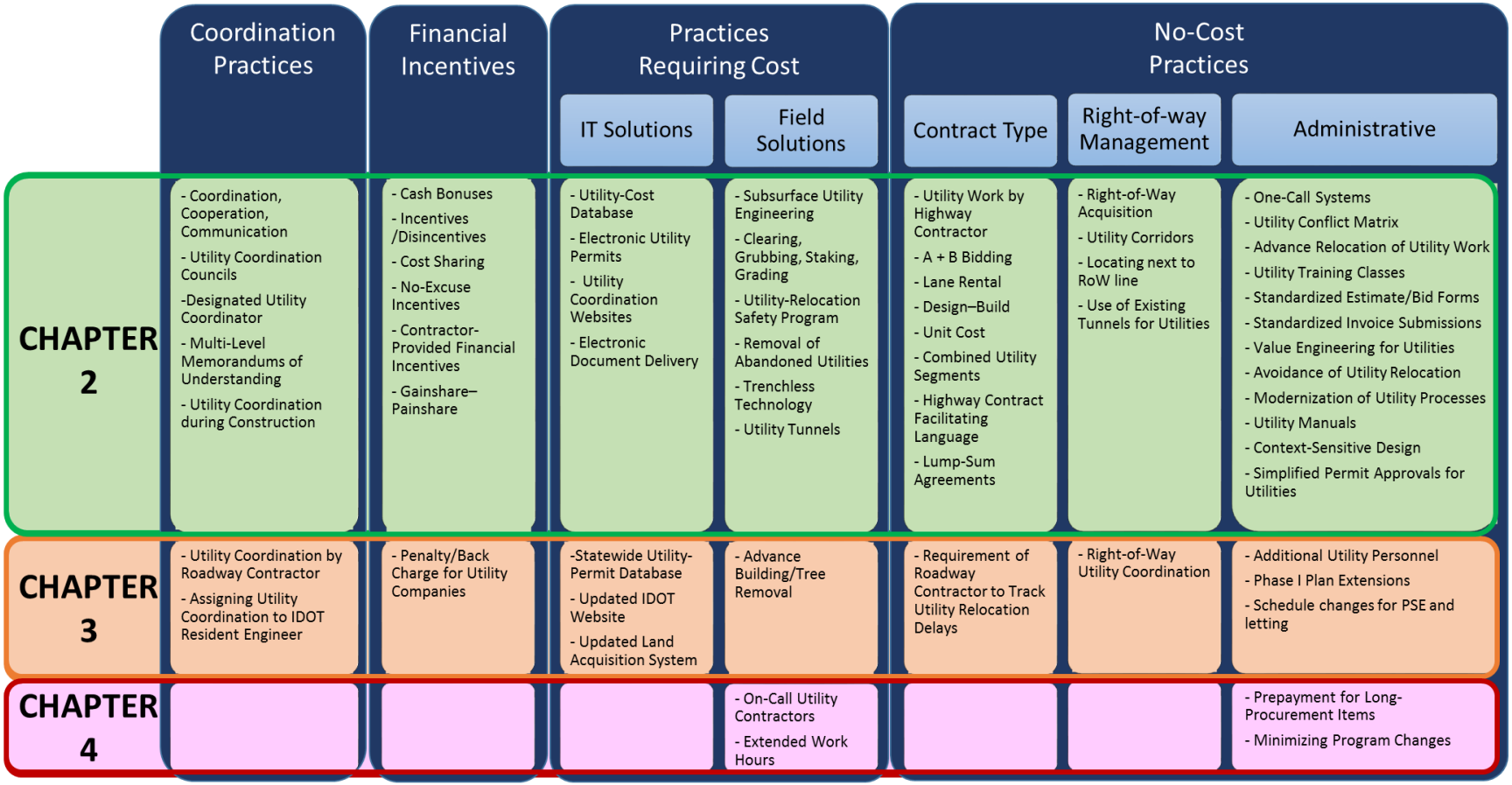

Figure 26. Best management practices and incentives identified.

5.2.1 Coordination Practices

These best management practices were identified or suggested as having the potential to expedite utility relocation through communication between the state DOT and the utility company. This category includes (1) coordination, cooperation, and communication; (2) utility coordination councils; (3) designated utility coordinators, (4) multi-level memorandums of understanding; (5) utility coordination during construction, (6) utility coordination by roadway contractor, and (7) assignment of utility relocation to the IDOT resident engineer, as shown in Table 12. A brief description of each coordination practice can be found in Appendix A. The following two subsections describe the compliant and noncompliant coordination practices.

Table 12. Compliance of Coordination Practices

Coordination Practices	Federal Laws	Illinois Laws
Coordination, Cooperation, Communication	✓	✓
Utility Coordination Councils	✓	✓
Designated Utility Coordinators	✓	✓
Multi-Level Memorandums of Understanding	✓	✓
Utility Coordination During Construction	✓*	✓
Utility Coordination by Roadway Contractor	✓	✓
Assignment of Utility Relocation to IDOT Resident Engineer	✓	✓

✓ = Fully compliant with federal and state laws, regulations, and guides

✓* = Compliant with clarifications(s)

5.2.1.1 Compliant Coordination Practices

All seven coordination practices identified were found to be compliant with all federal and Illinois state laws, regulations, and guides governing utility relocation, as shown in Table 12. It should be noted that the use of the "utility coordination during construction" BMP (see Table 12) is compliant with federal laws; however, there are restrictions on using federal funding to pay for construction-delay claims caused by utilities or by the use of this BMP. This limitation is specified in the "Construction Delay Claims" section of the FHWA program guide on "Utility Relocation and Accommodation on Federal-aid Highway Projects" (FHWA 2003). This section states: "The FHWA may participate in construction-delay claims caused by utilities. As a general rule, all utility relocations should be completed before a related highway construction project is advertised for bids. Sometimes, however, utility facilities cannot be relocated until some highway construction work has been completed." The section continues, stating: "the FHWA may participate in delay claims if it is determined that (1) utilities were either relocated and/or adjusted prior to advertising for bids, or necessary coordination was arranged with the appropriate utility companies to avoid causing any delay to the construction contractor; (2) the approved procedures in the State's utility accommodation policy were followed in making arrangements for the relocation and/or adjustment of the utilities; (3) the construction work was actually delayed by the utility work through no fault of the construction contractor; and (4) the State exercised reasonable efforts to control the situation" (FHWA 2003). As long as these four conditions have been met, federal funding can be used to pay for claims resulting from utility-relocation delays. The section in the FHWA program guide concludes: "the FHWA should not participate in any construction delay claims caused by conflicts with

underground utilities that would have been avoided if subsurface utility engineering had been used" (FHWA 2003).

5.2.1.2 Noncompliant Coordination Practices

No coordination practices were found to be prohibited by federal or Illinois state laws, regulations, or guides governing utility relocation.

5.2.2 Financial Incentives

These practices have the potential to expedite utility relocation through financial incentives provided by the state DOT to the utility company. This category includes (1) cash bonuses, (2) incentives/disincentives, (3) cost-sharing, (4) no-excuse incentives, (5) contractor-provided financial incentives, (6) gainshare–painshare, and (7) penalty/back charge to utility company for delays, as shown in Table 13. A brief description of each financial incentive can be found in Appendix A. The following two subsections describe the compliant and noncompliant financial incentives.

Table 13. Compliance of Financial Incentives

Financial Incentives	Federal Laws	Illinois Laws
Cash Bonuses	Ø	Ø
Incentive/Disincentives	Ø	✓*
Cost-Sharing	✓*	✓*
No-Excuse Incentives	Ø	Ø
Contractor-Provided Financial Incentives	Ø	Ø
Gainshare–Painshare	Ø	Ø
Penalty/Back Charge to Utility Company for Delays	Ø	✓*

✓* = Compliant with clarification(s)
Ø = Compliant with restricted use of federal funding

5.2.2.1 Compliant Financial Incentives

The cost-sharing BMP was the only financial incentive found to be compliant with all federal and Illinois state laws, regulations, and guides governing utility relocation, as shown in Table 13. The FHWA program guide on "Utility Relocation and Accommodation on Federal-aid Highway Projects" provides an example of the utility cost-sharing BMP and states: "Federal reimbursement to a State for the cost of relocating utilities is to be made only on the basis of State funds actually expended for the relocation" (FHWA 2003). The program guide expands on the requirements for reimbursement in a section titled "State's Own Funds," stating: "Federal reimbursement to a State for the cost of relocating utility facilities to be made only on the basis of State funds actually expended, and not for funds paid, advanced, donated or contributed by or from any other sources" (FHWA 2003). This indicates that the cost-sharing BMP can utilize federal funding after "any funds provided by the utility are to be deducted from the total overall costs" (FHWA 2003).

Federal laws, regulations, and guides restrict the use of federal funds to pay for the other six financial incentives on federally funded utility-adjustment projects (see Table 13). Additionally, Illinois state

laws prohibit the use of federal funding to pay for financial incentives on interstate highways but do not explicitly prohibit the use of state-funded financial incentives on interstate highways or other types of highways and roads. The specific federal and state laws, regulations, and guides that restrict the use of federal funding for financial incentives are discussed in more detail in the next section.

5.2.2.2 Noncompliant Financial Incentives

Federal and state laws, regulations, and guides prohibit the use of federal funds to pay for six of the seven financial incentives listed in Table 13. The use of federal funding as part of any financial incentives is expressly prohibited in federal laws 23 USC 123, and 23 CFR 645 A. The federal law "Relocation of Utility Facilities" (23 USC § 123) describes the requirements for reimbursement for utility relocation on federal-aid highway projects, stating: "When a State shall pay for the cost of relocation of utility facilities necessitated by the construction of a project on any Federal-aid highway, Federal funds may be used to reimburse the State for such cost in the same proportion as Federal funds are expended on the project." The law defines "cost of relocation" as "the entire amount paid by such utility properly attributed to such relocation after deducting therefrom any increase in the value of the new facility and any salvage value derived from the old facility" (23 USC § 123(a) et seq.). Similarly, subpart A of section 645 of title 23 of the Code of Federal Regulations, titled "Utility Relocations, Adjustments & Reimbursements," provides the same definition for "cost of relocation" (23 CFR 645.105). This definition indicates that Federal funding cannot be used to pay for any financial incentives or cash bonuses because they are not considered cost of relocation, based on the aforementioned definition. In addition, the Illinois Complied Statutes (ILCS) chapter 605, article 3, titled "Federal Aid," provides a definition for the "cost of relocation" that is similar to the aforementioned definition provided by federal laws and regulations. This article defines the "cost of such relocation" as "the entire amount paid by such utility properly attributable to such relocation after deducting therefrom any increase in the value of the new facility and any salvage value derived from the old facility" (605 ILCS 5/3-107). Accordingly this article indicates that financial incentives or cash bonuses cannot be included as part of the "cost of such relocation" and therefore cannot be funded by federal aid.

Furthermore, the use of the "incentive/disincentives" and "penalty/back charge to utility company for delays" BMPs in Table 13 can be restricted by the "90-day utility-relocation law." These restrictions can be encountered if the utility company follows the procedures set forth in article 9 of chapter 605 ILCS 5, commonly known as the 90-day utility-relocation law. Subsection b of section 113 in article 9 defines the terms of the 90-day utility-relocation law, which requires utility companies to remove, relocate, or modify utilities within 90 days of a written request from the DOT. If the utility company has not completed the utility relocation to the reasonable satisfaction of the state, or if other arrangements have not been made, the state DOT is permitted to relocate the utilities and bill the utility company for the cost (605 ILCS 5/113b). Additionally, subsection f has a provision for the utility company to "request for a waiver of the 90 day deadline" (605 ILCS 5/113f).

5.2.3 Practices Requiring Cost

These practices may require additional cost from the state DOT to implement; and they include 16 BMPs, as shown in Table 14. A brief description of each of these BMPs can be found in Appendix A.

The compliance analysis is discussed in the following two subsections: (1) compliant practices requiring cost and (2) noncompliant practices requiring cost.

Table 14. Compliance of Practices Requiring Cost

Practices Requiring Cost	Federal Laws	Illinois Laws
Utility-Cost Database	✓	✓
Electronic Utility Permits	✓	✓
Utility Coordination Websites	✓	✓
Electronic Document Delivery	✓	✓
Statewide Utility-Permit Database	✓	✓
Updated IDOT Website	✓	✓
Updated Land-Acquisition System	✓	✓
Subsurface-Utility Engineering	✓	✓
Clearing, Grubbing, Staking, Grading	✓	✓
Utility-Relocation Safety Programs	✓	✓
Removal of Abandoned Utilities	✓	✓
Trenchless Technology	✓	✓
Utility Tunnels	✓	✓
Advance Building/Tree-Removal	✓	✓
On-Call Utility Contractors	✓	✓
Extended Work Hours	✓	✓

✓ = Fully compliant with federal and state laws, regulations, and guides

5.2.3.1 Compliant Practices Requiring Cost

All 16 identified practices requiring cost were found to be compliant with all federal and Illinois state laws, regulations, and guides governing utility relocation, as shown in Table 14.

5.2.3.2 Noncompliant Practices Requiring Cost

No practices requiring cost were found to be prohibited by federal or Illinois state laws, regulations, or guides governing utility relocation.

5.2.4 No-Cost Practices

This category includes all identified BMPs that do not require additional cost from the state DOT to implement; and it includes 31 BMPs, as shown in Table 15. A brief description of each no-cost practice can be found in Appendix A. The following two subsections describe the compliant and noncompliant no-cost practices.

Table 15. Compliance of No-Cost Practices

No-Cost Practices	Federal Laws	Illinois Laws
Utility Work by Highway Contractors	✓	✓
A + B Bidding	✓	✓
Lane Rental	✓	✓
Design–Build for Utilities	✓	✓
Unit Costs	✓	✓
Combined Utility Segments	✓	✓
Highway-Contract-Facilitating Language	✓	✓
Lump-Sum Agreements	✓	✓
Requirement of Roadway Contractor to Track Utility-Relocation Delays	✓	✓
Right-of-Way Acquisition	✓	✓*
Utility Corridors	✓	✓
Locating Next to RoW Line	✓	✓
Use of Existing Tunnels for Utilities	✓	✓
Right-of-Way Utility Coordination	✓	✓
One-Call Systems	✓	✓
Utility Conflict Matrix	✓	✓
Advance Relocation of Utility Work	✓	✓
Utility Training Classes	✓	✓
Standardized Estimate/Bid Form	✓	✓
Standardized Invoice Submissions	✓	✓
Value-Engineering for Utilities	✓	✓
Avoidance of Utility Relocation	✓	✓
Modernization of the Utility Procedures	✓	✓
Utility Manuals	✓	✓
Context-Sensitive Design	✓	✓
Simplified Permit Approvals for Utilities	✓	✓
Additional Utility Personnel	✓	✓
Phase I Plan Extensions	X	X
Schedule Changes for PSE and Letting Dates	✓	✓
Prepayment for Long-Procurement Items	Ø	Ø
Minimizing Program Changes	✓	✓

✓ = Fully compliant with federal and state laws, regulations, and guides

✓* = Compliant with clarification(s)

Ø = Compliant with restricted use of federal funding

X = Noncompliant with federal and state laws, regulations, and guides

5.2.4.1 Compliant No-Cost Practices

A total of 29 of the 31 no-cost practices are fully compliant with federal and Illinois laws, regulations, and guides governing utility relocation, as shown in Table 15. One of these 29 compliant BMPs, namely “right-of-way acquisition,” might be difficult to implement under current IDOT procedures. According to 605 ILCS 5, section 4-505, for IDOT to acquire right-of-way on behalf of the utility company for utility adjustment/relocation, the DOT and the public utility must enter into an

agreement approved by the Illinois Commerce Commission (605 ILCS 5/4-505). Current IDOT procedures listed in the BDE manual specify that the land-acquisition and utility company agreements are performed concurrently. To utilize this practice, the utility company agreement must be executed before land acquisition for right-of-way, which may require modifying the aforementioned IDOT procedures.

5.2.4.2 Noncompliant No-Cost Practices

Only two of the 31 no-cost practices do not fully comply with federal and Illinois state laws, as shown in Table 15. These two BMPs are (a) "phase 1 plan extensions," found to be noncompliant with federal and Illinois state laws, and (b) "prepayment for long-procurement items," found to be compliant with restricted use of federal funding. First, the "phase 1 plan extensions" BMP was suggested by personnel in one IDOT district to extend the expiration date of phase I plans, specifically, the environmental impact statement (EIS), which is valid for three years from the completion of the analysis. The implementation of this suggested BMP does not comply with federal laws that do not permit an extension and require a reevaluation of the final EIS if major portions of a project have not occurred within three years after the approval of the final EIS (23 CFR 771.129(b)).

Second, the "prepayment for long-procurement items" BMP was suggested by a state DOT survey respondent to provide advanced funding to the utility company to secure materials with long-procurement times, such as culverts. Federal regulations restrict the use of federal funds for the prepayment of long-procurement items, based on subsection i of section 645.117 of title 23 of the Code of Federal Regulations, which states: "After the executed TD/utility agreement has been approved by the FHWA, the utility may be reimbursed through the STD by progress billings for costs incurred. Cost for materials stockpiled at the project site or specifically purchased and delivered to the utility for use on the project may also be reimbursed on progress billings" (23 CFR 645.117(i)). This subsection restricts the use of federal funds to materials that are either stockpiled at the project site or purchased and delivered to the utility company; and therefore federal funds cannot be used to prepay for material that has not already been delivered, as suggested by this BMP. It should be noted that there are no restrictions on using state funds to prepay for long-procurement items, as suggested by this BMP; and later, the state can be reimbursed by federal funds after the long-procurement items are delivered to the project site or the utility company.

5.2.5 Compliant BMPs and Incentives for Utility Relocation

This section summarizes the compliance of the 61 identified best management practices and incentives with all federal and Illinois state laws governing utility relocation, as shown in Figure 27.

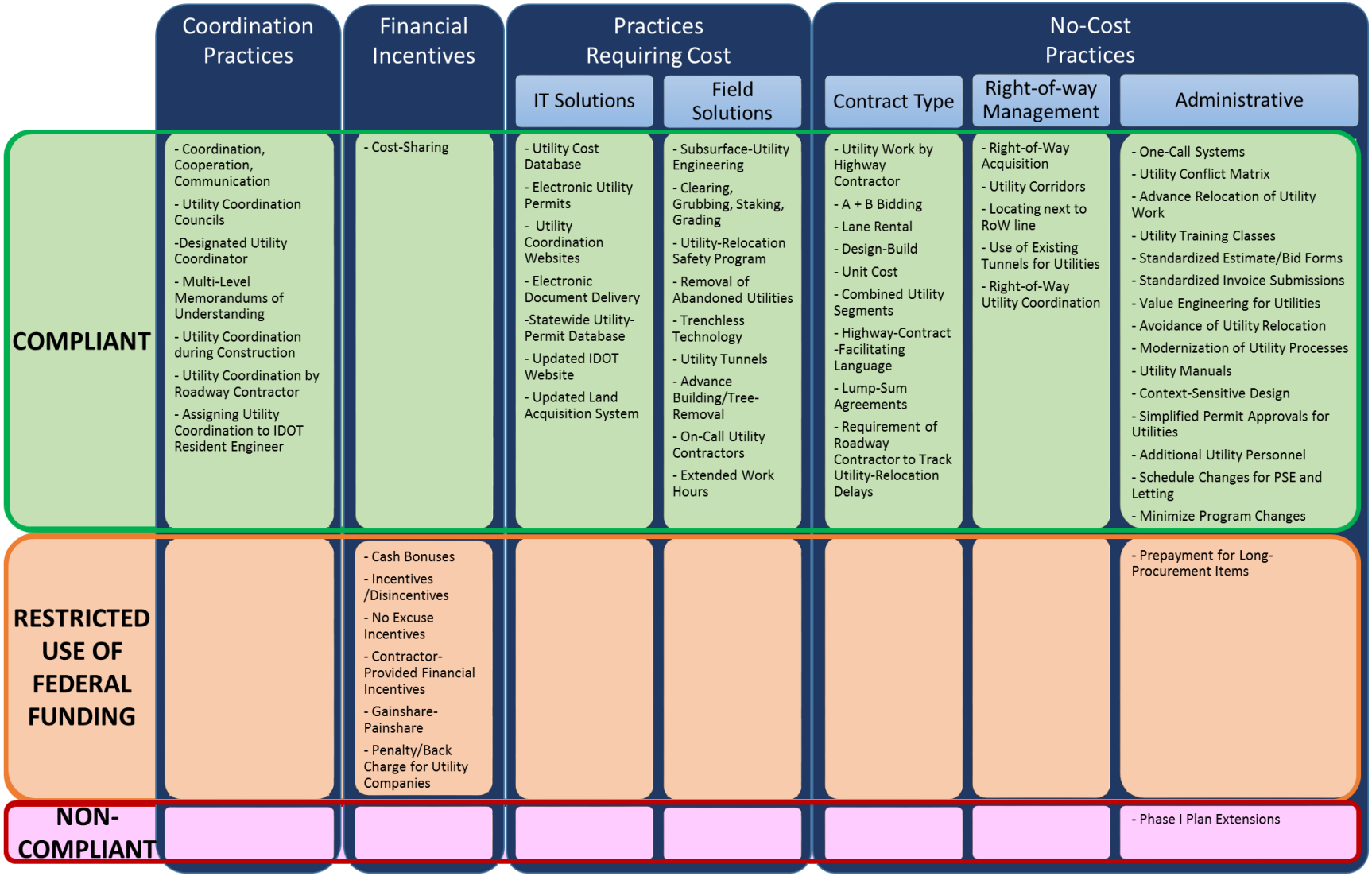

Figure 27. Compliance of BMPs and incentives.

CHAPTER 6: COST-BENEFIT ANALYSIS

This chapter presents the findings of a comprehensive cost-benefit analysis of the 60 compliant utility-relocation best management practices and incentives. The two main objectives of this analysis were to (1) analyze and quantify the costs and benefits of each BMP using cost-benefit factor analysis; and (2) rank the BMPs based on their cost-benefit factor, using varying relative importance weights. The findings of this analysis are described in the following two sections.

6.1 COST-BENEFIT FACTOR ANALYSIS

This section calculates a cost-benefit factor (CBF_i) for each of the 60 compliant BMPs, considering its reported cost and benefits in the aforementioned state DOT surveys. This cost-benefit factor is calculated in three steps that are designed to calculate:

1. Normalized implementation cost (NC_i) for each BMP *i* based on its reported implementation cost (C_i), as well as the least (C_{min}) and highest (C_{max}) reported implementation costs of all 60 BMPs using Equation 1. The value of this calculated normalized implementation cost (NC_i) can range from 0%, which represents a BMP with the highest implementation cost, to 100%, which represents a BMP with the least implementation cost.

2. Normalized benefit factor (NB_i) for each BMP *i* based on its normalized effectiveness rate (NE_i), its normalized impact on reducing the project duration (ND_i), and their relative importance weights as shown in Equation 2. The normalized effectiveness rate (NE_i) and the normalized impact on reducing the project duration (ND_i) are calculated using Equation 3 and Equation 4, respectively. It should be noted that the value of calculated normalized benefit cost (NB_i) can range from 0%, which represents a BMP with the least benefit factor, to 100%, which represents a BMP with the greatest benefit factor.

3. Cost-benefit factor (CBF_i) for each BMP *i* that quantifies both its implementation cost and benefits, as shown in Equation 5. The value of this calculated cost-benefit factor (CBF_i) can range from 0%, which represents the least cost-effective BMP, to 100%, which represents the most cost-effective BMP, as shown in Figure 28.

$$NC_i = \left[1 - \frac{(C_i - C_{min})}{(C_{max} - C_{\min})}\right] x\ 100\% \qquad \text{Equation 1}$$

$$NB_i = [(NE_i\ x\ W_1) + (ND_i\ x\ W_2)] \qquad \text{Equation 2}$$

$$NE_i = \frac{(E_i - E_{min})}{(E_{max} - E_{\min})}\ x\ 100\% \qquad \text{Equation 3}$$

$$ND_i = \frac{(D_i - D_{min})}{(D_{max} - D_{\min})}\ x\ 100\% \qquad \text{Equation 4}$$

$$CBF_i = NC_i\ x\ NB_i \qquad \text{Equation 5}$$

Where

NC_i: Normalized implementation cost of BMP *i*
C_i: Reported implementation cost of BMP *i*
C_{min}: Minimum implementation cost of all BMPs
C_{max}: Maximum implementation cost of all BMPs
NB_i: Normalized benefits factor of BMP *i*
NE_i: Normalized effectiveness rate of BMP *i*
W_1: Weight of BMP effectiveness rate
ND_i: Normalized impact of BMP *i* on reducing project duration
W_2: Weight of impact of BMP on reducing project duration
E_i: Reported effectiveness rate of BMP *i*
E_{min}: Minimum effectiveness rate of all BMPs
E_{max}: Maximum effectiveness rate of all BMPs
D_i: Reported impact of BMP *i* on reducing project duration
D_{min}: Minimum impact of all BMPs on reducing project duration
D_{max}: Maximum impact of all BMPs on reducing project duration
CBF_i: Cost-benefit factor of BMP *i*

6.2 RANKING OF BMPS

This section ranks all 60 compliant BMPs based on their aforementioned calculated cost-benefit factors. This ranking analysis was conducted for five different scenarios to analyze the sensitivity of the ranking to variations in the relative-importance weights of the BMP effectiveness and its impact on reducing project duration, as shown in Table 16. Scenario 1 provides the ranking of the 60 BMPs, assuming that the effectiveness is much less important to the DOT decision maker than the impact on reducing project duration (W_1 = 10%:W_2 = 90%). Scenario 2 assumes that the effectiveness is less important to the DOT decision maker than the impact on reducing project duration (W_1 = 30%:W_2 = 70%). Scenario 3 assumes that the effectiveness and impact on reducing project duration are equally important to the DOT decision maker (W_1 = 50%:W_2 = 50%). Scenario 4 assumes that the effectiveness is more important to the DOT decision maker than the impact on reducing project duration (W_1 = 70%:W_2 = 30%). Scenario 5 assumes that the effectiveness is much more important to the DOT decision maker than the impact on reducing project duration (W_1 = 90%:W_2 = 10%). The main findings of this conducted sensitivity analysis can be summarized as

- For the first scenario, the top 5 BMPs with the highest calculated cost-benefit factor are (1) removal of abandoned utilities; (2) clearing, grubbing, staking, grading; (3) advance building/tree-removal; (4) right-of-way utility coordination; and (5) prepayment for long-procurement items, as shown in Table 16 and Figure 28.
- For scenarios 2, 3, and 4, the top 5 BMPs with the highest calculated cost-benefit factor are (1) removal of abandoned utilities; (2) clearing, grubbing, staking, grading; (3) advance building/tree-removal; (4) utility work by highway contractors; and (5) right-of-way utility coordination; however, their ranking within each scenario is slightly different, as shown in Table 16 and Figure 28.

- For the fifth scenario, the top 5 BMPs with the highest calculated cost-benefit factor are (1) utility work by highway contractor; (2) clearing, grubbing, staking, grading; (3) advance relocation of utility work; (4) advance building/tree-removal; and (5) right-of-way utility coordination, as shown in Table 16 and Figure 28.

Table 16. Sensitivity Analysis of the Cost-Benefit Factor for the Top 25 Best Management Practices and Incentives

Best Management Practices and Incentives	Cost-Benefit Factor Based on Weight Distribution: W_1 (Effectiveness): W_2 (Project-Duration Reduction)									
	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	Rank	10%:90%	Rank	30%:70%	Rank	50%:50%	Rank	70%:30%	Rank	90%:10%
Removal of Abandoned Utilities	1	98.16	1	94.48	1	90.80	2	87.12	10	83.44
Clearing, Grubbing, Staking, Grading	2	83.64	2	85.20	2	86.76	1	88.32	2	89.89
Advance Building/Tree-Removal	3	75.70	3	78.52	3	81.34	3	84.17	4	86.99
Utility Work by Highway Contractors	6	50.41	5	61.43	4	72.45	4	83.47	1	94.49
Right-of-Way Utility Coordination	4	56.99	4	64.47	5	71.96	5	79.44	5	86.92
Prepayment for Long-Procurement Items	5	53.10	6	59.29	6	65.48	11	71.67	25	77.86
Advance Relocation of Utility Work	12	40.56	8	52.29	7	64.01	6	75.74	3	87.47
Unit Costs	10	42.90	7	52.51	8	62.11	10	71.72	20	81.33
Simplified Permit Approvals for Utilities	11	40.98	10	51.52	9	62.06	7	72.59	11	83.13
Utility Coordination during Construction	16	34.78	12	47.20	10	59.62	8	72.04	8	84.46
Trenchless Technology	17	34.78	13	47.20	11	59.62	9	72.04	9	84.46
Utility Coordination by Roadway Contractor	9	43.48	11	51.31	12	59.15	18	66.98	28	74.82
Requirement of Roadway Contractor to Track Utility-Relocation Delays	7	44.57	9	51.58	13	58.58	21	65.59	33	72.59
Minimizing Program Changes	18	34.30	15	45.74	14	57.19	14	68.64	22	80.09
Right-of-Way Acquisition	25	30.31	19	43.30	15	56.29	13	69.29	14	82.28
Electronic Utility Permits	32	25.36	28	40.38	16	55.40	12	70.41	7	85.43
Assigning Utility Relocation to IDOT Resident Engineer	13	37.89	14	46.26	17	54.64	30	63.01	40	71.38
Standardized Invoice Submissions	28	28.03	24	41.23	18	54.43	17	67.63	21	80.83
Utility Manuals	14	36.82	16	45.51	19	54.20	31	62.89	36	71.57
Schedule Changes for PSE and Letting Dates	19	33.58	18	43.60	20	53.62	23	63.64	31	73.66
One-Call Systems	29	27.85	26	40.69	21	53.53	20	66.37	23	79.21
Utility-Cost Database	20	33.42	20	43.12	22	52.82	34	62.52	34	72.22
Utility Coordination Websites	34	21.92	33	37.20	23	52.48	15	67.75	12	83.03
Electronic Document Delivery	35	21.92	34	37.20	24	52.48	16	67.75	13	83.03
Utility Training Classes	26	29.05	25	40.75	25	52.46	22	64.16	27	75.86

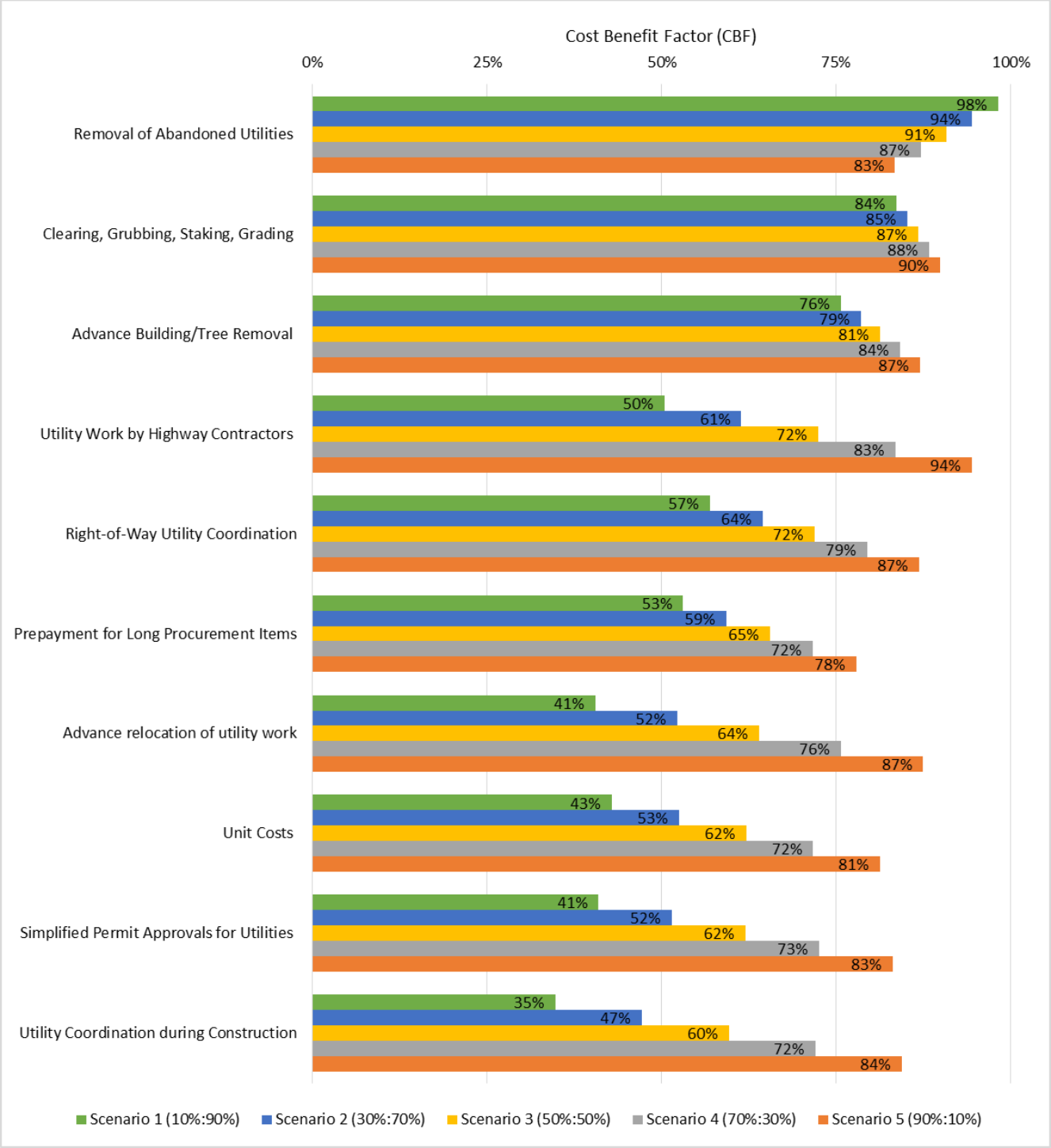

Figure 28. Impact of relative-importance weights on the cost-benefit factor for the top 10 BMPs.

CHAPTER 7: DYNAMIC BMP-SELECTION TOOL

This chapter presents a dynamic BMP-selection tool that can be used by IDOT personnel to select BMPs and incentives to reduce utility-related delays and expedite utility-relocation projects. The dynamic BMP-selection tool is provided as a stand-alone Excel file that can run on any version of Excel 1997 or newer. The tool can be used by decision makers to rank the 60 compliant BMPs based on their overall performance in five main criteria: (1) implementation cost, (2) effectiveness, (3) impact on reducing the project duration, (4) utilization rate by other state DOTs, and (5) implementation problems. The following three sections provide a concise description of the dynamic BMP-selection tool developed; and they focus on (1) its calculation and ranking procedure, (2) its dynamic and flexible capabilities, and (3) its potential use by decision makers.

7.1 CALCULATION AND RANKING PROCEDURE

The calculation and ranking procedure of the BMP-selection tool developed is performed in three main steps that are designed to

1. Calculate for each BMP *i* its normalized implementation cost (NC_i), normalized effectiveness rate (NE_i), normalized impact on reducing the project duration (ND_i), normalized utilization rate (NU_i), and normalized implementation problems (NP_i). The normalized implementation cost, normalized effectiveness rate, and normalized impact on reducing the project duration are calculated using Equation 1, Equation 3, and Equation 4, respectively, as described earlier. The normalized utilization rate (NU_i) and normalized implementation problems (NP_i) are calculated using a similar procedure, as shown in Equation 6 and Equation 7, respectively.

2. Compute a weighted performance score (BPS_i) for each BMP *i* that quantifies and aggregates its overall performance in the aforementioned five main criteria of implementation cost, effectiveness rate, impact on reducing the project duration, utilization rate, and implementation problems, as shown in Equation 8. The value of this calculated BMP performance score (BPS_i) can range from 0, which represents the worst-performing BMP, to 100, which represents the best-performing BMP. The performance score of each of the 60 compliant BMPs is precalculated and built into the BMP-selection tool.

3. Rank the 60 compliant BMPs based on their performance score (BPS_i) calculated in the previous step.

$$NU_i = \frac{(U_i - U_{min})}{(U_{max} - U_{min})} x\ 100\% \qquad \text{Equation 6}$$

$$NP_i = \left[1 - \frac{(P_i - P_{min})}{(P_{max} - P_{min})}\right] x\ 100\% \qquad \text{Equation 7}$$

$$BPS_i = (NC_i\ x\ W_1) + (NE_i\ x\ W_2) + (ND_i\ x\ W_3) + (NU_i\ x\ W_4) + (NP_i\ x\ W_5) \qquad \text{Equation 8}$$

Where

NU_i: Normalized utilization rate of BMP *i*
U_i: Reported utilization rate of BMP *i*
U_{min}: Minimum utilization rate of all BMPs
U_{max}: Maximum utilization rate of all BMPs
NP_i: Normalized implementation problems of BMP *i*
P_i: Reported implementation problems of BMP *i*
P_{min}: Minimum implementation problems of all BMPs
P_{max}: Maximum implementation problems of all BMPs
BPS_i: Performance score of BMP *i*
NC_i: Normalized implementation cost of BMP *i*
W_1: Weight of BMP implementation cost
NE_i: Normalized effectiveness rate of BMP *i*
W_2: Weight of BMP effectiveness rate
ND_i: Normalized impact of BMP *i* on reducing project duration
W_3: Weight of impact of BMP on reducing project duration
W_4: Weight of BMP utilization rate
W_5: Weight of BMP implementation problems

7.2 DYNAMIC AND FLEXIBLE CAPABILITIES

The dynamic BMP-selection tool is designed to provide flexibility in accounting for the varying and unique requirements of different districts. This flexibility is achieved by enabling decision makers to specify (a) the categories of BMPs that can be implemented in their district and, accordingly, should be included in the ranking analysis; and (b) the relative-importance weights of the five aforementioned criteria that represent the specific priorities and requirements of their district.

7.2.1 BMP Category-Selection Interface

The BMP selection tool provides the user the option to select "Yes" to include or "No" to exclude any of the four BMP categories (coordination practices, financial incentives, practices requiring cost, and no-cost practices), as shown in Figure 29. Selecting "No" prompts the BMP-selection tool to exclude the entire category of BMPs from the ranking analysis by converting their BMP performance scores to 0. These "excluded BMPs" still appear at the bottom of the overall rankings, with a BMP performance score of 0.

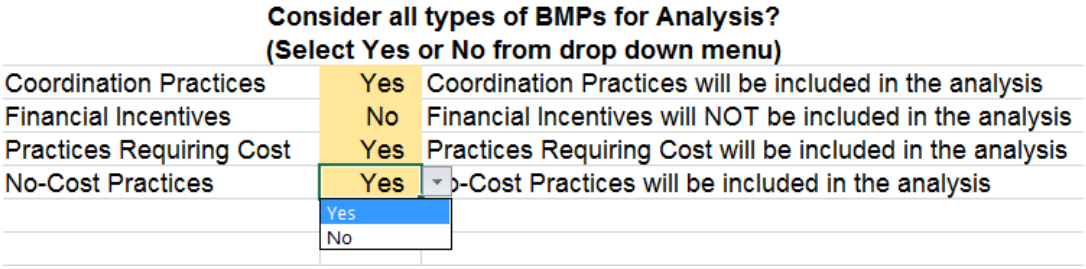

Figure 29. Screenshot of the BMP category-selection interface.

7.2.2 User-Specified Relative-Importance Weights

The BMP selection tool allows the decision maker to specify the relative-importance weight of each of the five categories (utilization rate, effectiveness rating, project-reduction percentage, implementation cost, and problems and challenges) to represent the specific needs of their IDOT district. These weights directly affect the calculation of the BMP performance score. For each category, the decision maker needs to input a numerical weight from 0 to 100. The total weight of these five categories must add up to 100. Otherwise, a total weight that does not equal 100 causes a red error message to appear, as shown in Figure 30.

User input weights (Must add up to 100)		
Weight 1	20	Utilization Rate
Weight 2	20	Effectiveness Rating
Weight 3	20	Impact on Reducing Project Duration
Weight 4	20	Implementation Cost
Weight 5	20	Implementation Problems
Total Weights	**100**	**Weight of 100 achieved**

User input weights (Must add up to 100)		
Weight 1	19	Utilization Rate
Weight 2	20	Effectiveness Rating
Weight 3	20	Impact on Reducing Project Duration
Weight 4	20	Implementation Cost
Weight 5	20	Implementation Problems
Total Weights	**99**	**Total Weights do NOT equal 100**

Figure 30. Screenshot of the user-assigned weight criteria.

7.3 APPLICATION EXAMPLE

A hypothetical example is analyzed to illustrate the use of the BMP-selection tool and demonstrate its capabilities. In this example, IDOT District X needs to identify a list of BMPs that have the highest potential to expedite utility-relocation projects. To generate this BMP list, the decision maker needs to specify the categories of BMPs that can be implemented in his/her district and the relative-importance weights of the five aforementioned criteria.

In this example, it is assumed that District X does not have funding available in its utility-relocation budget; and therefore it can consider only BMPs that do not require implementation costs. Accordingly, the decision maker needs to exclude the “financial incentives” and “practices requiring cost” categories in the BMP-selection tool, as shown in Figure 31.

It is also assumed that the top three priorities of District X in this example are to (1) achieve on-time completion of utility-relocation projects, (2) implement the most effective BMPs, and (3) minimize the use of BMPs that are expected to encounter problems. Accordingly, the decision maker in this example specifies the relative-importance weights of the five categories (see Figure 30) as follows:

- Utilization Rate – 0
- Effectiveness Rating – 30
- Impact on Reducing Project Duration – 40
- Implementation Cost – 0
- Implementation Problems – 30

Based on this user-specified input data, the dynamic BMP-selection tool generated a set of 38 feasible BMPs and ranked them based on the specified criteria. The top 25 BMPs identified, their performance scores, and their corresponding categories are shown in Figure 31. Furthermore, the

results in this figure illustrate that the top five BMPs identified are (1) avoidance of utility relocation, (2) additional utility personnel, (3) simplified permit approvals for utilities, (4) utility work by highway contractors, and (5) right-of-way utility coordination.

Rank	Best Management Practice	BMP Performance Score (Maximum score of 100)	Category of BMP
1	Avoidance of Utility Relocation	76.568	No-Cost Practices
2	Additional Utility Personnel	71.924	No-Cost Practices
3	Simplified Permit Approvals for Utilities	64.806	No-Cost Practices
4	Utility Work by Highway Contractors	62.959	No-Cost Practices
5	Right-of-Way Utility Coordination	62.784	No-Cost Practices
6	Requirement of Roadway Contractor to Track Utility Re	60.686	No-Cost Practices
7	Designated Utility Coordinator	60.228	Coordination Practice
8	Right-of-Way Acquisition	59.234	No-Cost Practices
9	Utility Coordination by Roadway Contractor	58.017	Coordination Practice
10	A+B Bidding	57.200	No-Cost Practices
11	Use of Existing Tunnels for Utilities	57.200	No-Cost Practices
12	Utility Corridors	56.781	No-Cost Practices
13	Coordination, Cooperation, Communication	56.659	Coordination Practice
14	Standardized Invoice Submissions	56.229	No-Cost Practices
15	Unit Costs	56.078	No-Cost Practices
16	Context Sensitive Design	56.029	No-Cost Practices
17	Prepayment for Long Procurement Items	55.536	No-Cost Practices
18	Standardized Estimate/Bid Form	55.500	No-Cost Practices
19	Utility Manuals	55.458	No-Cost Practices
20	Minimize Program Changes	54.314	No-Cost Practices
21	Advance relocation of utility work	54.230	No-Cost Practices
22	Lane Rental	53.800	No-Cost Practices
23	Locate next to ROW line	53.650	No-Cost Practices
24	Modernization of the Utility Procedures	52.749	No-Cost Practices
25	Utility Training Classes	52.684	No-Cost Practices

Figure 31. Screenshot of the top 25 BMPs identified for the application example.

CHAPTER 8: FUTURE RESEARCH

During the course of this study, the research team identified a number of promising research areas that need further in-depth analysis and investigation. Building on the accomplishments in this project, the research team foresees an opportunity to continue studying and improving the implementation of BMPs to expedite utility relocation by focusing on one or more of the following research areas.

8.1 RESEARCH AREA 1: IDENTIFYING AND QUANTIFYING IDOT UTILITY-RELOCATION DELAYS

8.1.1 Problem Statement

During the review of utility-relocation practices in selected IDOT districts, there was a lack of quantitative data on project delays caused by utility relocation. During the IDOT interviews conducted, it was revealed that the majority of utility-relocation delay data is obtained from the roadway contractor. Accordingly, there is a pressing need to identify accurately and objectively delays caused by utility relocation and to quantify the impact of these delays. This collection of reliable field data can be used to identify which BMPs would be most beneficial to mitigate delays on similar projects.

8.1.2 Objective and Scope of Proposed Research

The objectives of this proposed research are to (1) collect and analyze field data to identify and quantify the delays on recently completed IDOT utility-relocation projects, and (2) develop a decision-support system (DSS) to select the appropriate utility-relocation BMPs to implement on future projects for mitigating the identified delays.

The proposed research will enable IDOT and other DOT agencies to (1) reduce delays to future utility-relocation projects, (2) optimize the programming and scheduling of utility-relocation projects, and (3) minimize delay claims and cost increases resulting from utility-relocation delays.

8.1.3 Expected Outcome

The deliverables of this proposed research would enable IDOT to (1) accurately predict the duration of utility-relocation delays, (2) quantify the additional project time and cost caused by these delays, and (3) identify the BMPs and incentives with the highest potential to mitigate these specific types of delays.

8.2 RESEARCH AREA 2: IMPROVING ACCURACY OF ESTIMATING IDOT COSTS TO IMPLEMENT UTILITY-RELOCATION BMPS

8.2.1 Problem Statement

During the survey, state DOTs officials reported a wide range of implementation costs for their utility-relocation BMPs. The wide range of reported costs can be attributed to the (a) lack of data on the scope and time of implementing each BMP and whether it was implemented at the project, district, or state level; (b) wide range of geographical locations, states, and cities that reported these BMP

implementation costs; and (c) lack of information on the reporting DOT's overall utility-relocation budget, especially for states that reported their implementation cost as a percentage of their utility-relocation budget. Accordingly, there is a pressing need to explore and evaluate the costs that IDOT would incur in implementing these BMPs. These costs would be specific to IDOT and its districts by using cost and budget data from Illinois.

8.2.2 Objective and Scope of Proposed Research

The objectives of this proposed research are to conduct an economic feasibility study to explore and evaluate the IDOT implementation costs of the identified utility-relocation BMPs. As a number of the identified BMPs were categorized as no-cost or low-cost, it is important to estimate the actual implementation cost, if any. The BMPs requiring cost will be estimated considering IDOT's utility-relocation budget, organization structure, and programming of utility-relocation projects.

8.2.3 Expected Outcome

The deliverables of this proposed research would provide IDOT decision makers with more accurate estimates on the implementation costs of the identified utility-relocation BMPs. This estimate combined with the dynamic BMP-selection tool discussed in the previous chapter would enable IDOT to select efficiently and effectively the most cost-effective utility-relocation BMPs to implement.

8.3 RESEARCH AREA 3: QUANTIFYING THE IMPACT OF MODERN TECHNOLOGY TOOLS ON REDUCING UTILITY-RELOCATION DELAYS

8.3.1 Problem Statement

IDOT project support engineers and utilities coordinators reported utility-relocation delays caused by problems that could have been avoided through the use of modern technology tools. For example, subsurface-utility engineering and other GPS systems were reported by a number of interviewed IDOT officials to improve their efficiency in locating undocumented utilities. Similarly, field tablets were reported to minimize coordination and communication problems on-site. Furthermore, interviewed IDOT officials reported that the use of online permit tracking, a statewide utility-permit database, and land-acquisition parcel tracking have the potential to improve the timely communication and sharing of project data among all project personnel. Despite the potential benefits of these modern technology tools and their potential to minimize utility-relocation delays, there is a lack of data that can be used to quantify their real impact. Accordingly, there is a pressing need to collect and analyze field data to quantify the impact of implementing these tools on reducing utility-relocation delays and improving the overall efficiency of IDOT operations.

8.3.2 Objective and Scope of Proposed Research

The objectives of this proposed research are to analyze and quantify the impact of utilizing modern technology tools on reducing utility-relocation delays. This analysis can be accomplished by (1) collecting data on utility-relocation delays that can be mitigated through the use of modern technology; (2) investigating and estimating the cost of implementing these tools and practices; and (3) quantifying the cost effectiveness of these modern technology tools and their impact on reducing delays, as well as improving the overall efficiency of IDOT operations.

8.3.3 Expected Outcome

The deliverables of this proposed research would include (1) field data and new knowledge on the extent of IDOT utility delays, (2) implementation costs of modernized utility-relocation BMPs, and (3) recommendations on the use of modern technology tools to reduce delays and improve the overall efficiency of IDOT operations.

8.4 RESEARCH AREA 4: DEVELOP COMPREHENSIVE IDOT UTILITY TRAINING PROGRAM

8.4.1 Problem Statement

Unfamiliarity with the latest IDOT policies and practices can cause utility-relocation delays. IDOT personnel and utility company representatives have reported that other states such as Indiana and Ohio have successfully implemented utility training programs. Accordingly, there is a pressing need to develop a comprehensive IDOT utility training program to inform internal and external personnel on IDOT utility policies and practices.

8.4.2 Objective and Scope of Proposed Research

The main objective of this proposed research is to analyze the IDOT utility-relocation practices and policies to (1) develop a comprehensive utility training program for informing internal and external utility-relocation personnel, and (2) create a practical utility-relocation field guide that can be used by on-site personnel.

8.4.3 Expected Outcome

The expected outcome of this research would enable IDOT to (1) provide widespread utility-relocation information through the use of an online utility training program for IDOT and utility company personnel and (2) develop a comprehensive utility-relocation field guide for on-site personnel.

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APPENDIX A: DETAILED BMP DEFINITIONS

A.1 COORDINATION PRACTICES

These best management practices were identified as effective to expedite utility relocation by promoting coordination between the state DOT and utility companies. They minimize delays by implementing plans and procedures for communication and addressing utility conflicts and project issues. This category includes (1) coordination, cooperation, communication, (2) utility coordination councils, (3) designated utility coordinators, (4) multi-level memorandums of understanding, and (5) utility coordination during construction (FHWA 2002, Scott 2011, Wilde et al. 2002, Ellis et al. 2009, and Quiroga et al. 2012).

A.1.1 Coordination, Cooperation, Communication (CCC)

Coordination, Cooperation, Communication (CCC) is a collaborative effort where members from the state DOT, utility companies and contractors are brought together to meet and coordinate their efforts early in the project. The main objectives of these meetings are to: (1) recognize the shared goals of all parties involved and the steps needed to accomplish these goals, (2) enable early identification of highway projects that affect existing utilities to give engineers adequate time to redesign projects that may originally require major utility relocations, (3) design alternatives to minimize the impact and relocations necessary on highway projects, (4) coordinate the construction schedule with the utility work to reduce disruptions, and (5) refine the coordination process for continued efficient communication (FHWA 2002).

Establishing these meetings as early as project development or the design phase can help alleviate any unfamiliarity issues that may arise during construction when new team members are assigned to the project. Meeting early in the planning process also provides the ability to share or request information on any existing facilities, and field data or surveys that one party may have already completed. This information may then be translated into project drawings that all participants would agree upon. Continuation of routine meetings throughout the project allows all parties to be advised of any concerns or issues and the mitigation of any problems that arise (Scott 2011 and FHWA 2002).

This BMP is the most used coordination practice and has been utilized with reported success by 39 states (Scott 2011, Ellis et al. 2009, FHWA 2002, Quiroga et al. 2012 and USGAO 1999).

A.1.2 Utility Coordination Councils (UCC)

Many states have formed Utility Coordination Councils (UCC) to discuss future plans and current issues. The purpose of these councils is to facilitate the organized planning and installation of underground facilities, and develop and implement measures to protect these facilities after their installation. To ensure the effectiveness and success of these UCCs, the American Public Works Association (APWA) recommended a number of coordinating actions by highway agencies and utility companies (Wilde et al. 2002).

The UCC includes personnel from utility companies, government agencies, contractors and support companies. These multi-disciplinary and multi-jurisdictional partnerships bring engineering,

transportation planning, and land use decision makers together to develop roadway designs and right-of-way needs based on land use plans and corridor/access management plans (Hard et al. 2010).

These state UCC were reported to hold meetings every 6 months, one year, or two years. These UCC meetings focus on overviews of current and upcoming projects, the raising of any systemic or new problems encountered, and discussions of possible solutions (OUCC 2014, WUCC 2014, GUCC 2014, and IDUCC 2014). Several state DOTs hold utility coordination meetings during the design phase to determine conflicts, analyze alternative design options, and open lines of communication. The meetings held during the preconstruction and construction phases allow ample time to resolve any utility-related issues. They also encourage partnership among utility companies and contractors. These UCC meetings were reported to focus mainly on utility issues especially during the planning and design of complex projects (Ellis et al. 2009).

A.1.3 Designated Utility Coordinators

The state DOT can designate or require a utility coordinator to provide a single contact between state DOT and utility companies. The utility coordinator can be selected from the state DOT personnel or hired by the contractor. This designated utility coordinator is responsible for coordinating issues encountered on any number of projects during the design or planning stages. This can be adjusted as necessary based on the size of the state or district, the number of utility companies, and the number of projects. This practice can provide enhanced consistency, improved coordination, and reduced utility relocation times (Scott 2011).

Georgia Department of Transportation requires a utility coordinator or utility coordination supervisor on every project. The utility contractor is required to hire a supervisor to act as a coordinator during the construction phase. This individual is also responsible for the creation and maintenance of an Emergency Response Plan. For example, if a main utility line breaks, he/she must know the location of the nearest cut off valve (Ellis et al. 2009).

A.1.4 Multi-Level Memoranda of Understanding (MOU)

In this practice, multi-level memoranda of understanding (MOU) are agreed upon between the state DOT and utility companies. Similar to letters of intent, MOUs summarize the objectives, obligations and the terms of agreement. These MOUs are structured in multiple levels: (1) high-level MOUs that set forth general cooperation principles, (2) mid-level MOUs that define roles and responsibilities, as well as standards, specifications, budgeting and general procedures for conflict resolution, and (3) project-level memorandums that provide detailed contract-specific provisions which were not addressed in the higher-level MOUs (Scott 2011 and Quiroga et al. 2012).

The Ohio Department of Transportation (OhioDOT) reported the use of a three-level MOUs between their senior leadership and utility owner's senior leadership to discuss the importance of utility coordination at a higher level and raise the awareness that frequent utility coordination is necessary. The first level focuses on general cooperation principles; the second level focuses on issues that are important to both parties, primarily during the design phase, such as budgeting and conflict resolution; and the third level focuses on project specific issues. (Quiroga et al. 2012).

A.1.5 Utility Coordination during Construction

Typically utility coordination is performed during the design phases of a project. Extending this utility coordination to cover the construction phase assists with any unexpected conditions encountered during construction. On projects where the contractor is required to perform utility work, the DOT may require the contractor to assign a full-time utility coordinator. The benefits of having utility coordinators during construction, whether provided by DOTs or contractors, include but are not limited to better CCC between contractors and utilities, enhanced opportunities to handle unexpected problems before they delay construction, and potential for using innovative approaches when the utility coordinator finds a better way to proceed (Scott 2011).

A.2 FINANCIAL INCENTIVES

In this category, the state DOT provides utility companies or contractors with financial incentives to expedite utility relocation. These practices include (1) cash bonuses, (2) incentives/disincentives, (3) cost sharing, (4) no-excuse incentives, (5) contractor-provided financial incentives, and (6) gainshare-painshare (FHWA 2002, FHWA 2004, Ellis et al. 2009, Scott 2011, and Hosseinian and Carmichael 2013).

A.2.1 Cash Bonuses

Cash bonuses are paid directly to utility companies or contractors for on-time or accelerated utility relocations. It should be noted that Federal law may restrict the use of federal funds to pay for this type of cash bonus. Federal law for the relocation of utility facilities on highway projects (23 U.S.C. § 123) states in part that (1) “Federal funds may be used to reimburse the State for the cost of relocation in the same proportion as Federal funds are expended on the project”; and (2) “the term ‘‘cost of relocation’’ shall include the entire amount paid by such utility properly attributable to such relocation after deducting therefrom any increase in the value of the new facility and any salvage value derived from the old facility” (23 U.S.C. § 123). This may be interpreted as excluding the cost of financial incentives such as cash bonuses for on-time or early completion as it is not a cost necessary for the actual relocation (Scott 2011). This practice is the most used financial incentive in this category of BMPs and has been utilized by 14 states (Scott 2011, FHWA 2002, and FHWA 2004).

A.2.2 Incentives/Disincentives (I/D)

An Incentives/Disincentives (I/D) contract structure compensates the contractor a specified amount of money for each day that identified milestones are completed ahead of schedule, and assesses a deduction for each day the contractor overruns the I/D time (Jaraiedi et al 1995). This requires the contract administrator to set forth key dates for reaching the agreed upon milestones.

As each project is different, values from one project cannot be transferred to similar project types. Generally, contracts of higher value have higher I/D amounts. This type of agreement however may cause contractors to increase the number of claims to extend both the contract cost and schedule to avoid missing key completion dates and suffering penalty costs.

It is important to note that disincentive clauses are not the same as liquidated damages clauses that are used in many construction contracts. The monetary value associated with liquidated damages is

often less than that of disincentives. Disincentives are generally larger in amount and accompany incentives to motivate the contractor to complete the work on or ahead of time. Liquidated damages are charges to collect for losses incurred by an owner in the case of delays caused by the contractor (Arditi et al. 1997).

The use of this incentive was reported by nine state DOTs including Alabama, Arizona, Illinois, Kansas, Massachusetts, Missouri, Montana, Tennessee, and Utah (Scott 2011 and Arditi et al. 1997). The use of this type of incentive may require modifying existing legislation or enacting new ones. For example, the Tennessee DOT was reported to successfully utilize this type of incentive/disincentive after enacting a new legislation in 2003 that enables the DOT to use this type of financial incentive to expedite utility relocation (Ellis et al. 2009).

A.2.3 Cost Sharing

There are two reported types of cost sharing agreements between the state DOT and the utility company. In the first type of cost sharing BMP, the state DOT requires the utility company to pay a specified share of any additional cost over an agreed upon target price. Prior to the project start, the utility company and state DOT agree on a target price. If the target price is exceeded, the utility company would be responsible to pay for a share of that additional cost. This cost sharing disincentive encourages utility companies to control and minimize the cost of utility relocation. The state DOT benefits from this agreement because it is required to pay only the agreed upon portion of any additional project costs resulting from redesign and/or additional work. This type of cost sharing agreement was successfully used on utility projects by the Maryland State Highway Association and Pennsylvania DOT (Scott 2011 and FHWA 2002).

The second type of reported cost sharing agreement is used to assign the majority of utility relocation costs not covered by federal funding to the utility company. In this type of cost sharing agreement, the state pays for a portion of the utility relocation cost which would later be reimbursed by the FHWA, while the remainder of the utility relocation cost is paid by the utility company (FHWA 2002).

A.2.4 No Excuses Incentives

No Excuses incentives offer the utility company/contractor a monetary bonus for early completion, regardless of any delays normally granted on construction projects. This type of incentive is known as "No Excuses" because the date established to receive the incentive will not be extended due to any delays that arise during construction, even though such delays are normally granted extensions under traditional contracting methods such as work disruptions, utility conflicts, design changes, right of-way issues, permitting issues, and weather conditions (FHWA 2004).

The use of this incentive was reported by the Virginia Department of Transportation (VDOT) and Idaho Transportation Department (ITD) (VDOT 2011 and Scott 2011). For example, VDOT successfully used this type of incentive in one of its contracts that specified that “the incentive amounted to $10 million if the work was completed on or before August 18, with the amount dropping to $5 million if completed on or before November 17, 2001” (FHWA 2004). The use of this type of incentive in this case study was reported to help the Virginia Department of Transportation (VDOT) and Federal

Highway Administration (FHWA) ensure timely completion of a major interchange project in 2001 (FHWA 2004).

A.2.5 Contractor-Provided Financial Incentives

This practice is typically used in design-build projects, and it allows the design-build firm to take full responsibility for all utility relocations instead of the state DOT. This offers more flexibility to use financial incentives to expedite utility relocation because design-build firms are not restricted by the same federal or state laws that may restrict the use of federal and/or state funds to pay for these types of financial incentives. For example, South Carolina DOT reported the successful use of this practice on the $300 million dollar Conway Bypass project in 2001. The contractor was responsible for coordinating with eight utility companies with a total utility relocation value of $14 million. SCDOT reported the project completed seven months early and was well under budget (Scott 2011).

A.2.6 Gainshare-Painshare

Gainshare-Painshare is cooperative contractual relationship where all parties share benefits and risks. Using an integrated management structure, all agencies, contractors and utilities use open communication and accounting to solve any obstructions during construction. This helps minimize the blame and instead focuses all parties on solutions when problems arise. This process has been used often in Australia for complex infrastructure projects (Hosseinian and Carmichael 2013).

A.3 PRACTICES REQUIRING COST

This category includes all identified BMPs that may require additional cost from the state DOT to implement. The identified BMPs in this category can be grouped and organized in two subcategories: (1) IT solutions, and (2) field solutions, which are discussed in the following section.

A.3.1 IT Solutions

This subcategory includes all BMPs that require the implementation of an IT solution to improve the efficiency and effectiveness of utility work and/or relocation. The identified BMPs in this subcategory include (1) utility cost database, (2) electronic utility permits, (3) utility coordination websites, and (4) electronic document delivery. The maintenance cost of these BMPs were reported to be minor but the IT solutions produced consistent benefits throughout the life of the system (FHWA 2002, Ellis et al. 2009, Bell et al. 2014 and Scott 2013).

A.3.1.1 Utility Cost Database

Several DOTs reported that they developed and used detailed cost databases to track and analyze utility relocation costs. The database includes dates of invoices and payments, invoice amounts, submittals and approvals of invoices, and dates and reasons for change orders, if any. The use of this type of databases can help the state DOT improve its efficiency in analyzing and approving invoices and change orders. The utility relocation cost database is updated to track invoices from utility companies and contractors, and the stored cost data can be used to generate more accurate cost estimates for future projects. Minnesota, South Carolina and Virginia DOTs reported that they all have utility cost databases (Anspach 2010). This practice is the most used BMP in this subcategory and has been utilized by 8 states (Scott 2013, Ellis et al. 2009, Bell et al. 2014 and FHWA 2002).

A.3.1.2 Electronic Utility Permits

Electronic utility permitting systems follow the same procedures as traditional permitting but save time by removing the need to mail in or physically deliver forms. They include the same basic steps: submitting permit applications, review of permit applications, determine permit requirements, establish permit fees, issue permits, enforce provisions and make final inspection. Electronic permitting saves time and money by providing faster responses and less personnel required to handle paper permitting procedures. In addition to the direct time and cost savings, this provides other benefits including elimination of paper copies, mail preparation and postage, improved management of the utility permitting process, convenience, better records and retention, shorter learning curves for new users, 24/7 access and a more robust audit trail (Scott 2013).

As of 2014, six states reported that they have formal systems accepting electronic permits for utilities. Eight states reported that they have partial electronic permitting systems in place, seven states reported systems under development and four states are considering such systems (Krause 2014).

A.3.1.3 Utility Coordination websites

Utility Coordination websites improves communication efforts among state DOTs, contractors and utility companies. Current construction project information is uploaded by DOT employees, contractors and the utility companies. Information such as electronic drawings and project schedules are uploaded and made available to all parties to review and identify any potential scheduling or logistics conflicts. For state DOTs this is beneficial as all projects would be accessible in a single location. Additional features such as uploading/sharing of correspondence, requests for information and drawing mark ups can also be included (Bell et al. 2014).

Four states including Florida, Georgia, Minnesota and Texas all have utility coordination websites to transfer and maintain project documents. Florida and Texas have received FHWA accommodation awards for communication efforts on their online information delivery processes (Bell et al. 2014).

A.3.1.4 Electronic Document Delivery (EDD)

Electronic Document Delivery (EDD) is typically reserved for design and permitting, however its use can be expanded to include other utility relocation tasks to expedite the work. For example, electronic project data and information generated by computer-aided drafting and design (CADD) systems, Geographical Information Systems (GIS), and the aforementioned SUE techniques can be electronically delivered to utility companies to expedite utility relocation. Other advanced systems also allow drawings with markups, photos and field notes to be uploaded directly from the work site via tablet or laptop computer. This allows project personnel to view actual field conditions and discrepancies without site visits. The use of File Transfer Protocol (FTP) and other web enabled document sites have become standard for sharing electronic data too large for e-mail (FHWA 2002).

The Georgia Department of Transportation (GDOT) currently uses a FTP site which is managed by the District Utilities Office of GDOT. The FTP site accepts multiple submissions of documentation and notifies team members of new project information (FHWA 2002).

A.3.2 Field Solutions

This subcategory includes all BMPs that require the implementation of field solutions to improve the efficiency and effectiveness of utility work and/or relocation. The identified BMPs in this subcategory include (1) subsurface utility engineering, (2) clearing, grubbing, staking, grading, (3) utility relocation safety programs, (4) removal of abandoned lines, (5) trenchless technology, and (6) utility tunnels. These field solutions require a cost to implement but have been reported to improve coordination, minimize risk of unknown utilities, and increase safety (Scott 2011, Ellis et al. 2009, FHWA 2002, FHWA 2003, Bell et al. 2014 and USGAO 1999).

A.3.2.1 Subsurface Utility Engineering (SUE)

Subsurface utility engineering involves the use of technology to map and manage underground utility data. This interdisciplinary approach of mapping utilities employed during the early development of highway projects has the potential to decrease project risks. By effectively recording the existing utilities in place, SUE has the potential to reduce both the project cost and duration. This allows coordination between utilities and contractors long before construction takes place. Any conflict or coordination issues can be mitigated as early as the design phase. Having this information early in the design process offers project designers the ability to redesign the project or avoid existing utilities (USGAO 1999).

Subsurface utility engineering techniques are often combined with other technologies such as Ground Penetrating Radar (GPR), Geographical Information Systems (GIS), and global positioning systems (GPS). Together these technologies allow for the development of accurate 3-D databases for newly installed utilities and for the rapid capture of accurate positional information of existing utilities (Sterling et al. 2009).

This is one of the most widely used best management practices and has been utilized by twenty-seven states (Purdue 1999, Ellis et al. 2009, Sterling et al 2009 and USGAO 1999). As the use of SUE has significantly increased among several DOTs, some states have created guidelines to determine whether SUE should be utilized on certain projects and what level of detail is required (Ellis et al. 2009). This practice is the most used field solution in this subcategory and has been utilized by 31 states (Scott 2011, Ellis et al. 2009, FHWA 2002, FHWA 2003, Bell et al. 2014 and USGAO 1999).

A.3.2.2 Clearing, Grubbing, Staking, Grading

In this practice, the state DOT employs the highway contractor or a subcontractor to prepare the utility relocation area prior to the utility contractor performing work. This preconstruction work allows the utility contractor to mobilize easily without needing to clear appropriate space and allows utility relocation work to start earlier. It also acts as a good faith effort to indicate that the project will begin shortly. If the project was delayed or cancelled, the state DOT or its contractor will be responsible for redoing the site preparation work if needed (Scott 2011).

Currently, clearing, grubbing, staking and grading is being successfully performed by fourteen states including Florida, Louisiana, Maine, Maryland, Michigan, Mississippi, Missouri, New Mexico, North Carolina, Ohio, Oregon, Rhode Island, South Carolina and Texas (Ellis et al. 2009, USGAO 1999 and FHWA 2002).

A.3.2.3 Utility Relocation Safety Programs

The purpose of utility relocation programs is to improve safety in utility pole locations that experience high rate of accidents. These types of accidents often result in injuries and sometimes fatalities, which highlights the need for this program. The program is implemented by compiling accident data to identify the most frequently damaged utility locations, and then taking the necessary measures improve safety in these locations. These measures include improving protection in these locations if they are involved in minor accidents or completely relocating them if they are involved in numerous fatal accidents. Implementation of this program leads to improved safety for motorists, limits litigation due to allegations of negligence, and reduces service losses and repair costs for the utility company (Bell et al. 2014).

The Georgia Department of Transportation (GDOT) launched a utility safety program in the 1990s. GDOT identified the top 100 utility sites with the highest crashes, injuries and fatalities, and developed a Clear Roadside Committee (CRC) to develop a plan to mitigate these accidents. The CRC program had measurable success and enabled GDOT to be awarded a FHWA safety award (Bell et al. 2014).

A.3.2.4 Removal of Abandoned Lines

Discovery of undocumented abandoned lines often leads to delays in finding ownership and confirmation of safe removal. Abandoned utility lines should be removed completely to avoid any future conflicts and delays. In the event that an abandoned line cannot be removed, it should be documented on the as-built plans as part of project record (FHWA 2002).

A.3.2.5 Trenchless Technology

Trenchless technologies, such as utility tunneling and directional drilling, has the potential to reduce project durations. The use of these technologies minimizes the need for surface work such as clearing, grubbing, staking and grading and reduces their costs. To minimize utility conflicts, trenchless technology does require the precise mapping of existing and abandoned utilities using the aforementioned SUE technologies.

As trenchless technology is more expensive than traditional trenching, especially in urban and suburban areas, financial incentives can encourage contractors to utilize this technology. While it may be more expensive to fund incentives for trenchless technologies, motorists experience fewer construction-related delays (Wilde et al. 2002).

A.3.2.6 Utility Tunnels

A utility tunnel, similar to a utility corridor, is a designated longitudinal space located as near as practical to the right-of-way line (AASHTO 2005). These tunnels would be constructed with large diameter pipes and manholes to access, maintain, and repair utilities if necessary. The use of abandoned sewer and storm sewer lines is also an option to consider. Due to their large size, utility tunnels may need a larger area than normally required for utilities. However their increased size and accessibility provide the opportunity to either expand or replace utility lines as needed (FHWA 2002).

A.4 NO-COST PRACTICES

This category includes all identified BMPs that do not require additional cost from the state DOT to implement. The identified BMPs in this category can be grouped and organized into three subcategories: (1) contract type, (2) right-of-way management, and (3) administrative, which are discussed in the following sections.

A.4.1 Contract Type

This subcategory includes all contract related BMPs and incentives to expedite utility relocation. The identified BMPs in this subcategory include (1) utility work by highway contractors, (2) A+B bidding, (3) lane rental, (4) design-build for utilities, (5) unit costs, (6) combined utility segments, (7) highway contract facilitating language, and (8) lump-sum agreements. These BMPs were reported to benefit highway construction projects but they have not been widely applied to utility relocation projects (Scott 2011, FHWA 2002, Herbsman et al. 1995, and Ellis et al. 2009).

A.4.1.1 Utility Work by Highway Contractors

Utility work by highway contractors allows the contractor performing roadwork to coordinate and support utility relocation with utility company. This type of agreement enables the use of the contractors' own resources to support and expedite utility relocation. Highway contractors performing utility work often results in reduced claims, delays and service interruptions to the public (Ellis et al. 2009). This practice is also referred to as "joint project agreement" by the Federal Highway Administration (FHWA 2002).

This practice requires utility companies to allow contractors to perform the work, and contractors capable of performing all assigned work. Using a single contractor eliminates conflicts between the contractor and utility company, allows the contractor to keep control of all facilities, and maintain the schedule. This is helpful in congested areas and restricted work sites where multiple crews may interfere with one another (Ellis et al. 2009). This practice is most used in this subcategory and has been utilized in twenty-nine states (Scott 2011, FHWA 2002, Herbsman et al. 1995, and Ellis et al. 2009).

A.4.1.2 A+B Bidding

A+B Bidding, also known as bidding on cost/time, is a competitive bid evaluation method that encourages contractors to minimize their bid for both the project time and cost. Bidders are evaluated based on the total combined bid that is the summation of (1) the A component of the bid which represents the bid cost, and (2) the B component of the bid that represents the monetary value of the submitted duration in the bid and is calculated by multiplying the project duration by the daily road user cost (DRUC). The DRUC value must be determined by the state DOT and shared with all interested bidders prior to request for proposal (Herbsman and Ellis 1992). The use of A+B bidding was reported to produce an average time reduction of 30% based on an analysis of 25 projects (Herbsman 1995, Herbsman et al. 1995, Herbsman and Ellis 1992). A+B bidding is often coupled with Incentives/Disincentives (I/D), in which the calculated DRUC can be used to specify the daily incentive or daily penalty value for early completion or late completion, respectively (Scott 2011).

Thirteen states reported the use of the A+B Bidding or A+B combined with I/D as a contract practice, but do not specify if it is applied toward utility relocation or road work contracts (Scott 2011 and Herbsman and Ellis 1992).

A.4.1.3 Lane Rental

Lane rental can be used to expedite utility relocation when the work requires partial or complete closure of the shoulder or a single lane for safety reasons. Lane Rental is a contracting technique that provides utility companies or contractors with an incentive/disincentive to reduce the duration of lane closures. Whenever lanes are closed during utility relocation, the utility company has to pay the DOT an agreed upon fee for renting and closing that lane. The lane rental fee can be estimated based on the value of the lane to the public similar to a road user cost. This incentivizes the utility company to minimize lane closures and expedite the work (Herbsman and Glagola 1998, Wilde et al. 2002).

Lane rental is currently used by thirteen states but according to the research it does not differentiate if it is currently applied toward utility relocation or roadwork contracts (Scott 2011 and Herbsman and Glagola 1998).

A.4.1.4 Design-Build for Utilities

The design-build contracting method can be used for utility work and relocation to fast track the project by overlapping the design and construction work. This enables construction work to start before completing the entire design and can lead to expediting the overall project duration (USGAO 2012 and FHWA 2003). The use of a single responsible firm in this method also reduces the number of design errors and claims (Scott 2011).

Six states including Florida, Minnesota, New Mexico, South Carolina, West Virginia and Maryland reported the successful use of design-build for utility work. Maryland DOT reported its successful utilization of the design-build contracting method on a $2.4 billion highway project in the densely-populated area north of Washington D.C. (Scott 2011).

A.4.1.5 Unit Costs

In this practice, the DOT utilized predetermined unit costs to reimburse contractors or utility companies for utility relocation instead of reimbursing them based on the actual number of units. The Montana Department of Transportation (MDT) has reported success using unit costs since 2000, and it reported the benefits of this approach include: (a) audits of each project's actual costs are not required; (b) cost accounting with extensive documentation for time and materials used on a project is not required; (c) detailed cost estimate preparation and subsequent State review is significantly simplified; (d) utility company contractors and consultant engineers need not be reviewed or pre-approved by the state; (e) state participation in utility cost overruns is eliminated, except for overruns caused by increased numbers of units; (f) prompt billing is facilitated and projects are closed in a timely manner; and (g) unit costs should be developed periodically and supported annually by a maintained database of relocation expenses. The MDT does not consider these benefits to be incentives but they are reported to have accelerated utility relocation work in Montana (Scott 2011). Similarly, the Texas Department of Transportation (TxDOT) has recently created a comprehensive

database of detailed unit costs that can be used in utility relocation projects. This database is expected to be used during agreement negotiations with utility companies and contractors (Quiroga et al 2008).

A.4.1.6 Combined Utility Segments

State DOTs often break up long highway projects into more manageable, smaller projects. This practice also segments the utility portion of each project rather than keeping the utility length as a single span. Combining these smaller utility segments while keeping the highway projects divided would improve the processing time of administrative forms. A single utility project would also reduce the number of potential errors on drawings and other contract forms. This would eliminate the need for multiple engineering, design, and relocation resources and would greatly expedite the work. A single utility contract also facilitates coordination between contractors and the state DOT (Scott 2011).

A.4.1.7 Highway Contract Language Facilitating

Many state DOTs and highway agencies use contract language that encourages highway contractors to aggressively minimize delays. For example, the Kansas Department of Transportation had a clause in one of its contracts that stated “if the contract date is not met, that delay claim may be passed on to the utility company”. This type of contract language however can result in creating contentious relationships between contractors and utility companies. To minimize the risk of this type of contract language, it can be combined with additional contract language that encourages good coordination, cooperation, and communication (CCC) between the contractor and utility company (Scott 2011).

A.4.1.8 Lump-Sum Agreements

Lump-sum contract agreements when applied to utility relocation allow both the state DOT and utility company to greatly reduce their administrative and record keeping costs. In 2000, the federal government removed the $100,000 cap on lump-sum payments for utilities. Despite the removal of this cap limit, many state DOTs continue not to use lump-sum contracts for utility relocation (Scott 2011).

A.4.2 Right-of-Way Management

In this subcategory of BMPs, the state DOT utilizes right-of-way management techniques to expedite utility relocation. The identified BMPs in this subcategory include (1) right-of-way acquisition, (2) utility corridors, (3) locate next to RoW line, and (4) use of existing tunnels for utilities. These right-of-way management practices expedite utility relocation through simplifying the right-of-way acquisition and utility installation site (Scott 2011, Quiroga et al. 2012, Ellis et al. 2009, FHWA 2002, Krause 2014 and USGAO 1999).

A.4.2.1 Right-of-Way (RoW) Acquisition

Traditionally, utility companies start their design and plans for utility relocation after roadways are designed and their right-of-ways are purchased. Upon completion of utility design, the state must acquire additional property adjacent to the roadway for the utility right-of-way. This conventional approach is time consuming, redundant, potentially expensive, and may cause frustration with

affected property owners. Combining right-of-way acquisition into a single phase for both the roadway and utility has the potential to mitigate delays associated with property negotiations and redesign. This greatly benefits state DOTs, utility companies and property owners (Scott 2011). Despite these benefits, a number of states reported that their state laws do not allow DOTs to purchase right-of-ways for non-highway purposes. To address this problem, the state DOT can have early coordination with the utility company in the design phase to enable these utility companies to acquire the right-of-way instead of the state DOT (Ellis et al. 2009). This BMP is the most used in this subcategory and has been utilized by 31 states (Scott 2011, Quiroga et al. 2012, Ellis et al. 2009, FHWA 2002, Krause 2014 and USGAO 1999).

A.4.2.2 Utility Corridors

A utility corridor is a narrow strip of right-of-way that is adjacent to highways and is used exclusively for utilities. This designated corridor prevents conflicts with highway work, and it allows utility and roadway to be performed simultaneously. In some cases multiple longitudinal utilities are required to be located in this specified utility corridor within the right-of-way (Kraus 2014).

This practice has the potential to shorten the overall project duration and increases workers safety as they do not need to be exposed to traffic conditions. Utility corridors also have the potential to save space by combining compatible utilities into a single common location that can been excavated and sealed once. This process requires more coordination but it saves space, time, and cost (Scott 2011).

Eighteen states currently use utility corridors with reported success, and several utility company representatives stated in surveys that “utility corridors would be a big help” as an effective no-cost/low-cost incentive (Scott 2011, Quiroga et al. 2012, Ellis et al 2009, and FHWA 2002).

A.4.2.3 Locate next to RoW line

The Federal Highway Administration (FHWA) requires that above ground utilities must be relocated as close as possible to the right-of-way line to ensure that they are at the farthest location from the highway. This placement reduces the risk of vehicle impacts and reduces any potential conflicts for future highway expansion. This practice was reported to increase driver safety, minimize impact to motorists and reduce costs of future utility relocation by placing utilities far from the travel path (FHWA 2002).

A.4.2.4 Use of Existing Tunnels for Utilities

In urban locations that have existing or abandoned tunnels, they could serve as passageways mimicking utility tunnels/corridors by providing a dry, accessible thoroughfare for utility installation. These large spaces would completely separate utility installation from the road construction and can be performed simultaneously without impacting the road work above (FHWA 2002).

A.4.3 Administrative

This subcategory includes administrative BMPs and incentives that improve the efficiency and effectiveness of utility work and/or relocation. The five most used no-cost administrative BMPs include (1) one-call systems, (2) utility conflict matrix, (3) advance relocation of utility work, (4) utility

training classes, and (5) standardized estimate/bid forms. These administrative practices include solutions to avoid conflicts, simplify administrative processing, reduce costs, and streamline procedures. These practices expedite utility relocation by reducing conflicts and issues between the state DOT and utility company (Scott 2011, Ellis et al. 2009, Quiroga et al. 2013, FHWA 2002, and Bell et al. 2014).

A.4.3.1 One-Call Systems

One-call systems are nationwide programs where the utility company is contacted prior to excavation to prevent damaging of utilities. This is applicable for instances where contractors are performing utility work. All utility owners/operators must participate in the one-call system, also known as "call before your dig". After receiving notification, the utility must mark the locations of their facilities before the contractor begins excavation. This is a mandatory program for all states to prevent damage to utilities (FHWA 2002). This practice is the most used in this subcategory and has been utilized by all 50 states, Washington D.C. and Puerto Rico (Scott 2011, Ellis et al. 2009, Quiroga et al. 2013, FHWA 2002, and Bell et al. 2014).

A.4.3.2 Utility Conflict Matrix

Utility Conflict Matrices (UCM) allows state DOTs and utility companies to organize and track utility conflict data. During the design phase, the project team identifies utility conflicts, potential utility conflicts and construction obstacles. These matrices are updated as needed to give designers ample time to resolve conflicts. Nineteen states currently employ these matrices and they have been recently optimized and standardized (Quiroga et al. 2012 and Anspach 2010).

Georgia Department of Transportation (GDOT) utilizes a utility impact matrix to identify potential conflicts on every project using subsurface utility engineering (SUE). As conflicts arise, a SUE consultant provides recommendations to each utility conflict. Resolutions may include relocating the utility or adjusting highway design. These resolutions have the potential to reduce the time and cost of utility relocation by identifying potential conflicts as early as the design phase (Ellis et al. 2009).

A.4.3.3 Advance relocation of utility work

Some states require utility relocation to be performed before highway construction begins. This technique minimizes contractor-utilities conflicts and alleviates the need to coordinate with contractors simultaneously. States that utilize this practice also experience fewer delays during the construction phase as contractors do not interfere with each other (Ellis et al. 2009).

There are a few challenges that have been identified with this practice. Specifically, it may not always be possible to relocate before highway construction (i.e. clearing and grubbing must be complete and RoW must be acquired) and in certain cases with larger utilities (water and sewer) it may not be practical to install beforehand due to the extensive work that is associated with installation (Ellis et al. 2009).

This practice is currently used in eleven states including Tennessee where utility relocation is required to be performed before road construction begins (Ellis et al. 2009).

A.4.3.4 Utility Training Classes

Some states have developed utility training classes that are offered either online or in person to familiarize personnel working utility projects with procedures and situations they may encounter. Some states offer certifications for utility training if a number of hours or selected classes have been successfully completed. The practice promotes good coordination, cooperation, and communication (CCC); and it prepares project personnel for unexpected situations and informs them of the relevant DOT procedures. Six states including Colorado, Florida, Georgia, Minnesota, Pennsylvania and Texas reported that they provide utility training classes (Quiroga et al. 2013). For example, Pennsylvania DOT (PennDOT) provides utility relocation training to designers. New advancements in construction methods and technology require designers and engineers to pursue continued and often lifelong training and learning (Ellis et al. 2009 and Anspach 2010).

A.4.3.5 Standardized Estimate/Bid Form

This practice can be used when the state DOT hires a utility contractor to manage and/or execute the utility relocation work. In this type of contractual arrangement, the state DOT can use a standardized estimate/ bid form to improve the efficiency of its review of the submitted bids. The utility contractor benefits from using these standardized forms because they simplify and streamline the process for submitting estimates and bids, and they shortened their processing time. These forms should be kept simple and accessible to all utility companies. Linking standardized forms with an electronic submission system can further improve the efficiency of storing and analyzing the cost data in the submitted bids (Bell et al. 2014).

Minnesota, South Carolina and Virginia DOTs all use standardized estimate/bid forms with varying degrees of detail. They reported that this practice saved time during their review of the cost data but they did not confirm if this practice expedited utility work (Bell et al. 2014).

A.4.3.6 Standardized Invoice Submissions

Several state DOTs have developed standardized invoice forms that must be used by utility contractors. These forms are similar to other DOTs billing forms but have been standardized by breaking down all costs into their appropriate categories, such as materials and supplies, labor, overhead, transportation, equipment, traffic control, right-of-way, salvage and abandoned facilities, removal of materials, credits and betterments. A standardized invoice facilitates the review of billing requests and enables the state DOT to expedite payment to utility contractors (Bell et al. 2014).

As of 2013, the Oregon Department of Transportation (ODOT), Alabama Department of Transportation (ALDOT) and South Carolina Department of Transportation (SCDOT) have developed a standardized utility costs submission process to facilitate faster payments (Quiroga et al. 2013).

A.4.3.7 Value Engineering for Utilities

Value Engineering (VE) is a practice where a qualified team of contractors, consultants and design personnel review and improve the project design and construction to maximize value for the DOT and minimize the project cost. The team provides recommendations to improve the project efficiency,

value, quality, schedule and safety. The use of value engineering in utility relocation projects has the potential to avoid relocating existing utilities, reduce costs, and minimize duration (FHWA 2002).

As of 2011, three states (Florida, Kentucky and Virginia) reported the use of value engineering in utility work and relocation. Virginia DOT applies VE to all projects in excess of $5 million dollars (Scott 2011).

A.4.3.8 Avoidance of Utility Relocation

Avoidance of utility relocation is a coordination practice used during the design phase. State DOT and utility company personnel would coordinate during the design process to minimize or avoid utility relocation altogether. Accurate Subsurface Utility Engineering (SUE) and Coordination, Cooperation, Communication, discussed earlier, facilitates this practice (Scott 2011).

The Montana Department of Transportation (MDT) issued a state law which splits the utility relocation cost between the DOT and utility company with a ratio of 75% to 25%, respectively. The purpose of the cost sharing in this law is to encourage MDT and utility company designers to avoid utility relocations altogether (Scott 2011).

A.4.3.9 Modernization of Utility Procedures

As utility procedures have expanded in many state DOTs to include a wide range of methods, relevant manuals and documentation are not kept up-to-date making it difficult for DOT officials, utility companies and contractors to follow outdated processes. In Texas, districts manage utility relocation differently, causing additional difficulties for utility companies spanning multiple districts. To address these issues, the Texas Department of Transportation (TxDOT) developed an updated, streamlined process of the utility process along with written descriptions of activities (Quiroga et al. 2013). The Illinois Department of Transportation also updated their utility procedures in 2010 and created a Utility Adjustment Process Flowchart (IDOT 2010).

A.4.3.10 Utility Manuals

The Minnesota Department of Transportation (MnDOT) has developed a utility manual, which highlights the roles and responsibilities of DOT employees and utility companies. The detailed utility manual includes a 15-step process to ensure timely delivery within the original budget. These 15 steps are: (1) utility identification, (2) initial utility coordination contact, (3) utility information meeting, (4) reviewing information from utility owners, (5) utility design meeting, (6) request for utility relocation plans, (7) utility coordination follow-up, (8) utility design change meeting, (9) one-call utility verification, (10) utility relocation plan and schedule review, (11) utility agreements and reimbursement, (12) permits for construction projects, (13) utility information in contract documents, (14) construction, and (15) close out (Bell et al. 2014).

The Georgia Department of Transportation (GDOT) reported its successful use of a similar plan (Bell et al. 2014).

A.4.3.11 Context Sensitive Design

Context Sensitive Design is often used when the utility work or relocation has to consider and address environmental and/or community requirements. Whenever the environment or nearby communities must not be disturbed, state DOTs, utility companies and contractors collaborate with community leaders to design a project plan that does not harm the environment, physical setting, scenery, or historic sites, but still allows for the installation and maintenance of utilities (FHWA 2002 and FHWA 2003).

The Maryland State Highway Administration (MSHA) reported using creative and cost-effective solutions to address community needs in their projects. Instead of installing underground utilities, which are more expensive than above ground, MSHA used taller poles that are spaced farther apart to improve cost effectiveness and appearance. These tall poles are consolidated to one side of the roadway and are disguised to look like trees to locate them above and outside the views of drivers and pedestrians (FHWA 2002).

A.4.3.12 Simplified Permit Approvals for Utilities

State DOTs require the utility company or contractor to obtain permits prior to the relocation of utilities, even if these relocations are required as part of the highway construction project. The creation of a simplified utility permitting process can expedite the administrative work of utility relocations. This process would eliminate any clerical issues or redundancy in submission of multiple permit requests (Scott 2011).

According to recently conducted surveys, several utility contractors/companies in Florida, Michigan, and Tennessee have suggested this as a potential best management practice to expedite utility relocation (Scott 2011).

APPENDIX B: IDOT DETAILS ON IMPLEMENTED AND RECOMMENDED BMPS

B.1 UTILIZED BMPS AND INCENTIVES IN SELECTED IDOT DISTRICTS

As part of the questionnaire, each interviewed IDOT official was provided the list of best management practices and incentives compiled in the conducted literature review (see Table 5). This list was provided to aid in identifying current BMPs used by each district as requested in question 2 in of the questionnaire that stated "Please list any current or past best management practices or incentives utilized by your district for utility relocation (i.e. Clearing, grubbing, staking; designated utility coordinators; utility coordination councils; CCC; lane rental, etc.)". During the conducted interviews, IDOT officials reported the use of sixteen BMPs and incentives in their districts, as shown in Table 17.

Table 17. Utilized BMPs and Incentives by Selected IDOT Districts

COORDINATION PRACTICES
1. Coordination, Cooperation, Communication (CCC)
2. Utility Coordination Councils (UCC)
3. Designated Utility Coordinators
4. Utility Coordination during Construction
FINANCIAL INCENTIVES
None selected
PRACTICES REQUIRING COST
IT Solutions
5. Electronic Utility Permits
6. Utility Coordination websites
7. Electronic Document Delivery (EDD)
Field Solutions
8. Subsurface Utility Engineering (SUE)
9. Clearing, Grubbing, Staking, Grading
10. Trenchless Technology
NO-COST PRACTICES
Contract Type
11. Highway Contract Language Facilitating
Right-of-Way Management
12. Right-of-Way (RoW) Acquisition
13. Locate next to RoW line
Administrative
14. One-Call Systems
15. Avoidance of Utility Relocation
16. Standardized Invoice Submissions

B.2 BENEFITS AND DRAWBACKS OF BMPS UTILIZED IN IDOT DISTRICTS

In addition to identifying the aforementioned 16 BMPs and incentives, interviewed IDOT officials were asked to provide feedback on their effectiveness, as shown in question 3 of the questionnaire

that stated “Have you experienced any benefits or drawbacks from the use of these BMPs? If so, which have been the most beneficial/advantageous, and similarly which have been the most problematic?” The reported benefits and drawbacks of these sixteen BMPs and incentives are discussed in the following sections that organize the collected feedback in four categories of BMPs: (1) coordination practices, (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices.

B.2.1 Coordination Practices Benefits and Drawbacks

These management practices were reported by IDOT personnel to improve coordination procedures with varying degrees of success. This category includes (1) coordination, cooperation, communication, (2) utility coordination councils, (3) designated utility coordinators, and (4) utility coordination during construction. The benefits and drawbacks are discussed in the following four sections.

B.2.1.1 Coordination, Cooperation, Communication (CCC)

All interviewed IDOT officials reported that coordination, cooperation and communication is a vital part of the utility relocation procedure in IDOT districts. The annual and multi-year programs are sent to utility companies to inform them of upcoming projects. This allows utility companies to effectively program and schedule their resources effectively. Despite the importance of coordination, cooperation, communication, districts reported mixed results due to the lack of communication received from utility companies.

B.2.1.2 Utility Coordination Councils (UCC)

One district reported that a utility coordination council previously existed to discuss the multi-year program, complex projects and utility issues. The council in that district, however, was reported to be dissolved three years ago and has not been renewed. The interviewed officials in the same district reported their support of re-establishing the dissolved utility coordination council to discuss upcoming programs, funding, conflicts and other utility related issues.

B.2.1.3 Designated Utility Coordinators

Each interviewed district currently utilizes utility coordinators to administer utility relocation projects, however, the roles and responsibilities of these coordinators were reported to vary from one district to another. Some districts currently have separate coordinators for projects involving railroads and projects involving utilities, while other districts have a single coordinator to handle both types of projects. Districts with multiple utility coordinators reported fewer utility coordination issues.

B.2.1.4 Utility Coordination during Construction

The “Utility Adjustment Process Flowchart” in the BDE manual specifies that “non-construction related utility adjustments” must be completed prior to the start of the “pre-construction meeting” and “start construction” activities. The interviewed officials, however, reported that delays in utility relocation often causes construction to be performed concurrently with utility relocation work, which creates the need for this BMP to minimize interference between these two operations that can cause delays in roadway construction and increase its cost.

B.2.2 Financial Incentives Benefits and Drawbacks

All interviewed IDOT officials reported that they do not use any financial incentives in their districts.

B.2.3 Practices Requiring Cost-Benefits and Drawbacks

This category includes BMPs requiring cost and are organized into two subcategories: (1) IT solutions, and (2) field solutions.

B.2.3.1 IT Solutions

This subcategory includes all identified IT related BMPs to improve the efficiency and effectiveness of utility work and/or relocation. The identified BMPs in this subcategory include (1) electronic utility permits, (2) utility coordination websites, and (3) electronic document delivery. The benefits and drawbacks are discussed in the following three sections.

B.2.3.1.1 Electronic Utility Permits

One of the interviewed IDOT officials who is responsible for permitting reported that electronic utility permits are used efficiently by utility companies and there were no reported issues with that online electronic system.

B.2.3.1.2 Utility Coordination websites

One of the interviewed IDOT districts reported their use of utility coordination websites but did not provide feedback on its benefits or drawbacks.

B.2.3.1.3 Electronic Document Delivery (EDD)

Electronic document delivery was reported by the interviewed officials to provide varying degrees of effectiveness in IDOT districts. They reported that this BMP was effective when utility companies communicate regularly with IDOT districts. On the other hand, the interviewed officials reported that several utility companies and railroad companies are unresponsive despite their accessibility to IDOT electronic documents. It was also reported that utility companies utilize electronic IDOT drawings to provide feedback on utility relocation plans, which enables IDOT personnel to identify conflicts and effectively manage utility adjustments.

B.2.3.2 Field Solutions

This subcategory includes all field related BMPs to expedite utility relocation. The identified BMPs by the interviewed officials in this subcategory include (1) subsurface utility engineering, (2) clearing, grubbing, staking and grading, and (3) trenchless technology. The benefits and drawbacks of these three BMPs are discussed in the following sections.

B.2.3.2.1 Subsurface Utility Engineering (SUE)

Subsurface utility engineering was reported to provide mixed results mainly due to its high cost. Urban districts that utilize SUE technology have stated “SUE allows for accurate utility information on

plans" and "reduces unexpected conflicts." Other districts reported SUE technologies are not cost effective because their use consumes a large portion of utility relocation budgets without providing commensurate return on that investment.

B.2.3.2.2 Clearing, Grubbing, Staking, Grading

The interviewed officials reported that utility relocation areas encumbered by trees and untended vegetation are currently cleared by roadway contractors prior to utility relocation. Accordingly, this current procedure prevents utility companies from starting their relocation work until after the roadway contractor has mobilized and cleared the utility relocation area. A number of district officials recommended changing this current procedure to enable clearing of the utility relocation area prior to the start of roadway construction.

B.2.3.2.3 Trenchless Technology

Three of the interviewed five districts reported that this BMP provides more advantages than conventional trenching including reduced disruption to nearby traffic and roadway construction.

B.2.4 No-Cost Practices Benefits and Drawbacks

This category includes all identified BMPs that do not require additional cost that are currently implemented by the interviewed IDOT districts. The identified BMPs in this category are grouped into three subcategories: (1) contract type, (2) right-of-way management, and (3) administrative, which are discussed in the following sections.

B.2.4.1 Contract Type

In this category, the only BMP that was reported to be used by the interviewed districts was highway contract facilitating language.

B.2.4.1.1 Highway Contract Facilitating Language

The Standard Specifications for Road and Bridge Construction and Supplemental Specifications and Recurring Special Provisions, state the requirements for roadway contractors to accommodate utility companies performing utility adjustments. This BMP is used in IDOT districts by including these standards as part of IDOT highway contracts. This BMP and its contract language was reported by all the interviewed IDOT officials to reduce the risk of claims; however, it was reported to cause delays to roadway construction due to the required accommodation of utility adjustments.

B.2.4.2 Right-of-Way Management

The identified BMPs in this subcategory include (1) right-of-way acquisition, and (2) locate next to RoW line.

B.2.4.2.1 Right-of-Way (RoW) Acquisition

A number of district officials reported that right-of-way acquisition is a primary source of utility relocation delays. On the other hand, the Bureau of Land Acquisition reported that land acquisition is

directly dependent on the design of the roadway and relocated utilities. The Bureau of Land Acquisition reported that if design engineers change the plans after the land acquisition process has begun, the process must restart from the beginning which causes delays. Additionally, any contested property must be condemned and requires additional time for court dates which causes further delays. Recommended solutions to this issue are discussed in section 3.4.3.4.2.1 of this report.

B.2.4.2.2 Locate next to RoW line

The Federal Highway Administration (FHWA) requires that above ground utilities must be relocated as close as possible to the right-of-way line to ensure that they are at the farthest location from the highway. This placement reduces the risk of vehicle impacts and reduces any potential conflicts for future highway expansion. This practice was reported to increase driver safety, minimize impact to motorists and reduce costs of future utility relocation by placing utilities far from the travel path (FHWA 2003). This BMP was reported to be utilized by interviewed IDOT districts without providing feedback on its effectiveness.

B.2.4.3 Administrative

This subcategory includes administrative practices that were reported to be used by interviewed districts, including (1) one-call systems, (2) avoidance of utility relocation, and (3) standardized invoice submissions.

B.2.4.3.1 One-Call Systems

A mandatory nationwide program, one-call systems require contractors to contact utility companies prior to excavation to prevent damaging of utilities. This is applicable for instances where contractors are performing excavation (FHWA 2003). Illinois' one-call system is the Joint Utility Locating Information for Excavators (JULIE). This BMP was reported to be utilized by interviewed IDOT districts without providing feedback on its effectiveness.

B.2.4.3.2 Avoidance of Utility Relocation

This BMP was reported to be utilized by one IDOT official without providing feedback on its effectiveness.

B.2.4.3.3 Standardized Invoice Submissions

This BMP was reported to be utilized by interviewed IDOT districts without providing feedback on its effectiveness.

B.3 DISTRICT RECOMMENDED BMPS AND INCENTIVES

In addition to the aforementioned BMPs that were reported to be used in IDOT districts, the interviewed officials were asked to recommend any additional practices that have the potential to expedite utility relocation, as shown in question 4 in Table 4 that stated "Can you suggest any BMPs or incentives currently not used that may be more beneficial?" The provided feedback on this question provided a total of 18 BMPs that are not currently used by the interviewed districts. These

18 BMPs consist of (a) eight BMPs that were included in the provided list of BMPs that was compiled in Table 5 in Chapter 3; and (b) ten new BMPs that were suggested by the interviewed IDOT officials, as shown in Table 18. These eighteen recommended BMPs are organized in four categories: (1) coordination practices; (2) financial incentives, (3) practices requiring cost, and (4) no-cost practices, as shown in Table 18 and Figure 32. The following sections provide a concise description of these 18 recommended BMPs.

Table 18. Recommended BMPs by Interviewed IDOT Districts

RECOMMENDED BMPS	(# of Recommending Districts /# of Interviewed Districts)	Percentage (%)
COORDINATION PRACTICES		
Utility Coordination by Roadway Contractor*	5/5	100%
Assign Utility Relocation to IDOT Resident Engineer	1/3	33%
FINANCIAL INCENTIVES		
Penalty/Back Charge for Utility Company for Delays	4/4	100%
PRACTICES REQUIRING COST		
IT Solutions		
Statewide Utility Permit Database*	2/2	100%
Updated IDOT Website	2/2	100%
Updated Land Acquisition System	1/1	100%
Field Solutions		
Clearing, Grubbing, Staking, Grading*	5/5	100%
Removal of Abandoned Utilities*	4/4	100%
Advance Building/Tree Removal	5/5	100%
NO-COST PRACTICES		
Contract Type		
Requirement of Roadway Contractor to Track Utility Relocation Delays	2/4	50%
Right-of-Way Management		
Right-of-Way Utility Coordination	1/5	20%
Administrative		
Utility Training Classes*	3/4	75%
Avoidance of Utility Relocation*	3/3	100%
Modernization of Utility Processes*	3/3	100%
Simplified Permit Approvals for Utilities*	1/3	33%
Additional Utility Personnel	5/6	83%
Schedule Changes for PSE and Letting Dates	6/6	100%
Phase I Plan Extensions	1/1	100%

* = Selected from Original 45 BMPs in Chapter 1 (see Table 5)

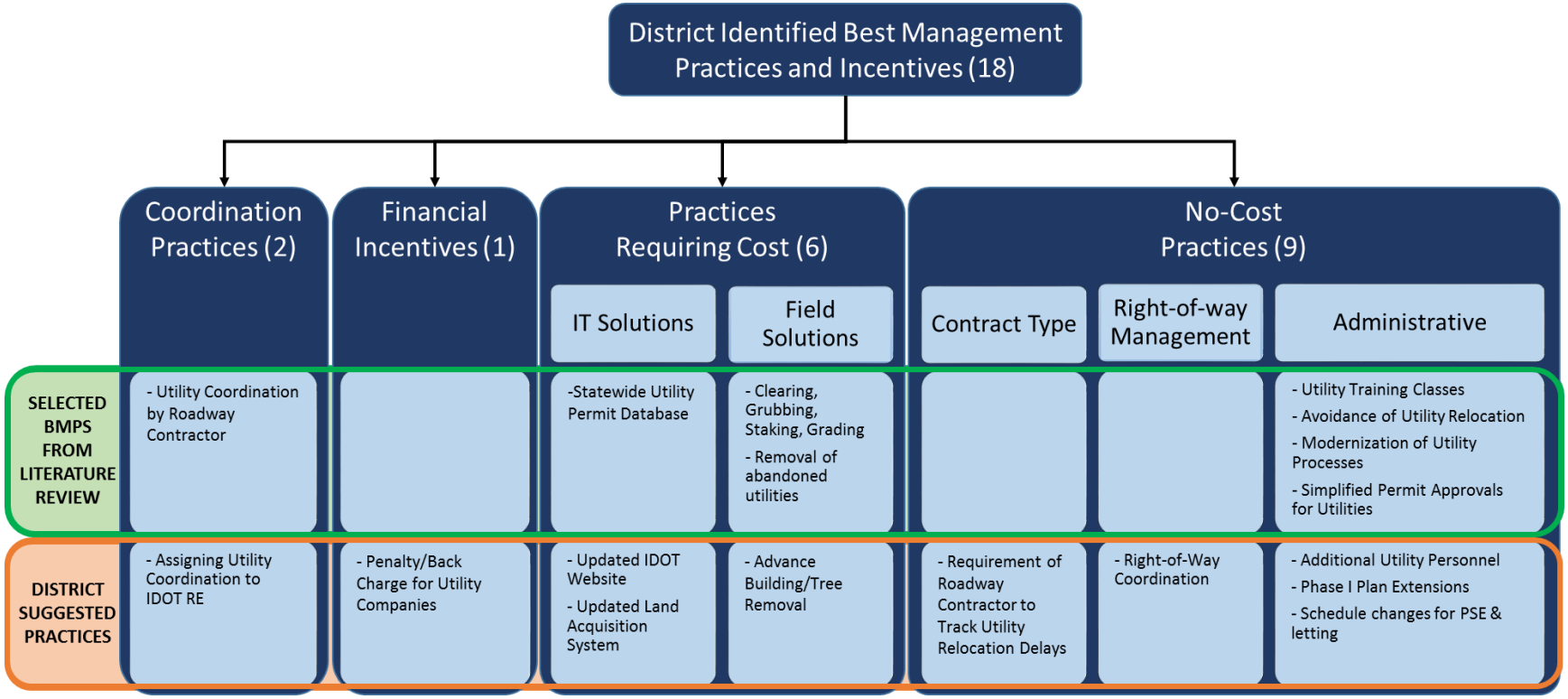

Figure 32. Organization of recommended BMPs by interviewed IDOT districts.

B.3.1 Coordination Practices

The following two BMPs were recommended by interviewed IDOT personnel to provide additional communication procedures to address utility conflicts earlier in the planning process in an effort to reduce delays caused by utility relocation.

B.3.1.1 Utility Coordination by Roadway Contractor

All interviewed IDOT districts recommended that roadway contractors be responsible for the coordination of utility relocation activities that are performed concurrently with roadway construction. Currently, roadway contractors contact IDOT personnel who must then relay the message to the utility company. Removing IDOT personnel as the intermediary would reduce delays on receiving responses and any misunderstandings in relaying messages. This recommended practice gives full responsibility to the roadway contractor for coordination and has the potential to reduce delay claims.

B.3.1.2 Assign Utility Relocation to IDOT Resident Engineer

One interviewed district recommended assigning the responsibility of coordinating utility relocations as early as possible to the designated IDOT Resident Engineer (RE) who is responsible for roadway project during construction. The RE must be familiar with the proposed roadway plans and be available to meet on-site for utility issues. This practice also can require the RE to monitor utility relocation work in order to avoid potential problems during construction. This creates a consistent contact person during the entire project duration.

B.3.2 Financial Incentives

No financial incentives were reported by IDOT officials as beneficial; however, a number of IDOT district officials recommended the use of a financial disincentive or back charge be implemented to hold utility companies responsible for causing delays.

B.3.2.1 Penalty/Back Charge for Utility Company for Delays

Interviewed IDOT officials from four districts recommended the use of a financial disincentive in case of relocation delays that are caused by the utility company that leads to roadway construction delays. Roadway contractors often submit change orders to IDOT claiming additional compensation from IDOT for their delayed work due to utility relocation delays that are caused by the utility company. The interviewed officials recommended that utility companies should be held financially responsible to cover the cost of this type of claims using a financial disincentive clause in the contractual agreements with utility companies. This disincentive was recommended by the interviewed officials because they reported that the existing 90-day law is ineffective.

B.3.3 Practices Requiring Cost

This category includes all district recommended BMPs that may require additional IDOT cost to implement. These recommendations are organized in two subcategories: (1) IT solutions, and (2) field solutions, which are discussed in the following sections.

B.3.3.1 IT Solutions

This subcategory includes the following three recommendations that require the implementation of an IT solution to mitigate utility adjustment delays.

B.3.3.1.1 Statewide Utility Permit Database

Interviewed IDOT officials recommended the use of a statewide permit database to identify utility lines that travel through multiple districts. District officials reported that this database can support and expedite the process of identifying the ownership of unanticipated utility lines. Additionally, a standardized utility permit throughout Illinois improves the consistency of the permitting process in all IDOT districts.

B.3.3.1.2 Updated IDOT Website

Two interviewed districts suggested that updating the IDOT website could provide better access to information and forms, which has the potential to improve coordination with utility companies, roadway contractors and IDOT personnel

B.3.3.1.3 Updated Land Acquisition System

The Bureau of Land Acquisition reported that the current Land Acquisition System (LAS) that tracks land procurement is antiquated. The IDOT official reports there are no alarms or alerts for upcoming deadlines or incorrectly entered information. The system currently tracks individual parcels of land, not referenced to any particular project, and therefore requires another program or spreadsheet to track if all parcels for a single project have been acquired. Additionally, the system only tracks when the warrant is requested and when it is sent to the district. The current LAS cannot track dates for appraisals, negotiations, court dates, offers, or any other intermediate milestones to help identify delays during the land acquisition process.

B.3.3.2 Field Solutions

This subcategory includes the following three recommendations that require the implementation of field solutions to improve the efficiency and effectiveness of utility work and/or relocation.

B.3.3.2.1 Clearing, Grubbing, Staking, Grading

Currently, the utility company must wait for the highway contractor to clear the utility relocation area as part of the contractor's roadway preconstruction activities. All interviewed district officials recommended changing this practice to employ a contractor to prepare the utility relocation area prior to the roadway contractor's mobilization. This preconstruction work allows the utility contractor to clear appropriate space and allows utility relocation work to start earlier. It also acts as a good faith effort to indicate that the project will begin shortly (Scott 2011). District officials reported that implementing this practice can enable the utility company to complete its relocation work before the roadway preconstruction meeting to ensure compliance with the aforementioned IDOT policy specified in the "utility adjustment process flowchart".

B.3.3.2.2 Removal of Abandoned Utilities

Recommended by both urban and rural interviewed districts, this practice would require utility companies to remove lines no longer in service to avoid any future conflicts and delays. IDOT officials in urban districts requested this practice due to limited space constraints in urban areas, while suburban/rural IDOT district officials reported issues with utility companies abandoning utilities without properly marking lines.

B.3.3.2.3 Advance Building/Tree Removal

More extensive than clearing, grubbing, staking and grading, all district officials recommended this practice to remove obstructions from the path of relocated utilities prior to road construction. As clearing, grubbing, staking and grading refers to vegetation along highways, interviewed district officials recommended this practice to remove all types of large obstructions such as buildings, structures, fences and tree roots from the designated utility path prior to the roadway contractor's mobilization.

B.3.4 No-Cost Practices

This category includes recommendations from interviewed IDOT district that do not require additional cost to implement. The recommended BMPs in this category are organized into three subcategories: (1) contract type, (2) right-of-way management, and (3) administrative, which are discussed in the following sections.

B.3.4.1 Contract Type

This subcategory includes one contract related practice to track utility relocation delays, as suggested by interviewed IDOT officials.

B.3.4.1.1 Requirement of Roadway Contractor to Track Utility Relocation Delays

Currently, none of the interviewed IDOT districts track utility adjustment delays. Two districts suggested that the roadway contractor be responsible for tracking utility relocation delays that disrupt roadway operations. The IDOT officials reported that pairing this suggestion with the aforementioned financial disincentive of back-charging utility companies for delays enables the roadway contractor to submit both time and cost claims against the utility company.

B.3.4.2 Right-of-Way Management

In this subcategory of recommendations, IDOT utilizes right-of-way coordination techniques to expedite utility relocation.

B.3.4.2.1 Right-of-Way Utility Coordination

One interviewed IDOT district reported that they provide a detailed right-of-way status sheet to utility companies to inform them if the right-of-way required for their adjustment work has been cleared. This suggested practice can be adopted by other districts to create a separate status sheet

for every utility company working on the project, noting the status of the parcels of land necessary for the specified utility company to perform utility relocation work. The district that currently provides this detailed right-of-way status sheet reported improved communication and coordination with utility companies.

B.3.4.3 Administrative

This subcategory includes the following seven administrative recommendations that have the potential to improve the efficiency and effectiveness of utility relocation work.

B.3.4.3.1 Utility Training Classes

Three districts recommended training classes to familiarize personnel working on utility projects with procedures and situations they may encounter. Interviewed officials reported that these classes would prepare both IDOT and outside project personnel, for unexpected situations and inform them of the relevant DOT procedures.

B.3.4.3.2 Avoidance of Utility Relocation

District personnel in three interviewed IDOT districts reported that IDOT design engineers occasionally do not consider existing utility plans during the design of roadway alterations. IDOT officials reported that overlooking existing utility plans can cause unnecessary utility adjustments. The interviewed officials suggested that IDOT design engineers coordinate with the affected utility company's design department to minimize or avoid utility relocations. This suggested practice increases coordination by involving utility company designers earlier in the design process.

B.3.4.3.3 Modernization of Utility Processes

Three interviewed IDOT districts recommended modernizing existing processes for coordinating utility relocation work with utility companies. District officials recommended the use of more modernized tools and software to improve coordination and communication with utility companies. This includes the use of tablets in field with communication and coordination applications capable of handling geo-location or global positioning software to identify utility lines. IDOT district officials reported that this practice can enhance communication with utility companies that currently utilize these techniques and reduce communication and clarification time.

B.3.4.3.4 Simplified Permit Approvals for Utilities

One IDOT district recommended that permitting be simplified for routine utility relocation projects. They reported that reducing the amount of paperwork for utility companies that perform routine and repetitive utility adjustments would alleviate the amount of clerical errors that district officials have to manage.

B.3.4.3.5 Additional Utility Personnel

A major complaint among four IDOT districts is that they do not have enough personnel to effectively supervise all utility relocation projects in their districts. These districts reported their need for additional personnel in their Project Support departments to provide more oversight on utility relocations. They reported that they need the additional personnel to work alongside the existing Utility Coordinators to adequately manage all projects.

B.3.4.3.6 Schedule Changes for PS&E and Letting Dates

All interviewed districts reported that the Plans, Specifications & Estimated (PS&E) submission date is too close to the letting dates in the "utility adjustment process flowchart", which does not provide adequate time for utility adjustments. They recommended that more time be programmed in between the completion of PS&E and the letting date for roadway contracts to provide adequate time for completing utility relocation work. District officials reported that increasing this timeframe would reduce most of the utility related delays and minimize interference between roadway construction and utility relocation work.

B.3.4.3.7 Phase I Plan Extensions

One district reported that in order to accomplish the aforementioned suggestion of increasing the schedule between PS&E and letting dates for roadway contracts it may be necessary to extend the expiration date of the Phase I plans, specifically, the environmental assessment which is valid for three years from the completion of the analysis. The district reported that extending this expiration date would allow more time for utility relocation work.

B.4 CAUSES AND IMPACTS OF UTILITY RELOCATION DELAYS

The following two subsections summarize the collected feedback from the interviewed IDOT districts on (1) causes of utility relocation delays; and (2) the impact of utility relocation delays on IDOT projects.

B.4.1 Causes of Utility Relocation Delays

The interviewed IDOT officials were asked to indicate causes of delays, as shown in question 5 of the questionnaire (see Table 4) that stated "Are there any specific types or phases of utility work that consistently experience delays? (such as a particular utility or utility company, right-of-way acquisition, work on specific highways or near specific cities, etc.)".

Delays due to utility relocation were reported by all five interviewed IDOT districts. The reported causes of utility relocation delays are grouped five categories: (1) IDOT policies and procedures; (2) ineffectiveness of the 90-day law, (3) coordination with utility companies, (4) political pressure; and (5) undocumented underground utilities.

B.4.1.1 IDOT Policies and Procedures

Interviewed IDOT officials reported that utility relocations are occasionally caused by IDOT policies and procedures. A number of district officials reported that the planning and design activities in the IDOT process and timeline focus on achieving the letting date for roadway construction projects. District officials reported that there is not enough time programmed, or scheduled, for utility adjustments to be completed. According to the Utility Adjustment Process Flowchart (see Figure 33), the duration of utility relocation is specified to be approximately ±5.5 months (i.e., summation of 'Complete of Utility Permits' that has a duration of ±6 weeks and 'Complete Adjustment Process of Non Construction Related Utilities' that has a duration of ±4 months), as shown at the bottom of Figure 33. On the other hand, the top of Figure 33 specifies a duration of ±4 months for the four concurrent activities that start with 'complete PS&E' and end with 'Award'. The interviewed officials reported that this creates an inconsistency of ±6 week between the duration of the two parallel and highlighted set of activities in Figure 33. They reported that the top concurrent path is often completed in ±4 months which puts pressure on the lower concurrent path of 'utility adjustments' to match the duration of the upper path and cut its duration from its specified ±5.5 months in the flowchart to ±4 months.

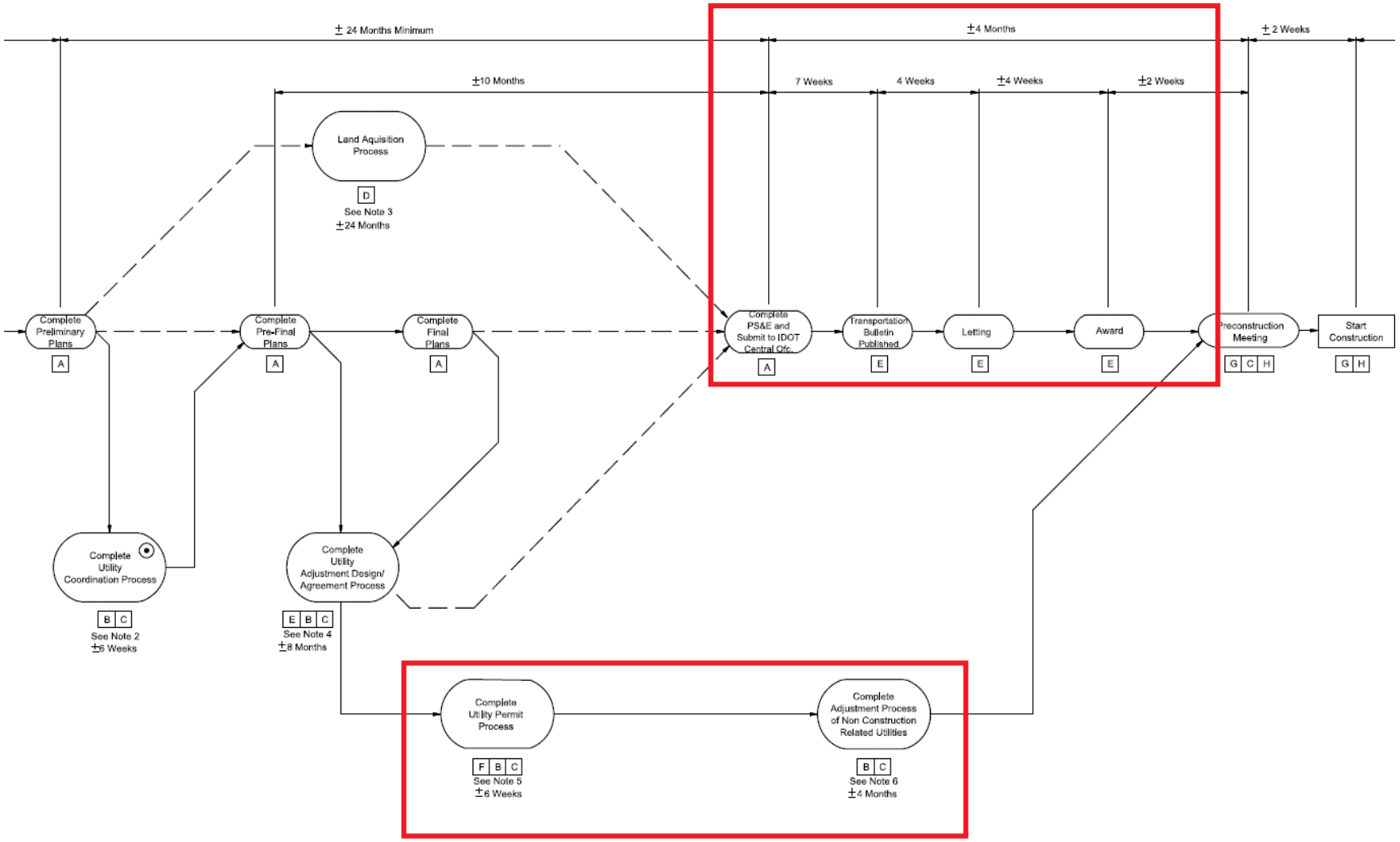

Figure 33. Enlarged utility adjustment process flowchart.

B.4.1.2 Ineffectiveness of the 90-day law

Interviewed IDOT officials reported that the current 90-day utility relocation law for ensuring timely utility relocations is ineffective and causes delays. The current 90-day utility relocation specifies that IDOT must provide written notice to utility companies to begin relocation work. The law further states "If within 90 days after receipt of such written notice, the ditches, drains, track, rails, poles, wires, pipe line, or other equipment have not been removed, relocated, or modified to the reasonable satisfaction of the State or county highway authority, or if arrangements are not made satisfactory to the State or county highway authority for such removal, relocation, or modification, the State or county highway authority may remove, relocate, or modify such ditches, drains, track, rails, poles, wires, pipe line, or other equipment and bill the owner thereof for the total cost of such removal, relocation, or modification" (605 ILCS 5/9-113(f)). The same law also states "at any time within 90 days after written notice was given, the owner of the drains, track, rails, poles, wires, pipe line, or other equipment may request the district engineer or, if appropriate, the county engineer for a waiver of the 90-day deadline" (605 ILCS 5/9-113(f)). A number of districts reported that utility companies often abuse this part of the law and request an extension for every single project and in some cases request multiple extensions on the same project. They reported that utility companies can and often consume 90 days or more from the planned duration of ±5.5 months that is specified for 'utility adjustments' in Figure 33.

B.4.1.3 Lack of Coordination with Utility Companies

Interviewed officials reported the lack of timely coordination with utility companies often causes delays. The lack of coordination was reported in three main areas (1) company policies and procedures for utility relocation, (2) fiscal year timing, and (3) railroad coordination.

First, the interviewed district officials reported that many utility companies servicing Illinois are large corporations with well-established internal policies and procedures that differs from those of IDOT. District officials reported that the policies and procedures of utility companies often do not match the ±5.5 months identified in the IDOT 'Utility Adjustment Process Flowchart'. In addition, they reported that the procedures of these companies often specify durations for utility relocation programming, designing, and contract agreements that are different from those specified in IDOT manuals and policies.

Second, the mismatch between the timing of the fiscal year of IDOT and utility companies occasionally affect whether or not utility work will be completed as planned. IDOT's fiscal year starts on July 1st and ends on June 30th, while the fiscal year of several utility companies follows the calendar year starting on January 1st and ending on December 31st. Several districts reported that if a utility relocation project is scheduled for October or November for example, and a utility company has exhausted its utility adjustment budget for the fiscal year, they may delay that work until after they receive their budget for the new fiscal year after January 1st. This practice was reported to cause delays on many projects.

Third, all districts reported that railroad companies are difficult to coordinate with. IDOT officials reported that this is due to the size of the railroad company districts, called divisions. For example, railroad companies, such as Norfolk Southern and Canadian National both service divisions that

comprise of multiple states and thousands of miles of track. IDOT district officials reported that it is difficult to contact the required railroad personnel due to the size of area they are responsible for. This makes coordination difficult and results in multiple IDOT districts all pursuing the same railroad contact. This does not include the other states that are part of the railroad company division and may be coordinating utility relocations as well.

B.4.1.4 Political Pressure

Interviewed officials reported that political pressure often results in delays, inefficiencies in work and/or increased costs. IDOT district officials reported that this is encountered when elected officials demand that a roadway be completed within a specified timeframe, often far shorter in duration than originally programmed. District officials reported that these demands are often made on major interstate highways which creates additional utility relocation challenges for IDOT due to the number of utilities involved in these large projects. They reported that these projects are often completed over budget due to overtime and acceleration costs associated with expediting the project schedule.

B.4.1.5 Undocumented Underground Utilities

IDOT district officials reported that encountering undocumented underground utilities causes unexpected delays and hardships. When discovering undocumented utilities, the contractor is forced to stop work and contact multiple utility companies to identify ownership of these lines and have them relocated. In districts that have multiple cable or fiber optic carriers, this can cause further delays in trying to identify ownership of the utility line. One district reported that an internet service provider in that district installed several miles of conduit but never installed wiring. Roadway contractors encounter these empty conduits, and the utility company denies ownership of these conduits and refuses to relocate them because an empty conduit has no value for the utility company. The district officials reported that this issue causes confusion and creates additional delays in identifying ownership.

B.4.2 Impacts of Utility Relocation Delays

IDOT district officials were asked to provide schedule and cost data for utility relocation projects in their districts, as shown in question 6 of the questionnaire that stated “Can you provide any project cost (invoice/manpower reports) and schedule (original and as built) data on recent utility relocation projects in your district? This will assist us in comparing how similar projects across different districts in Illinois compare to each other”. The interviewed IDOT districts reported that they do not track utility relocation delays and its impact on project schedule and cost. They reported the impact of utility relocation delays on roadway projects in a three main areas: (1) productivity impacts, (2) financial impacts, and (3) personnel impacts.

B.4.2.1 Productivity Impacts

Interviewed IDOT officials reported that rather than experiencing delays, roadway contractors often utilize short term solutions commonly called “work-arounds”. These work-arounds may include the shifting of crews, remobilizing to another area, or double handling materials. Districts officials reported that work-arounds often cause productivity losses to roadway contractors and increases in the project cost. These productivity losses and their mitigation costs are often submitted as change orders to IDOT and result in increasing the project cost.

B.4.2.2 Financial Impacts

During the conducted interviews, IDOT officials reported that utility relocation delays combined with rising material costs occasionally lead to additional change orders. IDOT officials reported when the cost of gas increased in 2011, the price of asphalt increased proportionally and caused several roadway contractors to file claims for their increased costs. While this was an isolated occurrence and gas prices dropped, district officials reported this resulted in several projects during that letting period being underestimated.

In addition, the interviewed officials reported that poor utility coordination between IDOT and individual municipalities can have a negative impact on the district finances for several years. District officials reported that the multi-year program is not always coordinated with the budgets of municipalities which may not have adequate funding to complete projects. In one rare case, an IDOT district performed the utility adjustment work on behalf of the municipality and was reimbursed by the village over the next few years. This was reported only once in the interviewed districts, but the district budget was reduced by this unexpected cost until reimbursed by the municipality.

B.4.2.3 Personnel Impacts

Interviewed districts reported that as projects experience delays due to design and land acquisition, letting dates will continue to slip. When this happens regularly, the multi-year program and letting schedules issued to utility companies becomes less relevant and insignificant. Several district officials reported that the frequent missing of letting dates often leads utility companies to ignore the IDOT multi-year plan. District officials reported that when letting dates are missed, utility companies must reallocate their resources and reschedule their work crews, and when a roadway project is finally ready to be let, utility companies no longer have the manpower allotted for that project to complete the utility adjustment. This causes further delays and frustrates project personnel.

In addition, the interviewed officials reported that internal IDOT personnel are negatively affected by utility delays. IDOT districts officials reported that construction personnel, who handle roadway contracts, often criticize project support personnel for utility adjustment delays. This results in a contentious relationship between the Construction department and the Project Support department in some districts.

APPENDIX C: STATE DOT SURVEY FORM

Best Management Practices for Utility Relocation

Introduction and Basic Information

The Illinois Department of Transportation is sponsoring an ongoing research project to study the use of Best Management Practices (BMPs) and incentives to expedite utility relocation. This online survey is designed to take less than 15 minutes to complete. Your valuable feedback will assist in evaluating the current use and effectiveness of BMPs to accelerate utility relocation projects. We would appreciate if you completed the survey by March 7th, 2016.

The research team will be glad to share the findings of this survey with you upon completion.

If you have any questions or comments, please contact the Principle Investigator (PI) of this research project:
Khaled El-Rayes, Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
E-mail: elrayes@illinois.edu

Thank you in advance for your time.

1. What is your name? (Optional) _____

2. What state do you represent? (Required) _____

3. What is your current job title? (Optional) _____

Best Management Practices (BMPs) and incentives to expedite utility relocation

4. Which of the following **Coordination Practices** have been utilized on DOT utility relocation projects in your state?

(Select all that apply)

[ ] Coordination, Cooperation, Communication

[ ] Utility Coordination Councils

[ ] Designated Utility Coordinator

[ ] Multi-Level Memorandums of Understanding

[ ] Utility Coordination during Construction

[ ] Other – Please specify and provide a brief description _____

5. Which of the following **Financial Incentives** have been utilized on DOT utility relocation projects in your state?

(Select all that apply)

[ ] Cash Bonuses

[ ] Incentives/Disincentives (I/D)

[ ] Cost Sharing

[ ] No Excuse Incentives

[ ] Contractor-Provided Financial Incentives

[ ] Gainshare-Painshare

[ ] Other – Please specify and provide a brief description _____

6. Which of the following **Practices Requiring Cost** have been utilized on DOT utility relocation projects in your state?

(Select all that apply)

[ ] Utility Cost Database

[ ] Electronic Utility Permits

[ ] Utility Coordination Web sites

[ ] Electronic Document Delivery

[ ] Subsurface Utility Engineering (SUE)

[ ] Clearing, Grubbing, Staking, Grading

[ ] Utility Relocation Safety Program

[ ] Removal of abandoned utilities

[ ] Trenchless Technology

[ ] Utility Tunnels

[ ] Other – Please specify and provide a brief description _____

7. Which of the following **No-Cost Practices** have been utilized on DOT utility relocation projects in your state?

(Select all that apply)

[ ] Utility Work by Highway Contractor

[ ] A+B Bidding

[ ] Lane Rental

[ ] Design-Build

[ ] Unit Cost

[ ] Combined Utility Segments

[ ] Highway Contract Facilitating Language

[ ] Lump-Sum Agreements

[ ] Right-of-Way (RoW) Acquisition

[ ] Utility Corridors

[ ] Locate next to RoW line

[ ] Use of Existing Tunnels for Utilities

[ ] One-Call Systems

[ ] Utility Conflict Matrix

[ ] Advance relocation of utility work

[ ] Utility Training Classes

[ ] Standardized Estimate/Bid Forms

[ ] Standardized Invoice Submissions

[ ] Value Engineering for Utilities

[ ] Avoidance of Utility Relocation

[ ] Modernization of Utility Processes

[ ] Utility Manuals

[ ] Context Sensitive Design

[ ] Simplified Permit Approvals for Utilities

[ ] Other – Please specify and provide a brief description _____

Utility Relocation Best Management Practices (BMPs) and incentives effectiveness

8. Please rank the effectiveness of each BMP in expediting utility relocation on a scale from 1 to 5.
(1 Not Effective, 2 Slightly Effective, 3 Moderately Effective, 4 Effective, and 5 Very Effective)

Coordination Practices	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Coordination, Cooperation, Communication					
Utility Coordination Councils					
Designated Utility Coordinator					
Multi-Level Memorandums of Understanding					
Utility Coordination during Construction					
Other – Please specify and provide a brief description					

Financial Incentives	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Cash Bonuses					
Incentives/Disincentives (I/D)					
Cost Sharing					
No Excuse Incentives					
Contractor-Provided Financial Incentives					
Gainshare-Painshare					
Other – Please specify and provide a brief description					

Practices Requiring Costs	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Utility Cost Database					
Electronic Utility Permits					
Utility Coordination Web sites					
Electronic Document Delivery					
Subsurface Utility Engineering (SUE)					
Clearing, Grubbing, Staking, Grading					
Utility Relocation Safety Program					
Removal of abandoned utilities					
Trenchless Technology					
Utility Tunnels					
Other – Please specify and provide a brief description					

No-Cost Practices	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Utility Work by Highway Contractor					
A+B Bidding					
Lane Rental					
Design-Build					
Unit Cost					
Combined Utility Segments					
Highway Contract Facilitating Language					
Lump-Sum Agreements					
Right-of-Way (RoW) Acquisition					
Utility Corridors					
Locate next to RoW line					
Use of Existing Tunnels for Utilities					
One-Call Systems					
Utility Conflict Matrix					
Advance relocation of utility work					
Utility Training Classes					
Standardized Estimate/Bid Forms					
Standardized Invoice Submissions					
Value Engineering for Utilities					
Avoidance of Utility Relocation					
Modernization of Utility Processes					
Utility Manuals					
Context Sensitive Design					
Simplified Permit Approvals for Utilities					
Other – Please specify and provide a brief description					

9. Please estimate the effectiveness in reducing project duration (in percentage of total project time) attributed to the use of each utility relocation BMP.
(If reduction percentage is unknown please indicate in terms of weeks/months)

Coordination Practices	Time Reduction (% of total project duration)
Coordination, Cooperation, Communication	
Utility Coordination Councils	
Designated Utility Coordinator	
Multi-Level Memorandums of Understanding	
Utility Coordination during Construction	
Other – Please specify and provide a brief description	

Financial Incentives	Time Reduction (% of total project duration)
Cash Bonuses	
Incentives/Disincentives (I/D)	
Cost Sharing	
No Excuse Incentives	
Contractor-Provided Financial Incentives	
Gainshare-Painshare	
Other – Please specify and provide a brief description	

Practices Requiring Costs	Time Reduction (% of total project duration)
Utility Cost Database	
Electronic Utility Permits	
Utility Coordination Web sites	
Electronic Document Delivery	
Subsurface Utility Engineering (SUE)	
Clearing, Grubbing, Staking, Grading	
Utility Relocation Safety Program	
Removal of abandoned utilities	
Trenchless Technology	
Utility Tunnels	
Other – Please specify and provide a brief description	

No-Cost Practices	Time Reduction (% of total project duration)
Utility Work by Highway Contractor	
A+B Bidding	
Lane Rental	
Design-Build	

Unit Cost	
Combined Utility Segments	
Highway Contract Facilitating Language	
Lump-Sum Agreements	
Right-of-Way (RoW) Acquisition	
Utility Corridors	
Locate next to RoW line	
Use of Existing Tunnels for Utilities	
One-Call Systems	
Utility Conflict Matrix	
Advance relocation of utility work	
Utility Training Classes	
Standardized Estimate/Bid Forms	
Standardized Invoice Submissions	
Value Engineering for Utilities	
Avoidance of Utility Relocation	
Modernization of Utility Processes	
Utility Manuals	
Context Sensitive Design	
Simplified Permit Approvals for Utilities	
Other – Please specify and provide a brief description	

Utility Relocation Best Management Practices (BMPs) and incentives implementation costs

10. Please estimate the cost required to implement these utility relocation BMPs on your projects.
(If implementation cost is unknown please indicate "Cost Unknown")

Coordination Practices	Cost in USD, if any
Coordination, Cooperation, Communication	
Utility Coordination Councils	
Designated Utility Coordinator	
Multi-Level Memorandums of Understanding	
Utility Coordination during Construction	
Other – Please specify and provide a brief description	

Financial Incentives	Cost in USD, if any
Cash Bonuses	
Incentives/Disincentives (I/D)	
Cost Sharing	
No Excuse Incentives	
Contractor-Provided Financial Incentives	
Gainshare-Painshare	
Other – Please specify and provide a brief description	

Practices Requiring Costs	Cost in USD, if any
Utility Cost Database	
Electronic Utility Permits	
Utility Coordination Web sites	
Electronic Document Delivery	
Subsurface Utility Engineering (SUE)	
Clearing, Grubbing, Staking, Grading	
Utility Relocation Safety Program	
Removal of abandoned utilities	
Trenchless Technology	
Utility Tunnels	
Other – Please specify and provide a brief description	

No-Cost Practices	Cost in USD, if any
Utility Work by Highway Contractor	
A+B Bidding	
Lane Rental	
Design-Build	
Unit Cost	
Combined Utility Segments	
Highway Contract Facilitating Language	
Lump-Sum Agreements	
Right-of-Way (RoW) Acquisition	
Utility Corridors	
Locate next to RoW line	
Use of Existing Tunnels for Utilities	
One-Call Systems	
Utility Conflict Matrix	
Advance relocation of utility work	
Utility Training Classes	
Standardized Estimate/Bid Forms	
Standardized Invoice Submissions	
Value Engineering for Utilities	
Avoidance of Utility Relocation	
Modernization of Utility Processes	
Utility Manuals	
Context Sensitive Design	
Simplified Permit Approvals for Utilities	
Other – Please specify and provide a brief description	

Utility Relocation Best Management Practices (BMPs) and incentives problems and challenges

11. Please list any problems or challenges encountered as a result of implementing these BMPs and incentives

Coordination Practices	Problems or challenges encountered, if any
Coordination, Cooperation, Communication	
Utility Coordination Councils	
Designated Utility Coordinator	
Multi-Level Memorandums of Understanding	
Utility Coordination during Construction	
Other – Please specify and provide a brief description	

Financial Incentives	Problems or challenges encountered, if any
Cash Bonuses	
Incentives/Disincentives (I/D)	
Cost Sharing	
No Excuse Incentives	
Contractor-Provided Financial Incentives	
Gainshare-Painshare	
Other – Please specify and provide a brief description	

Practices Requiring Costs	Problems or challenges encountered, if any
Utility Cost Database	
Electronic Utility Permits	
Utility Coordination Web sites	
Electronic Document Delivery	
Subsurface Utility Engineering (SUE)	
Clearing, Grubbing, Staking, Grading	
Utility Relocation Safety Program	
Removal of abandoned utilities	
Trenchless Technology	
Utility Tunnels	
Other – Please specify and provide a brief description	

No-Cost Practices	Problems or challenges encountered, if any
Utility Work by Highway Contractor	
A+B Bidding	
Lane Rental	
Design-Build	
Unit Cost	
Combined Utility Segments	
Highway Contract Facilitating Language	
Lump-Sum Agreements	
Right-of-Way (RoW) Acquisition	
Utility Corridors	
Locate next to RoW line	
Use of Existing Tunnels for Utilities	
One-Call Systems	
Utility Conflict Matrix	
Advance relocation of utility work	
Utility Training Classes	
Standardized Estimate/Bid Forms	
Standardized Invoice Submissions	
Value Engineering for Utilities	
Avoidance of Utility Relocation	
Modernization of Utility Processes	
Utility Manuals	
Context Sensitive Design	
Simplified Permit Approvals for Utilities	
Other – Please specify and provide a brief description	

Utility Relocation Delays

12. Please list any causes of utility relocation delays experienced on DOT projects and estimate the percentage of projects affected by these types of causes.
(Examples: Lengthy/complicated DOT policies and procedures, lack of coordination between parties, programming/schedule delays, design delays, political pressure, undocumented underground utilities, etc.)

	Description	Frequency (% of projects affected)
Cause 1		
Cause 2		
Cause 3		
Cause 4		
Cause 5		
Cause 6		

13. Please list the impacts resulting from utility relocation delays on DOT projects, if any, and estimate the percentage of projects affected.
(Examples:
Productivity impacts: Shifting or remobilizing crews, double-handling of materials
Financial impacts: Escalation costs
Personnel impacts: Reallocation of crews, lack of manpower
Etc.)

	Description	Frequency (% of projects affected)
Impact 1		
Impact 2		
Impact 3		
Impact 4		
Impact 5		
Impact 6		

Feedback

14. Can you suggest any BMPs or incentives that were not listed and could have the potential to expedite utility relocation?

_____
_____
_____

15. Please list any additional comments regarding BMPs and incentives for utility relocation

_____
_____
_____

16. Would you be willing to provide more information, if needed?

( ) Yes (Please provide e-mail address) _____

( ) No

17. Are you interested in receiving the main findings of this survey upon completion?
( ) Yes (Please provide e-mail address) _____
( ) No

Thank You!

We thank you for your time in completing our survey.
Thank you for taking our survey. Your response is very important to us.

APPENDIX D: ILLINOIS UTILITY COMPANY SURVEY FORM

Best Management Practices and Incentives for Utility Relocation in Illinois

Introduction and Basic Information

The Illinois Department of Transportation is sponsoring an ongoing research project to study the use of Best Management Practices (BMPs) and incentives to expedite utility relocation. This online survey is designed to take less than 15 minutes to complete. Your valuable feedback will assist in evaluating the current use and effectiveness of BMPs to accelerate utility relocation projects. We would appreciate if you completed the survey by March 7th, 2016.

The research team will be glad to share the findings of this survey with you upon completion.

If you have any questions or comments, please contact the Principle Investigator (PI) of this research project:
Khaled El-Rayes, Professor
Department of Civil and Environmental Engineering
University of Illinois at Urbana-Champaign
E-mail: elrayes@illinois.edu

Thank you in advance for your time.

1. What is your name? (Optional) _____

2. What is your current job title? (Optional) _____

3. What utility company do you represent? (Required) _____

4. What type of utility company do you represent? (Required)
(Select all that apply) *

[ ] Water

[ ] Gas

[ ] Electric

[ ] Telecommunications

[ ] Cable Television

[ ] Other – Please specify _____

Best Management Practices (BMPs) and incentives to expedite utility relocation

5. Which of the following **Coordination Practices** have been used on your DOT utility relocation projects? **(Select all that apply)**

[ ] Coordination, Cooperation, Communication

[ ] Utility Coordination Councils

[ ] Designated Utility Coordinator

[ ] Multi-Level Memorandums of Understanding

[ ] Utility Coordination during Construction

[ ] Other – Please specify and provide a brief description _____

6. Which of the following **Financial Incentives** have been used on your DOT utility relocation projects? **(Select all that apply)**

[ ] Cash Bonuses

[ ] Incentives/Disincentives (I/D)

[ ] Cost Sharing

[ ] No Excuse Incentives

[ ] Contractor-Provided Financial Incentives

[ ] Gainshare-Painshare

[ ] Other – Please specify and provide a brief description _____

7. Which of the following **Practices Requiring Cost** have been used on your DOT utility relocation projects? **(Select all that apply)**

[ ] Utility Cost Database

[ ] Electronic Utility Permits

[ ] Utility Coordination Web sites

[ ] Electronic Document Delivery

[ ] Subsurface Utility Engineering (SUE)

[ ] Clearing, Grubbing, Staking, Grading

[ ] Utility Relocation Safety Program

[ ] Removal of abandoned utilities

[ ] Trenchless Technology

[ ] Utility Tunnels

[ ] Other – Please specify and provide a brief description _____

8. Which of the following **No-Cost Practices** have been used on your DOT utility relocation projects?
(Select all that apply)

[ ] Utility Work by Highway Contractor

[ ] A+B Bidding

[ ] Lane Rental

[ ] Design-Build

[ ] Unit Cost

[ ] Combined Utility Segments

[ ] Highway Contract Facilitating Language

[ ] Lump-Sum Agreements

[ ] Right-of-Way (RoW) Acquisition

[ ] Utility Corridors

[ ] Locate next to RoW line

[ ] Use of Existing Tunnels for Utilities

[ ] One-Call Systems

[ ] Utility Conflict Matrix

[ ] Advance relocation of utility work

[ ] Utility Training Classes

[ ] Standardized Estimate/Bid Forms

[ ] Standardized Invoice Submissions

[ ] Value Engineering for Utilities

[ ] Avoidance of Utility Relocation

[ ] Modernization of Utility Processes

[ ] Utility Manuals

[ ] Context Sensitive Design

[ ] Simplified Permit Approvals for Utilities

[ ] Other – Please specify and provide a brief description _____

Utility Relocation Best Management Practices (BMPs) and incentives effectiveness

9. Please rank the effectiveness of each BMP in expediting utility relocation on a scale from 1 to 5.
(1 Not Effective, 2 Slightly Effective, 3 Moderately Effective, 4 Effective, and 5 Very Effective)

Coordination Practices	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Coordination, Cooperation, Communication					
Utility Coordination Councils					
Designated Utility Coordinator					
Multi-Level Memorandums of Understanding					
Utility Coordination during Construction					
Other – Please specify and provide a brief description					

Financial Incentives	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Cash Bonuses					
Incentives/Disincentives (I/D)					
Cost Sharing					
No Excuse Incentives					
Contractor-Provided Financial Incentives					
Gainshare-Painshare					
Other – Please specify and provide a brief description					

Practices Requiring Costs	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Utility Cost Database					
Electronic Utility Permits					
Utility Coordination Web sites					
Electronic Document Delivery					
Subsurface Utility Engineering (SUE)					
Clearing, Grubbing, Staking, Grading					
Utility Relocation Safety Program					
Removal of abandoned utilities					
Trenchless Technology					
Utility Tunnels					
Other – Please specify and provide a brief description					

No-Cost Practices	1 Not Effective	2 Slightly Effective	3 Moderately Effective	4 Effective	5 Very Effective
Utility Work by Highway Contractor					
A+B Bidding					
Lane Rental					
Design-Build					
Unit Cost					
Combined Utility Segments					
Highway Contract Facilitating Language					
Lump-Sum Agreements					
Right-of-Way (RoW) Acquisition					
Utility Corridors					
Locate next to RoW line					
Use of Existing Tunnels for Utilities					
One-Call Systems					
Utility Conflict Matrix					
Advance relocation of utility work					
Utility Training Classes					
Standardized Estimate/Bid Forms					
Standardized Invoice Submissions					
Value Engineering for Utilities					
Avoidance of Utility Relocation					
Modernization of Utility Processes					
Utility Manuals					
Context Sensitive Design					
Simplified Permit Approvals for Utilities					
Other – Please specify and provide a brief description					

Utility Relocation Best Management Practices (BMPs) and incentives problems and challenges

10. Please list any problems or challenges that were encountered as a result of these BMPs and incentives

Coordination Practices	Problems or challenges encountered, if any
Coordination, Cooperation, Communication	
Utility Coordination Councils	
Designated Utility Coordinator	
Multi-Level Memorandums of Understanding	
Utility Coordination during Construction	
Other – Please specify and provide a brief description	

Financial Incentives	Problems or challenges encountered, if any
Cash Bonuses	
Incentives/Disincentives (I/D)	
Cost Sharing	
No Excuse Incentives	
Contractor-Provided Financial Incentives	
Gainshare-Painshare	
Other – Please specify and provide a brief description	

Practices Requiring Costs	Problems or challenges encountered, if any
Utility Cost Database	
Electronic Utility Permits	
Utility Coordination Web sites	
Electronic Document Delivery	
Subsurface Utility Engineering (SUE)	
Clearing, Grubbing, Staking, Grading	
Utility Relocation Safety Program	
Removal of abandoned utilities	
Trenchless Technology	
Utility Tunnels	
Other – Please specify and provide a brief description	

No-Cost Practices	Problems or challenges encountered, if any
Utility Work by Highway Contractor	
A+B Bidding	
Lane Rental	
Design-Build	
Unit Cost	
Combined Utility Segments	
Highway Contract Facilitating Language	
Lump-Sum Agreements	
Right-of-Way (RoW) Acquisition	
Utility Corridors	
Locate next to RoW line	
Use of Existing Tunnels for Utilities	
One-Call Systems	
Utility Conflict Matrix	
Advance relocation of utility work	
Utility Training Classes	
Standardized Estimate/Bid Forms	
Standardized Invoice Submissions	
Value Engineering for Utilities	
Avoidance of Utility Relocation	
Modernization of Utility Processes	
Utility Manuals	
Context Sensitive Design	
Simplified Permit Approvals for Utilities	
Other – Please specify and provide a brief description	

Scheduling of IDOT Projects

11. For **state reimbursable** projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and receipt of permit, if required?
(in Months)

_____

12. For **non-reimbursable** projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and receipt of permit, if required?
(in Months)

_____

13. For **state reimbursable** projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and start of utility adjustment/relocation work?
(in Months)

_____

14. For **non-reimbursable** projects, what is the average duration between Contract Agreement Execution (by both the utility company and IDOT) and start of utility adjustment/relocation work?
(in Months)

_____

15. What is the average duration of utility adjustment/relocation on your IDOT projects once your relocation work begins?
(in Months)

_____

16. How far in advance does your utility company schedule DOT utility relocation projects before work starts?

( ) 1-6 months in advance

( ) 6-12 months in advance

( ) 1-3 years in advance

( ) 3+ years in advance

17. Do you have any additional comments regarding your experiences with the duration, timeline or sequencing of IDOT utility relocation projects?
(Examples: Experienced delays due to contract negotiations or permitting, experienced delays due to highway contractor interference, utility relocation program/schedule is based directly on IDOT's multi-year plan, etc.)

_____
_____
_____

Utility Relocation Delays

18. Please list any causes of utility relocation delays experienced on DOT projects and estimate the percentage of projects affected by these types of causes.

	Description	Frequency (% of projects affected)
Cause 1		
Cause 2		
Cause 3		
Cause 4		
Cause 5		
Cause 6		

19. Please list the types of impacts resulting from utility relocation delays on DOT projects and estimate the percentage of projects affected.
(Examples:
Productivity impacts: Shifting, remobilizing crews, double-handling of materials
Financial impacts: Escalation costs
Personnel impacts: Reallocation of crews, lack of manpower
Etc.)

	Description	Frequency (% of projects affected)
Impact 1		
Impact 2		
Impact 3		
Impact 4		
Impact 5		
Impact 6		

Feedback

20. Can you suggest any BMPs or incentives that were not listed and could have the potential to expedite utility relocation on DOT projects?

_____
_____
_____

21. Please list any additional comments regarding BMPs and incentives for utility relocation

_____
_____
_____

22. Would you be willing to provide more information, if needed?
( ) Yes (Please provide e-mail address) _____
( ) No

23. Are you interested in receiving the main findings of this survey upon completion?
( ) Yes (Please provide e-mail address) _____
( ) No

Thank You!

We thank you for your time in completing our survey.
Thank you for taking our survey. Your response is very important to us.

APPENDIX E: ADDITIONAL SURVEY RESULTS

E.1 USE OF BMPS AND INCENTIVES ON DOT PROJECTS

The state DOT officials and Illinois utility company representatives were asked to identify the BMPs and incentives that have been utilized on their DOT utility relocation projects. Each respondent was provided a list of 45 BMPs and incentives along with a brief description of each BMP. The collected feedback on the use of these 45 BMPs and incentives is analyzed and grouped in the following four main categories of BMPs: (1) coordination practices; (2) financial incentives; (3) practices requiring cost; and (4) no-cost practices, which are discussed in the following four subsections.

E.1.1 Utilized Coordination Practices

A total of 136 respondents reported their use of the seven coordination practices listed in the survey and Table 19 on their projects. These 136 respondents included 49 state DOT officials and 87 Illinois utility company representatives. The number of respondents reporting the use of each of these seven coordination practices and their percentages are summarized in Table 19 and Figure 34. In addition to these five coordination practices that were listed in the survey, respondents reported the use of five additional practices that are listed as 'other' in Table 19.

Table 19. Use of Coordination Practices by Survey Respondents

Coordination Practice	State DOTs	Percentage of State DOTs*		Illinois Utility Companies	Percentage of Illinois Utility Companies**
Coordination, Cooperation, Communication	29	93.55%		67	77.01%
Utility Coordination Councils	11	44.00%		12	13.79%
Designated Utility Coordinator	37	94.87%		35	40.23%
Multi-Level Memorandums of Understanding	5	20.00%		12	13.79%
Utility Coordination during Construction	21	84.00%		55	63.22%
Utility Coordination by Roadway Contractor	21	67.74%			
Assigning Utility Coordination to DOT Resident Engineer	15	48.39%			
Other - DOT1 - Web Accessible Utility Information	1	N/A			
Other - DOT2 - State Provisions Governing Utility Relocations	1	N/A			
Other - DOT3 - Master Relocation Agreements	1	N/A			
Other - IUC1 - Right-of-Way Agents				1	N/A
Other - IUC2 - Permit Review Officers				1	N/A

$$* \ \% \text{ of state DOTs} = \frac{\text{Number of state DOTs selecting coordination practice}}{\text{Total number of state DOTs answering this question}}$$

$$** \ \% \text{ of Illinois utility companies} = \frac{\text{Number of Illinois utility companies selecting coordination practice}}{\text{Total number of Illinois utility companies answering this question}}$$

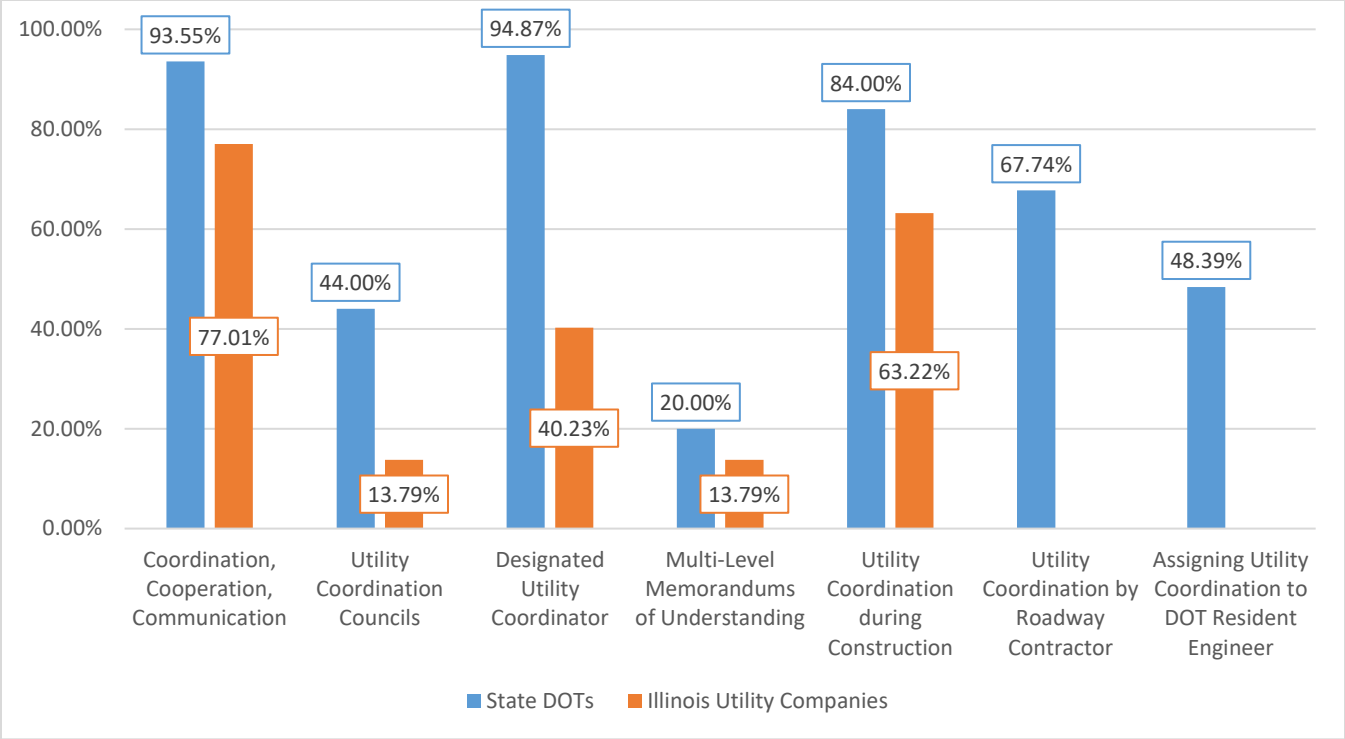

Figure 34. Percentage of survey respondents utilizing coordination practices.

The results of the survey illustrate that the top three coordination practices that were reported to be used by more than 80% of the participating state DOTs are (1) designated utility coordinator; (2) coordination, cooperation, communication; and (3) utility coordination during construction, as shown in Figure 34. The results also show that the top three coordination practices used by participating Illinois utility companies are (a) coordination, cooperation, communication; (b) utility coordination during construction; and (c) designated utility coordinator, as shown in Figure 34. It should be noted that the percentage of Illinois utility companies reporting the use of these coordination practices were less than those reported by state DOTs (see Figure 34). For example, the coordination practice of 'designated utility coordinators' was reported to be used by 94.87% and 40.23% of the participating DOT respondents and Illinois utility companies, respectively. This difference can be attributed to the fact that only half of IDOT districts utilize 'designated' utility coordinators while the remaining IDOT districts have combined utilities and railroad coordinators. This can explain the reason for the lower reported use (40.23%) of designated utility coordinators by Illinois utility companies. Similarly, the coordination practice of 'utility coordination councils' was reported to be used by 44.00% and 13.79% of the participating state DOTs and Illinois utility companies, respectively. This difference can be attributed to the lack of an existing active utility coordination council in Illinois. Three IDOT district officials reported during the conducted interviews that a utility coordination council previously existed approximately three years ago, but has not been renewed since then.

E.1.2 Utilized Financial Incentives

Twenty-eight state DOTs officials and 34 Illinois utility company representatives reported their use of the seven financial incentives listed in the survey and Table 20. The number of respondents reporting the use of each of these six financial incentives and their percentages are summarized in Table 20 and Figure 35. Respondents also reported seven 'other' financial incentives that are listed in Table 20.

Table 20. Use of Financial Incentives by Survey Respondents

Financial Incentive	State DOTs	Percentage of State DOTs*		Illinois Utility Companies	Percentage of Illinois Utility Companies**
Cash Bonuses	0	0.00%		1	2.94%
Incentives/Disincentives (I/D)	5	31.25%		1	2.94%
Cost Sharing	9	60.00%		22	64.71%
No Excuse Incentives	1	7.14%		4	11.76%
Contractor-Provided Financial Incentives	1	6.67%		4	11.76%
Gainshare-Painshare	0	0.00%		2	5.88%
Penalty/Backcharge for Utility Companies	14	82.35%			
Other - DOT1 - 50% DOT Relocation Costs Covered for Small Companies	1	N/A			
Other - DOT2 - 100% State Reimbursement	1	N/A			
Other - DOT3 - State Provisions Prohibiting Financial Incentives	1	N/A			
Other - DOT4 - State Provisions Governing Utility Relocations	1	N/A			
Other - IUC1 - 100% Utility Funded Relocations				2	N/A
Other - IUC2 - Motor Fuel Tax (MFT) Fund				1	N/A
Other - IUC3 - Bonded Contracts				1	N/A

$$* \ \% \text{ of state DOTs} = \frac{\text{Number of state DOTs selecting financial incentive}}{\text{Total number of state DOTs answering this question}}$$

$$** \ \% \text{ of Illinois utility companies} = \frac{\text{Number of Illinois utility companies selecting financial incentive}}{\text{Total number of Illinois utility companies answering this question}}$$

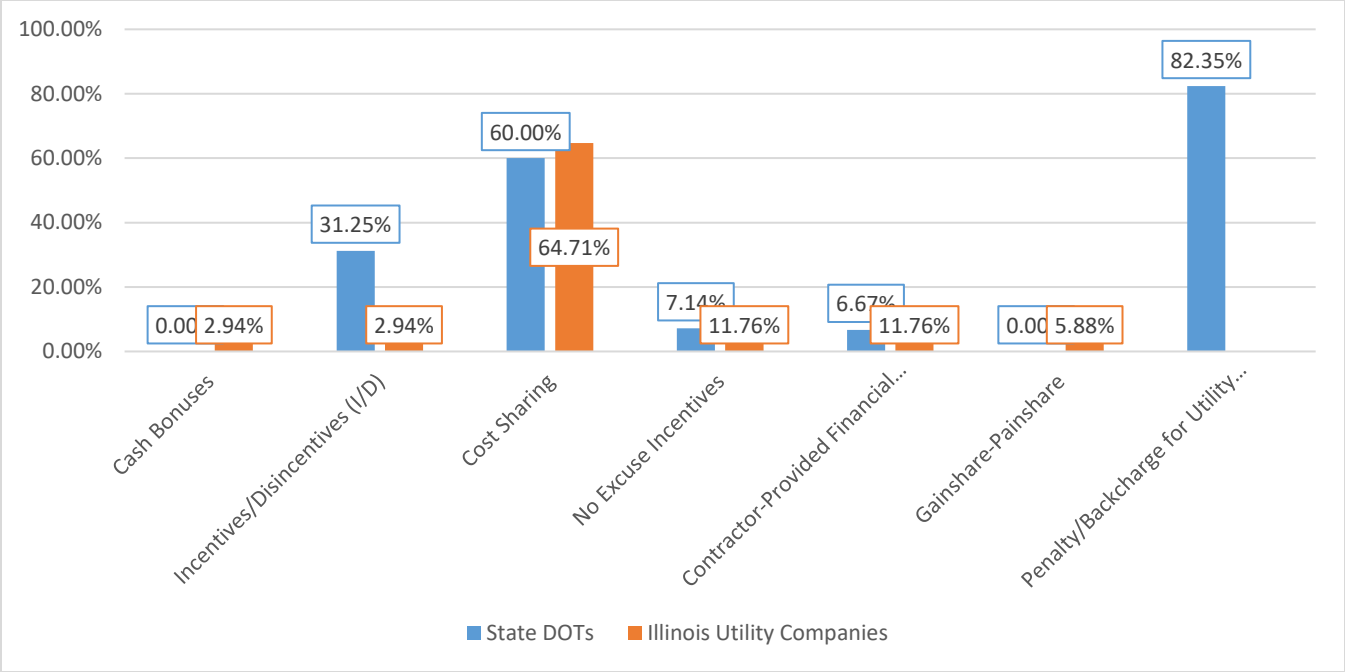

Figure 35. Percentage of survey respondents utilizing financial incentives

The survey results in Figure 35 show that the top three financial incentives that were reported to be used by participating state DOTs are (1) penalty/backcharge for utility company; (2) cost sharing; and (3) incentives/disincentives. The top three financial incentives used by participating Illinois utility companies are (a) cost sharing; (b) no-excuse incentives; and (c) contractor-provided financial incentives. With the exception of 'penalty/backcharge for utility company' that was reported to be used by 82.35% of participating state DOTs, and 'cost sharing' that was reported to be used by 60.00% of participating state DOTs and 64.71% of Illinois utility company respondents, the use of all other financial incentives was less than 35.00%. These low reported utilization rates of the financial incentives can be attributed to Federal and state laws that prohibit the use of federal funds to pay any cost over and above the actual utility relocation costs.

E.1.3 Utilized Practices Requiring Cost

A total of 105 respondents reported their use of the ten listed practices requiring costs in the survey. These 105 respondents included 45 state DOT officials and 60 Illinois utility company representatives, as shown in Table 21. The number of respondents reporting the use of each of these ten practices requiring cost and their percentages are summarized in Table 21 and Figure 36. In addition to these 16 practices requiring cost that were listed in the survey, state DOT respondents reported the use of three additional practices that are listed as 'other' in Table 21.

Table 21. Use of Practices Requiring Cost by Survey Respondents

Practice Requiring Cost	State DOTs	Percentage of State DOTs*		Illinois Utility Companies	Percentage of Illinois Utility Companies**
Utility Cost Database	8	32.00%		1	1.67%
Electronic Utility Permits	12	48.00%		16	26.67%
Utility Coordination Web sites	8	32.00%		12	20.00%
Electronic Document Delivery	13	50.00%		23	38.33%
Subsurface Utility Engineering (SUE)	23	88.46%		17	28.33%
Clearing, Grubbing, Staking, Grading	18	69.23%		16	26.67%
Utility Relocation Safety Program	2	8.00%		8	13.33%
Removal of abandoned utilities	11	44.00%		12	20.00%
Trenchless Technology	17	68.00%		36	60.00%
Utility Tunnels	1	4.00%		2	3.33%
Statewide Utility Permit Database	18	64.29%			
Updated DOT Website	12	42.86%			
Updated Land Acquisition System	0	0.00%			
Advanced Building/Tree Removal	10	35.71%			
On-Call Utility Contractors	0	0.00%			
Extended Work Hours	7	25.00%			
Other - DOT1 - Utility Relocation Database	1	N/A			
Other - DOT2 - Maintenance of Traffic	1	N/A			
Other - DOT3 - Environmental Permit Assistance	1	N/A			

$$* \ \% \text{ of state DOTs} = \frac{\text{Number of state DOTs selecting practice requring cost}}{\text{Total number of state DOTs answering this question}}$$

$$** \ \% \text{ of Illinois utility companies } = \frac{\text{Number of Illinois utility companies selecting practice requiring cost}}{\text{Total number of Illinois utility companies answering this question}}$$

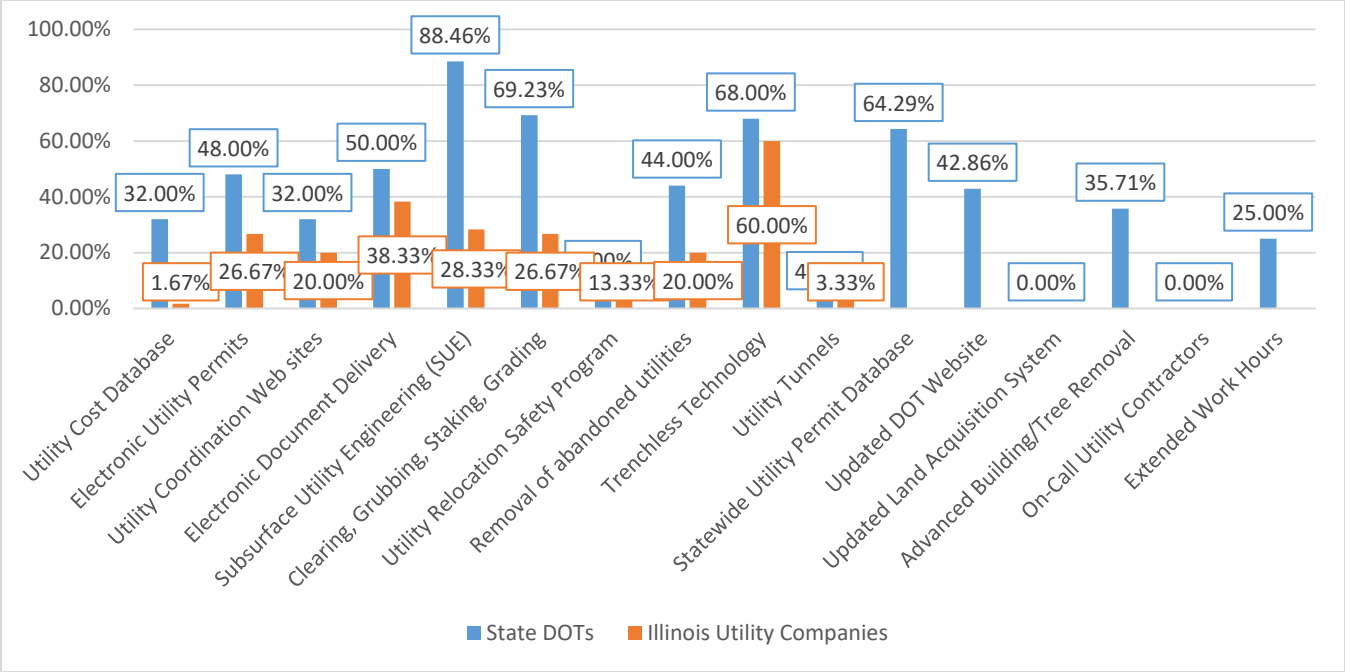

Figure 36. Percentage of survey respondents utilizing practices requiring cost.

The top four practices requiring cost that were reported to be used by more than 60% of participating state DOTs are (1) subsurface utility engineering; (2) clearing, grubbing, staking, grading; (3) trenchless technology; and (4) statewide utility permit database, as shown in Figure 36. The top four practices requiring cost used by Illinois utility companies are (a) trenchless technology; (b) electronic document delivery; (c) subsurface utility engineering; and (d) clearing, grubbing, staking, grading. It should be noted that the percentage of Illinois utility companies reporting the use of these practices requiring cost were less than those reported by state DOTs (see Figure 36). For example, 'subsurface utility engineering' was reported to be used by 88.46% of participating state DOTs and 28.33% of Illinois utility companies. The difference can be attributed to the limited used of SUE technologies in non-urban environments. Three IDOT officials reported that SUE methods are not cost effective and consume a large portion of the utility relocation budget. Similarly, the 'clearing, grubbing, staking, grading' practice was reported to be used by 69.23% of participating state DOTs and 26.67% of Illinois utility companies respondents. According to interviewed IDOT district officials, this practice is performed on a limited basis due to right-of-way acquisition delays. Delays in obtaining the right-of-way prevent early clearing of the utility relocation area until the arrival of the roadway contractor.

E.1.4 Utilized No-Cost Practices

Forty-eight state DOTs officials and 74 Illinois utility company representatives reported their use of the 31 no-cost practices listed in the survey and Table 22. The number of respondents reporting the use of each of these 31 no-cost practices and their percentages are summarized in Table 22 and Figure 37. Survey respondents also reported two 'other' no-cost practices, as shown in Table 22.

Table 22. Use of No-Cost Practices by Survey Respondents

No-Cost Practice	State DOTs	Percentage of State DOTs*		Illinois Utility Companies	Percentage of Illinois Utility Companies**
Utility Work by Highway Contractor	19	73.08%		18	24.32%
A+B Bidding	4	15.38%		5	6.76%
Lane Rental	4	15.38%		0	0.00%
Design-Build	13	50.00%		5	6.76%
Unit Cost	5	19.23%		13	17.57%
Combined Utility Segments	1	3.57%		1	1.35%
Highway Contract Facilitating Language	2	7.69%		5	6.76%
Lump-Sum Agreements	13	50.00%		19	25.68%
Right-of-Way (RoW) Acquisition	13	50.00%		25	33.78%
Utility Corridors	6	23.08%		13	17.57%
Locate next to RoW line	15	57.69%		26	35.14%
Use of Existing Tunnels for Utilities	2	7.69%		2	2.70%
One-Call Systems	18	69.23%		55	74.32%
Utility Conflict Matrix	11	40.74%		9	12.16%
Advance relocation of utility work	18	66.67%		34	45.95%
Utility Training Classes	10	38.46%		7	9.46%
Standardized Estimate/Bid Forms	4	15.38%		12	16.22%
Standardized Invoice Submissions	7	26.92%		7	9.46%
Value Engineering for Utilities	4	15.38%		8	10.81%
Avoidance of Utility Relocation	17	65.38%		22	29.73%
Modernization of Utility Processes	9	34.62%		1	1.35%
Utility Manuals	16	61.54%		12	16.22%
Context Sensitive Design	4	15.38%		6	8.11%
Simplified Permit Approvals for Utilities	10	38.46%		15	20.27%
Requirement of Roadway Contractor to Track Utility Relocation Delays	14	46.67%			
Right-of-Way Utility Coordination	21	70.00%			
Additional Utility Personnel	12	40.00%			
Phase I Plan Extensions	0	0.00%			
Schedule changes for PSE & letting	17	56.67%			
Prepayment for Long Procurement Items	8	26.67%			
Minimize Program Changes	14	46.67%			
Other - DOT1 - Monthly Local Utility Status Meeting	1	N/A			
Other - IUC1 - Bypass Pumping Permits				1	N/A

$$* \ \% \text{ of state DOTs} = \frac{\text{Number of state DOTs selecting no} - \text{cost practice}}{\text{Total number of state DOTs answering this question}}$$

$$** \ \% \text{ of Illinois utility companies } = \frac{\text{Number of Illinois utility companies selecting no} - \text{cost practice}}{\text{Total number of Illinois utility companies answering this question}}$$

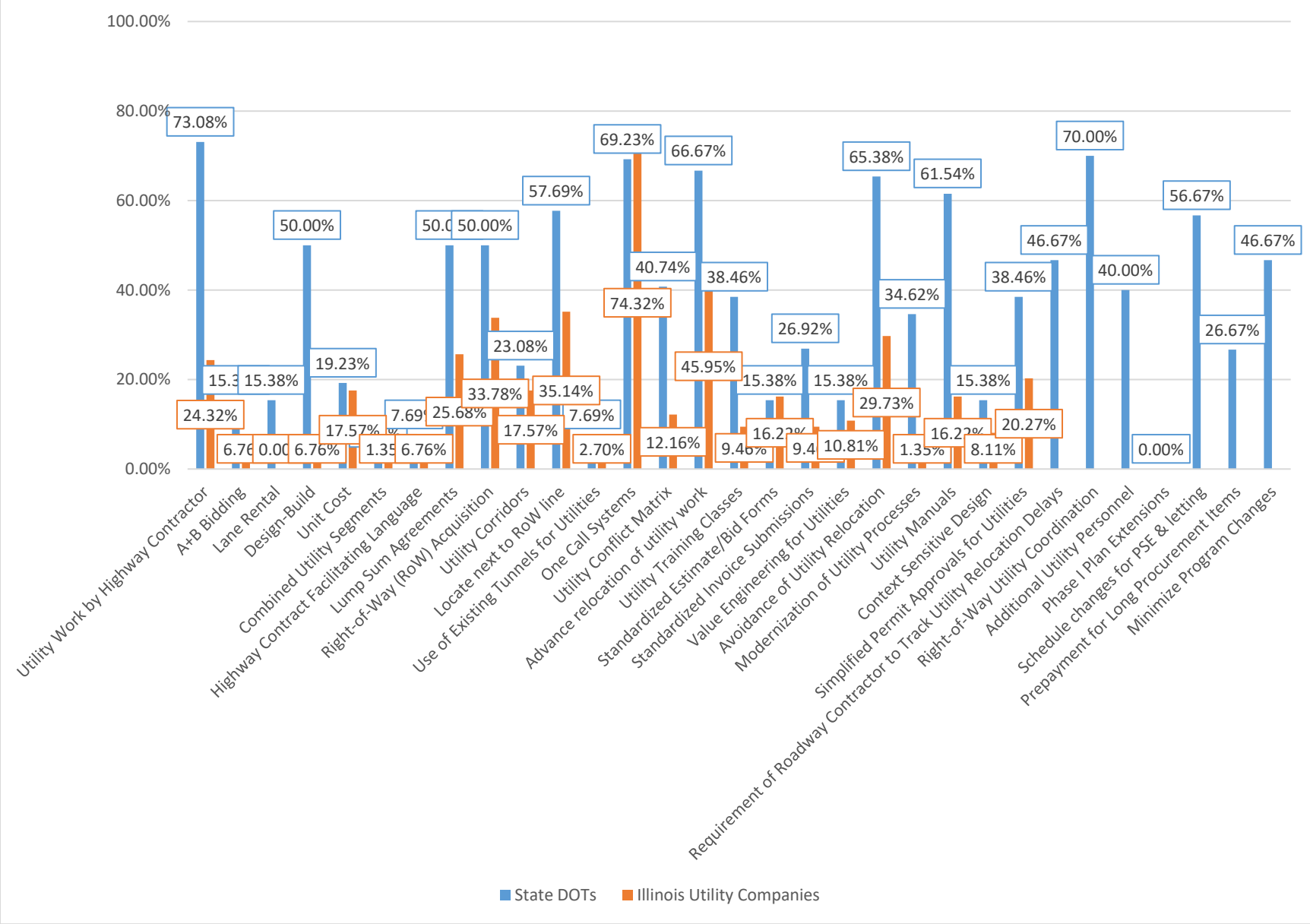

Figure 37. Percentage of survey respondents utilizing no-cost practices.

As shown in Figure 37, the top six no-cost practices that were reported to be used by more than 60% of participating state DOTs are (1) utility work by highway contractor; (2) right-of-way utility coordination; (3) one-call systems; (4) advance relocation of utility work; (5) avoidance of utility relocation; and (6) utility manuals. The top four no-cost practices used by participating Illinois utility companies are (a) one-call systems; (b) advance relocation of utility work; (c) locate next to RoW line; and (d) right-of-way acquisition, as shown in Figure 37. With the exception of the practice 'one-call systems', the percentages of Illinois utility companies reporting the use of these no-cost practices were less than those reported by participating state DOTs (see Figure 37). For example, the no-cost practice 'utility work by highway contractor' was reported to be used by 73.08% of participating state DOTs and 24.32% of participating Illinois utility companies. This difference can be attributed to Illinois utility companies performing their own relocation and adjustment work. According to feedback provided by Illinois utility companies, they cannot guarantee work performed by outside parties. Additionally, Illinois utility companies noted that using third party contractors has resulted in poor quality of work and system operation issues.

E.2 EFFECTIVENESS OF BMPS AND INCENTIVES

Survey respondents were asked to rank the effectiveness of the 45 utility relocation BMPs and incentives identified in the previous section. A total of 99 respondents including 24 state DOT officials and 75 Illinois utility company representatives reported the effectiveness of these 45 BMPs, using a five-point scale: not effective, slightly effective, moderately effective, effective, and very effective. To identify the average effectiveness for each BMP, the categories are represented numerically using a scale that ranges from 1 to 5, where 1 represents "not effective" and 5 represents "very effective". A weighted average effectiveness of each BMP was calculated separately for the state DOT and the Illinois utility company responses. The effectiveness and weighted averages of these BMPs are analyzed in the following sections that group these BMPs in four categories: (1) coordination practices; (2) financial incentives; (3) practices requiring cost; and (4) no-cost practices, discussed in the following four subsections.

E.2.1 Effectiveness of Coordination Practices

The level of effectiveness for the seven coordination practices listed in the survey was provided by 42 state DOT officials and 75 Illinois utility company representatives. The reported effectiveness and its weighted average of each coordination practice by state DOTs and Illinois utility companies are summarized in Table 23 and Table 24, respectively. A comparison of the weighted average effectiveness for each coordination practice is shown in Figure 38.

Table 23. Effectiveness of Coordination Practices by State DOTs

Coordination Practice	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Coordination, Cooperation, Communication	5	12	3	0	0	4.10
Utility Coordination Councils	2	1	5	1	0	3.44
Designated Utility Coordinator	8	10	4	0	0	4.18
Multi-Level Memorandums of Understanding	1	0	2	1	0	3.25
Utility Coordination during Construction	6	9	2	2	0	4.00
Utility Coordination by Roadway Contractor	3	6	7	3	0	3.47
Assigning Utility Coordination to DOT Resident Engineer	1	8	4	2	0	3.53

Table 24. Effectiveness of Coordination Practices by Illinois Utility Companies

Coordination Practice	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Coordination, Cooperation, Communication	18	29	8	4	0	4.03
Utility Coordination Councils	3	2	4	2	0	3.55
Designated Utility Coordinator	11	18	2	1	0	4.22
Multi-Level Memorandums of Understanding	1	7	4	0	0	3.75
Utility Coordination during Construction	17	20	7	1	1	4.11
Utility Coordination by Roadway Contractor	0	0	0	0	0	N/R
Assigning Utility Coordination to DOT Resident Engineer	0	0	0	0	0	N/R

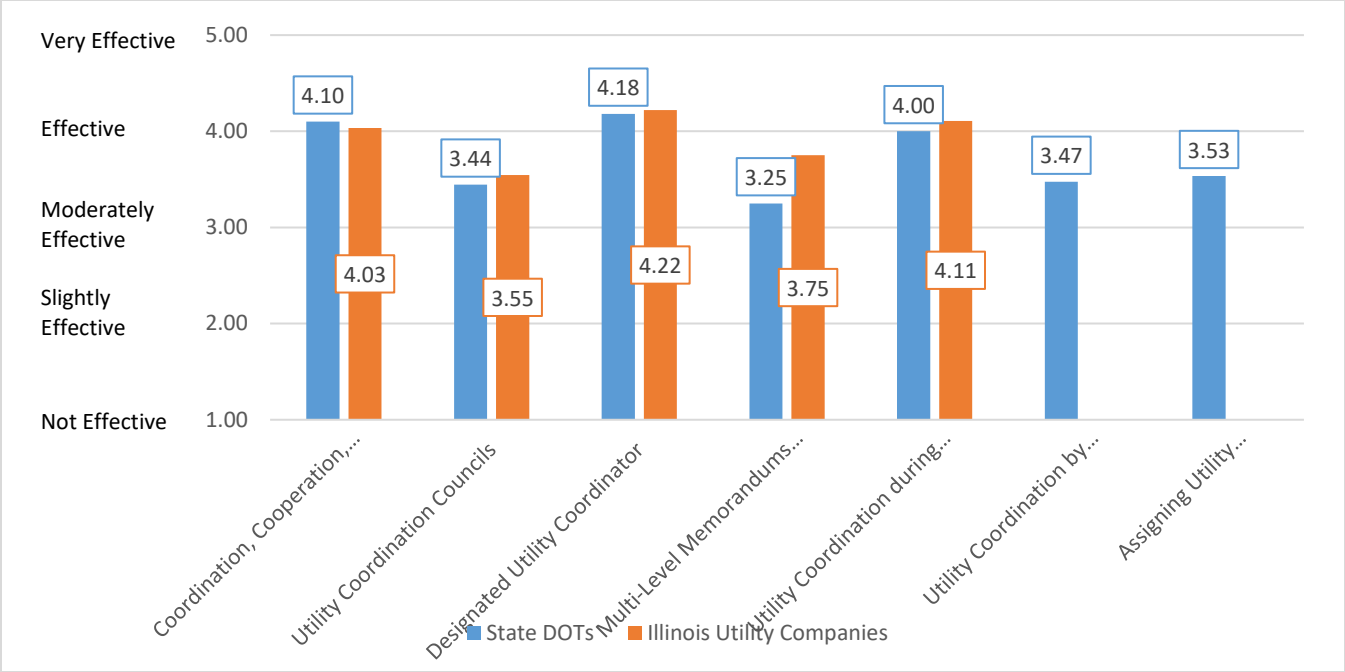

Figure 38. Average effectiveness of coordination practices.

The survey results illustrate that the top three coordination practices that received a weighted average effectiveness greater than or equal to 4.00 (effective) from state DOTs are (1) designated utility coordinators; (2) coordination, cooperation, communication; and (3) utility coordination during construction. These three coordination practices also received the highest weighted average effectiveness from Illinois utility companies; however their ranking was slightly different from that of the state DOTs (see Figure 38). The most effective coordination practice was 'designated utility coordinators' with a reported average effectiveness from participating State DOTs and Illinois utility companies of 4.18 and 4.22, respectively. This weighted average score indicates that respondents rate this practice as 'effective' to 'very effective' according to the five-point scale.

E.2.2 Effectiveness of Financial Incentives

Twenty state DOT officials and thirty-one utility company representatives provided effectiveness scores for the seven financial incentives listed in the survey. The reported effectiveness and its weighted average of each financial incentive by state DOTs and Illinois utility companies are summarized in Table 25 and Table 26, respectively. A comparison of the weighted average effectiveness for each financial incentive is shown in Figure 39.

Table 25. Effectiveness of Financial Incentives by State DOTs

Financial Incentive	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Cash Bonuses	0	0	0	0	0	N/R
Incentives/Disincentives (I/D)	0	0	2	0	0	3.00
Cost Sharing	0	4	3	1	0	3.38
No Excuse Incentives	0	0	0	0	0	N/R
Contractor-Provided Financial Incentives	0	0	0	0	0	N/R
Gainshare-Painshare	0	0	0	0	0	N/R
Penalty/Backcharge for Utility Companies	2	3	3	3	1	3.17

Table 26 Effectiveness of Financial Incentives by Illinois Utility Companies

Financial Incentive	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Cash Bonuses	0	1	0	0	0	4.00
Incentives/Disincentives (I/D)	0	1	0	0	0	4.00
Cost Sharing	2	8	5	4	1	3.30
No Excuse Incentives	0	1	1	1	1	2.50
Contractor-Provided Financial Incentives	0	1	0	1	0	3.00
Gainshare-Painshare	0	1	0	0	0	4.00
Penalty/Backcharge for Utility Companies	0	0	0	0	0	N/R

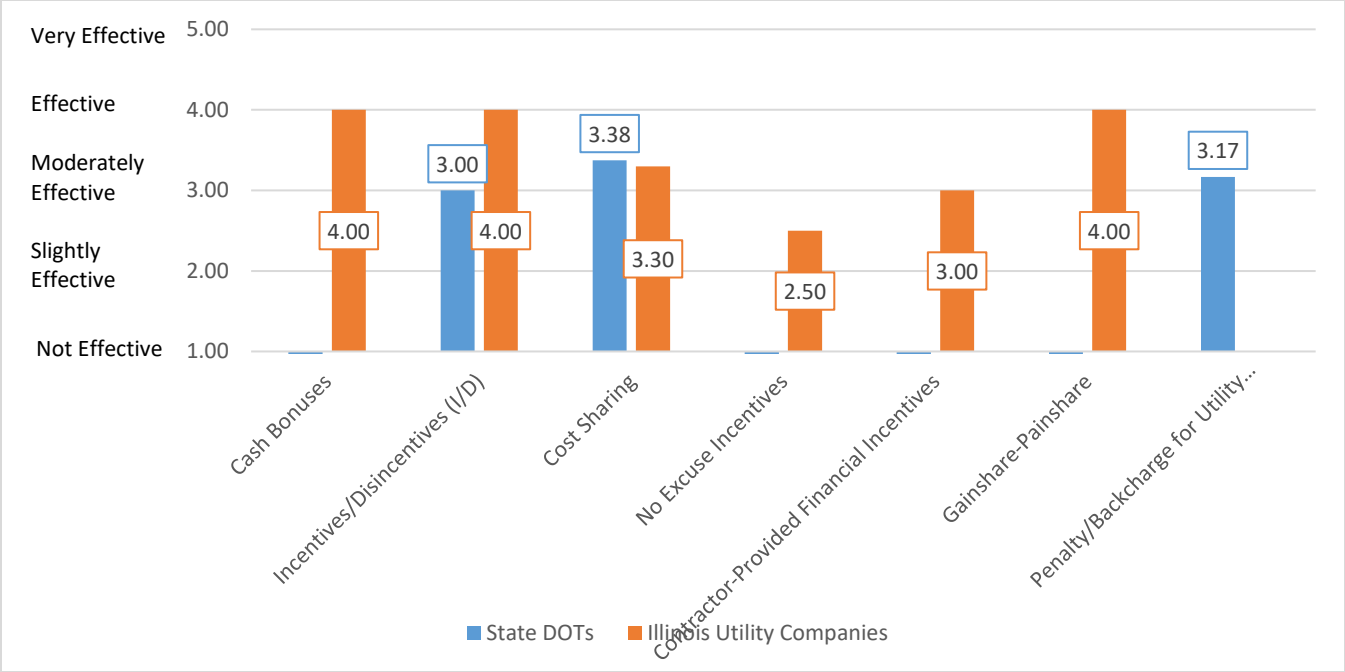

Figure 39. Average effectiveness of financial incentives.

The survey results in Table 25 and Figure 39 show that state DOTs reported effectiveness for three financial incentives: (1) cost sharing; (2) penalty/backcharge for utility companies; and (3) incentives/disincentives. The weighted average effectiveness score for these three financial incentives from participating state DOTs are 3.38 (moderately effective), 3.17 (moderately effective) and 3.00 (moderately effective), respectively. On the other hand, the four financial incentives that received a weighted average effectiveness of 3.00 (moderately effective) or higher from participating Illinois utility companies are (a) cash bonuses; (b) incentives/disincentives; (c) gainshare-painshare; and (d) contractor-provided financial incentives, as shown in Table 26 and Figure 39.

E.2.3 Effectiveness of Practices Requiring Cost

The effectiveness of the 16 aforementioned practices requiring cost were reported by 40 state DOT officials and 34 Illinois utility company representatives. The reported effectiveness and weighted average score of these practices by state DOT and Illinois utility company respondents are shown in Table 27 and Table 28, respectively. A comparison of the weighted average effectiveness for each of these ten practices is shown in Figure 40.

Table 27. Effectiveness of Practices Requiring Cost by State DOTs

Practice Requiring Cost	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Utility Cost Database	0	2	3	0	0	3.40
Electronic Utility Permits	2	7	1	0	0	4.10
Utility Coordination Web sites	2	2	2	0	0	4.00
Electronic Document Delivery	2	6	2	0	0	4.00
Subsurface Utility Engineering (SUE)	9	6	5	0	0	4.20
Clearing, Grubbing, Staking, Grading	3	9	1	1	0	4.00
Utility Relocation Safety Program	0	1	1	0	0	3.50
Removal of abandoned utilities	0	6	4	0	0	3.60
Trenchless Technology	4	7	4	0	0	4.00
Utility Tunnels	0	1	0	0	0	4.00
Statewide Utility Permit Database	1	8	6	1	2	3.28
Updated DOT Website	0	5	5	0	0	3.50
Updated Land Acquisition System	0	0	0	0	0	0.00
Advanced Building/Tree Removal	2	6	1	1	0	3.90
On-Call Utility Contractors	0	0	0	0	0	0.00
Extended Work Hours	1	3	1	1	0	3.67

Table 28. Effectiveness of Practices Requiring Cost by Illinois Companies

Practice Requiring Cost	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Utility Cost Database	1	0	0	0	0	5.00
Electronic Utility Permits	6	9	1	0	0	4.31
Utility Coordination Web sites	1	7	3	1	0	3.67
Electronic Document Delivery	7	13	1	0	0	4.29
Subsurface Utility Engineering (SUE)	5	10	1	0	0	4.25
Clearing, Grubbing, Staking, Grading	3	7	3	1	0	3.86
Utility Relocation Safety Program	0	4	3	0	1	3.25
Removal of abandoned utilities	1	1	4	3	1	2.80
Trenchless Technology	14	14	6	0	0	4.24
Utility Tunnels	0	1	1	0	0	3.50
Statewide Utility Permit Database	0	0	0	0	0	N/R
Updated DOT Website	0	0	0	0	0	N/R
Updated Land Acquisition System	0	0	0	0	0	N/R
Advanced Building/Tree Removal	0	0	0	0	0	N/R
On-Call Utility Contractors	0	0	0	0	0	N/R
Extended Work Hours	0	0	0	0	0	N/R

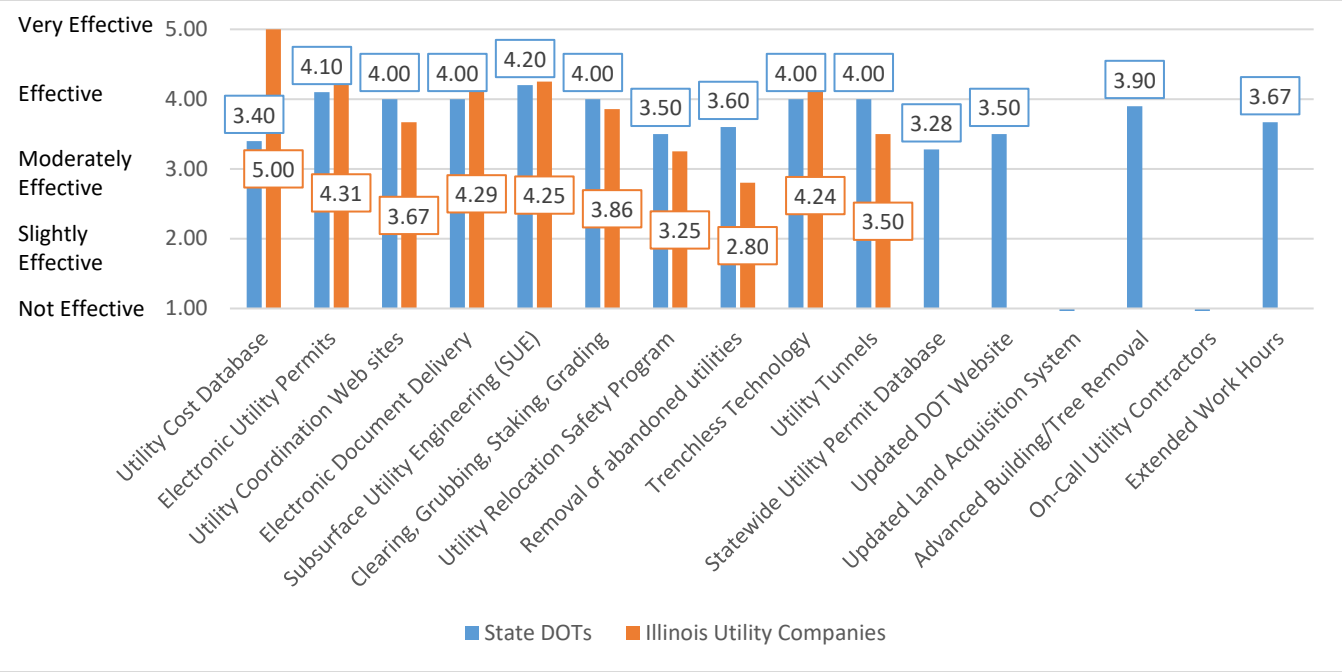

Figure 40. Average effectiveness of practices requiring cost.

The results of the survey illustrate that seven practices requiring cost received a weighted average effectiveness greater than or equal to 4.00 (effective) from state DOTs. There top seven practices are (1) subsurface utility engineering; (2) electronic utility permits; (3) utility coordination websites; (4) electronic document delivery; (5) clearing, grubbing, staking, grading; (6) trenchless technology; and (7) utility tunnels (see Figure 40). The results also show that the top five practices requiring cost that received an average effectiveness scores of 4.00 or higher (effective) from participating Illinois utility companies are (a) utility cost database; (b) electronic utility permits; (c) electronic document delivery; (d) subsurface utility engineering; and (e) trenchless technology, as shown in Figure 40. It should be noted that the effectiveness of the 'utility cost database' practice of 5.00 (very effective) was received from a single Illinois utility company respondent.

E.2.4 Effectiveness of No-Cost Practices

The effectiveness of the 31 no-cost practices listed in the survey were reported by 45 state DOT and 23 Illinois utility company respondents. The reported effectiveness and weighted average of these practices by state DOTs and Illinois utility companies are summarized in Table 29 and Table 30 respectively. A comparison of the weighted average effectiveness for these 24 practices is shown in Figure 41.

Table 29. Effectiveness of No-Cost Practices by State DOTs

No-Cost Practice	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Utility Work by Highway Contractor	7	10	0	0	0	4.41
A+B Bidding	0	2	0	0	0	4.00
Lane Rental	0	1	1	0	0	3.50
Design-Build	0	6	1	4	0	3.18
Unit Cost	0	4	1	0	0	3.80
Combined Utility Segments	0	1	0	0	0	4.00
Highway Contract Facilitating Language	0	1	1	0	0	3.50
Lump-Sum Agreements	0	5	3	4	0	3.08
Right-of-Way (RoW) Acquisition	3	6	2	1	0	3.92
Utility Corridors	0	5	1	0	0	3.83
Locate next to RoW line	0	13	1	1	0	3.80
Use of Existing Tunnels for Utilities	0	2	0	0	0	4.00
One-Call Systems	4	8	4	2	0	3.78
Utility Conflict Matrix	4	4	2	0	0	4.20
Advance relocation of utility work	4	11	2	0	0	4.12
Utility Training Classes	1	5	4	0	0	3.70
Standardized Estimate/Bid Forms	0	3	1	0	0	3.75
Standardized Invoice Submissions	1	4	2	0	0	3.86
Value Engineering for Utilities	1	2	1	0	0	4.00
Avoidance of Utility Relocation	6	4	6	1	0	3.88
Modernization of Utility Processes	1	3	5	0	0	3.56
Utility Manuals	1	6	8	1	0	3.44
Context Sensitive Design	0	2	1	1	0	3.25
Simplified Permit Approvals for Utilities	0	9	1	0	0	3.90
Requirement of Roadway Contractor to Track Utility Relocation Delays	1	5	6	2	0	3.36
Right-of-Way Utility Coordination	5	12	3	1	0	4.00
Additional Utility Personnel	2	6	4	0	0	3.83
Phase I Plan Extensions	0	0	0	0	0	0.00
Schedule changes for PSE & letting	2	7	6	1	1	3.47
Prepayment for Long Procurement Items	0	4	3	0	0	3.57
Minimize Program Changes	2	8	3	1	0	3.79

Table 30. Effectiveness of No-Cost Practices by Illinois Utility Companies

No-Cost Practice	5 Very Effective	4 Effective	3 Moderately Effective	2 Slightly Effective	1 Not Effective	Weighted Average
Utility Work by Highway Contractor	4	4	3	2	0	3.77
A+B Bidding	1	3	0	0	0	4.25
Lane Rental	0	0	0	0	0	0.00
Design-Build	0	3	0	2	0	3.20
Unit Cost	2	3	3	3	0	3.36
Combined Utility Segments	0	1	0	0	0	4.00
Highway Contract Facilitating Language	0	3	1	1	0	3.40
Lump-Sum Agreements	5	9	2	1	0	4.06
Right-of-Way (RoW) Acquisition	13	8	3	0	0	4.42
Utility Corridors	3	3	3	2	0	3.64
Locate next to RoW line	6	13	6	0	0	4.00
Use of Existing Tunnels for Utilities	0	0	2	0	0	3.00
One-Call Systems	23	21	5	4	0	4.19
Utility Conflict Matrix	3	4	2	0	0	4.11
Advance relocation of utility work	17	12	3	1	1	4.26
Utility Training Classes	0	2	4	0	1	3.00
Standardized Estimate/Bid Forms	2	3	7	0	0	3.58
Standardized Invoice Submissions	0	2	4	1	0	3.14
Value Engineering for Utilities	0	5	3	0	0	3.63
Avoidance of Utility Relocation	7	11	2	2	0	4.05
Modernization of Utility Processes	0	1	0	0	0	4.00
Utility Manuals	1	4	3	3	0	3.27
Context Sensitive Design	0	2	3	0	0	3.40
Simplified Permit Approvals for Utilities	0	0	0	0	0	N/R
Requirement of Roadway Contractor to Track Utility Relocation Delays	0	0	0	0	0	N/R
Right-of-Way Utility Coordination	0	0	0	0	0	N/R
Additional Utility Personnel	0	0	0	0	0	N/R
Phase I Plan Extensions	0	0	0	0	0	N/R
Schedule changes for PSE & letting	0	0	0	0	0	N/R
Prepayment for Long Procurement Items	0	0	0	0	0	N/R
Minimize Program Changes	0	0	0	0	0	N/R

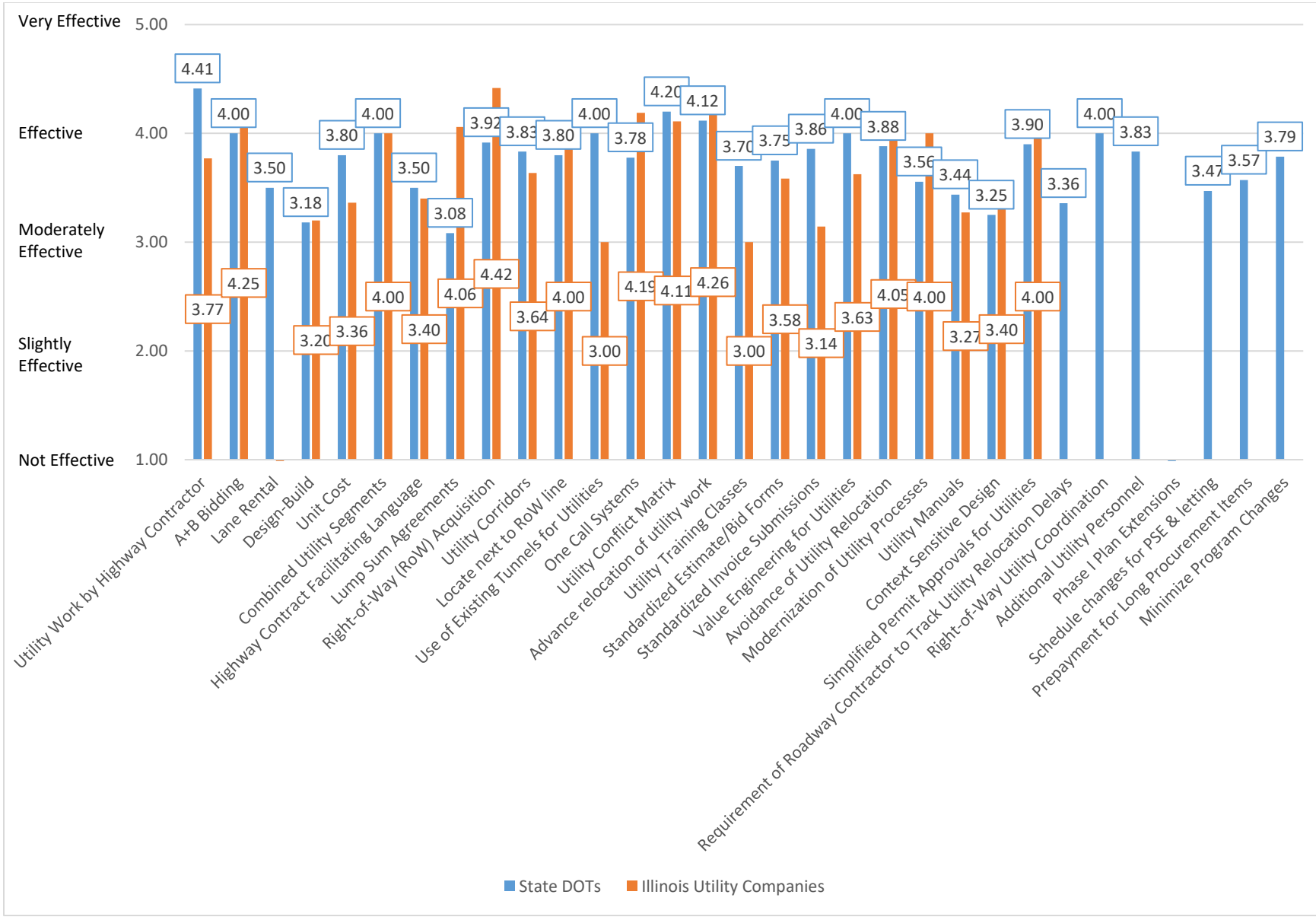

Figure 41. Average effectiveness of no-cost practices.

The survey results in Table 29 and Figure 41 illustrate that eight no-cost practices received a weighted average effectiveness score greater than or equal to 4.00 (effective) from state DOTs. These top DOT practices are (1) utility work by highway contractor; (2) utility conflict matrix; (3) advance relocation of utility work; (4) A+B bidding; (5) combined utility segments; (6) use of existing tunnels for utilities; (7) value engineering for utilities; and (8) right-of-way utility coordination. On the other hand, Illinois utility companies provided eleven no-cost practices with a weighted average effectiveness score greater than or equal to 4.00 (effective). These top utility company practices are (a) right-of-way acquisition; (b) advance relocation of utility work; (c) A+B bidding; (d) one-call systems; (e) utility conflict matrix; (f) lump-sum agreements; (g) avoidance of utility relocation; (h) combined utility segments; (i) located next to RoW line; (j) modernization of utility processes; and (k) simplified permit approvals for utilities, as shown in Table 30 and Figure 41.

E.3 IMPACT OF BMPS AND INCENTIVES ON REDUCING PROJECT DURATION

State DOT officials were asked to estimate the reduction in project duration resulting from implementing each of the aforementioned BMPs and incentives in terms of percent of project duration. If the percentage reduction was unknown, respondents were asked to provide the time reduction in months or input “unknown”. Accordingly, the collected data on project duration reduction from this question is represented using three metrics: percentage, months, and unknown, as shown in Table 31. The collected feedback on the impact of each BMP and incentive on reducing the project duration is analyzed and grouped in the following four main categories of BMPs: (1) coordination practices; (2) financial incentives; (3) practices requiring cost; and (4) no-cost practices.

E.3.1 Impact of Coordination Practices on Reducing Project Duration

Thirty-nine state DOT officials reported the impact of the aforementioned seven coordination practices on reducing project duration in terms of percentages and months, as shown in Table 31. The survey results illustrate that the four coordination practices that were reported to reduce project duration by 10% or more are (1) utility coordination by roadway contractor; (2) assigning utility coordination to DOT resident engineer; (3) designated utility coordinator; and (4) utility coordination during construction, as shown in Table 31. The ‘coordination, cooperation, communication’ practice received an average project duration reduction of 8.9%, while the two remaining coordination practices ‘utility coordination councils’ and ‘multi-level memorandums of understanding’, were reported to reduce project durations by 1 month, as shown in Table 31.

Table 31. Impact of Coordination Practices on Reducing Project Duration

Coordination Practice	Project Duration Reduction							
	Percentage					Months		Unknown
	Number of responses				Average	Number of responses	Average	Number of responses
	0% to 4%	5% to 10%	11% to 20%	21%+				
Coordination, Cooperation, Communication	0	8	1	0	8.9%	0	0	3
Utility Coordination Councils	0	0	0	0	0.0%	2	1	1
Designated Utility Coordinator	0	7	3	0	11.5%	1	3	4
Multi-Level Memorandums of Understanding	0	0	0	0	0.0%	1	1	1
Utility Coordination during Construction	1	4	1	1	10.0%	2	2	3
Utility Coordination by Roadway Contractor	6	4	1	2	13.8%	3	1	2
Assigning Utility Coordination to DOT Resident Engineer	2	1	2	1	12.5%	4	2.25	4

E.3.2 Impact of Financial Incentives on Reducing Project Duration

Twenty-six state DOT respondents reported duration reduction responses for three of the seven financial incentives listed in the survey. The project reduction responses and average reduction percentages of each financial incentive reported by participating state DOTs is shown in Table 32. The survey results in Table 32 show that the three financial incentives that received reported reductions in reducing the durations of utility relocation projects are (1) incentives/disincentives; (2) penalty/backcharge for utility companies; and (3) cost sharing. Penalty/backcharge for utility companies and cost sharing each received additional reported non-percentage project reduction amounts averages of 1 month, as show in Table 32.

Table 32. Impact of Financial Incentives on Reducing Project Duration

Financial Incentive	Project Duration Reduction							
	Percentage					Months		Unknown
	Number of responses				Average	Number of responses	Average	Number of responses
	0% to 4%	5% to 10%	11% to 20%	21%+				
Cash Bonuses	0	0	0	0	0.0%	0	0	0
Incentives/Disincentives (I/D)	0	1	0	0	10.0%	0	0	1
Cost Sharing	0	3	0	0	6.7%	1	1	1
No Excuse Incentives	0	0	0	0	0.0%	0	0	0
Contractor-Provided Financial Incentives	0	0	0	0	0.0%	0	0	0
Gainshare-Painshare	0	0	0	0	0.0%	0	0	0
Penalty/Backcharge for Utility Companies	3	2	0	2	10.0%	2	1	1

E.3.3 Impact of Practices Requiring Cost on Reducing Project Duration

Thirty-five state DOT respondents reported the impact of the aforementioned 16 practices requiring cost on reducing project duration. The 35 respondents reported 57 project reduction percentages and 15 non-percentage reduction values for the practices as shown in Table 33. The survey results illustrate that the top four practices requiring cost that were reported to reduce project duration by more than 20% are (1) removal of abandoned utilities; (2) clearing, grubbing, staking, grading; (3) advanced building/tree removal; and (4) subsurface utility engineering, as shown in Table 33. The 'removal of abandoned utilities' practice was reported to reduce the project duration by an average of 35.0%. Additionally, this practice was also reported by three other state DOT respondents to reduce project duration by one month (see Table 33).

Table 33. Impact of Practices Requiring Cost on Reducing Project Duration

Practices Requiring Cost	Project Duration Reduction							
	Percentage					Months		Unknown
	Number of responses				Average	Number of responses	Average	Number of responses
	0% to 4%	5% to 10%	11% to 20%	21%+				
Utility Cost Database	0	1	1	0	10.0%	0	0	2
Electronic Utility Permits	1	3	0	0	6.3%	1	1	1
Utility Coordination Web sites	0	1	0	0	5.0%	1	1	1
Electronic Document Delivery	0	2	0	0	5.0%	1	2	2
Subsurface Utility Engineering (SUE)	0	4	3	2	23.3%	1	2	2
Clearing, Grubbing, Staking, Grading	0	3	1	1	29.0%	1	1	1
Utility Relocation Safety Program	0	0	0	0	0.0%	0	0	1
Removal of abandoned utilities	0	2	1	1	35.0%	3	1	1
Trenchless Technology	0	3	1	0	10.0%	2	2.5	3
Utility Tunnels	0	0	0	0	0.0%	0	0	0
Statewide Utility Permit Database	5	3	1	0	3.9%	2	1	4
Updated DOT Website	5	0	1	0	2.5%	1	0	1
Updated Land Acquisition System	0	0	0	0	0.0%	0	0	0
Advanced Building/Tree Removal	0	4	0	1	26.0%	2	1	0
On-Call Utility Contractors	0	0	0	0	0.0%	0	0	0
Extended Work Hours	1	4	1	0	0.0%	0	0	1

E.3.4 Impact of No-Cost Practices on Reducing Project Duration

Thirty-seven state DOT officials reported the impact of the aforementioned 31 no-cost practices on reducing project duration in terms of percentages and months, as shown in Table 34. The survey results illustrate that the five no-cost practices that were reported to reduce project duration by more than 15% are (1) avoidance of utility relocation; (2) additional utility personnel; (3) right-of-way utility coordination; (4) prepayment for long-procurement items; and (5) utility work by highway contractor (see Table 34). The 'avoidance of utility relocation' was reported to reduce the project duration by an

average of 30.0%. This practice was also reported by two other respondents to reduce project durations by 2 months, as shown in Table 34.

Table 34. Impact of No-Cost Practices on Reducing Project Duration

No-cost practices	Project Duration Reduction							
	Percentage					Months		Unknown
	Number of responses				Average	Number of responses	Average	Number of responses
	0% to 4%	5% to 10%	11% to 20%	21%+				
Utility Work by Highway Contractor	0	3	2	2	15.7%	0	0	4
A+B Bidding	0	0	0	0	0.0%	0	0	1
Lane Rental	0	0	0	0	0.0%	0	0	1
Design-Build	0	3	0	0	8.3%	0	0	2
Unit Cost	0	2	1	0	13.3%	1	1	1
Combined Utility Segments	0	0	0	0	0.0%	1	1	0
Highway Contract Facilitating Language	0	0	0	0	0.0%	0	0	0
Lump-Sum Agreements	1	0	0	0	0.0%	2	1	2
Right-of-Way (RoW) Acquisition	1	1	1	0	8.3%	1	2	1
Utility Corridors	0	1	0	0	5.0%	1	3	1
Locate next to RoW line	1	2	0	0	3.3%	2	1	3
Use of Existing Tunnels for Utilities	0	0	0	0	0.0%	0	0	0
One-Call Systems	1	2	1	0	7.5%	2	1	4
Utility Conflict Matrix	1	0	0	0	0.0%	3	1.3	1
Advance relocation of utility work	0	5	0	2	12.1%	0	0	3
Utility Training Classes	0	2	1	0	8.3%	1	1	3
Standardized Estimate/Bid Forms	0	0	0	0	0.0%	0	0	1
Standardized Invoice Submissions	0	2	0	0	7.5%	1	1	1
Value Engineering for Utilities	0	0	0	0	0.0%	0	0	2
Avoidance of Utility Relocation	0	2	2	2	30.0%	2	2	3
Modernization of Utility Processes	0	2	0	0	7.5%	2	1	1
Utility Manuals	0	2	1	0	11.7%	2	1	3
Context Sensitive Design	0	2	0	0	10.0%	1	1	0
Simplified Permit Approvals for Utilities	0	1	1	0	12.5%	0	0	2
Requirement of Roadway Contractor to Track Utility Relocation Delays	5	2	0	1	14.4%	3	1	1
Right-of-Way Utility Coordination	1	6	2	2	18.6%	4	1	3
Additional Utility Personnel	1	2	0	2	27.0%	3	1.5	2
Phase I Plan Extensions	0	0	0	0	0.0%	0	0	0
Schedule changes for PSE & letting	2	2	1	1	10.0%	2	2	3
Prepayment for Long Procurement Items	0	1	0	1	17.5%	3	3.5	0
Minimize Program Changes	3	1	2	2	10.0%	2	1	1

E.4 IMPLEMENTATION COSTS OF BMPS AND INCENTIVES

This section analyzes the reported implementation costs of BMPs and incentives by participating state DOTs. The survey respondents were asked to estimate the required cost to implement each BMP. If the cost was unknown to the respondent, they were asked to input 'cost unknown'. The collected feedback on the implementation costs of the BMPs and incentives is analyzed in the following four categories: (1) coordination practices; (2) financial incentives; (3) practices requiring cost; and (4) no-cost practices.

E.4.1 Implementation Costs of Coordination Practices

The implementation cost of the aforementioned seven coordination practices was reported by 38 state DOT respondents. These reported implementation costs are summarized in Table 35. The survey results show that the majority of state DOT respondents reported 'cost unknown' for these coordination practices. Other state DOT respondents reported estimated implementation costs for three coordination practices (1) coordination, cooperation, communication; (2) designated utility coordinator; and (3) assigning utility coordination to DOT resident engineer, as shown in Table 35. For example, the implementation cost of the 'coordination, cooperation, communication' practice was reported by fourteen survey respondents (see Table 35). This included responses of zero dollars by two respondents, 5% of utility relocation cost by a third respondent, $40,000/year by a fourth respondent, and unknown by ten other respondents. The zero dollar implementation cost indicates that the state DOT respondents do not require additional resources to implement this practice. The '5% of utility relocation cost' suggests that a portion of the utility relocation budget is reserved for this coordination practice. Similarly, the annual cost of $40,000/year, indicates either a budgeted cost or a salaried employee who is responsible for implementing this 'coordination, cooperation, communication' practice.

Table 35. Implementation Costs of Coordination Practices

Coordination Practice	Cost	Number of Responses
Coordination, Cooperation, Communication	$0	2
	5% of Utility Relocation Cost	1
	$40,000/year	1
	Cost Unknown	10
Utility Coordination Councils	Cost Unknown	3
Designated Utility Coordinator	$0	2
	2% of Utility Relocation Cost	1
	$40,000/year	1
	Cost Unknown	12
Multi-Level Memorandums of Understanding	Cost Unknown	3
Utility Coordination during Construction	$0	3
	Cost Unknown	10
Utility Coordination by Roadway Contractor	$0	2
	Cost Unknown	17
Assigning Utility Coordination to DOT Resident Engineer	$16,000	1
	$50,000/year	1
	Cost Unknown	8

E.4.2 Implementation Costs of Financial Incentives

Implementation cost responses for three of the seven financial incentives listed in the survey were reported by 16 state DOT respondents. Their implementation cost responses and number of respondents for financial incentives are shown in Table 36. The survey results indicate that the three financial incentives that received an implementation cost response from state DOT respondents are (1) incentives/disincentives; (2) cost sharing; and (3) penalty/backcharge for utility companies, as shown in Table 36.

Table 36. Implementation Costs of Financial Incentives

Financial Incentive	Cost	Number of Responses
Cash Bonuses	No Responses	
Incentives/Disincentives (I/D)	$5,000/day	1
	Cost Unknown	1
Cost Sharing	Cost Unknown	6
No Excuse Incentives	No Responses	
Contractor-Provided Financial Incentives	No Responses	
Gainshare-Painshare	No Responses	
Penalty/Backcharge for Utility Companies	$0	2
	Cost Unknown	6

E.4.3 Implementation Costs of Practices Requiring Costs

Implementation cost responses for 13 of the 16 practices requiring cost listed in the survey were reported by 38 state DOT respondents. The implementation cost responses and number of respondents for these practices requiring cost are shown in Table 37. The survey results show that the majority of state DOT respondents reported 'cost unknown' or 'zero dollars' for these practices requiring cost. The implementation cost of the 'subsurface utility engineering' practice was reported to be $50,000 by one state DOT official, and $100,000/year by another, as shown in Table 37.

Table 37. Implementation Costs of Practices Requiring Costs

Practice Requiring Cost	Cost	Number of Responses
Utility Cost Database	$0	1
	Cost Unknown	3
Electronic Utility Permits	$0	1
	Cost Unknown	5
Utility Coordination Web sites	Cost Unknown	3
Electronic Document Delivery	$0	1
	Cost Unknown	5
Subsurface Utility Engineering (SUE)	$50,000	1
	$100,000/year	1
	Cost Unknown	11
Clearing, Grubbing, Staking, Grading	$0	1
	Cost Unknown	7
Utility Relocation Safety Program	Cost Unknown	1
Removal of abandoned utilities	$0	2
	Cost Unknown	7
Trenchless Technology	$0	2
	Cost Unknown	8
Utility Tunnels	No Responses	0
Statewide Utility Permit Database	$0	2
	$150,000 + $75,000/year	1
	$1,500,000	1
	Cost Unknown	11
Updated DOT Website	$0	1
	Cost Unknown	8
Updated Land Acquisition System	No Responses	0
Advanced Building/Tree Removal	$0	1
	$20,000 - $200,000	1
	Cost Unknown	6
On-Call Utility Contractors	No Responses	0
Extended Work Hours	50% More	1
	Cost Unknown	5

E.4.4 Implementation Costs of No-Cost Practices

Implementation cost responses for 28 of the 31 no-cost practices listed in the survey were reported by 35 state DOT respondents. Their implementation cost responses and number of respondents for no-cost practices are shown in Table 38. The survey results illustrate that the five no-cost practices that were reported with implementation costs are (1) utility corridors; (2) utility training classes; (3) avoidance of utility relocation; (4) utility manuals; and (5) additional utility personnel, as shown in Table 38. The implementation cost for the 'utility corridor' practice was reported to be $200,000/year by one respondent. Utility training classes were reported to have implementation costs of $5,000 from one respondent; $10,000 from a second respondent; and $200/student from a third respondent. The 'avoidance of utility relocation' practice was reported by one respondent to have a $100,000 implementation cost. An additional comment provided by one survey respondent indicates that the $100,000 was the cost for completing alternate designs to avoid the relocation of utilities. Utility manuals were reported by one state DOT respondent to have an implementation cost of $10,000 for printing and distribution, as shown in Table 38. All other no-cost practices were reported by state DOT respondents to have no implementation costs or 'cost unknown'.

Table 38A. Implementation Costs of No-Cost Practices

No-Cost Practices	Cost	Number of Responses
Utility Work by Highway Contractor	$0	1
	Cost Unknown	10
A+B Bidding	Cost Unknown	1
Lane Rental	Cost Unknown	1
Design-Build	Cost Unknown	6
Unit Cost	Cost Unknown	5
Combined Utility Segments	Cost Unknown	1
Highway Contract Facilitating Language	No Responses	0
Lump-Sum Agreements	$0	2
	Cost Unknown	5
Right-of-Way (RoW) Acquisition	$0	1
	Cost Unknown	5
Utility Corridors	$0	1
	$200,000/year	1
	Cost Unknown	2
Locate next to RoW line	$0	4
	Cost Unknown	6
Use of Existing Tunnels for Utilities	No Responses	
One-Call Systems	$0	4
	Cost Unknown	8
Utility Conflict Matrix	$0	2
	Cost Unknown	4
Advance relocation of utility work	$0	3
	Cost Unknown	8
Utility Training Classes	$0	1
	$5,000	1
	$10,000	1
	$200/student	1
	Cost Unknown	4
Standardized Estimate/Bid Forms	$0	1
	Cost Unknown	1
Standardized Invoice Submissions	$0	2
	Cost Unknown	3

Table 38B. Implementation Costs of No-Cost Practices

No-Cost Practices	Cost	Number of Responses
Value Engineering for Utilities	Cost Unknown	2
Avoidance of Utility Relocation	$0	2
	$100,000	1
	Cost Unknown	7
Modernization of Utility Processes	Cost Unknown	5
Utility Manuals	$0	1
	$10,000	1
	Cost Unknown	7
Context Sensitive Design	Cost Unknown	3
Simplified Permit Approvals for Utilities	$0	2
	Cost Unknown	3
Requirement of Roadway Contractor to Track Utility Relocation Delays	$0	4
	Cost Unknown	9
Right-of-Way Utility Coordination	$0	4
	Cost Varies	2
	Cost Unknown	10
Additional Utility Personnel	200000/year	2
	$280,000	1
	Cost Varies	1
	Cost Unknown	5
Phase I Plan Extensions	No Responses	0
Schedule changes for PSE & letting	$0	3
	Cost Unknown	9
Prepayment for Long Procurement Items	0	4
	Cost Unknown	2
Minimize Program Changes	0	1
	Cost Unknown	11

E.5 PROBLEMS AND CHALLENGES EXPERIENCED

Survey respondents were asked to report any problems and challenges that they may have experienced as a result of implementing the aforementioned BMPs and incentives on their DOT utility relocation projects. The respondents reported 441 problems and challenges encountered due to the implementation of the 61 BMPs and incentives listed in the survey. To facilitate and streamline the analysis of these reported 441 problems and challenges, they were grouped and organized into 21 categories, as shown in Table 39. The collected feedback on the problems and challenges is analyzed and grouped in the following four main categories of BMPs: (1) coordination practices; (2) financial incentives; (3) practices requiring cost; and (4) no-cost practices.

Table 39. Categories of Reported Problems and Challenges

Cost ineffectiveness	Lack of resources
Difficulty hiring SUE firms	Lack of time
Improper utilization	Lack of updated information
Inaccurate information	Late project changes
IT issues	Not utilized on all utilities
Lack of attendance	Overall ineffectiveness
Lack of communication	Personnel issues
Lack of cooperation	Public perception
Lack of coordination	Site logistics constraints
Lack of funding	Statutory requirement limitations
Lack of qualified personnel	

E.5.1 Coordination Practices Problems and Challenges

Sixty-one respondents including 34 state DOTs and 27 Illinois utility companies reported 113 problems and challenges that they encountered during their use of the aforementioned seven coordination practices. The number of respondents reporting each problem and their percentages are summarized in Table 40, Table 41 and Figure 42.

Table 40. Problems and Challenges of Coordination Practices Reported by State DOTs

Coordination Practice	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Coordination, Cooperation, Communication	11	37.93%	Lack of cooperation	6
			Lack of time	2
			Lack of coordination	1
			Lack of qualified personnel	1
			Lack of resources	1
			Late project changes	1
Utility Coordination Councils	3	27.27%	Lack of attendance	2
			Lack of qualified personnel	1
			Lack of cooperation	1
Designated Utility Coordinator	14	37.84%	Lack of qualified personnel	8
			Personnel issues	3
			Improper utilization	2
			Lack of communication	1
			Cost ineffectiveness	1
			Lack of cooperation	1
Multi-Level Memorandums of Understanding	1	20.00%	Lack of time	1
Utility Coordination during Construction	12	57.14%	Lack of time	5
			Lack of qualified personnel	3
			Lack of communication	2
			Lack of cooperation	2
			Lack of resources	1
			Cost ineffectiveness	1
Utility Coordination by Roadway Contractor	8	38.10%	Inaccurate information	1
			Lack of communication	2
			Lack of cooperation	4
			Lack of coordination	2
			Lack of qualified personnel	3
			Lack of updated information	1
			Not utilized on all utilities	2
			Overall ineffectiveness	1
Assigning Utility Coordination to DOT Resident Engineer	9	60.00%	Lack of cooperation	2
			Lack of coordination	1
			Lack of qualified personnel	5
			Lack of time	1

$$* \text{ \% of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 41. Problems and Challenges of Coordination Practices Reported by Illinois Utility Companies

Coordination Practice	Number of Respondents Reporting Problem	Percentage of Illinois Utility Companies Reporting problems*	Reported Problem/Challenge	Number of Times Reported
Coordination, Cooperation, Communication	14	20.90%	Lack of time	4
			Lack of cooperation	3
			Lack of qualified personnel	2
			Lack of updated information	2
			Lack of coordination	1
			Lack of communication	1
			Lack of resources	1
			Inaccurate information	1
			Cost ineffectiveness	1
			Personnel issues	1
Utility Coordination Councils	3	25.00%	Lack of communication	2
			Lack of time	2
Designated Utility Coordinator	5	14.29%	Lack of qualified personnel	2
			Lack of communication	1
			Personnel issues	1
			Late project changes	1
			Lack of cooperation	1
Multi-Level Memorandums of Understanding	3	25.00%	Lack of communication	2
			Lack of time	2
Utility Coordination during Construction	9	16.36%	Lack of time	3
			Cost ineffectiveness	3
			Lack of communication	1
			Lack of coordination	1
			Lack of resources	1
			Lack of updated information	1

$$* \ \% \text{ of Illinois utility companies reporting problem} = \frac{\text{Number of Illinois utility companies reporting problem}}{\text{Total number of Illinois utility companies utilizing this BMP}}$$

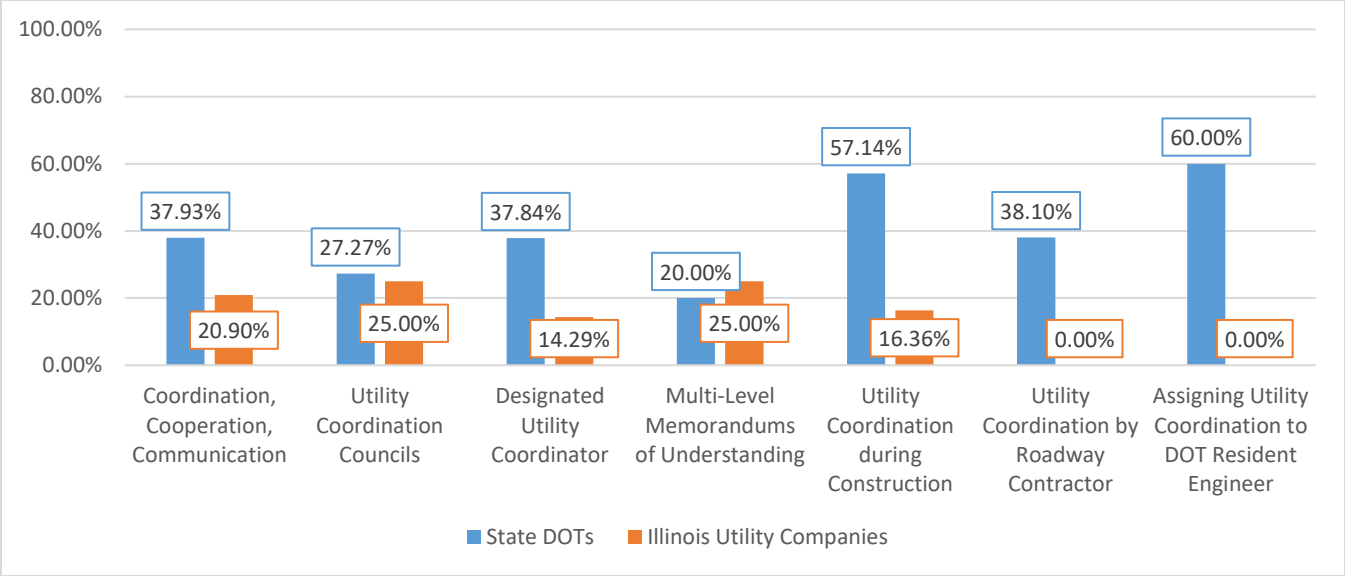

Figure 42. Reported problems or challenges of coordination practices.

The survey results illustrate that the two coordination practices that were reported by more than 50% of state DOTs to cause problems are: (1) assigning utility coordinating to DOT resident engineer; and (2) utility coordination during construction, as shown in Figure 42. For the 'assigning utility coordinating to DOT resident engineer' practice, the most reported problem was the 'lack of qualified personnel', which was listed by five state DOT respondents, as shown in Table 40. The top three coordination practices that received the highest percentage of reported problems from Illinois utility companies are: (a) utility coordination councils; (b) multi-level memorandums of understanding; and (c) coordinating, cooperation, communication (see Figure 42). It should be noted that 'lack of communication' problem was reported by Illinois utility companies for every coordination practice, as shown in Table 41.

E.5.2 Financial Incentive Problems and Challenges

Fourteen respondents including twelve state DOTs and two Illinois utility companies reported that they encountered 14 problems and challenges during their use of the aforementioned seven financial incentives. The number of respondents reporting problems for each of these incentives and their percentages are summarized in Table 42, Table 43, and Figure 43. The survey results show that the financial incentive 'penalty/backcharge for utility companies' received the highest number of reported problems from state DOTs respondents (see Table 42). State DOTs reported that the main problems with this practice were 'lack of cooperation' and 'overall ineffectiveness'.

Table 42. Problems and Challenges of Financial Incentives Reported by State DOTs

Financial Incentive	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Cash Bonuses	0	0.00%	No problems reported	
Incentives/Disincentives (I/D)	0	0.00%	No problems reported	
Cost Sharing	3	37.50%	Overall ineffectiveness	2
			Statutory requirement limitations	1
No Excuse Incentives	0	0.00%	No problems reported	
Contractor-Provided Financial Incentives	0	0.00%	No problems reported	
Gainshare-Painshare	0	0.00%	No problems reported	
Penalty/Backcharge for Utility Companies	9	64.29%	Lack of cooperation	4
			Lack of qualified personnel	1
			Overall ineffectiveness	4

$$* \text{ \% of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 43. Problems and Challenges of Financial Incentives Reported by Illinois Utility Companies

Financial Incentive	Number of Responses	Percentage of Illinois Utility Companies Reporting problems*	Reported Problem/Challenge	Number of Times Reported
Cash Bonuses	0	0.00%	No problems reported	
Incentives/Disincentives (I/D)	0	0.00%	No problems reported	
Cost Sharing	2	9.09%	Lack of funding	2
No Excuse Incentives	0	0.00%	No problems reported	
Contractor-Provided Financial Incentives	0	0.00%	No problems reported	
Gainshare-Painshare	0	0.00%	No problems reported	

$$*\text{\% of Illinois utility companies reporting problem} = \frac{\text{Number of Illinois utility companies reporting problem}}{\text{Total number of Illinois utility companies utilizing this BMP}}$$

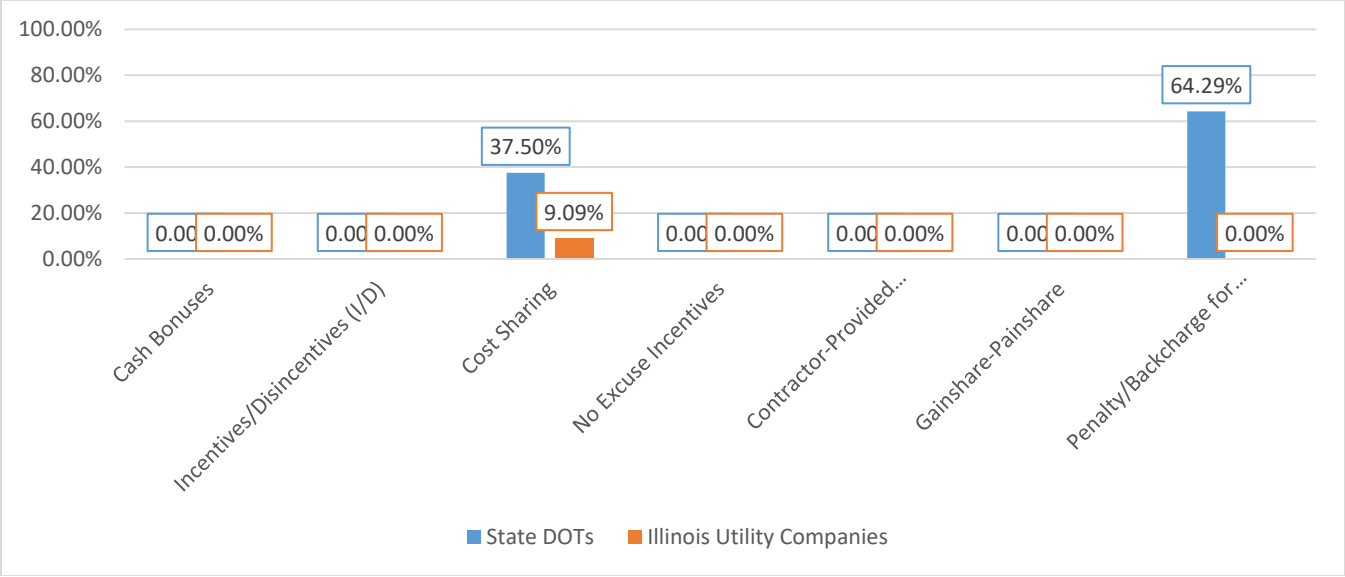

Figure 43. Reported problems or challenges of financial incentives.

E.5.3 Practices Requiring Cost Problems and Challenges

Forty-nine respondents including 28 state DOTs and 21 Illinois utility companies reported 97 problems and challenges that they encountered during their use of the aforementioned ten practices requiring cost. The number of respondents reporting each problem and their percentages are summarized in Table 44, Table 45 and Figure 44. The survey results illustrate that the top three practices requiring cost that received the highest percentage of reported problems from state DOTs are: (1) advance building/tree removal; (2) extended work hours; and (3) utility relocation safety program, as shown in Figure 44. The top three practices requiring cost that received the highest percentage of reported problems from Illinois utility companies are: (a) subsurface utility engineering; (b) electronic document delivery; and (c) removal of abandoned utilities (see Figure 44). Illinois utility companies reported that 'lack of updated information' as the main problem with these three practices.

Table 44A. Problems and Challenges of Practices Requiring Cost Reported by State DOTs

Practice Requiring Cost	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Utility Cost Database	2	22.22%	Lack of updated information	2
Electronic Utility Permits	1	9.09%	IT issues	1
Utility Coordination Web sites	3	42.86%	IT issues	1
			Lack of updated information	1
			Cost ineffectiveness	1
Electronic Document Delivery	1	8.33%	IT issues	
Subsurface Utility Engineering (SUE)	10	45.45%	Cost ineffectiveness	8
			Inaccurate information	3
			Lack of qualified personnel	1
			Difficulty hiring SUE firms	1
Clearing, Grubbing, Staking, Grading	7	41.18%	Lack of time	4
			Lack of coordination	2
			Lack of resources	1
			Cost ineffectiveness	1
			Late project changes	1
			Statutory requirement limitations	1
Utility Relocation Safety Program	1	50.00%	Cost ineffectiveness	1
Removal of abandoned utilities	5	45.45%	Lack of coordination	3
			Cost ineffectiveness	3
			Lack of updated information	2
			Lack of time	1
			Lack of resources	1
Trenchless Technology	5	27.78%	Lack of updated information	2
			Lack of coordination	1
			Lack of resources	1
			Site logistics constraints	1
			Cost ineffectiveness	1
Utility Tunnels	0	0.00%	No problems reported	

$$* \ \% \text{ of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 44B. Problems and Challenges of Practices Requiring Cost Reported by State DOTs

Practice Requiring Cost	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Statewide Utility Permit Database	7	38.89%	Lack of cooperation	1
			Lack of coordination	1
			Lack of funding	1
			Lack of qualified personnel	2
			Lack of updated information	2
			Overall ineffectiveness	1
Updated DOT Website	1	8.33%	Lack of qualified personnel	1
Updated Land Acquisition System	0	0.00%	No problems reported	
Advanced Building/Tree Removal	7	70.00%	Improper utilization	1
			Lack of coordination	2
			Lack of funding	1
			Site logistics constraints	3
On-Call Utility Contractors	0	0.00%	No problems reported	
Extended Work Hours	4	57.14%	Lack of funding	2
			Lack of cooperation	1
			Lack of qualified personnel	2
			Lack of resources	1
			Lack of time	1

$* \%$ of state DOTs reporting problem $= \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$

Table 45. Problems and Challenges of Practices Requiring Cost Reported by Illinois Utility Companies

Practice Requiring Cost	Number of Responses	Percentage of Illinois Utility Co. Reporting problems*	Reported Problem/Challenge	Number of Times Reported
Utility Cost Database	0	0.00%	No problems reported	
Electronic Utility Permits	2	12.50%	Lack of updated information	2
Utility Coordination Web sites	1	8.33%	Not utilized on all utilities	
Electronic Document Delivery	6	26.09%	Lack of resources	2
			Lack of communication	2
			Lack of updated information	2
			Lack of qualified personnel	1
Subsurface Utility Engineering (SUE)	6	35.29%	Lack of updated information	3
			Lack of communication	1
			Lack of coordination	1
			Not utilized on all utilities	1
Clearing, Grubbing, Staking, Grading	2	12.50%	Lack of time	1
			Lack of coordination	1
Utility Relocation Safety Program	0	0.00%	No problems reported	
Removal of abandoned utilities	3	25.00%	Lack of coordination	2
			Lack of updated information	1
Trenchless Technology	7	19.44%	Lack of updated information	3
			Not utilized on all utilities	2
			Cost ineffectiveness	2
Utility Tunnels	0	0.00%	No problems reported	

$$* \% \text{ of Illinois utility companies reporting problem} = \frac{\text{Number of Illinois utility companies reporting problem}}{\text{Total number of Illinois utility companies utilizing this BMP}}$$

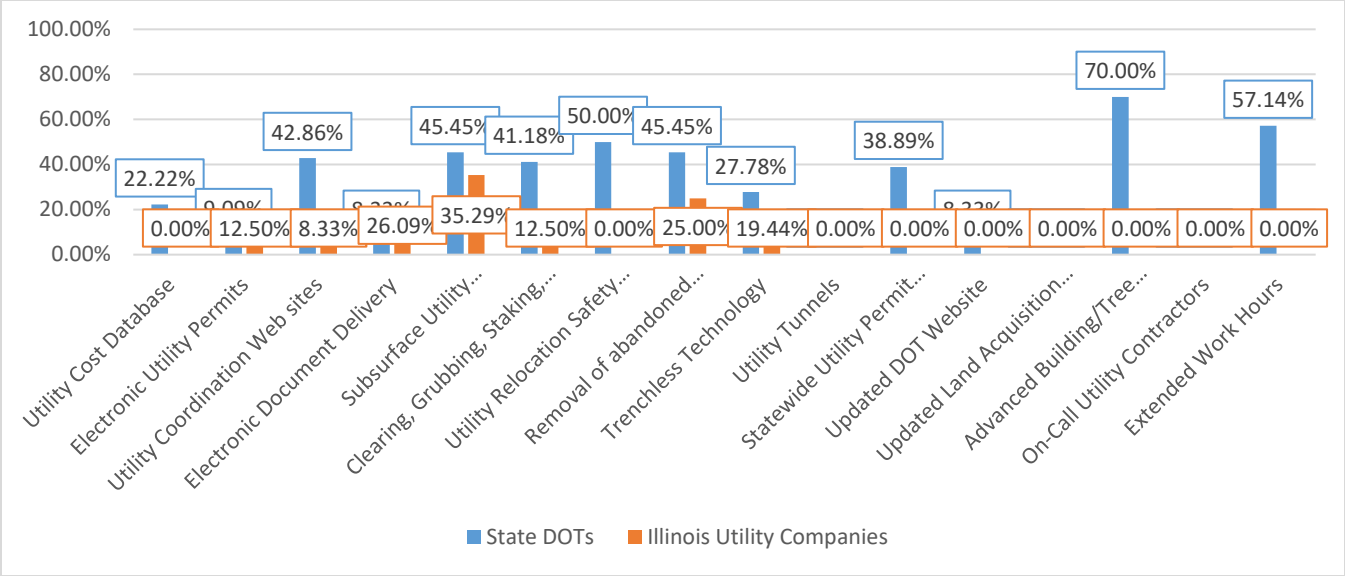

Figure 44. Reported problems or challenges of practices requiring cost.

E.5.4 No-Cost Practices Problems and Challenges

Fifty-six respondents including 31 state DOTs and 25 Illinois utility companies provided 217 problems and challenges encountered while utilizing 26 of the 31 no-cost practices listed in the survey. The number of respondents reporting each no-cost practice problem and their percentages are summarized in Table 46A, 47B, Table 47A, 48B, and Figure 45. The survey results illustrate that the top three no-cost practices that were reported to cause problems by more than 50% of state DOTs are: (1) combined utility segments; (2) prepayment for long-procurement items; and (3) advance relocation of utility work. The top three no-cost practices that were reported to cause problems by Illinois utility companies are: (a) A+B bidding; (b) utility conflict matrix; and (c) right-of-way acquisition, as shown in Figure 45. Illinois utility companies list the 'lack of updated information' as a main problem for these no-cost practices, as shown in Table 33A and B.

Table 46A. Problems and Challenges of No-Cost Practices Reported by State DOTs

No-Cost Practice	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Utility Work by Highway Contractor	10	50.00%	Lack of coordination	4
			Not utilized for all utilities	3
			Lack of qualified personnel	1
			Lack of updated information	1
			Cost ineffectiveness	1
A+B Bidding	0	0.00%	No problems reported	
Lane Rental	0	0.00%	No problems reported	
Design-Build	4	30.77%	Lack of qualified personnel	2
			Lack of coordination	1
			Cost ineffectiveness	1
Unit Cost	3	50.00%	Cost ineffectiveness	1
			Lack of updated information	1
			Lack of qualified personnel	1
Combined Utility Segments	1	100.00%	Lack of time	1
Highway Contract Facilitating Language	1	50.00%	Lack of qualified personnel	1
Lump-Sum Agreements	4	30.77%	Not utilized for all utilities	2
			Lack of coordination	1
			Lack of resources	1
			Lack of qualified personnel	1
Right-of-Way (RoW) Acquisition	3	23.08%	Lack of time	3
			Cost ineffectiveness	1
Utility Corridors	1	16.67%	Lack of coordination	1
Locate next to RoW line	3	20.00%	Site logistics constraints	3
Use of Existing Tunnels for Utilities	0	0.00%	No problems reported	
One-Call Systems	9	50.00%	Lack of updated information	9
			Lack of qualified personnel	3
			Lack of time	2
Utility Conflict Matrix	4	40.00%	Lack of cooperation	1
			Lack of time	1
			Lack of updated information	1
			Cost ineffectiveness	1
Advance relocation of utility work	10	58.82%	Lack of time	6
			Cost ineffectiveness	2
			Lack of coordination	1
			Lack of qualified personnel	1
			Lack of resources	1
			Lack of updated information	1
			Late project changes	1
			Site logistics constraints	1
			Not utilized for all utilities	1
			Public perception	1

$$* \ \% \text{ of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 46B. Problems and Challenges of No-Cost Practices Reported by State DOTs

No-Cost Practice	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Utility Training Classes	4	40.00%	Lack of resources	3
			Lack of attendance	1
			Lack of cooperation	1
			Lack of qualified personnel	1
Standardized Estimate/Bid Forms	0	0.00%	No problems reported	
Standardized Invoice Submissions	2	28.57%	Lack of resources	1
			Lack of updated information	1
Value Engineering for Utilities	1	25.00%	Not utilized for all utilities	1
Avoidance of Utility Relocation	8	47.06%	Lack of cooperation	3
			Cost ineffectiveness	3
			Lack of coordination	2
			Lack of updated information	2
			Lack of time	1
			Not utilized for all utilities	1
Modernization of Utility Processes	3	33.33%	Lack of qualified personnel	1
			Lack of updated information	1
			Late project changes	1
			Cost ineffectiveness	1
			Lack of cooperation	1
Utility Manuals	6	37.50%	Lack of updated information	5
			Lack of cooperation	1
Context Sensitive Design	1	25.00%	Cost ineffectiveness	1
Simplified Permit Approvals for Utilities	2	20.00%	Lack of cooperation	1
			Lack of updated information	1
Requirement of Roadway Contractor to Track Utility Relocation Delays	4	28.57%	Lack of qualified personnel	2
			Lack of updated information	1
			Overall ineffectiveness	1
Right-of-Way Utility Coordination	11	52.38%	Lack of communication	1
			Lack of cooperation	2
			Lack of coordination	3
			Lack of qualified personnel	2
			Lack of time	1
			Lack of updated information	1
			Not utilized for all utilities	1
Additional Utility Personnel	6	50.00%	Lack of qualified personnel	5
			Overall ineffectiveness	1
Phase I Plan Extensions	0	0.00%	No problems reported	
Schedule changes for PSE & letting	9	52.94%	Lack of coordination	3
			Lack of qualified personnel	2
			Lack of time	1
			Overall ineffectiveness	3

$$* \ \% \text{ of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 46C. Problems and Challenges of No-Cost Practices Reported by State DOTs

No-Cost Practice	Number of Respondents Reporting Problem	Percentage of State DOTs Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Prepayment for Long Procurement Items	5	62.50%	Lack of cooperation	1
			Lack of coordination	2
			Lack of qualified personnel	1
			Lack of updated information	1
Minimize Program Changes	6	42.86%	Lack of coordination	2
			Lack of funding	1
			Lack of qualified personnel	1
			Late project changes	1
			Public perception	1
Utility Training Classes	4	40.00%	Lack of resources	3
			Lack of attendance	1
			Lack of cooperation	1
			Lack of qualified personnel	1
Standardized Estimate/Bid Forms	0	0.00%	No problems reported	
Standardized Invoice Submissions	2	28.57%	Lack of resources	1
			Lack of updated information	1
Value Engineering for Utilities	1	25.00%	Not utilized for all utilities	1
Avoidance of Utility Relocation	8	47.06%	Lack of cooperation	3
			Cost ineffectiveness	3
			Lack of coordination	2
			Lack of updated information	2
			Lack of time	1
			Not utilized for all utilities	1
Modernization of Utility Processes	3	33.33%	Lack of qualified personnel	1
			Lack of updated information	1
			Late project changes	1
			Cost ineffectiveness	1
			Lack of cooperation	1
Utility Manuals	6	37.50%	Lack of updated information	5
			Lack of cooperation	1
Context Sensitive Design	1	25.00%	Cost ineffectiveness	1
Simplified Permit Approvals for Utilities	2	20.00%	Lack of cooperation	1
			Lack of updated information	1

$$* \ \% \text{ of state DOTs reporting problem} = \frac{\text{Number of state DOTs reporting problem}}{\text{Total number of state DOTs utilizing this BMP}}$$

Table 47A. Problems and Challenges of No-Cost Practices Reported by Illinois Utility Companies

No-Cost Practice	Number of Responses	Percentage of Illinois Utility Companies Reporting problems*	Reported Problem/Challenge	Number of Times Reported
Utility Work by Highway Contractor	4	22.22%	Cost ineffectiveness	2
			Lack of qualified personnel	1
			Lack of time	1
			Lack of updated information	1
A+B Bidding	2	40.00%	Lack of updated information	1
			Lack of cooperation	1
Lane Rental	0	0.00%	No problems reported	
Design-Build	0	0.00%	No problems reported	
Unit Cost	4	30.77%	Lack of updated information	3
			Not utilized on all utilities	1
Combined Utility Segments	0	0.00%	No problems reported	
Highway Contract Facilitating Language	0	0.00%	No problems reported	
Lump-Sum Agreements	6	31.58%	Not utilized on all utilities	3
			Late project changes	1
			Lack of updated information	1
			Lack of funding	1
Right-of-Way (RoW) Acquisition	8	32.00%	Lack of coordination	3
			Lack of time	2
			Lack of funding	1
			Lack of updated information	1
			Statutory requirement limitations	1
			Cost ineffectiveness	1
Utility Corridors	2	15.38%	Site logistics constraints	1
			Lack of coordination	1
Locate next to RoW line	5	19.23%	Site logistics constraints	5
			Lack of coordination	3
Use of Existing Tunnels for Utilities	0	0.00%	No problems reported	
One-Call Systems	11	20.00%	Lack of coordination	4
			Lack of updated information	3
			Lack of communication	2
			Lack of time	2
			Lack of cooperation	2
			Not utilized on all utilities	1
Utility Conflict Matrix	3	33.33%	Lack of cooperation	1
			Lack of qualified personnel	1
			Lack of coordination	1

Table 47B. Reported Problems and Challenges of No-Cost Practices by Illinois Utility Companies

No-Cost Practice	Number of Respondents Reporting Problem	Percentage of Illinois Utility Companies Reporting Problems*	Reported Problem/Challenge	Number of Times Reported
Utility Conflict Matrix	3	33.33%	Lack of cooperation	1
			Lack of qualified personnel	1
			Lack of coordination	1
Advance relocation of utility work	10	29.41%	Lack of communication	4
			Lack of coordination	4
			Lack of updated information	3
			Lack of funding	1
			Lack of time	1
			Site logistics constraints	1
Utility Training Classes	0	0.00%	No problems reported	
Standardized Estimate/Bid Forms	0	0.00%	No problems reported	
Standardized Invoice Submissions	2	28.57%	Lack of updated information	1
			Lack of communication	1
			Lack of coordination	1
Value Engineering for Utilities	1	12.50%	Lack of qualified personnel	1
Avoidance of Utility Relocation	3	13.64%	Lack of communication	1
			Lack of coordination	2
Modernization of Utility Processes	0	0.00%	No problems reported	
Utility Manuals	1	8.33%	Lack of updated information	1
Context Sensitive Design	0	0.00%	No problems reported	
Simplified Permit Approvals for Utilities	0	0.00%	No problems reported	

$$* \ \% \text{ of Illinois utility companies reporting problem} = \frac{\text{Number of Illinois utility companies reporting problem}}{\text{Total number of Illinois utility companies utilizing this BMP}}$$

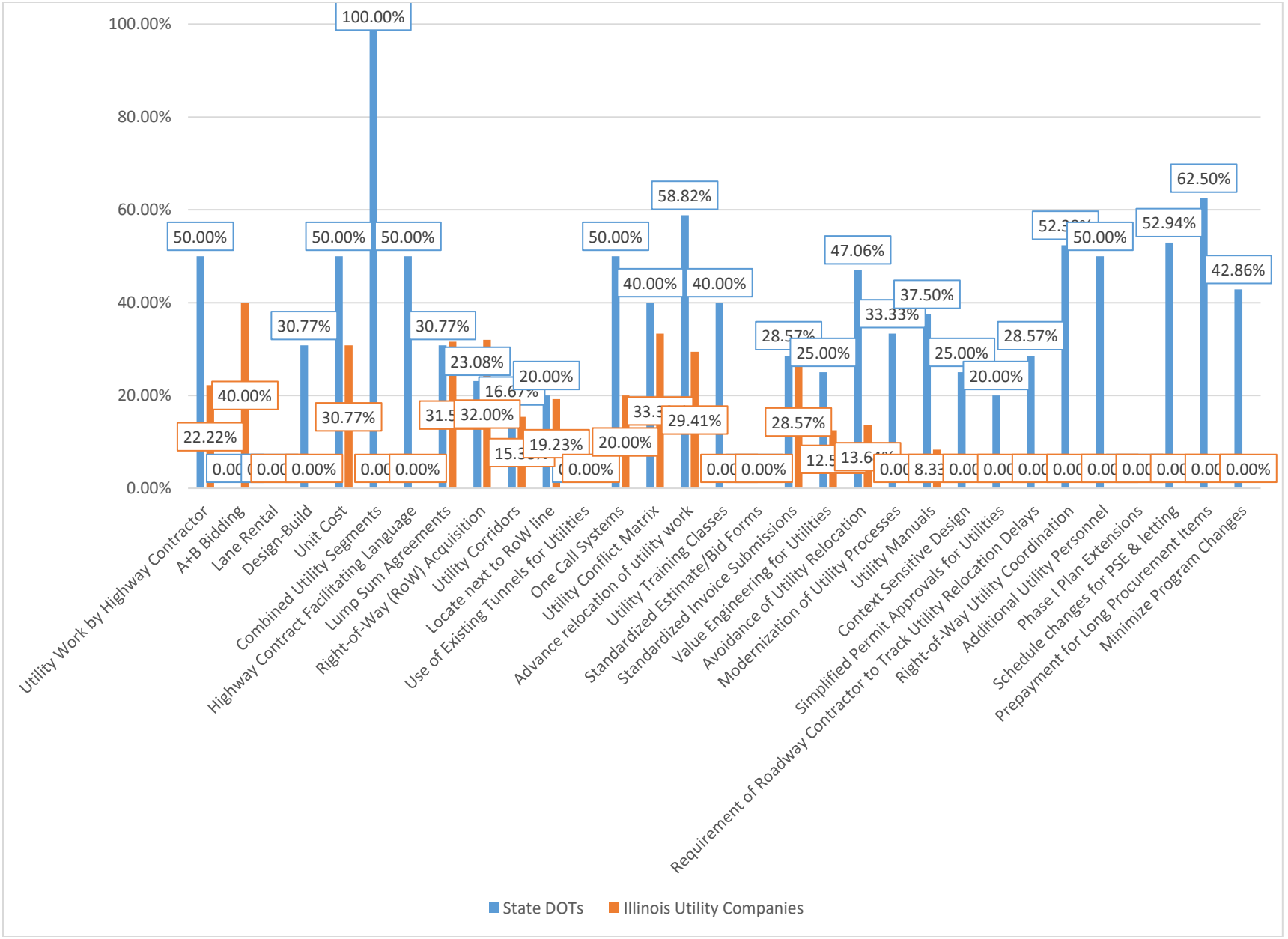

Figure 45. Reported problems or challenges of no-cost practices.

E.5.5 Ranking of BMPs based on their Reported Problems

The top 25 most BMPs and incentives that were reported to cause the highest percentage of problems from state DOTs and Illinois utility companies that implemented them are ranked, as shown in Figure 46 and Figure 47, respectively.

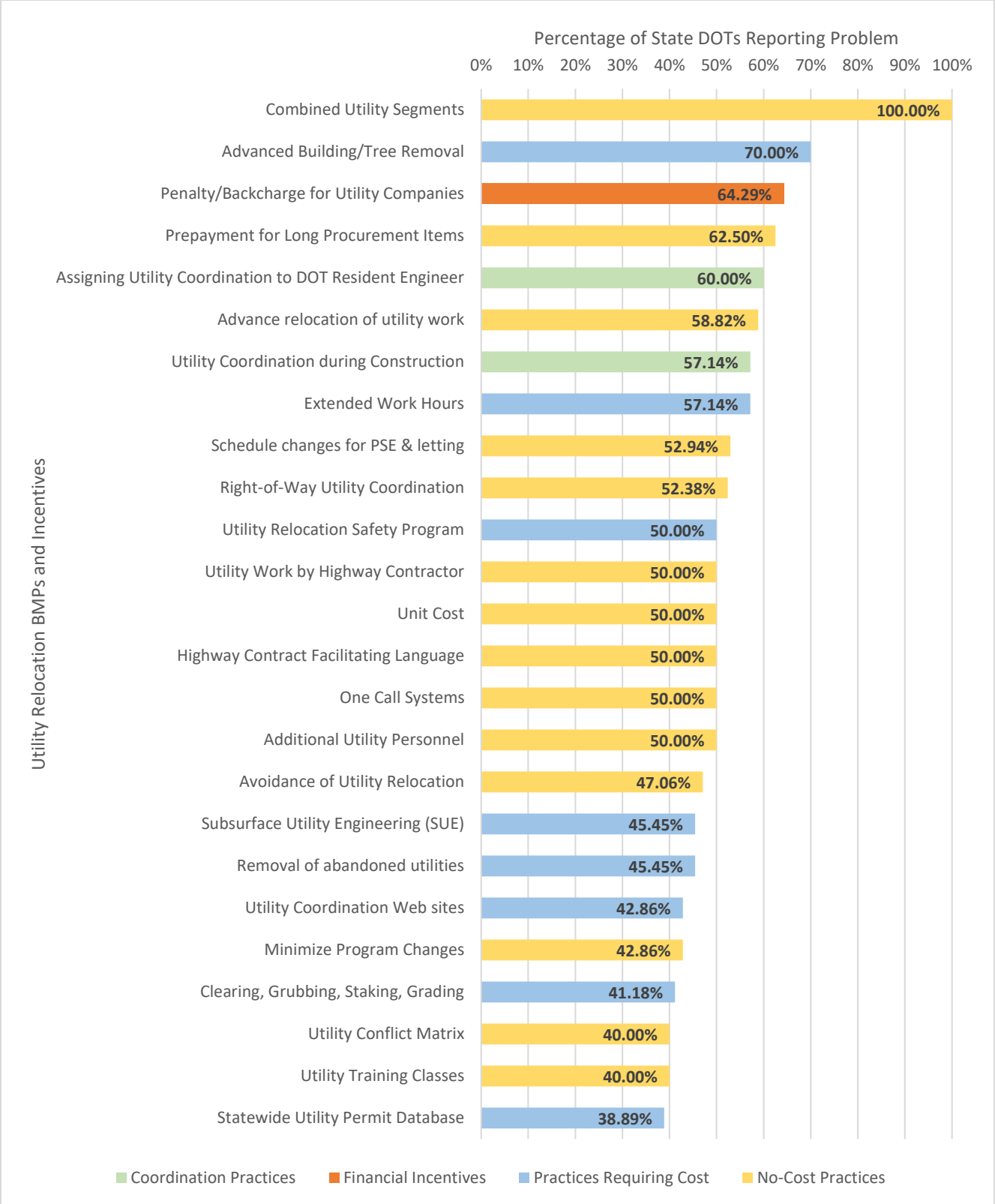

Figure 46. Top 25 BMPs and incentives with reported problems by state DOTs.

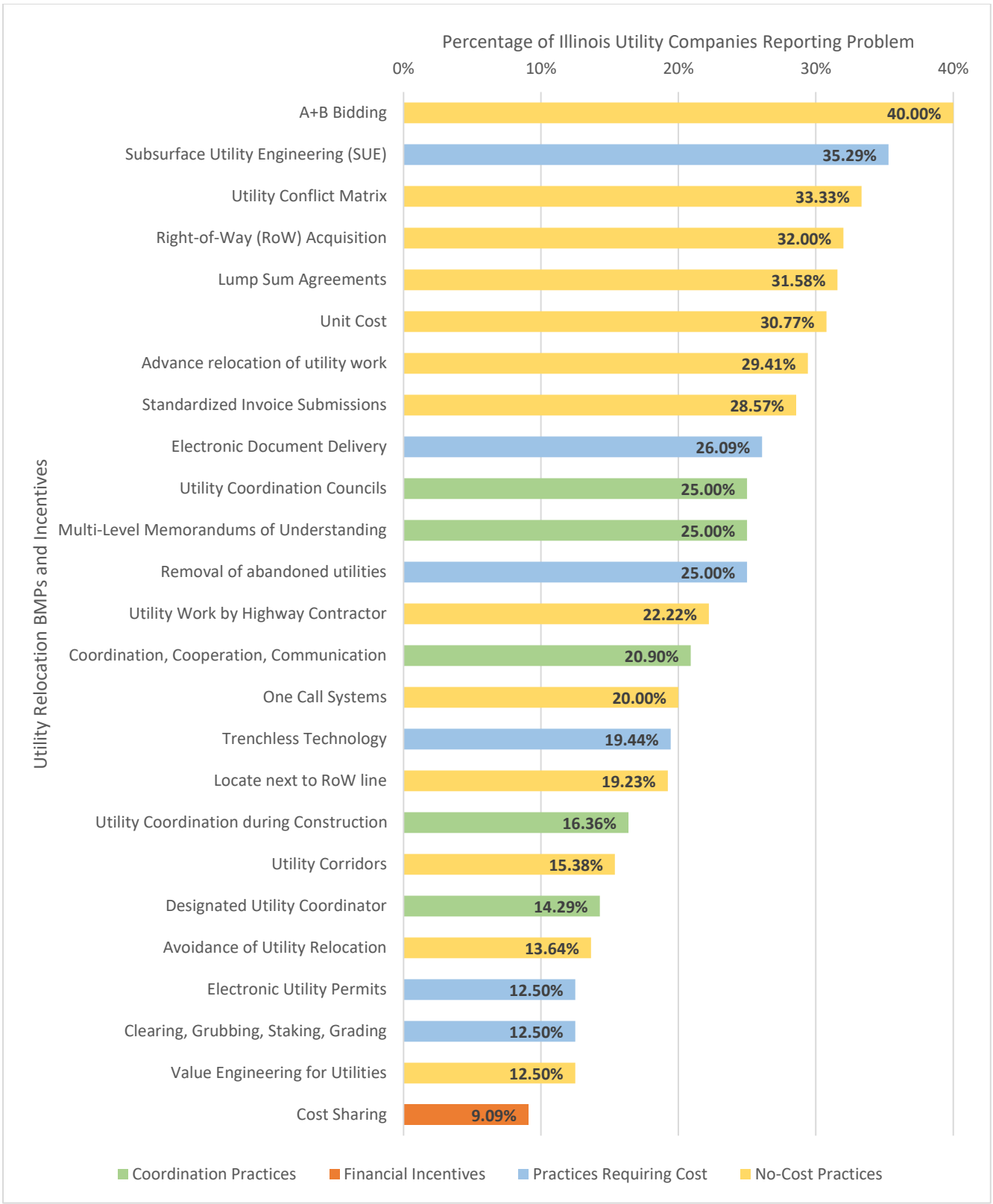

Figure 47. Top 25 BMPs and incentives with reported problems by Illinois utility companies.

E.6 REPORTED CAUSES AND IMPACTS OF UTILITY RELOCATION DELAYS

The following two sections summarize the collected feedback from the state DOT and Illinois utility company respondents on (1) causes of utility relocation delays; and (2) the impact of utility relocation delays on DOT projects.

E.6.1 Causes of Utility Relocation Delays

Survey respondents were asked to list the causes of delays and their frequency of occurrence on DOT utility relocation projects. A total of 223 causes of delay were reported by 45 state DOT officials and 20 utility company representatives. These 223 responses were grouped into 15 categories of causes of delays, as shown in Table 48. The number of state DOT and Illinois utility company respondents reporting each of these 15 causes of delays, and the percentage of projects affected by these delays are shown in Table 48 and Table 49, respectively. The frequency of encountering these 15 causes of delays on utility relocation projects that were reported state DOTs and Illinois utility companies are shown in Figure 48 and Figure 49, respectively. In addition, the average percent of projects affected by these 15 causes of delays is shown in Figure 50.

Table 48. Causes of Utility Relocation Delays Reported by State DOTs

Cause of Delay	Frequency		% of Project Affected		
	Number of Responses	Percentage of Responses	Minimum	Maximum	Average
Undocumented utilities	30	16.39%	1.0%	100.0%	19.5%
Design delays	10	5.46%	5.0%	75.0%	27.0%
Design changes	24	13.11%	2.0%	100.0%	26.4%
Programming changes	4	2.19%	5.0%	70.0%	25.0%
Lack of manpower	10	5.46%	5.0%	50.0%	23.6%
Lack of materials	3	1.64%	10.0%	20.0%	13.3%
Agreement delays	8	4.37%	2.0%	50.0%	20.3%
ROW acquisition delays	12	6.56%	3.0%	95.0%	37.3%
Environmental delays	3	1.64%	5.0%	30.0%	16.7%
Lack of coordination	36	19.67%	2.0%	60.0%	28.9%
Utility relocation delays	18	9.84%	2.0%	75.0%	15.2%
Scheduling delays	9	4.92%	5.0%	50.0%	29.0%
Accelerated Schedule	7	3.83%	26.0%	50.0%	42.0%
Availability of funding	4	2.19%	5.0%	100.0%	52.5%
Political pressure	3	1.64%	2.0%	25.0%	13.5%
Weather	2	1.09%	10.0%	25.0%	17.5%
TOTAL	183	100.00%			

Table 49. Causes of Utility Relocation Delays Reported by Illinois Utility Companies

Cause of Delay	Frequency		% of Project Affected		
	Number of Responses	Percentage of Responses	Minimum	Maximum	Average
Undocumented utilities	5	12.50%	20.0%	50.0%	33.0%
Design delays	3	7.50%	20.0%	80.0%	41.7%
Design changes	3	7.50%	10.0%	50.0%	23.3%
Programming changes	0	0.00%	Not Reported		
Lack of manpower	1	2.50%	10.0%	10.0%	10.0%
Lack of materials	2	5.00%	10.0%	100.0%	55.0%
Agreement delays	3	7.50%	10.0%	100.0%	63.3%
ROW acquisition delays	3	7.50%	25.0%	90.0%	58.3%
Environmental delays	3	7.50%	10.0%	100.0%	45.0%
Lack of coordination	11	27.50%	10.0%	95.0%	41.2%
Utility relocation delays	0	0.00%	Not Reported		
Scheduling delays	3	7.50%	2.0%	100.0%	39.0%
Accelerated Schedule	0	0.00%	Not Reported		
Availability of funding	1	2.50%	98.0%	98.0%	98.0%
Weather	2	5.00%	20%	50%	35%
TOTAL	40	100.00%			

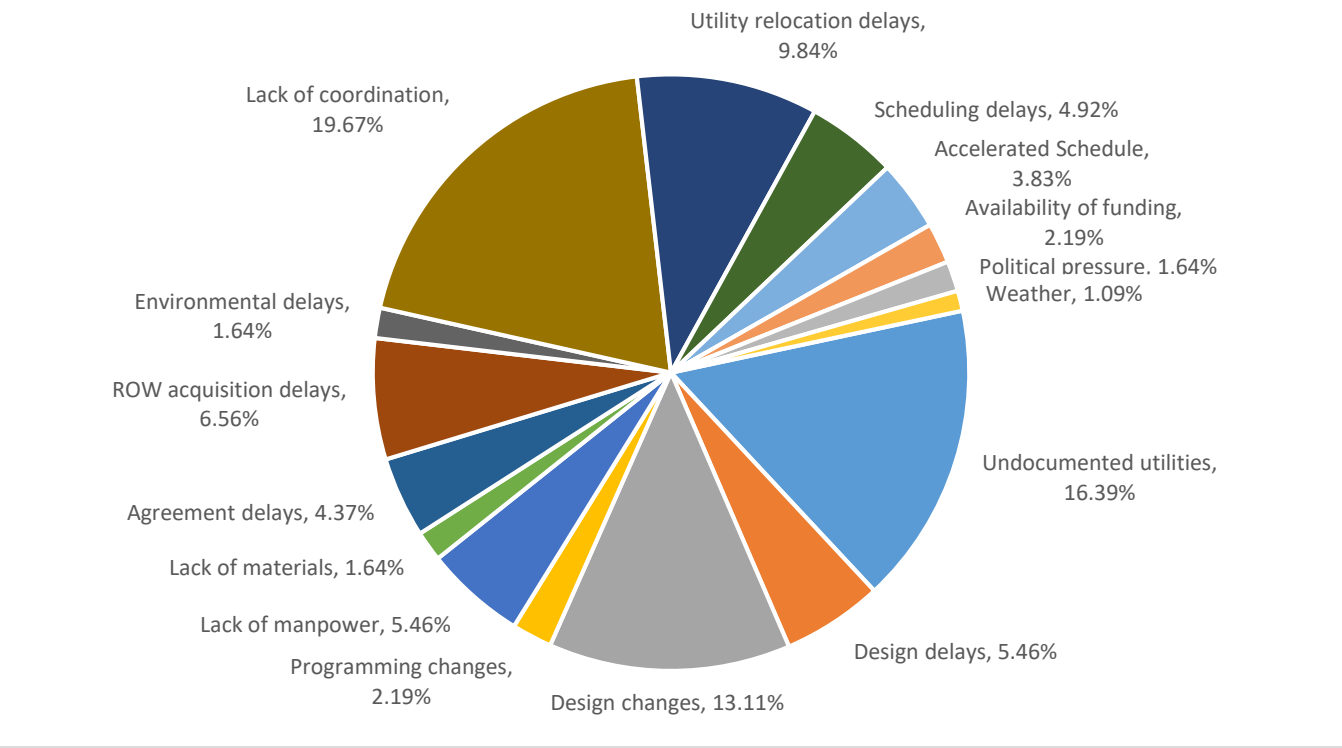

Figure 48. Reported causes of delays on utility relocation projects by state DOTs.

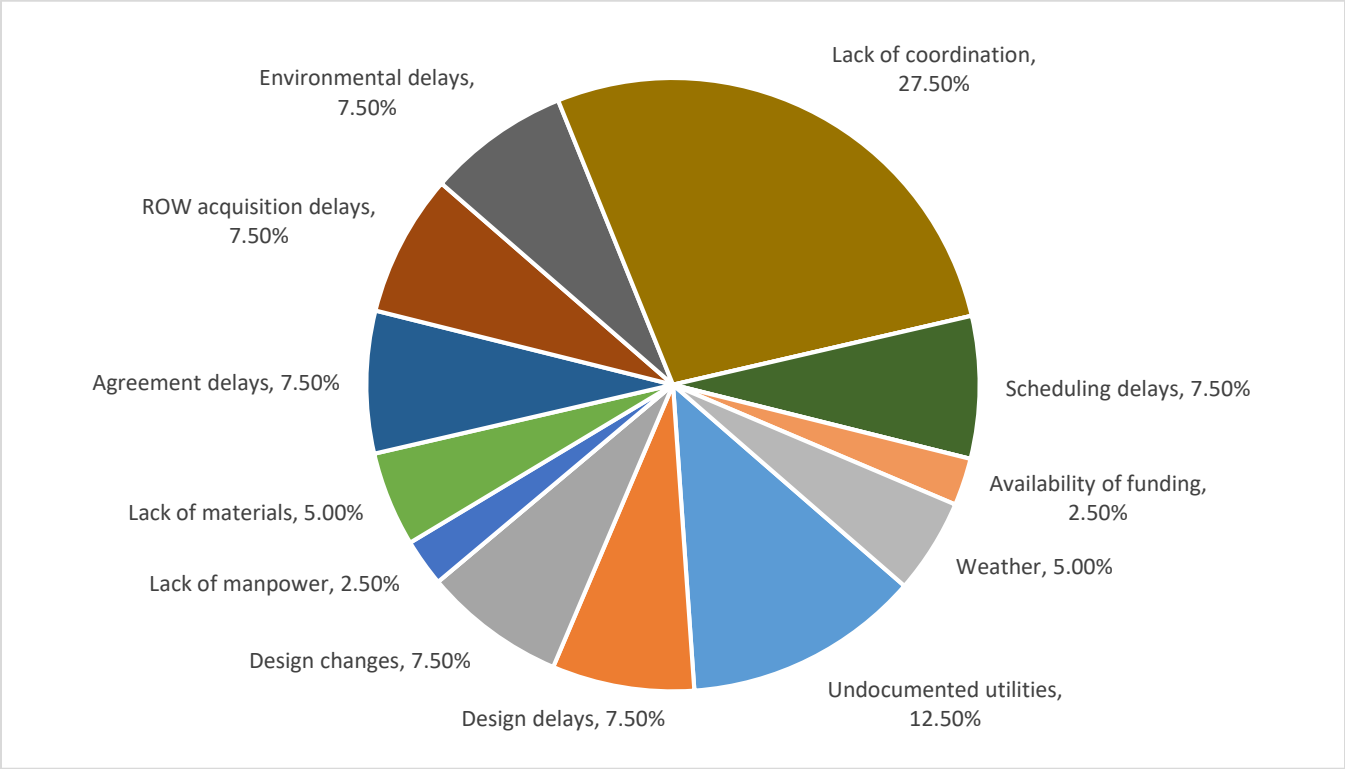

Figure 49. Reported causes of delays on utility relocation projects by Illinois utility companies.

The survey results illustrate that the top five reported causes of delays by state DOTs (see Figure 48) are (1) lack of coordination; (2) undocumented utilities; (3) design changes; (4) utility relocation delays; and (5) right-of-way acquisition delays. On the other hand, the top eight reported causes of delays by Illinois utility companies are (a) lack of coordination; (b) undocumented utilities; (c) design delays; (d) design changes; (e) agreement delays; (f) RoW delays; (g) environmental delays; and (h) scheduling delays, as shown in Figure 49. The 'lack of coordination' was reported by 19.67% of the participating state DOTs and 27.50% of participating Illinois utility companies to cause delays on utility relocation projects, while 'undocumented utilities' was reported by 16.39% of state DOTs and 12.50% of Illinois utility companies to cause delays.

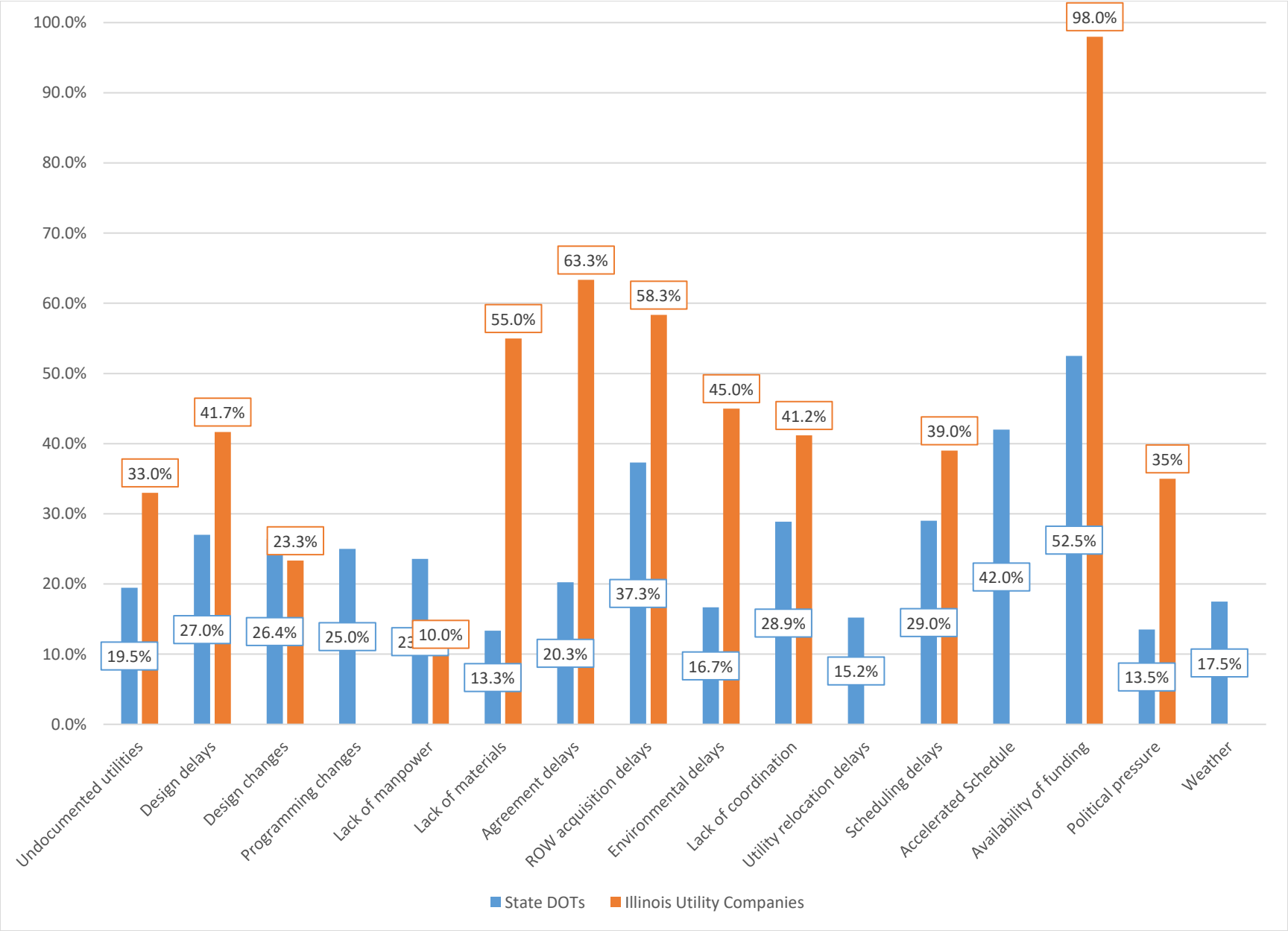

Figure 50. Average percent of projects affected by the reported 15 causes of delay.

As shown in Figure 50, the top three causes of delays that were reported by state DOTs to affect the highest percentage of their projects are (1) availability of funding; (2) scheduling delays; and (3) design changes. The top four causes of delays that were reported to affect more than 50% of Illinois utility company projects are (a) availability of funding; (b) agreement delays; (c) ROW acquisition delays; and (d) lack of materials, as shown in Figure 50.

E.6.2 Impacts of Utility Relocation Delays

Survey respondents were asked to list the impact of delays and frequency of occurrence for each impact on DOT utility relocation projects. A total of 130 impacts were reported by 40 state DOT officials and 20 utility company representatives. These 130 impacts were grouped and organized into five categories of impacts, as shown in Table 50. The number of state DOT and Illinois utility company respondents reporting each of these five impacts of delays, and the percentage of projects affected by these impacts are shown in Table 50 and Table 51, respectively. The frequency of encountering these five impacts on utility relocation projects that were reported state DOTs and Illinois utility companies are shown in Figure 51 and Figure 52. In addition, the average percent of projects affected by these 5 impacts of delays is shown in Figure 53.

Table 50. Impacts of Utility Relocation Delays Reported by State DOTs

Impact of Delay	Frequency		% of Project Affected		
	Number of Responses	Percentage of Responses	Minimum	Maximum	Average
Additional Delays	33	32.67%	2.0%	100.0%	26.2%
Financial Impact	34	33.66%	1.0%	100.0%	23.4%
Personnel Impact	7	6.93%	15.0%	50.0%	27.0%
Productivity Impact	26	25.74%	2.0%	90.0%	22.3%
Various Impacts	1	0.99%	2.0%	2.0%	2.0%
TOTAL	101	100.00%			

Table 51. Impacts of Utility Relocation Delays Reported by Illinois Utility Companies

Impact of Delay	Frequency		% of Project Affected		
	Number of Responses	Percentage of Responses	Minimum	Maximum	Average
Additional Delays	8	27.59%	10.0%	100.0%	51.3%
Financial Impact	7	24.14%	25.0%	75.0%	44.2%
Personnel Impact	6	20.69%	15.0%	100.0%	50.0%
Productivity Impact	8	27.59%	10.0%	75.0%	36.9%
Various Impacts	0	0.00%	0.0%	0.0%	0.0%
TOTAL	29	100.00%			

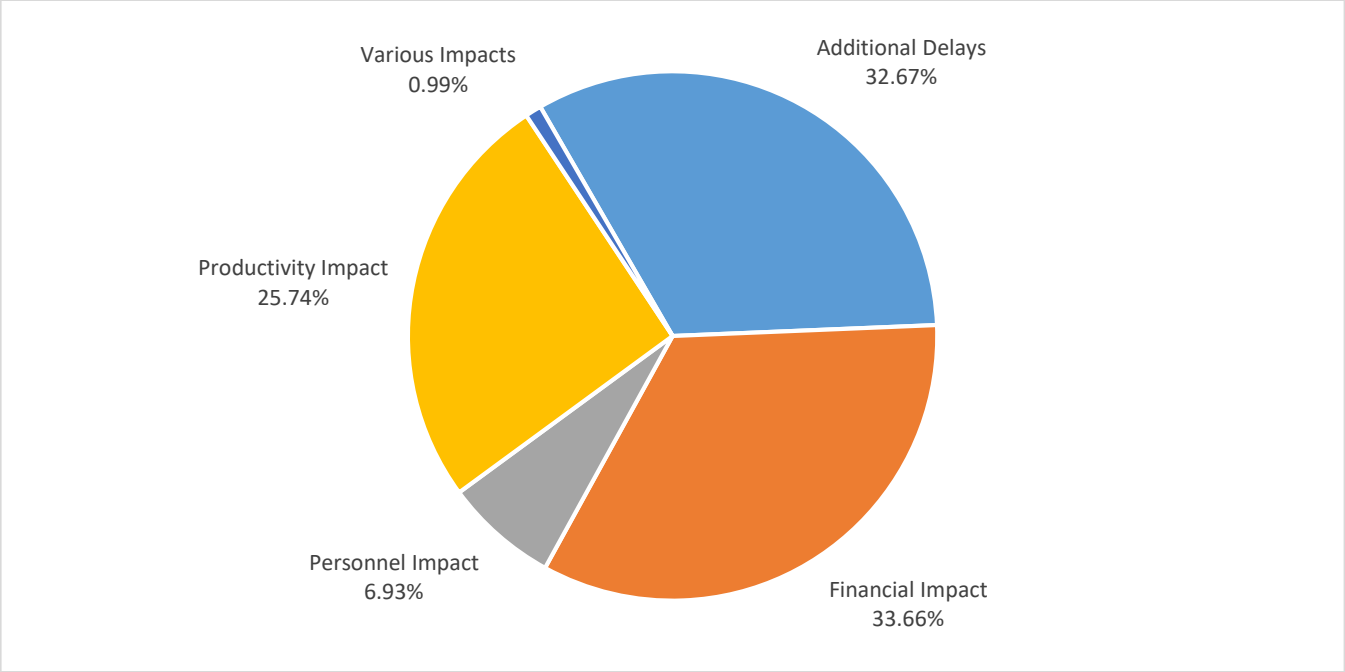

Figure 51. Reported impacts of delays on utility relocation projects by state DOTs.

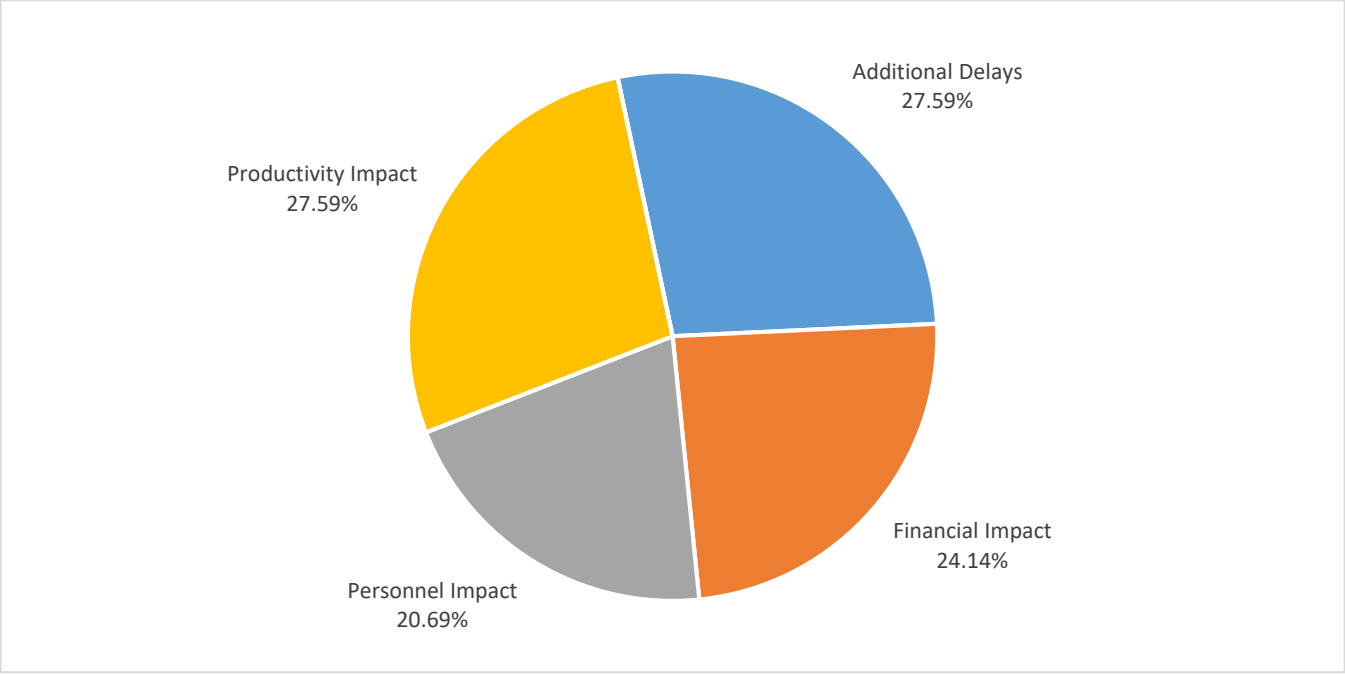

Figure 52. Reported impacts of delays on utility relocation projects by Illinois utility companies.

The survey results illustrate that the most reported impacts of delays by state DOTs are (1) financial impacts; (2) additional delays; (3) productivity impacts; (4) personnel impacts; and (5) various impacts as shown in Figure 51. On the other hand, the most reported impacts by Illinois utility company respondents are (a) additional delays, tied with (b) productivity impacts; (c) financial impacts; and (d)

personnel impacts (See Figure 52). The most reported impact was 'additional delays' which was reported by 40.91% of the participating state DOTs and 27.59% of the participating state Illinois utility companies.

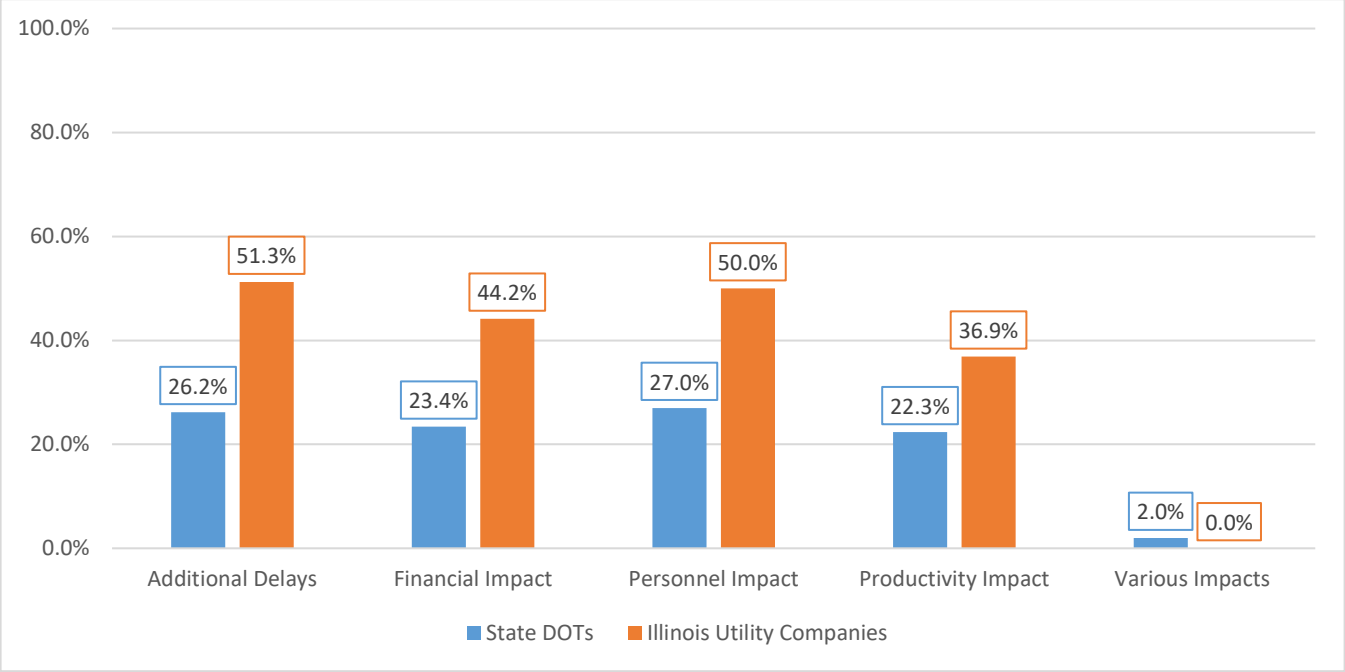

Figure 53. Average percent of projects affected by the reported five impacts of delays.

As shown in Figure 53, the top three impacts of delays that were reported by state DOTs to affect the highest percentage of their projects are (1) personnel impacts; (2) additional delays; and (3) financial impacts. The top three impacts of delays that were reported to affect more than 40% of Illinois utility company projects are (a) additional delays; (b) personnel impacts; and (c) financial impacts, as shown in Figure 53.

E.7 DURATION, TIMELINE AND SEQUENCING OF IDOT PROJECTS

This section analyzes the collected feedback from Illinois utility companies on their scheduling practices of IDOT projects. They were asked to provide data on (1) the duration between contract execution and permit receipt; (2) the duration between contract execution and start of utility relocation; (3) the duration of IDOT utility relocation projects; (4) their programming of IDOT utility relocation projects; and (5) additional comments on duration, timeline and sequencing of IDOT projects.

E.7.1 Duration between Contract Execution and Permit Receipt

Illinois utility companies were asked to estimate the average duration between contract execution and receipt of permit for state-reimbursable and non-reimbursable IDOT utility relocation projects. The reported values were grouped and organized into durations of (a) 6 weeks or less; (b) 6 weeks to 3 months; (c) 3 to 6 months; (d) 6 to 12 months; and (e) more than 12 months, as shown in Table 52 and Figure 54 and Figure 55.

Table 52. Duration between Contract Execution and Permit Receipt Reported by Illinois Utility Companies

Duration	State reimbursable projects		Non-reimbursable projects	
	Number of Responses	Percentage of Responses	Number of Responses	Percentage of Responses
6 weeks or less	11	34.38%	17	42.50%
6 weeks to 3 months	8	25.00%	10	25.00%
3 to 6 months	6	18.75%	6	15.00%
6 to 12 months	6	18.75%	5	12.50%
More than 12 months	1	3.13%	2	5.00%
Total	32	100.00%	40	100.00%

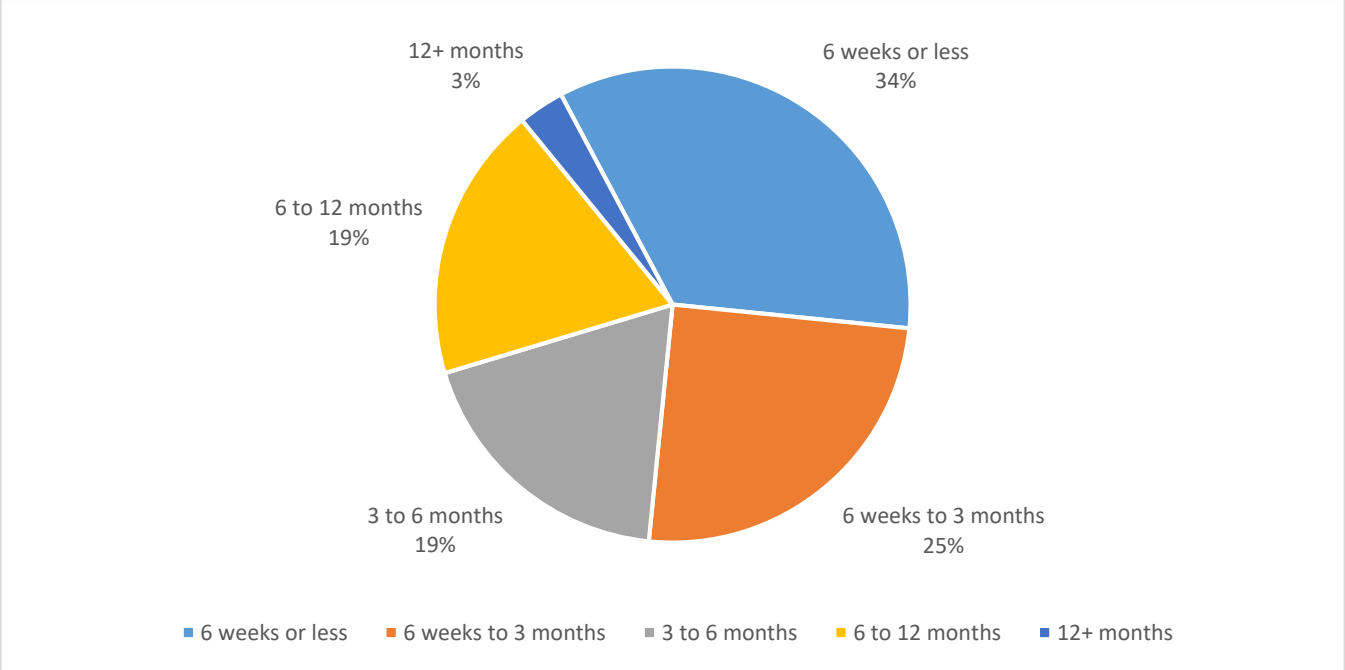

Figure 54. Duration between contract execution and permit receipt for state reimbursable projects.

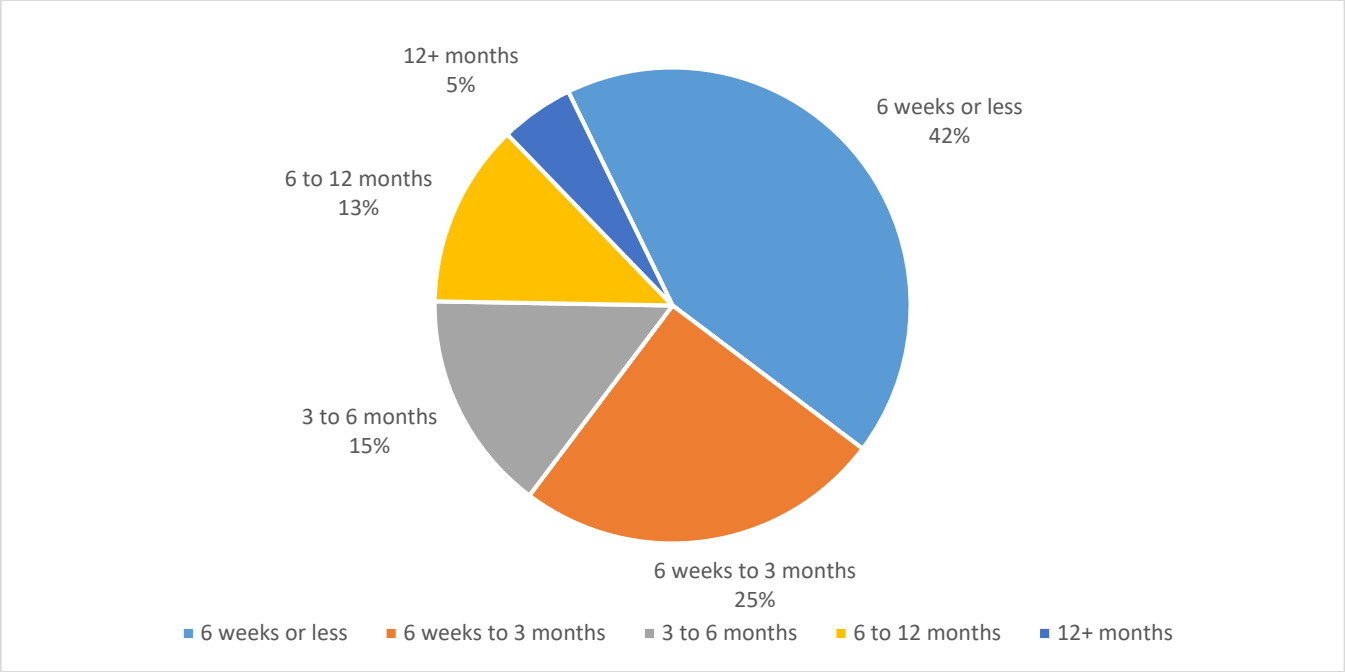

Figure 55. Duration between contract execution and permit receipt for non-reimbursable projects.

The survey results illustrate the most reported duration between contract execution and permit receipt for both state reimbursable and non-reimbursable projects is '6 weeks or less'. The '6 weeks or less' duration was reported by 34.38% of Illinois utility company respondents for state reimbursable projects, and 42.50% on non-reimbursable projects. This indicates that 65.62% of state reimbursable projects and 57.50% of non-reimbursable projects exceed the IDOT utility permit estimate of ±6 weeks that is listed in the Bureau of Design and Environment Manual, Utility Adjustment Process Flowchart (IDOT 2010).

E.7.2 Duration between Contract Execution and Start of Utility Relocation

Illinois utility companies were asked to estimate the average duration between contract execution and start of utility relocation work for state-reimbursable and non-reimbursable IDOT utility relocation projects. The reported values were grouped and organized into durations of (a) 6 weeks or less; (b) 6 weeks to 3 months; (c) 3 to 6 months; (d) 6 to 12 months; and (e) more than 12 months, as shown in Table 53 and Figure 56 and Figure 57.

Table 53. Duration between Contract Execution and Start of Utility Relocation Reported by Illinois Utility Companies

Duration	State reimbursable projects		Non-reimbursable projects	
	Number of Responses	Percentage of Responses	Number of Responses	Percentage of Responses
6 weeks or less	6	18.75%	8	21.62%
6 weeks to 3 months	9	28.13%	14	37.84%
3 to 6 months	13	40.63%	9	24.32%
6 to 12 months	4	12.50%	5	13.51%
More than 12 months	0	0.00%	1	2.70%
Total	32	100.00%	37	100.00%

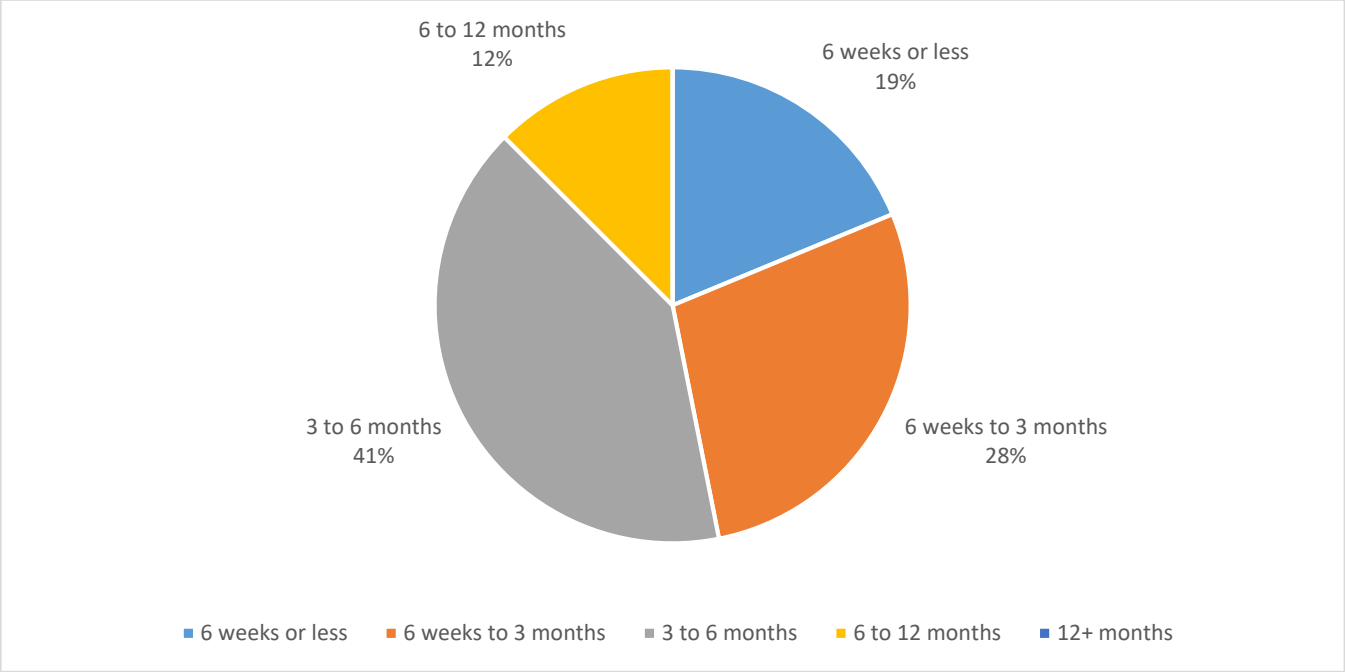

Figure 56. Duration between contract execution and utility relocation start for state reimbursable projects.

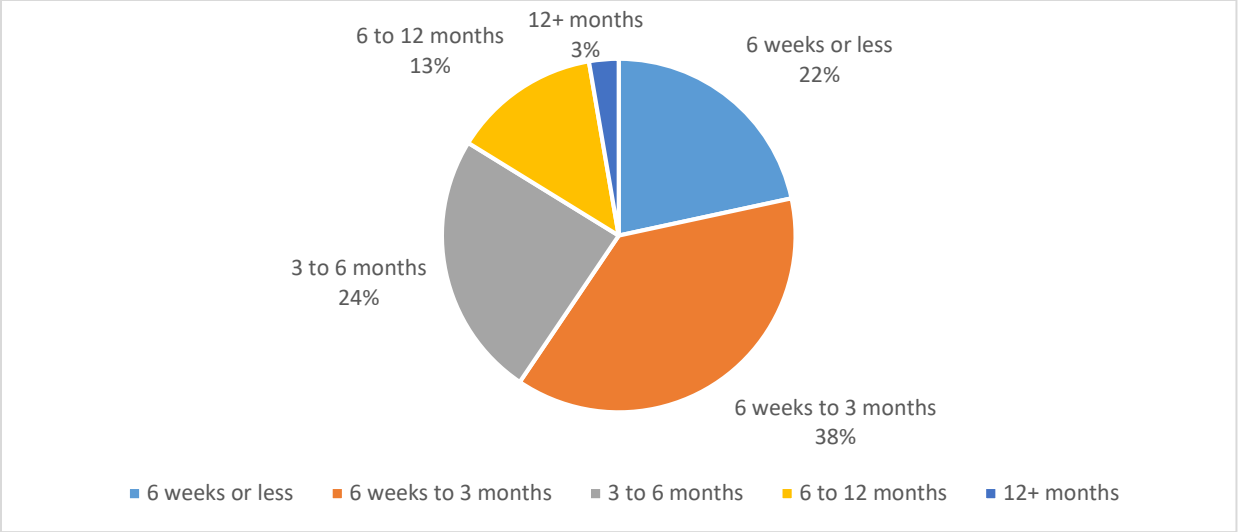

Figure 57. Duration between contract execution and utility relocation start for non-reimbursable projects.

The survey results illustrate that the most reported duration between contract execution and the start of utility relocation work are (a) '3 to 6 months' for state reimbursable projects; and (b) '6 weeks to 3 months' for non-reimbursable projects. The survey results also indicate that the percentage of Illinois utility companies that start work within 3 months of contract execution are (i) 46.88% for state reimbursable projects; and (ii) 59.46% for non-reimbursable projects. This means that 53.12% of state reimbursable projects and 40.54% of non-reimbursable projects could be non-compliant with the '90-day law' that requires utility companies to remove, relocate or modify utilities within 90 days of a written request from IDOT (605 ILCS 5/113b), which was reported to be made concurrently with or shortly after contract execution by IDOT district officials during the conducted interviews.

E.7.3 Duration of IDOT Utility Adjustment/Relocation Work

Illinois utility companies were asked to estimate the average duration of their IDOT utility relocation projects. The reported average durations and percentages of each response are summarized in Table 54 and Figure 58. According to the survey results, the majority of Illinois utility company respondents (54.0%) reported that the duration of their IDOT utility relocation work lasts 1 to 3 months.

Table 54. Duration of IDOT Utility Relocation Work Reported by Illinois Utility Companies

Duration	Number of responses	Percentage of Responses
2 months or less	23	58.97%
2 to 4 months	10	25.64%
4 to 6 months	5	12.82%
6 to 12 months	1	2.56%
More than 12 months	0	0.00%
Total	39	100.00%

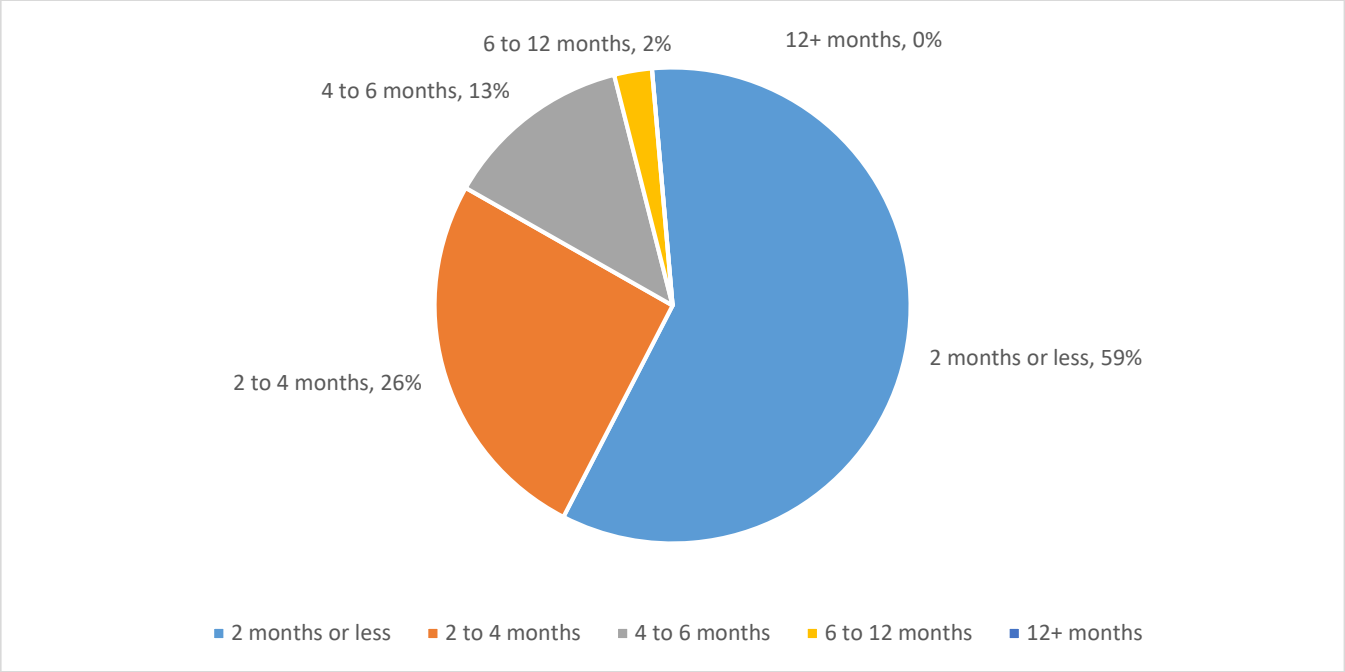

Figure 58. Duration of IDOT utility relocation work reported by Illinois utility companies.

E.7.4 Scheduling of IDOT Relocation Projects by Illinois Utility Companies

Illinois utility companies were asked to estimate how far in advance their utility company schedules IDOT utility relocation projects. The respondents were provided four duration options (a) 1 to 6 months in advance; (b) 6 to 12 months in advance; (c) 1 to 3 years in advance; and (d) 3+ years in advance. The number of responses and percentages of each response are summarized in Table 55and Figure 59. The survey results indicate that 48% of Illinois utility company respondents schedule IDOT utility relocation projects 1 to 6 months in advance of the project start. These results are consistent with the findings of the conducted interviews of IDOT officials who reported that utility companies often ignore IDOT's multi-year plan and schedule projects months in advance.

Table 55. Programming of IDOT Projects Reported by Illinois Utility Companies

Duration	Number of responses	Percentage of Responses
1-6 months in advance	24	48.00%
6-12 months in advance	14	28.00%
1-3 years in advance	11	22.00%
3+ years in advance	1	2.00%
Total	50	100.00%

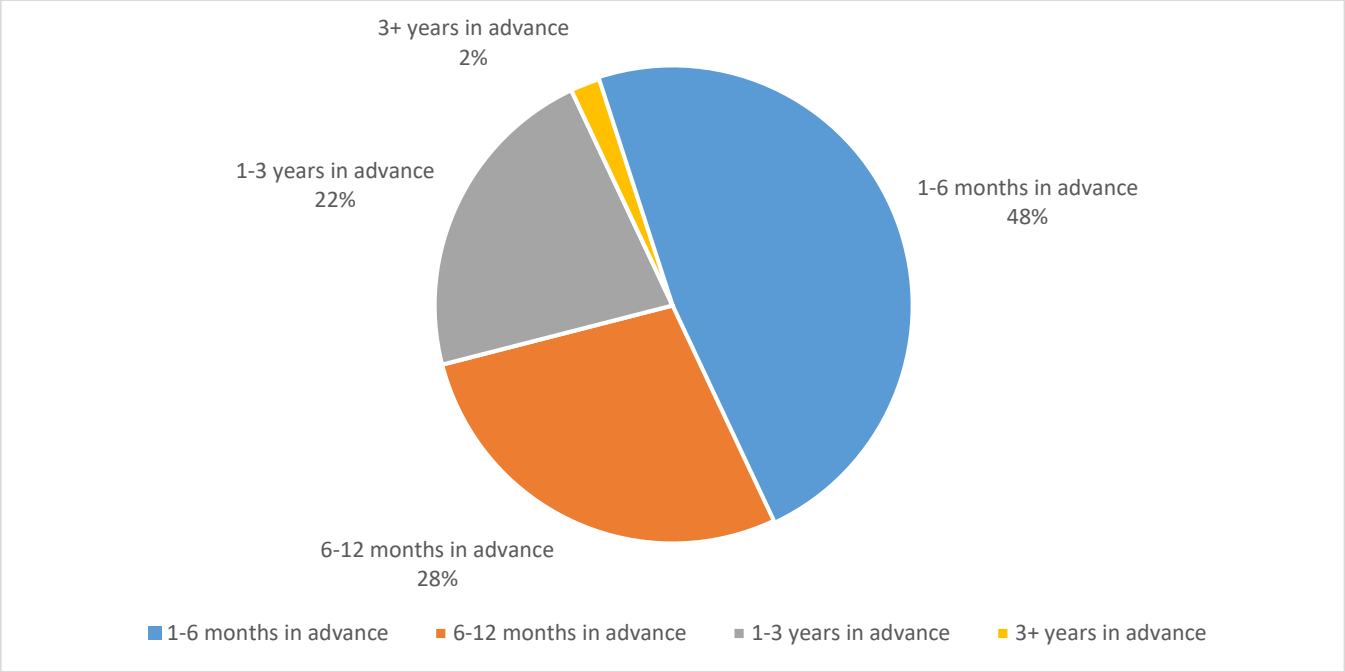

Figure 59. Scheduling of IDOT utility relocation projects reported by Illinois utility companies.

E.7.5 Comments on Duration, Timeline or Sequencing

Illinois utility company respondents were asked to provide any additional feedback on the duration, timeline or sequencing of IDOT utility relocation projects. The respondents comments are organized in Table 56.

Table 56. Additional Projects Scheduling Comments by Illinois Utility Companies

Additional comments	Number of responses
Request more communication	8
IDOT utility permitting process is time consuming	4
Advance notice and constant communication work well	1
Not enough time between final plans and contract start	1
Schedule and resources based on IDOTs MYP	1
Success with constant communication with IDOT officials	1
Total	**16**

The most repeated comment that was provided by eight Illinois utility company respondents was 'request more communication' from IDOT. These eight comments requested (a) improved communication from IDOT and IDOT designers; and (b) more communication of programming changes, environmental issues and advance projects. Four respondents reported in their comments that the IDOT permitting process is too time consuming and may take up to 3-4 months, and they requested improving the permitting process and/or utilizing a standardized permitting process. On the other hand, one respondent reported that they have experienced 'success with constant communication with IDOT officials'.

E.8 ADDITIONAL FEEDBACK AND COMMENTS

At the end of the survey, respondents were asked to (1) provide information on State owned facilities; (2) suggest any additional BMPs and incentives that were not listed in the survey; (3) provide any additional feedback; and (4) indicate if they wish to receive the main findings of this survey.

E.8.1 Locating State Owned Facilities

State DOT respondents were asked if their state requires the utility company to locate the State owned facilities or if the State locates their own facilities. The respondents were provided three options (1) State locates own facilities; (2) utility company locates state owned facilities; and (3) other with a fill-in response. The number of responses and percentages of each response are summarized in Table 57 and Figure 60. The survey results indicate that 85% of State DOT respondents locate their own facilities. No State DOTs reported that the utility company locates the state owned facilities. Four State DOTs responded with 'Other', their write-in responses notes that their 'states utilize third parties to locate State owned facilities.'

Table 57. Locating State Owned Facilities Reported by State DOT Respondents

Locating State Owned Facilities	Number of Responses	Percentage of Responses
Utility company locates State owned facilities	0	0.00%
State locates own facilities	23	85.19%
Other - Please Explain	4	14.81%
TOTAL	27	100.00%

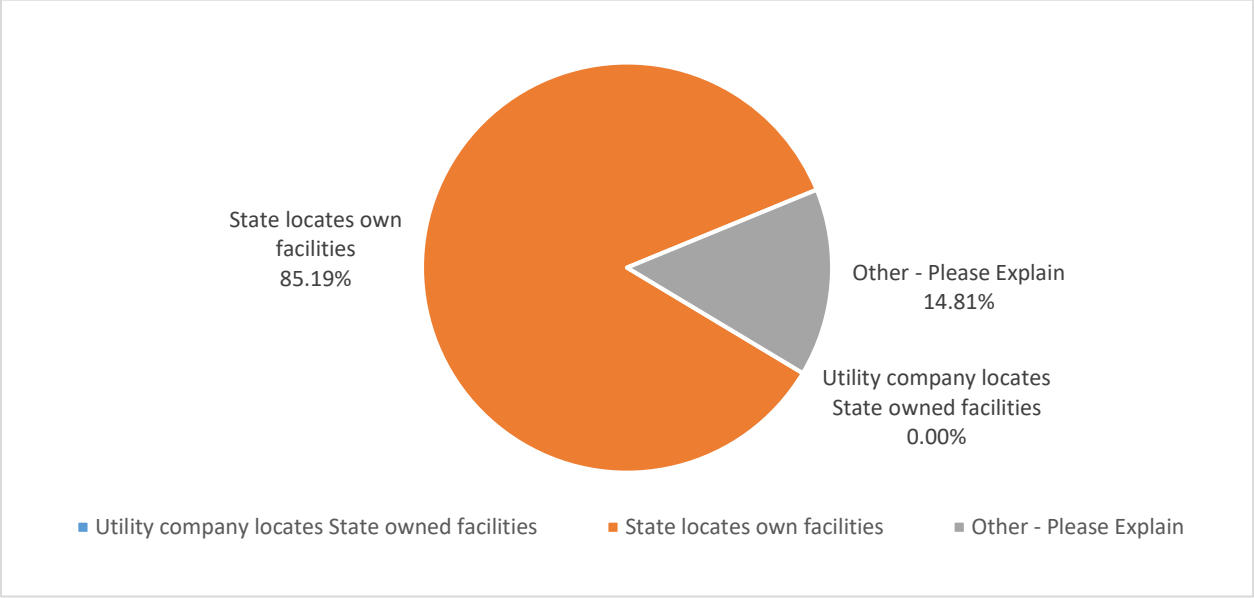

Figure 60. Locating state owned facilities reported by state DOTs.

E.8.2 Suggested BMPs and Incentives

Respondents were asked to suggest additional BMPs or incentives that were not listed in the survey that could have the potential to expedite utility relocation of DOT projects. The respondents provided six additional BMPs and incentives including two from state DOTs and four from Illinois utility companies, as shown in Table 58.

Table 58. Additional BMPs and Incentives by Survey Respondents

State DOTs	Illinois Utility Companies
Prepayments in advance of construction to secure materials with long-procurement times such as culverts	Extended work hours
On-Call Utility Contractors	Standardized IDOT electronic permit submittal
	Minimize program changes
	Continue utility coordination meetings

The two suggested BMPs by state DOT responses are (1) prepayments in advance of construction to secure materials with long-procurement times such as culverts; and (2) on-call utility contractors. The four suggested BMPs by Illinois utility companies are (a) extended work hours; (b) standardized IDOT electronic permit submittal; (c) minimize program changes; and (d) continue utility coordination meetings. The Illinois utility company respondent who suggested 'extended work hours' noted that longer work days would be helpful on "linear utility relocation projects" with "long durations".

E.8.3 Additional Feedback

Survey respondents were asked to provide any additional comments regarding utility relocation BMPs and incentives. The respondents provided 11 comments including five from state DOTs and six from Illinois utility companies, as shown in Ta**ble** 59.

Table 59. Additional Feedback Provided by Survey Respondents

State DOTs	Illinois Utility Company
Clearing and grubbing in advance of the construction project is a good practice	Earlier communication of projects allow local agencies to budget accordingly
Early coordination helps cooperation between DOTs and Utility Companies	Provide more qualified personnel
Delays can have compounding effects	We are 100% in the public ROW and move at our expense
State laws should govern obligations of utilities and reimbursements.	Penalties are more common than incentives
Varying laws and regulations prohibit some of these BMPs	Have not experienced any delays or problems on projects
	Experienced success with specific IDOT districts

The additional comments provided by the state DOT respondents included favorable feedback on the effectiveness of two of the aforementioned BMPs: (1) clearing, grubbing, staking, grading; and (2) communication, coordination, cooperation (see Table 59). Other the other hand, two state DOT respondents noted that laws and regulations may prohibit the use of a few of the listed financial incentives. A thorough review of the state and federal compliance of these BMPs and incentives is discussed in Chapter 5 of this report. The feedback provided by the Illinois utility company

respondents included favorable comments that include 'experienced success with specific IDOT districts' and 'have not experienced any delays or problems on projects', as shown in Table 59. Another respondent requested 'more qualified personnel'.

E.8.4 Locating State Owned Facilities

As the final question of the survey, respondents were asked if they are interested in receiving the main findings of this survey. The responses and their percentages are summarized in Table 60. The survey results show that 92.3% of state DOT respondents are interested in receiving the main findings of the collected data on BMPs and incentives. This indicates that other state DOTs are experiencing similar utility relocation issues and may be considering the use of BMPs and incentives to expedite their projects. On the other hand, 56.0% of Illinois utility companies expressed interest in receiving the main findings of this survey.

Table 60. Requested Survey Results

Interested in Findings	State DOTs		Illinois Utility Companies	
	Number Reported	Percent	Number Reported	Percent
Yes	36	92.3%	28	56.0%
No	3	7.7%	22	44.0%
Total	**39**	**100%**	**50**	**100%**


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