Strategies and Recommendations for Integrating Utility and Environmental Processes at TxDOT

Workshop Presentation

Research Project 0-6065
"Integrating Utility Conflict Elimination and Environmental Processes"

Texas Transportation Institute

Transportation Operations Group

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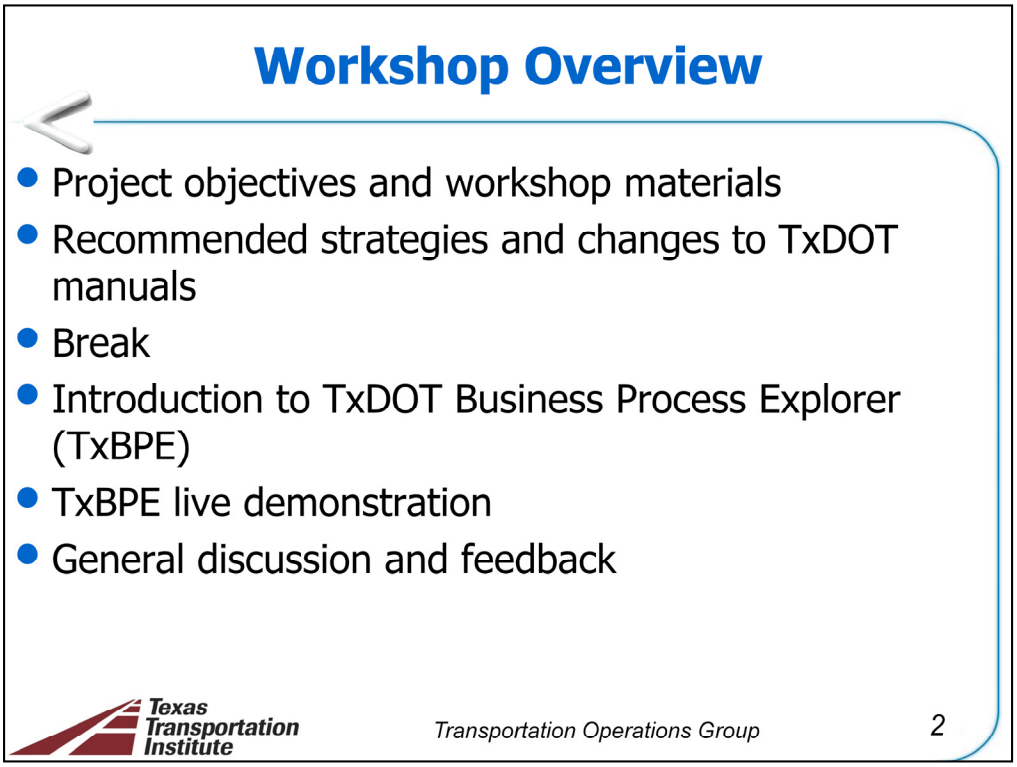
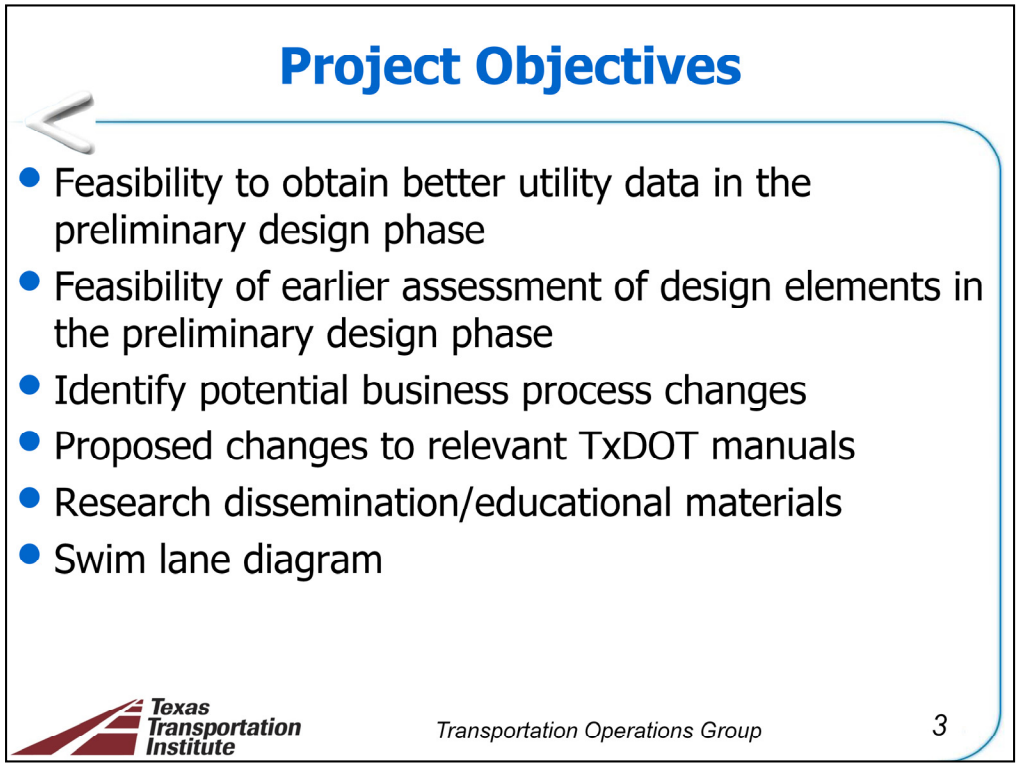
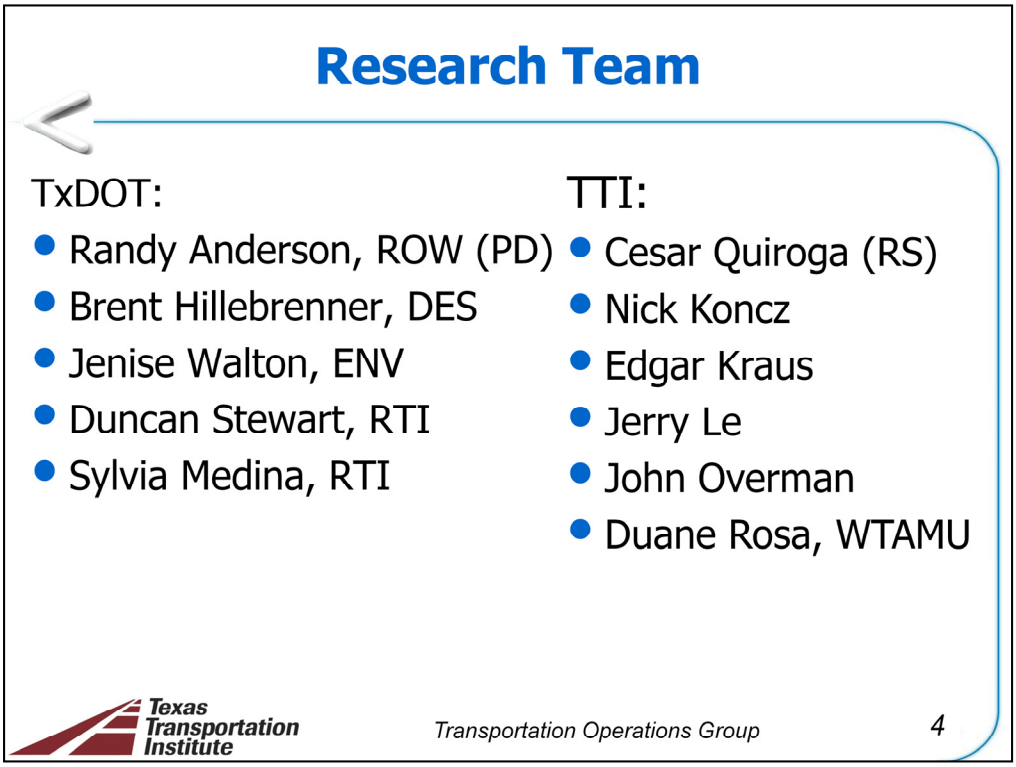


This workshop is one of the main products of research project 0-6065 "Integrating Utility Conflict Elimination and Environmental Processes." This slide describes the workshop agenda. The total anticipated duration is 2 hours, with a short 5-minute break after the first hour.



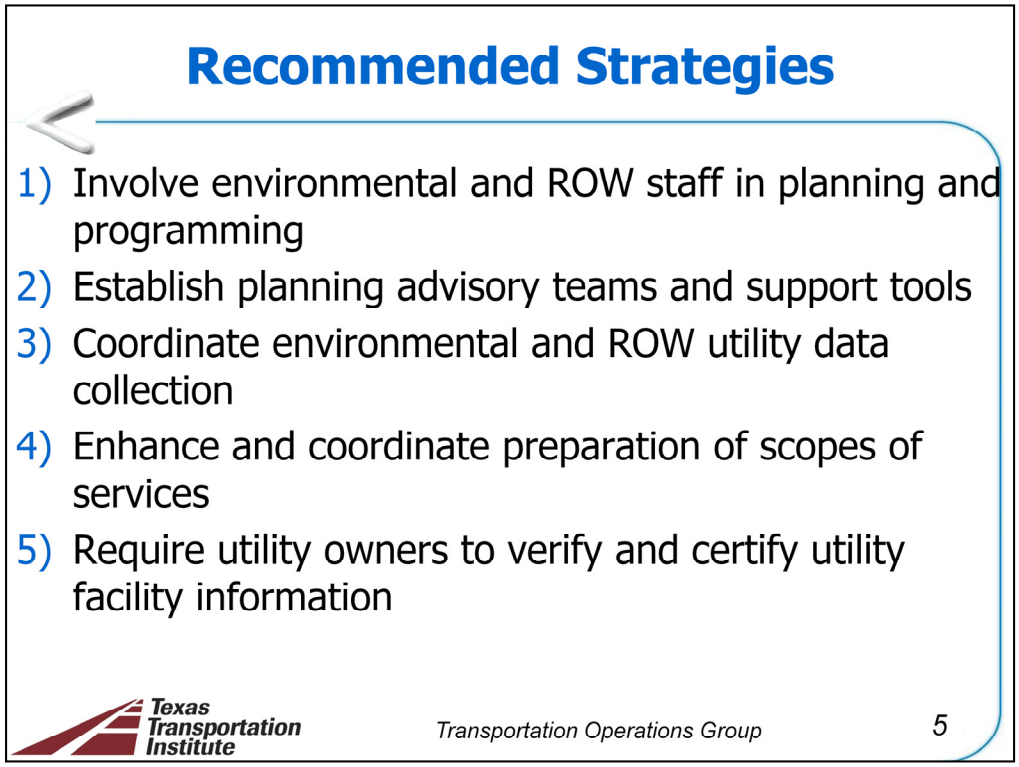
The objectives of Research Project 0-6065 were to:

- evaluate the feasibility to obtain better utility data in the preliminary design phase;
- evaluate the feasibility of earlier assessment of design elements in the preliminary design phase;
- identify potential business process changes in the project development process;
- develop proposed changes to relevant TxDOT manuals, including the Project Development Process Manual, the Environmental Manual, and the TxDOT Right of Way Division (ROW) Utility Manual;
- develop research dissemination and educational materials; and
- develop a business process model in the form of a swim lane diagram.



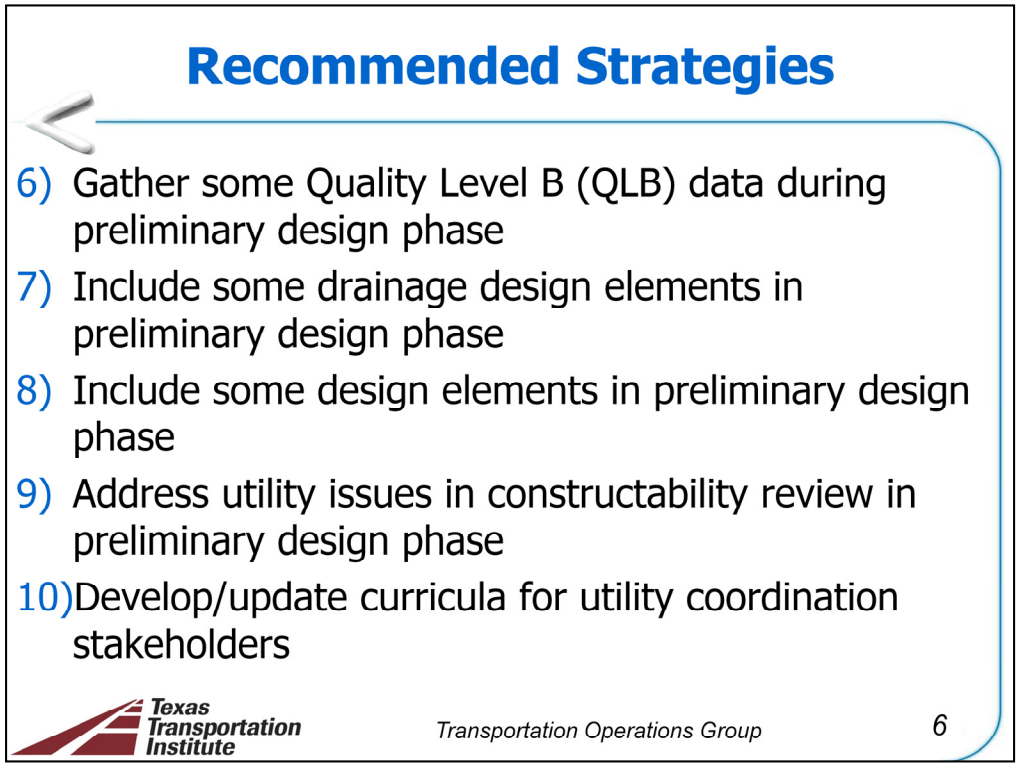
Randy Anderson was the Project Director at TxDOT.

Cesar Quiroga was the Research Supervisor at the Texas Transportation Institute (TTI).



The research project resulted in 10 recommended strategies. This slide lists the first five strategies:

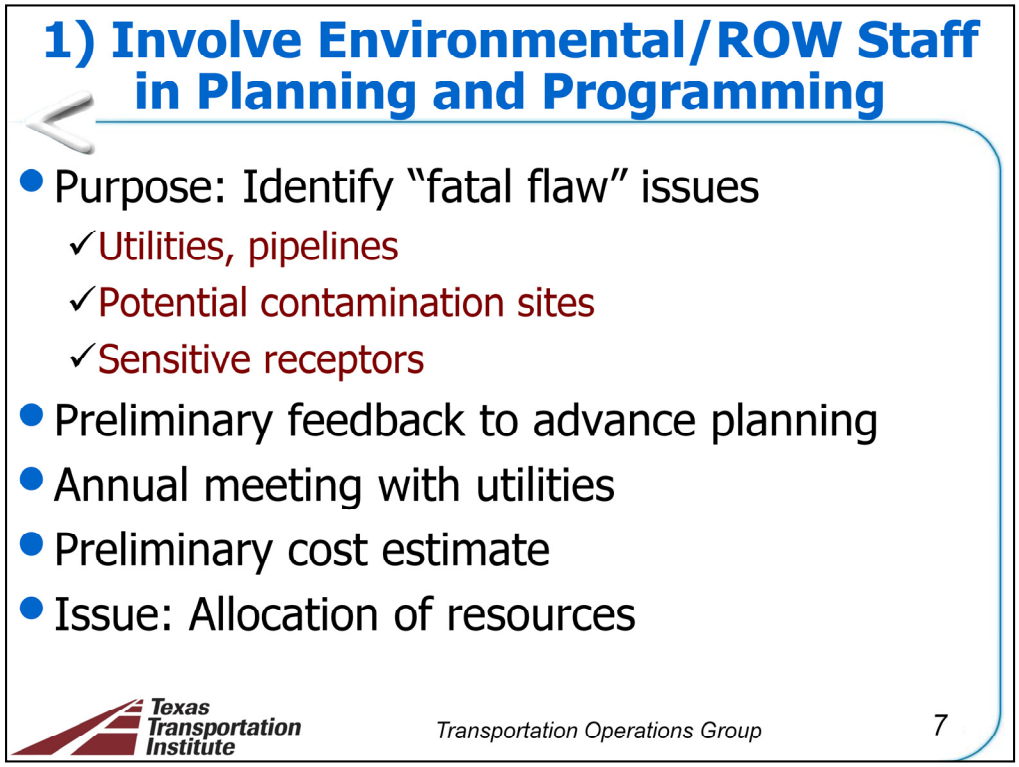
1. Involve environmental and ROW staff in planning and programming.
2. Establish planning advisory teams and support tools.
3. Coordinate environmental and ROW utility data collection.
4. Enhance and coordinate preparation of scopes of services.
5. Require utility owners to verify and certify utility facility information.



This slide lists the next five strategies:

6. Gather some QLB data during preliminary design phase.
7. Include some drainage design elements in preliminary design phase.
8. Include some design elements in preliminary design phase.
9. Address utility issues in constructability review in preliminary design phase.
10. Develop/update curricula for utility coordination stakeholders.

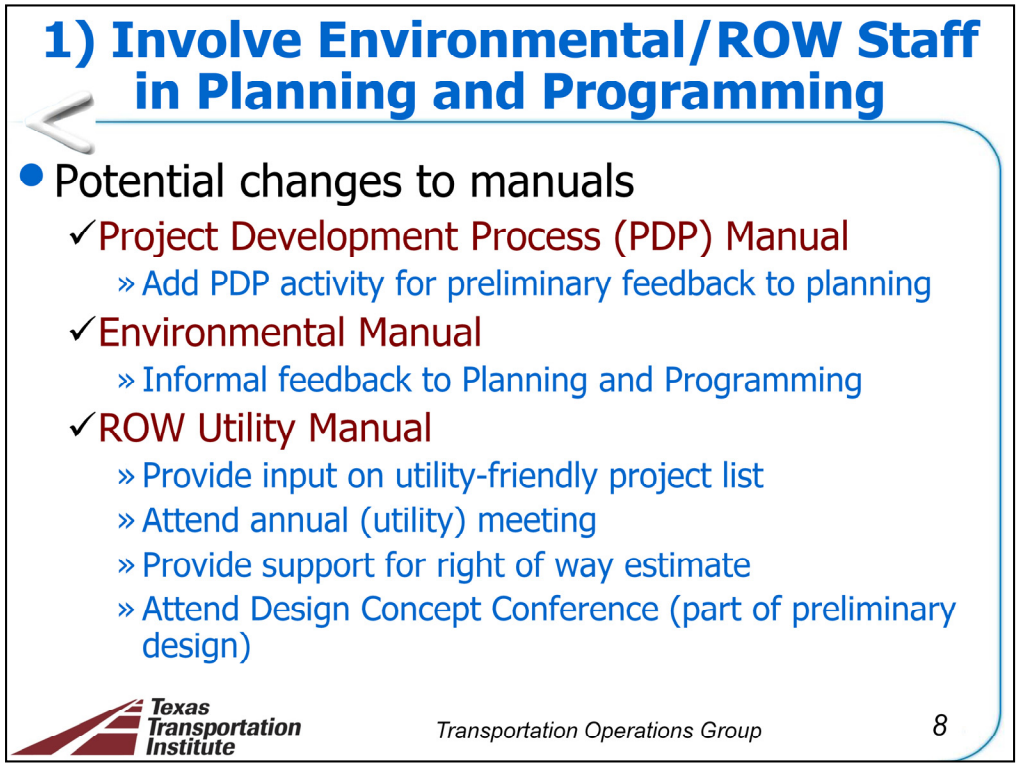
The next few slides discuss each strategy in detail, along with a summary of proposed changes to several manuals, in particular the Project Development Process Manual, the Environmental Manual, and the ROW Utility Manual.



Most right of way and environmental staff at TxDOT districts are only involved late in the preliminary design or even later in the design phase. Both environmental and right of way staff rarely become involved during the planning stages of a project.

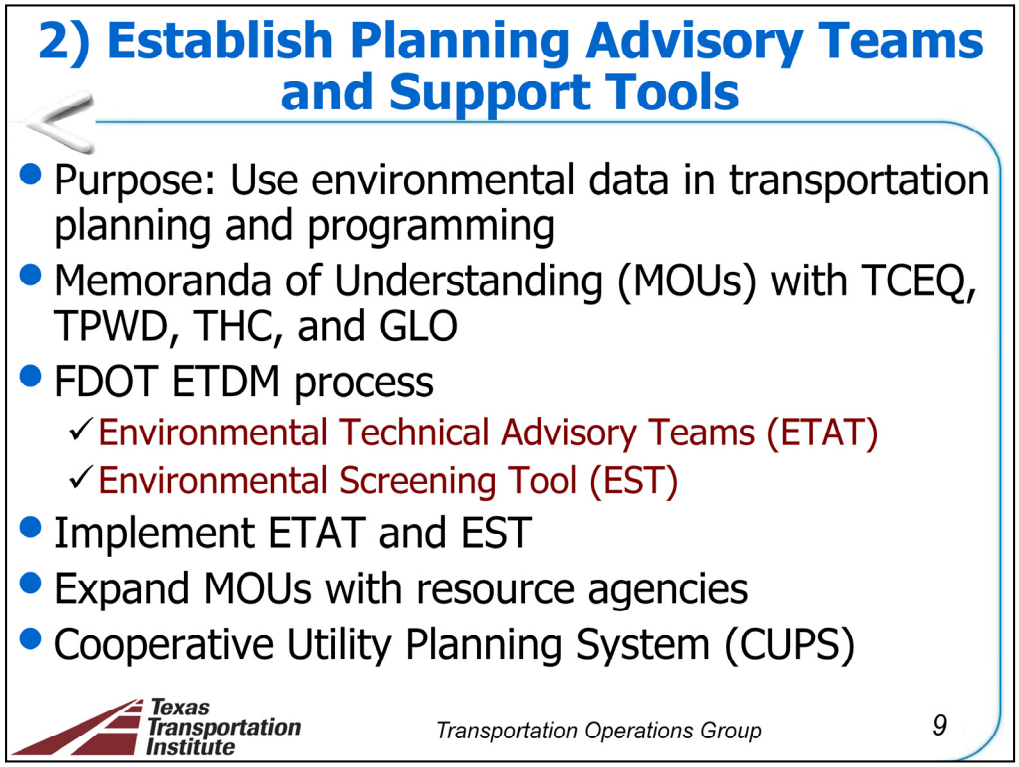
The purpose of involving right of way and environmental staff at this point in the project development process is to identify "fatal flaws" of a project. Right of way and environmental staff are very knowledgeable about issues that can delay a project significantly and may be able to point these out in the early stages of project development.

The idea is to engage environmental and right of way staff in a limited, but meaningful, capacity. Districts that are using this strategy conveyed that typically only a few hours are needed to review projects. The same staff could also be helpful in determining early cost estimates. Since typically there is not an account for right of way or environmental activities at this point, time would have to be charged to an advance planning or overhead account.



Potential changes to manuals include the following:

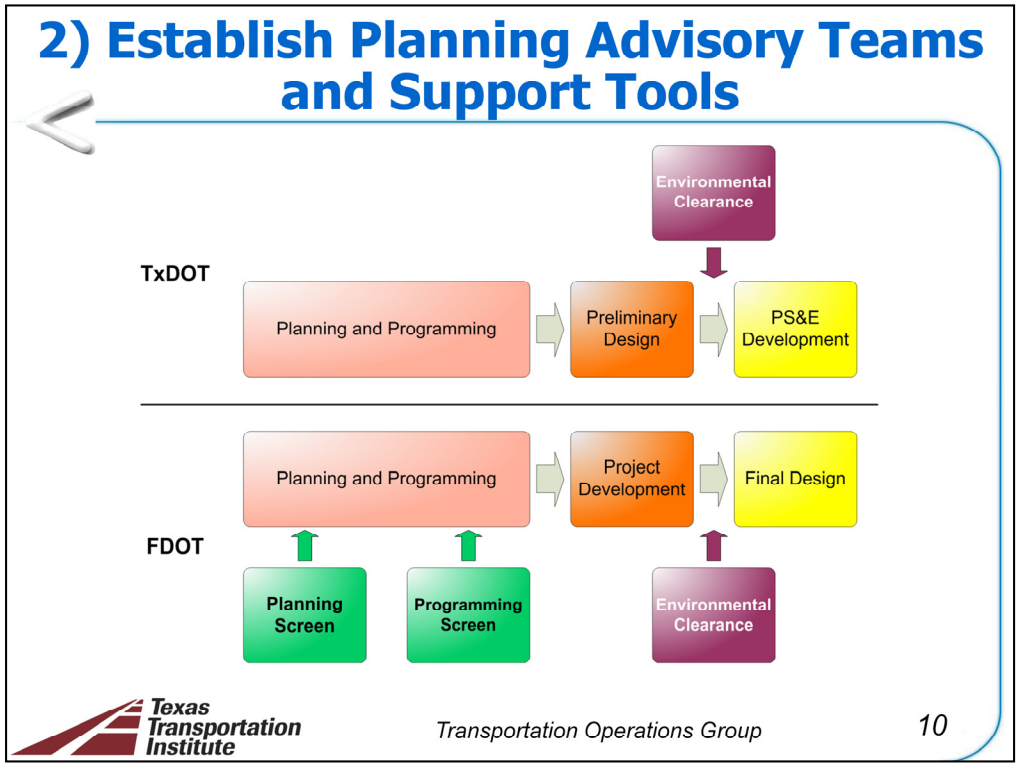
- There would be a new task in the Project Development Process (PDP) Manual that planning groups should request feedback from environmental and right of way staff.
- In the Environmental Manual, there would be references to provide informal feedback to the project planning and programming group.
- In the ROW Utility Manual, there would be references to provide input into the utility-friendly project list, attend the annual utility meeting, provide support for the right of way cost estimate, and attend project design concept conferences.



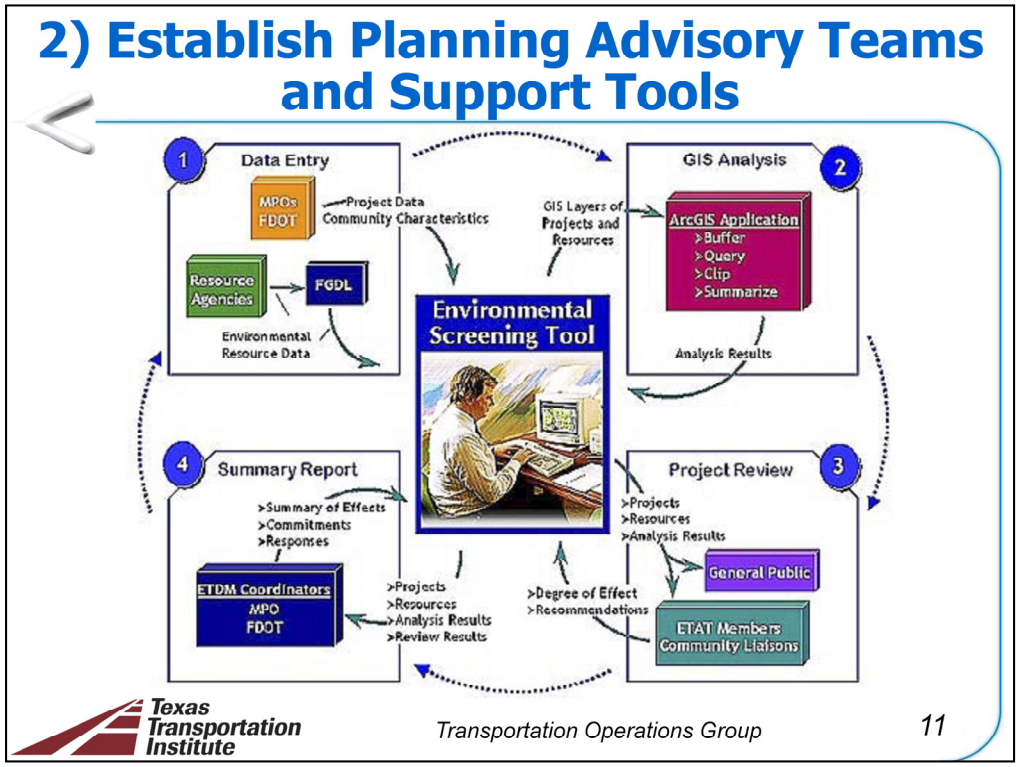
As part of the environmental process, TxDOT has MOUs with resource agencies such as the Texas Commission on Environmental Quality (TCEQ), the Texas Parks and Wildlife Department (TPWD), the Texas Historical Commission (THC), and the Texas General Land Office (GLO), which outline the roles and responsibilities of each party as well as the protocols for project review and feedback.

There is increasing interest in incorporating environmental process components into the planning and programming phase. The Florida DOT developed a process called Efficient Transportation Decision Making (ETDM), which enables Environmental Technical Advisory Teams (ETATs) to provide early feedback during the planning and programming phase using a web-based application called Environmental Screening Tool (EST). The following two slides describe this process in more detail. The strategy involves implementing the ETAT/EST approach at TxDOT and expanding MOUs with resource agencies to support that implementation.

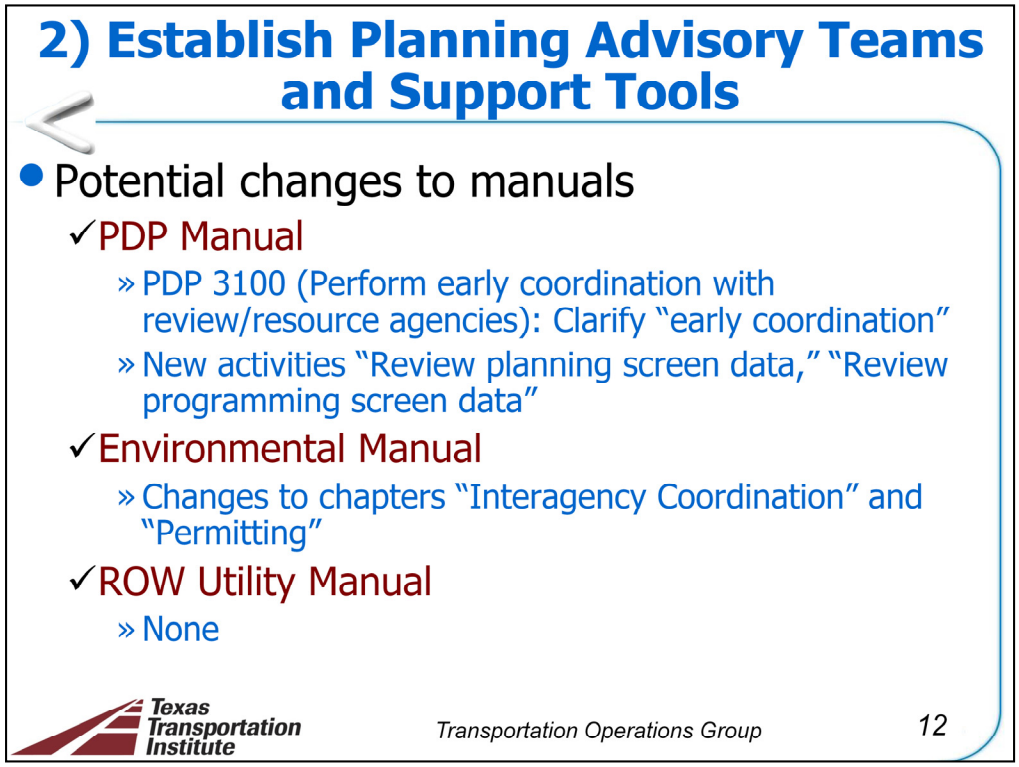
In the case of utilities, a similar web-based planning tool could be beneficial, although the focus and scope would be different because the relationship between TxDOT and the utility industry is not the same as that between TxDOT and resource agencies (e.g., resource agencies issue permits and play an oversight role, but the utility industry does not). To emphasize the cooperation and coordination aspects of the web-based planning tool for utilities, a suitable name for the application could be something like Cooperative Utility Planning System (CUPS).



In response to past major project delays and costly redesigns, the Florida project development process now provides two opportunities (i.e., a planning screen and a programming screen) for resource agencies to review project information during the planning and programming phase. This strategy enables resource agencies to get involved much earlier in the process, that is before the preliminary design phase.

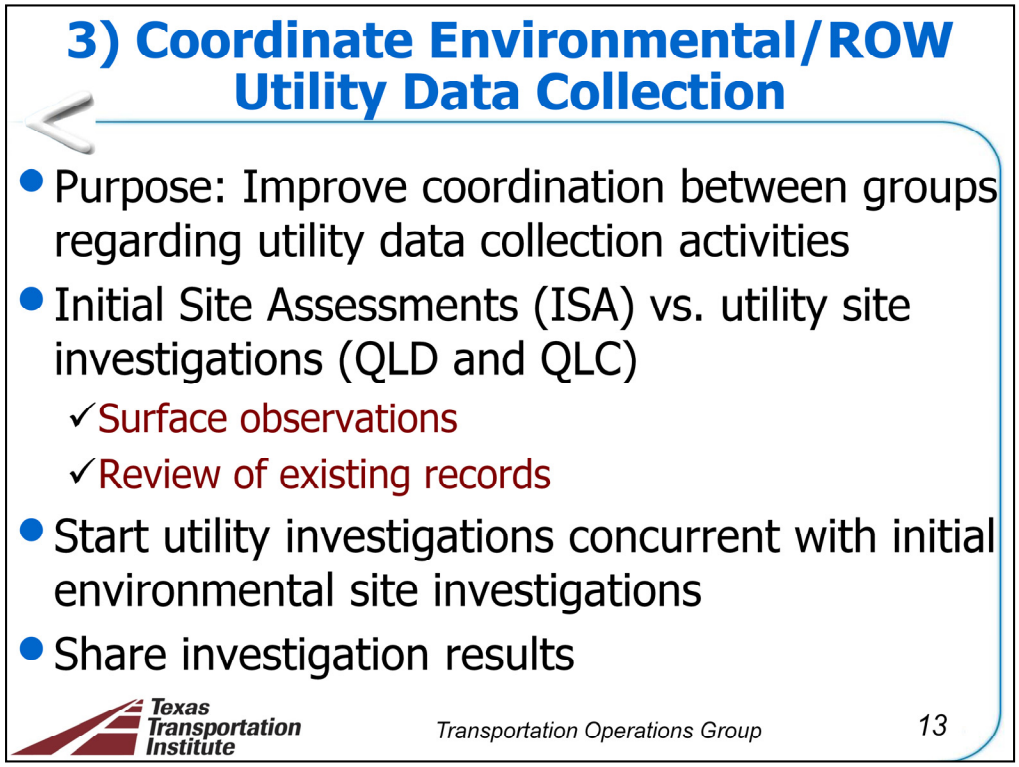


The way this process works is as follows: A Department of Transportation (DOT) official enters project information into the web-based EST system, followed by a Geographic Information System (GIS) analysis at the DOT. ETAT members then review the project information and provide feedback online, with a focus on the identification of potential "fatal flaws."



Recommended changes to manuals include a clarification of the term "early coordination" as described in PDP 3100, and new activities involving the screening of project data by resource agencies and feedback by utility companies during the planning phase.

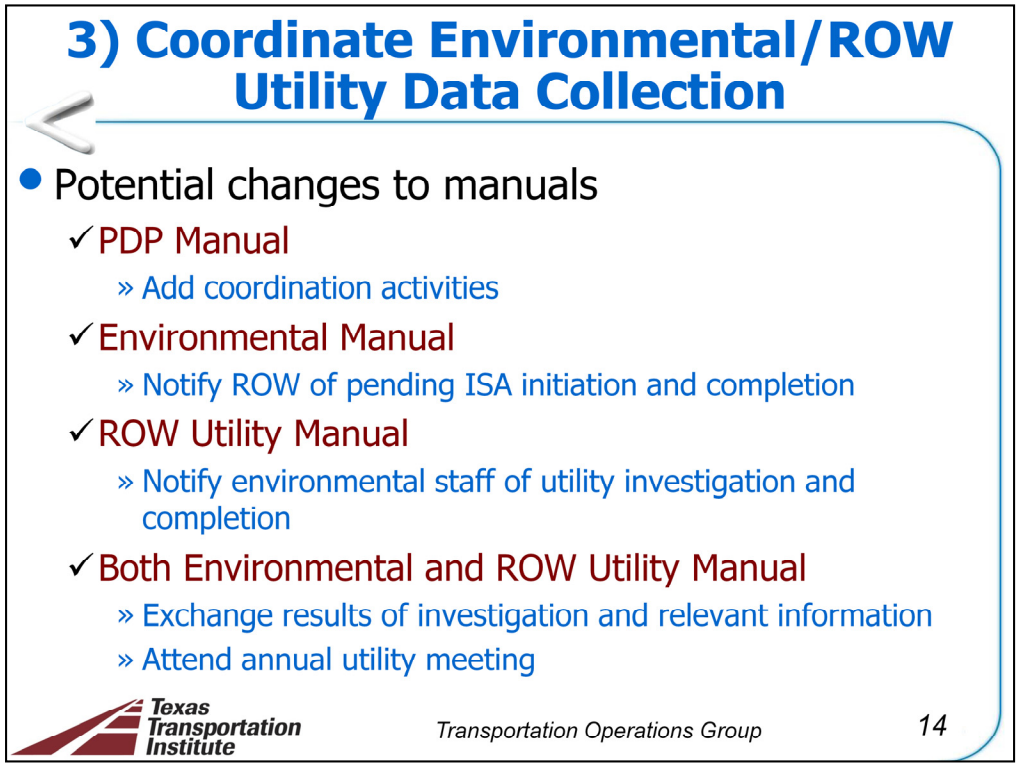
This change in process would also require changes to the Environmental Manual, specifically the sections "Interagency Coordination" and "Permitting."



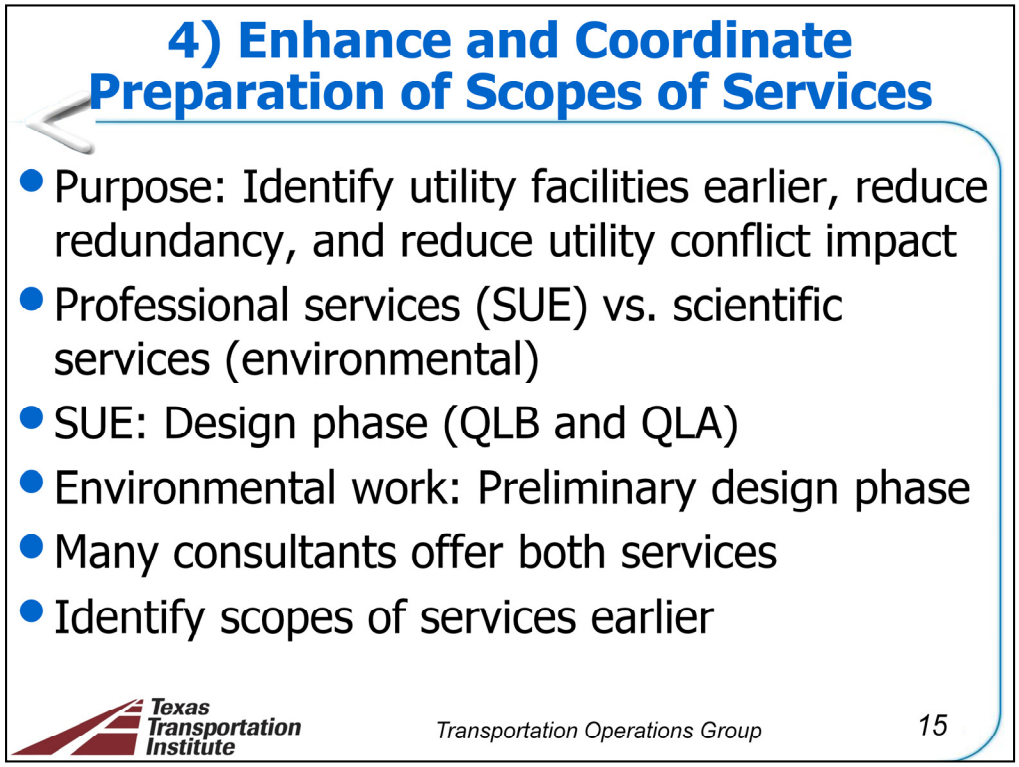
This strategy focuses on the coordination of environmental and right of way utility data collection. On the environmental side, there is data collection for the initial site assessment (ISA). On the utility side, there are subsurface utility investigations. Subsurface utility engineering (SUE) data can be collected at four quality levels, of which two quality levels are relevant here:

- QLD – existing data and oral records, and
- QLC – surveying visible utility appurtenances and making inferences about the pipes that connect the visible features.

The collection of QLD data can be easily coordinated between environmental and right of way staff if investigations start concurrently. Sharing of investigation results is important.

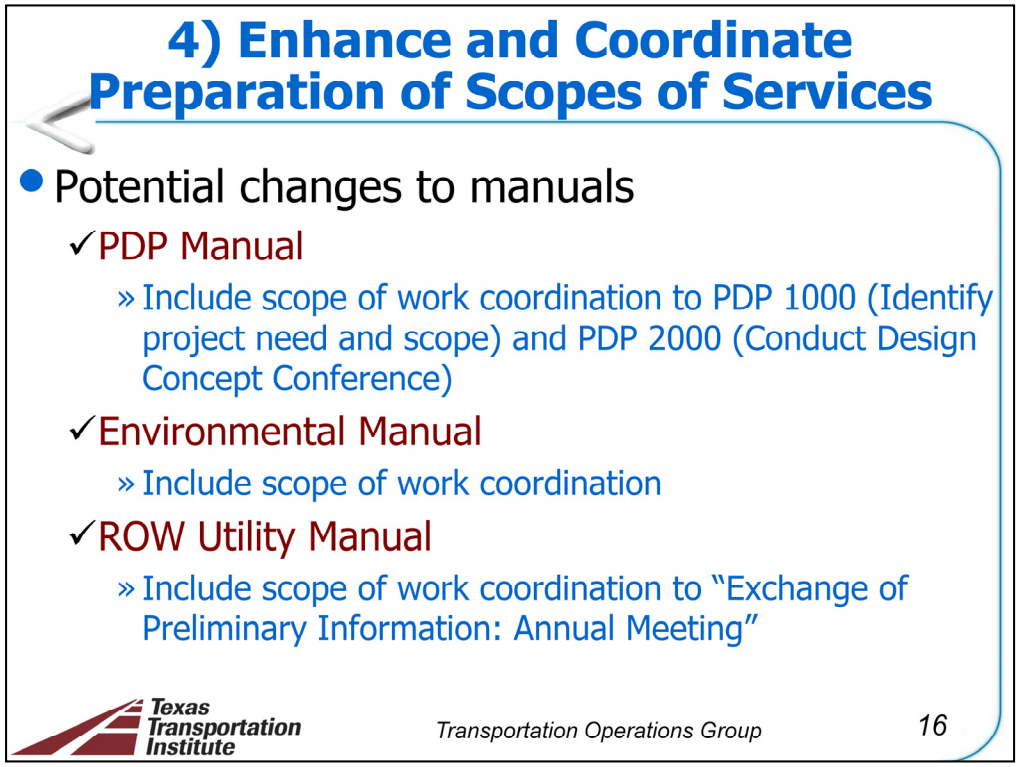


In terms of changes to existing manuals, a recommendation is to include wording in all three manuals to notify other groups of pending site assessment and data collection to coordinate activities.

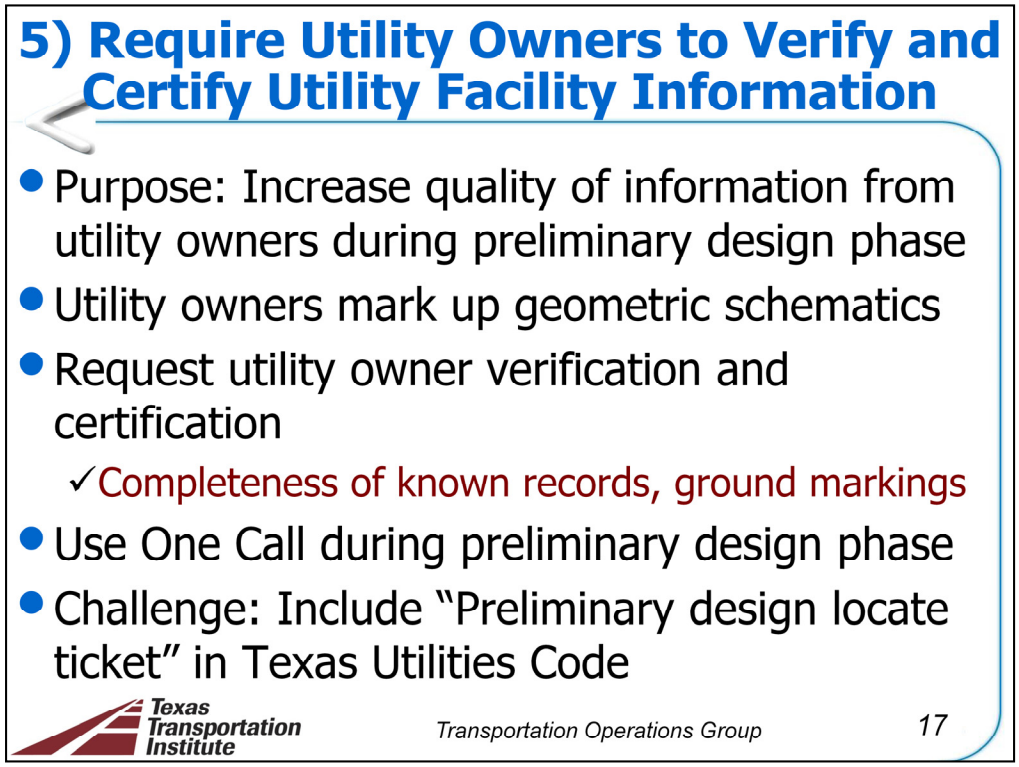


Environmental studies are considered scientific services. By comparison, utility investigations are frequently undertaken as professional services. Both types of services have different scopes, and the timing is typically different as well. SUE takes place mostly during the design phase (QLB and QLA), whereas the environmental work mostly takes place during the preliminary design phase.

However, in some cases, there may be an opportunity for cooperation and information exchange, for example, if the environmental study produces information that can assist with the gathering of utility information. A similar situation would arise if some QLB data could be collected during the preliminary design phase (see strategy description). If it is possible to identify scopes of services earlier, there may be an opportunity to provide linkages between the environmental and utility data collection.

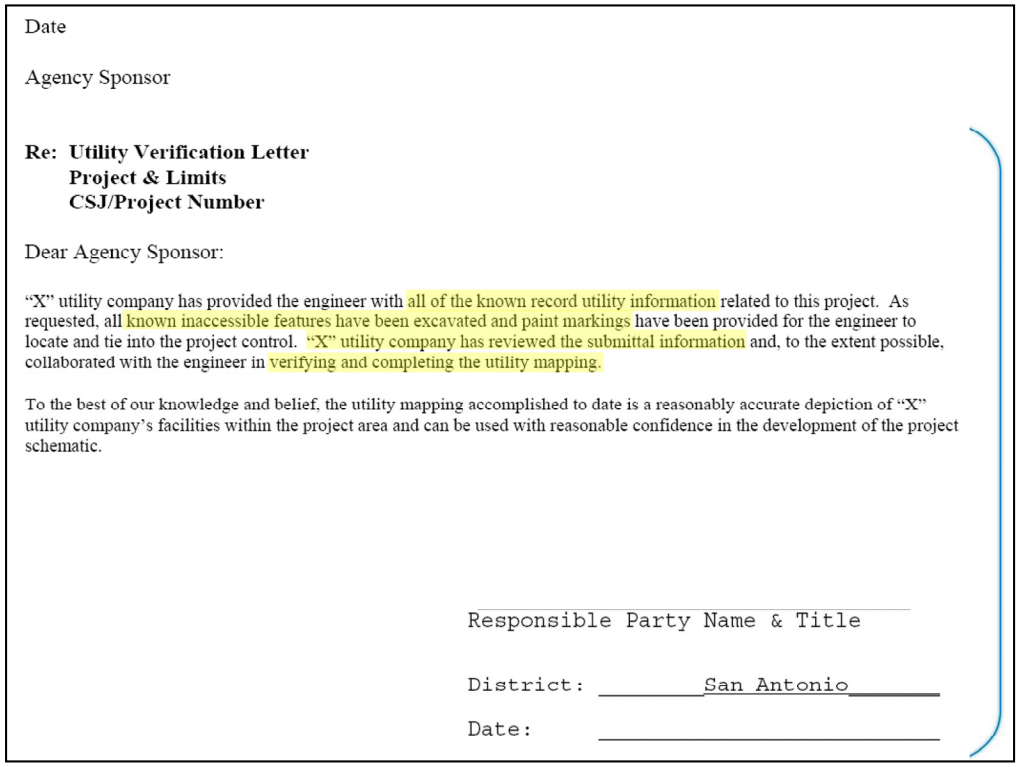


Potential changes to manuals include descriptions of the scope of work coordination in Tasks 1000 and 2000 of the PDP manual and similar references in the ROW Utility Manual and the Environmental Manual.



This strategy was a recommendation that came from the San Antonio District. The purpose of this strategy is to improve the quality of the data that districts receive from utility companies by making them more accountable for the type, amount, and quality information they provide.

Using One Call during preliminary design would be useful. However, there is currently no provision in the Texas Utilities Code that would make this possible. Other states already allow One Call design tickets (typically used during the design phase) and have had positive experiences with its implementation. A challenge for implementing this strategy, therefore, would be to work with the legislature to introduce changes in the Texas Utilities Code to enable design tickets and preliminary design locate tickets.



Date

Agency Sponsor

Re: Utility Verification Letter
Project & Limits
CSJ/Project Number

Dear Agency Sponsor:

"X" utility company has provided the engineer with all of the known record utility information related to this project. As requested, all known inaccessible features have been excavated and paint markings have been provided for the engineer to locate and tie into the project control. "X" utility company has reviewed the submittal information and, to the extent possible, collaborated with the engineer in verifying and completing the utility mapping.

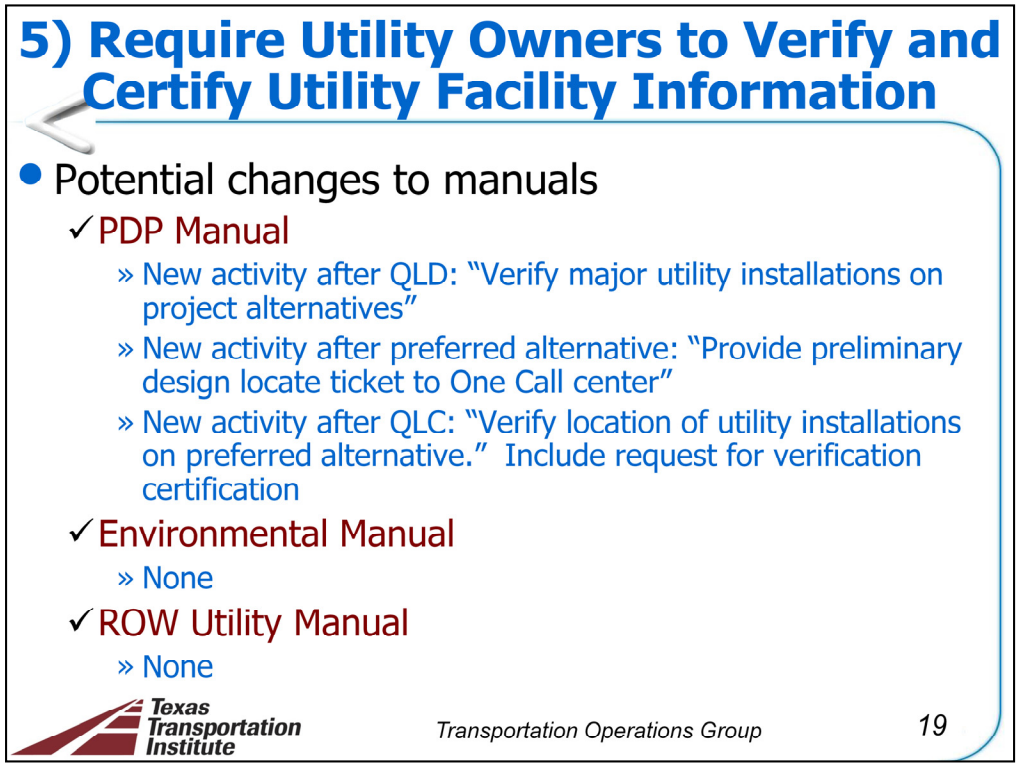
To the best of our knowledge and belief, the utility mapping accomplished to date is a reasonably accurate depiction of "X" utility company's facilities within the project area and can be used with reasonable confidence in the development of the project schematic.

Responsible Party Name & Title

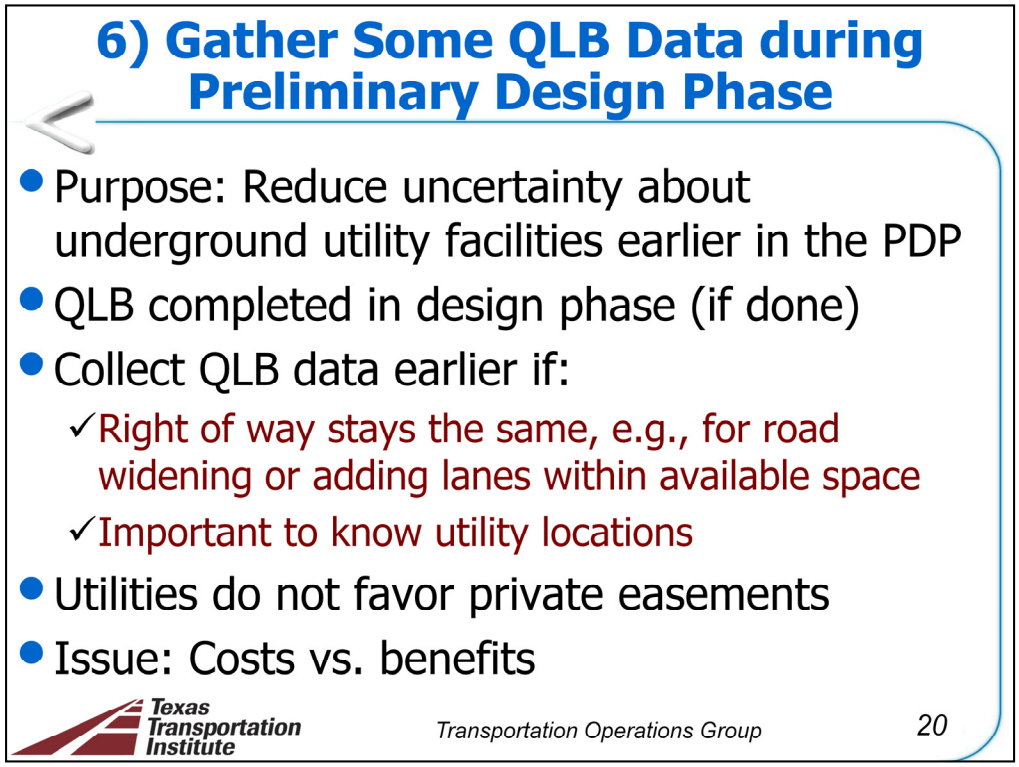
District: San Antonio

Date: _____

The San Antonio District sends out utility verification letters such as the one shown here. Some key elements in this letter are highlighted here, with the intention to get utility companies involved during the preliminary design stage of a project and ensure that the information provided by the utility is complete and correct.



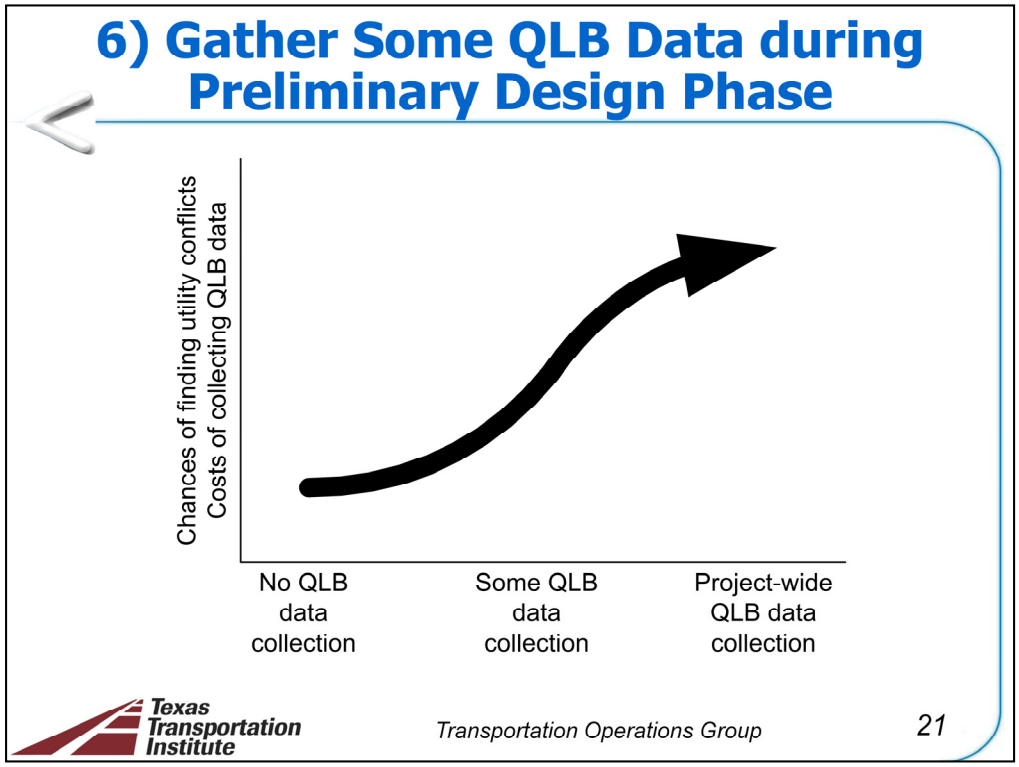
Potential changes to manuals include a new task in the PDP manual to require utility owners to verify major utility installations on project alternatives; a new task "Provide preliminary design locate ticket to one call center," subject to changes in the Texas Utilities Code; and a new activity "Verify location of utility installations on preferred alternative," including a certification of the information similar to the certification in use at the San Antonio District.



The purpose of this strategy is to help reduce the uncertainty about underground utility facilities earlier in the project development process.

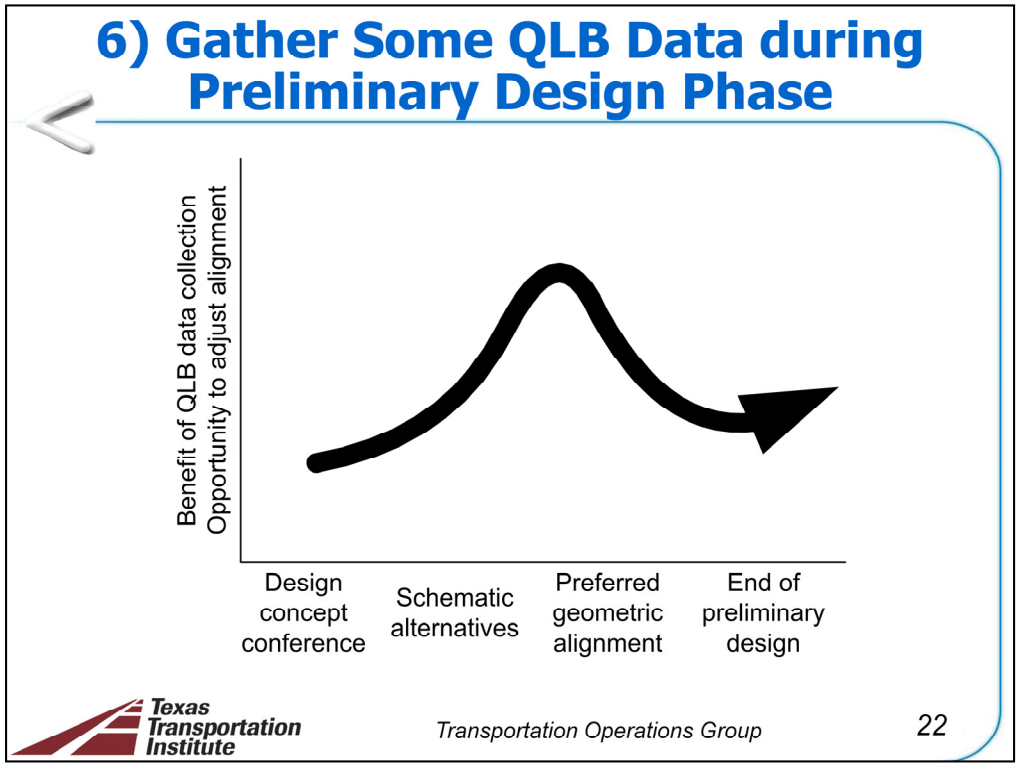
Normally, QLB is conducted during the design phase. Several national studies have documented the net benefits of using QLB in the design phase. Nonetheless, the benefit is not always immediately evident to project managers.

In situations where the right of way stays the same, i.e., there is no right of way acquisition, and there is indication about potential utility issues on the project, collecting QLB data in the preliminary design phase could be beneficial because it can help reduce the uncertainty regarding potential utility conflicts.



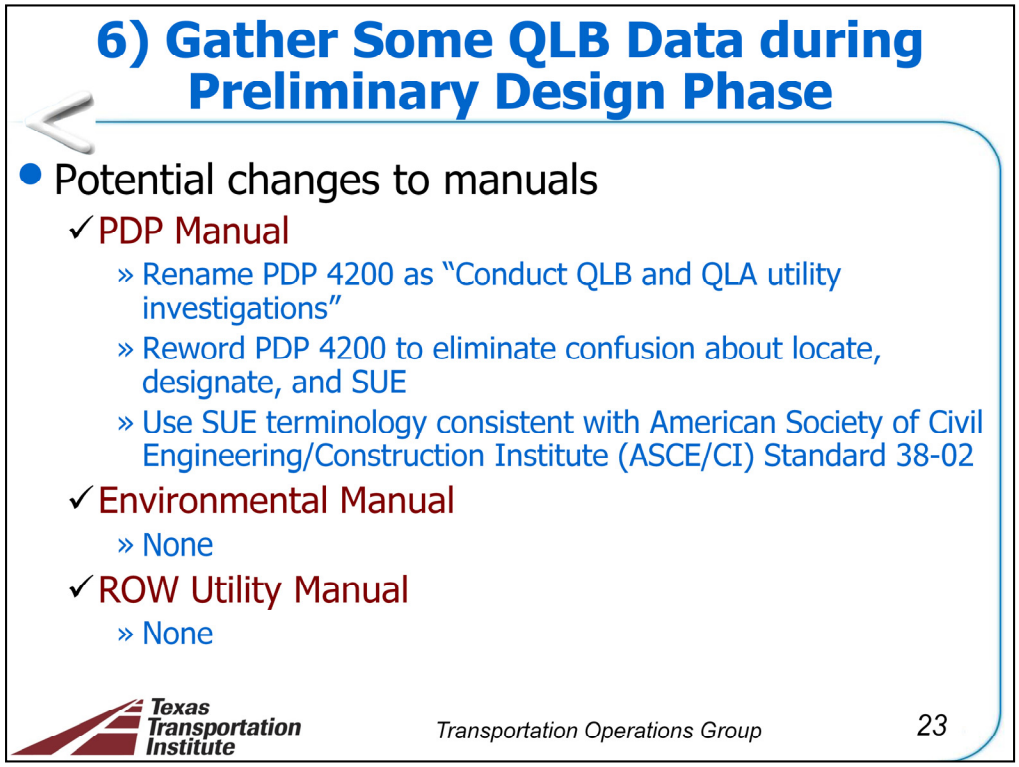
This figure shows both the chances of finding utility conflicts *and* the costs of collection QLB data as a function of QLB data collection extent. Note: Trend is descriptive in nature.

The chances of finding utility conflicts increase if one conducts some QLB data collection and are highest if one collects QLB data project-wide. Obviously, the cost increases as the extent of QLB data collection increases. The key is to identify specific locations where collecting QLB data might be most beneficial.

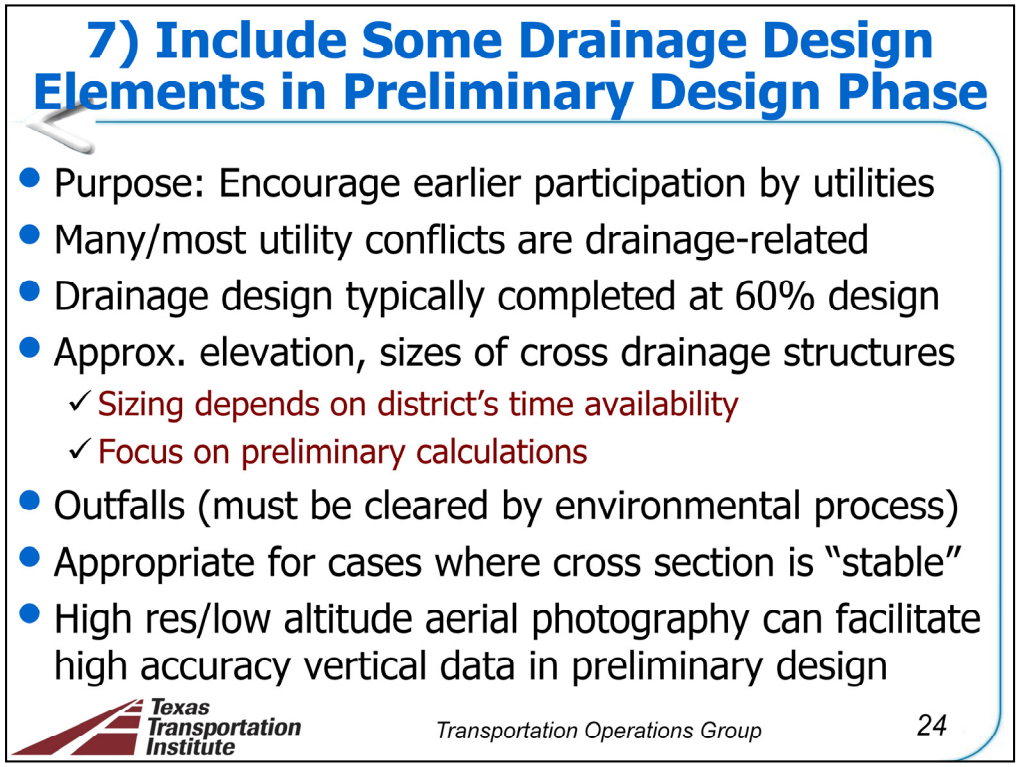


This figure shows the anticipated benefit of collecting QLB data during the preliminary design phase with regard to the opportunity to adjust the alignment.

The most benefit of QLB data collection could probably be realized around the time the project has a preferred geometric alignment, as shown by the peak in this graph. A second peak would occur during the design phase. Note: Trend is descriptive in nature.



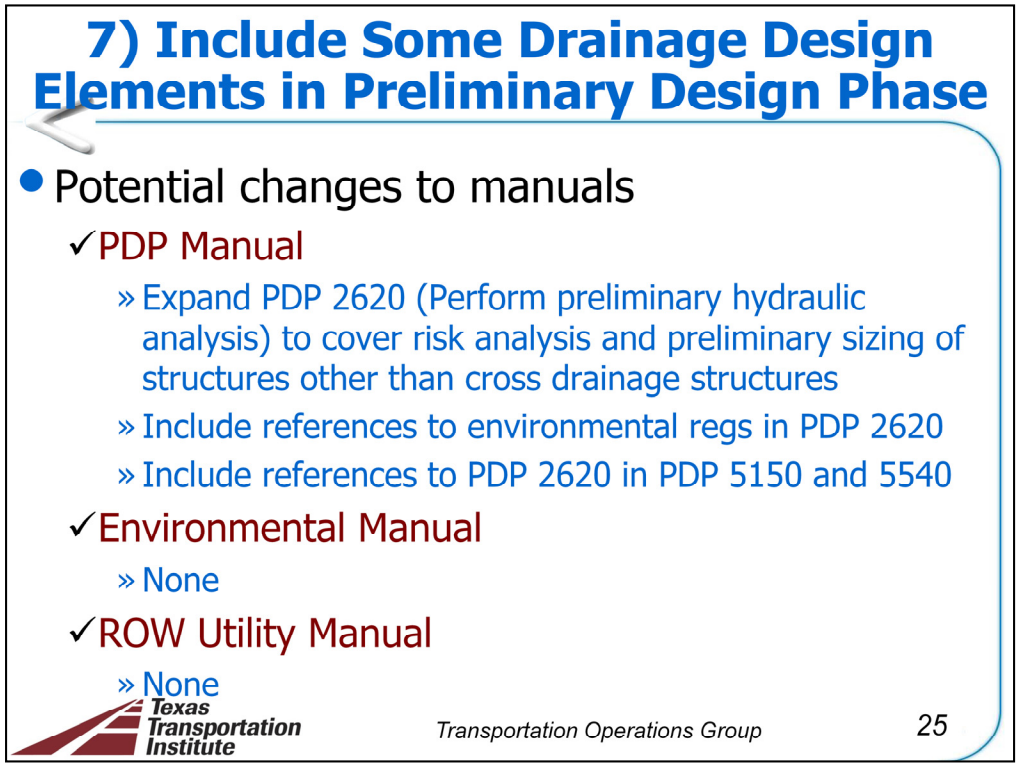
Potential changes to manuals include renaming PDP 4200 and removing some of the confusion about locate, designate, and SUE in the same task. Another recommendation is to use utility investigation terminology consistent with American Society of Civil Engineers/Construction Institute (ASCE/CI) Standard 38-02.



The purpose of this strategy is to encourage earlier participation of utilities in the project development process. Most utility conflicts are related to drainage design, which is typically completed around 60 percent design.

The Hydraulic Design Manual includes a section that enables sizing certain structures during the preliminary design phase. While some districts size some structures during the preliminary design phase, it is also common to leave all sizing activities for the design phase. In reality, certain structures such as outfalls must be cleared by the environmental process. In any case, it is clear that any sizing considerations during the preliminary design phase must be preliminary in nature to avoid preempting the environmental process.

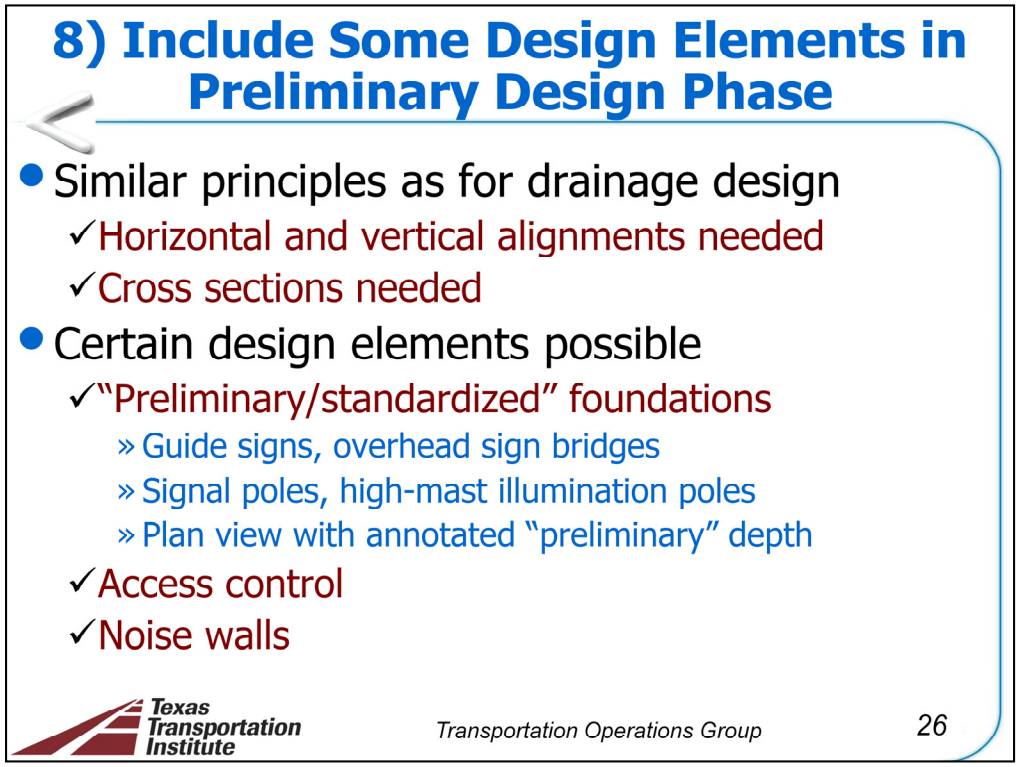
This strategy would be valid for cases where the cross section is stable (i.e., typically not for new location and reconstruction [4R] projects). A key to the success of this strategy is high-resolution, low-altitude aerial photography, although the data can be costly. Some districts share this data collection with other local public agencies, such as cities and counties, to make the cost bearable.



Potential changes to manuals include expanding PDP 2620 to cover a risk analysis and preliminary sizing of structures other than cross drainage structures, adding references to environmental regulations in PDP 2620, and adding references to PDP 2620 in PDP 5150 and PDP 5540.

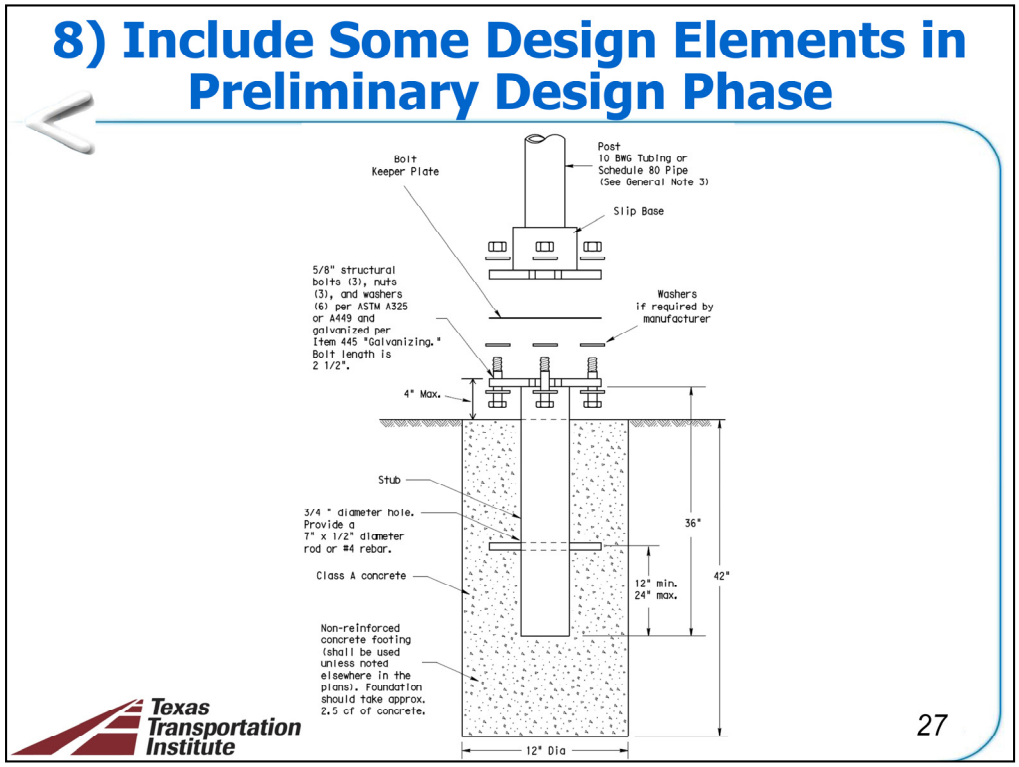
PDP 5150: Prepare stream crossing hydraulics

PDP 5540: Prepare hydraulic design for culverts and storm drains



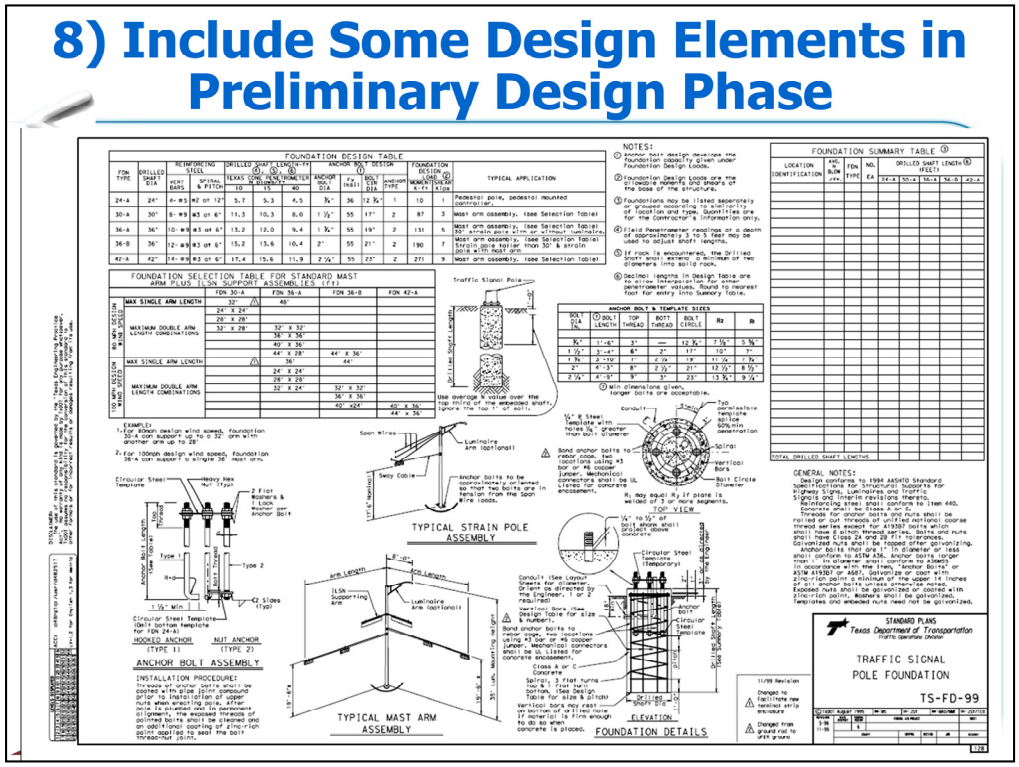
It is critical not to preempt the environmental process during preliminary design. This reason explains why, in general, districts do not show structures such as illumination, Intelligent Transportation Systems (ITS) infrastructure, or signal details on schematics. Some districts do include control of access lines, guide signs (which they send to the operations section for review and comment, e.g., regarding spacing requirements), as well as noise walls.

It should be possible to show information about certain standardized foundations on preliminary schematics, including guide signs, overhead sign bridges, and sign poles, because those foundations tend to be standardized. In fact, utilities and other stakeholders (including environmental stakeholders) can benefit from that information. The objective is not to replicate the standard details on schematics, but only relevant information that can be used to determine potential impacts, e.g., foundation footprints and typical depths.



For example, in the case of sign posts, the standard detail provides foundation dimensions (42 inches in depth and 12 inches in diameter). Showing relevant information on preliminary engineering design schematics (e.g., a dotted circle 12 inches in diameter on a plan view and/or a note indicating the sign post's typical foundation dimensions) could help utilities and other stakeholders determine if there is a potential conflict with existing and/or proposed utility installations.

Notice that the intent is to show typical foundation requirements on the schematic, not to replicate the detail (which is part of the design phase).



Another example is a traffic signal pole foundation. The following slide shows a zoomed in view of the the foundation design table.

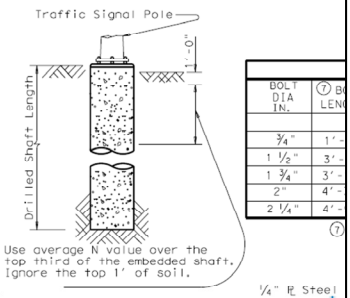
8) Include Some Design Elements in Preliminary Design Phase

FOUNDATION DESIGN TABLE

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL		DRILLED SHAFT LENGTH ft ④, ⑤, ⑥			ANCHOR BOLT DESIGN ①				FOUNDATION DESIGN LOAD ②		TYPICAL APPLICATION
		VERT BARS	SPIRAL & PITCH	TEXAS CONE PENETROMETER N blows/ft 10	15	40	ANCHOR BOLT DIA	Fy (ksi)	BOLT CIR DIA	ANCHOR TYPE	MOMENT K-ft	SHEAR Kips	
24-A	24"	4- #5	#2 at 12"	5.7	5.3	4.5	¾"	36	12 ¾"	1	10	1	Pedestal pole, pedestal mounted controller.
30-A	30"	8- #9	#3 at 6"	11.3	10.3	8.0	1 ½"	55	17"	2	87	3	Mast arm assembly. (see Selection Table)
36-A	36"	10- #9	#3 at 6"	13.2	12.0	9.4	1 ¾"	55	19"	2	131	5	Mast arm assembly. (see Selection Table) 30' strain pole with or without luminaire.
36-B	36"	12- #9	#3 at 6"	15.2	13.6	10.4	2"	55	21"	2	190	7	Mast arm assembly. (see Selection Table) Strain pole taller than 30' & strain pole with mast arm
42-A	42"	14- #9	#3 at 6"	17.4	15.6	11.9	2 ¼"	55	23"	2	271	9	Mast arm assembly. (see Selection Table)

FOUNDATION SELECTION TABLE FOR STANDARD MAST ARM PLUS ILSN SUPPORT ASSEMBLIES (ft)

		FDN 30-A	FDN 36-A	FDN 36-B	FDN 42-A
80 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH	32' ⚠1	48'		
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS	24' X 24'			
		28' X 28'			
		32' X 28'	32' X 32'		
			36' X 36'		
			40' X 36'		
			44' X 28'	44' X 36'	
100 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH	⚠1	36'	44'	
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS		24' X 24'		
			28' X 28'		
			32' X 24'	32' X 32'	
				36' X 36'	
				40' x24'	40' X 36'
					44' x 36'



BOLT DIA IN.	⑦ B LEN
¾"	1'-
1 ½"	3'-
1 ¾"	3'-
2"	4'-
2 ¼"	4'-

⑦

¼" ℄ Steel

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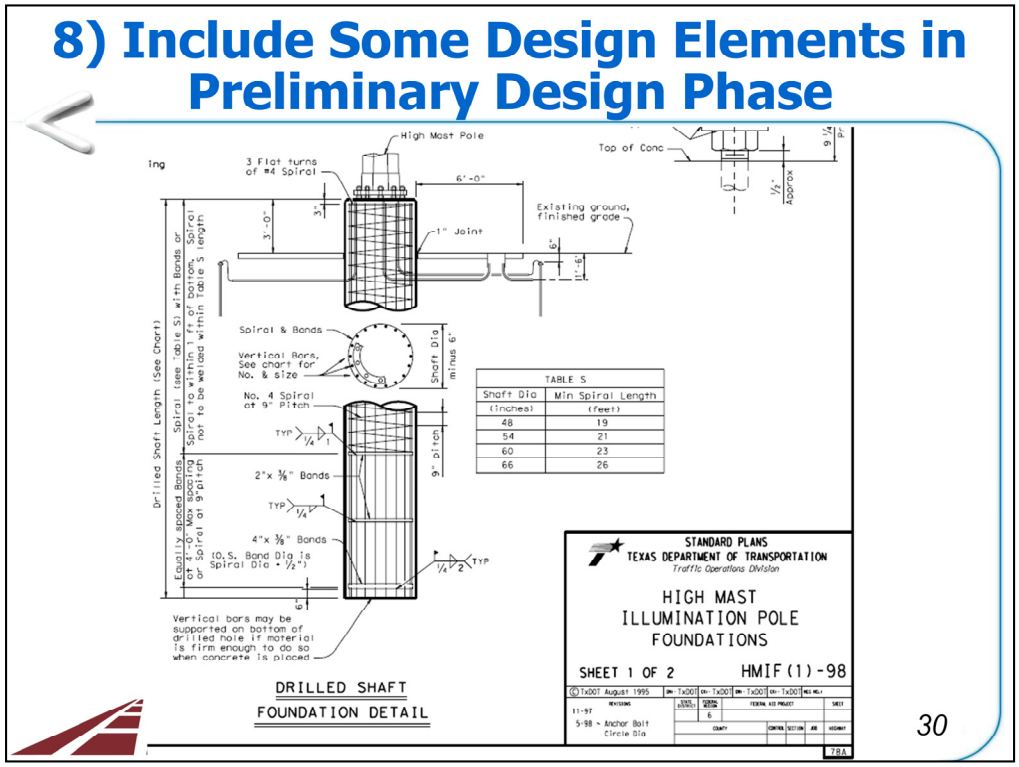
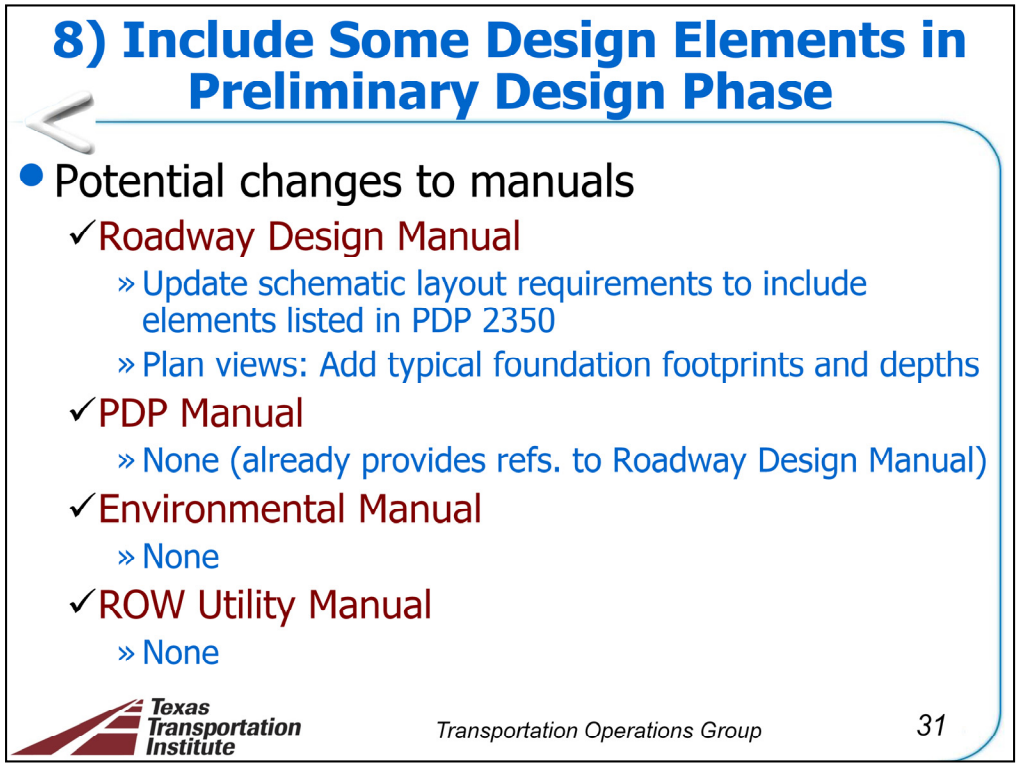
Depending on soil conditions, the requirement for shaft diameter and minimum depth could change. However, based on a general understanding of the project's soil conditions, a schematic could include a note indicating "preliminary" drilled shaft diameters and lengths (or a note indicating that, depending on soil conditions, drilled shaft diameters could be up to "X" inches and drilled shaft lengths could be up to "Y" feet).



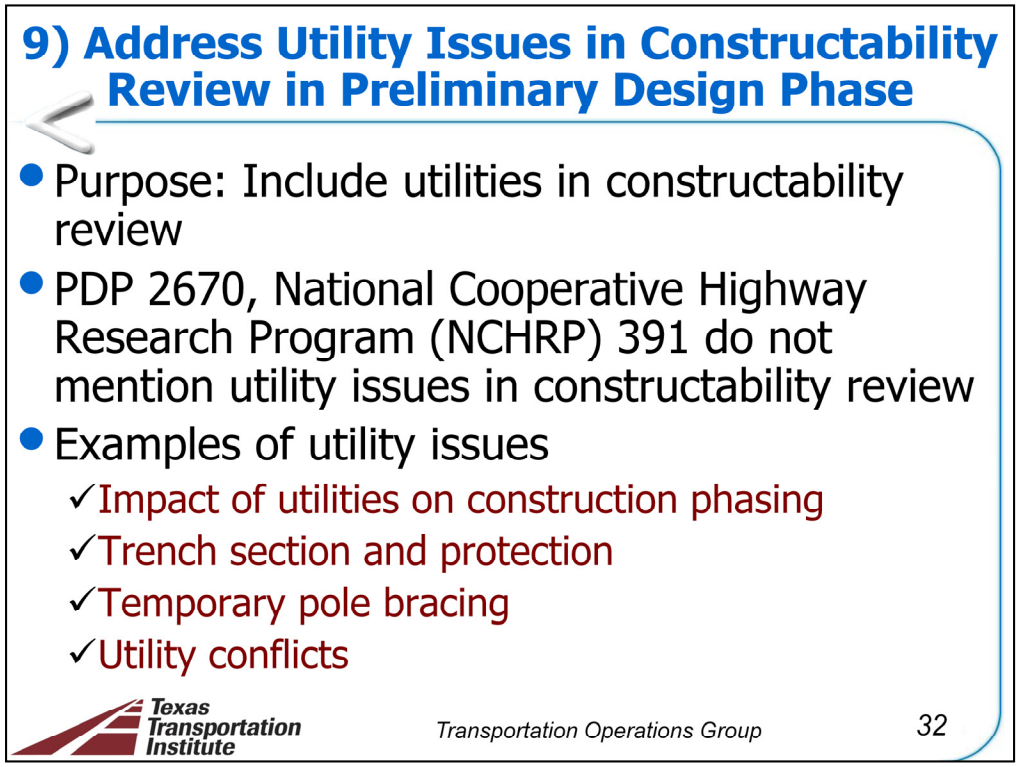
Another example is a high mast illumination pole foundation. As with the previous examples, the schematic could provide a note indicating typical, preliminary, or anticipated maximum shaft diameters and depths. The schematic plan view could also include a dotted circle representing the foundation footprint.



Potential changes to manuals include changes to the Roadway Design Manual, more specifically updating schematic layout requirements to include elements such as drainage structures and project constraints, which are listed in Task PDP 2350, and add typical foundation footprints and depths.

Notice that PDP 2350 (Evaluate geometric alternatives) applies to new location, added capacity, or controlled-access projects or projects requiring an Environmental Impact Statement (EIS). However, the proposed update to the Roadway Design Manual does not need to be limited to those types of projects.

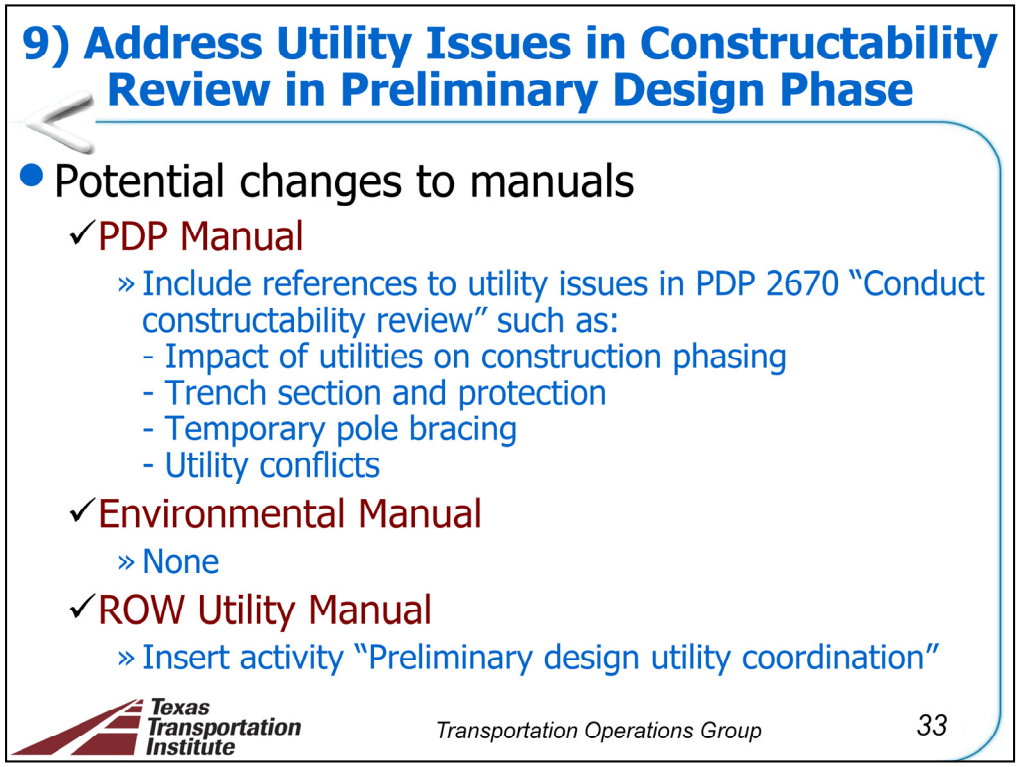
The PDP Manual already provides adequate references to the Roadway Design Manual, making it unnecessary to make changes in the PDP Manual. No changes are needed for the Environmental Manual or the ROW Utility Manual.



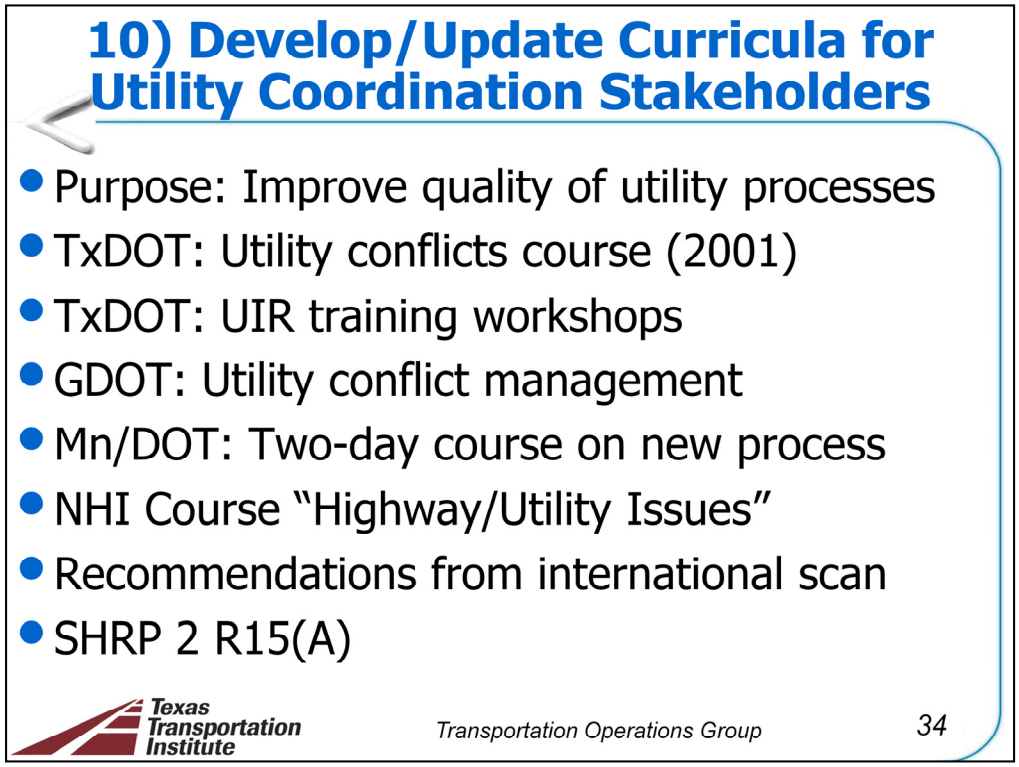
Task PDP 2670 "Conduct constructability review" in the PDP Manual does not mention utilities. Further, PDP 2670 references the National Cooperative Highway Research Program (NCHRP) 391 report, but this report does not mention utility issues.

Realistically, information about utilities during the constructability review could be highly beneficial. For example, a project requiring the adjustment of gas and sewer lines could benefit from a constructability review to determine the sequence of adjustments. Examples of utility issues that could be included in the constructability review include the following:

- impact of utilities on construction phasing,
- trench section and protection,
- temporary pole bracing, and
- utility conflicts.

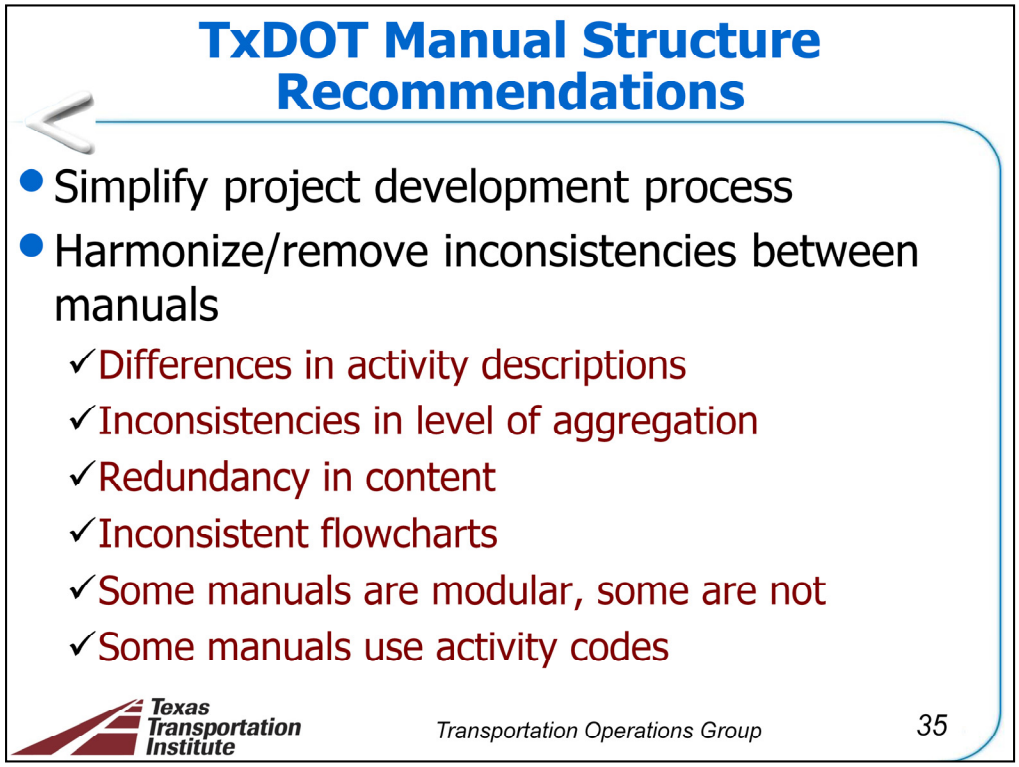


Potential changes to manuals include a reference to utility issues in Task PDP 2670 of the PDP Manual and a new activity "Preliminary design utility coordination" in the ROW Utility Manual.



This strategy deals with the development of curricula for utility coordination stakeholders (both TxDOT and utility industry). Many stakeholders are not sufficiently knowledgeable of the utility coordination and adjustment process, requirements and procedures during construction, or even pertinent laws and regulations. There is a need to update and/or develop training materials for utility stakeholders, taking into consideration conditions, laws, and regulations prevalent in Texas. Examples of existing training materials at TxDOT include the utility conflicts course, which was developed in 2001 but needs updating, and the training materials developed as part of the Utility Installation Review (UIR) system, which only covers the utility permitting process.

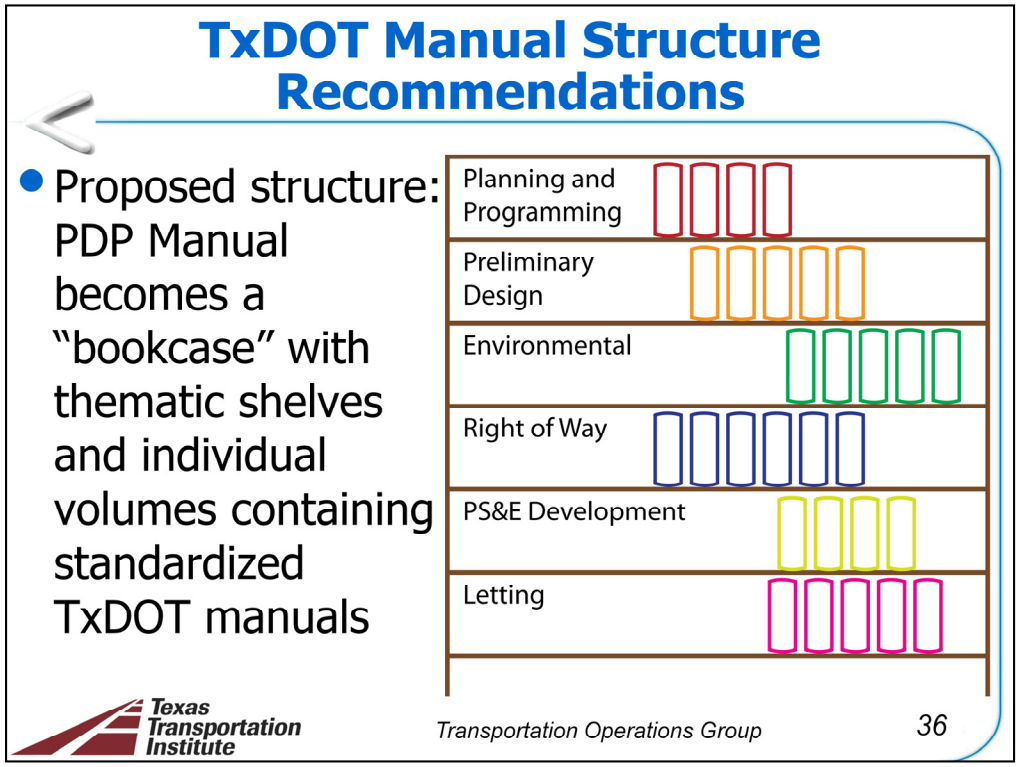
The need for appropriate training materials has also been acknowledged in other states. A number of state DOTs have recently developed training materials, e.g., Georgia DOT (GDOT) and Minnesota DOT (Mn/DOT). At the national level, the National Highway Institute (NHI) offers a course titled "Highway/Utility Issues," but this course needs updating. In addition, the course is generic and not necessarily adjusted to the conditions, laws, and regulations of individual states. As a reference, a recent international scan on right of way and utilities included recommendations for the development of curricula for right of way and utility professionals. In addition, the Strategic Highway Research Program (SHRP 2) is expected to activate a project in 2010 (project R15[A]), to develop training materials for utility coordinators.



The previous slides described business process strategies and specific recommendations for changes to manuals at the individual activity level. This slide provides higher-level recommendations to address structural TxDOT manual structure and content issues.

A conclusion from the 2008 Sunset Advisory Commission report was that TxDOT's project development process was too complicated, making it difficult to understand how important decisions are made. One strategy to simplify the project development process is to harmonize, or otherwise eliminate, sources of inefficiency and redundancy in the description of PDP activities.

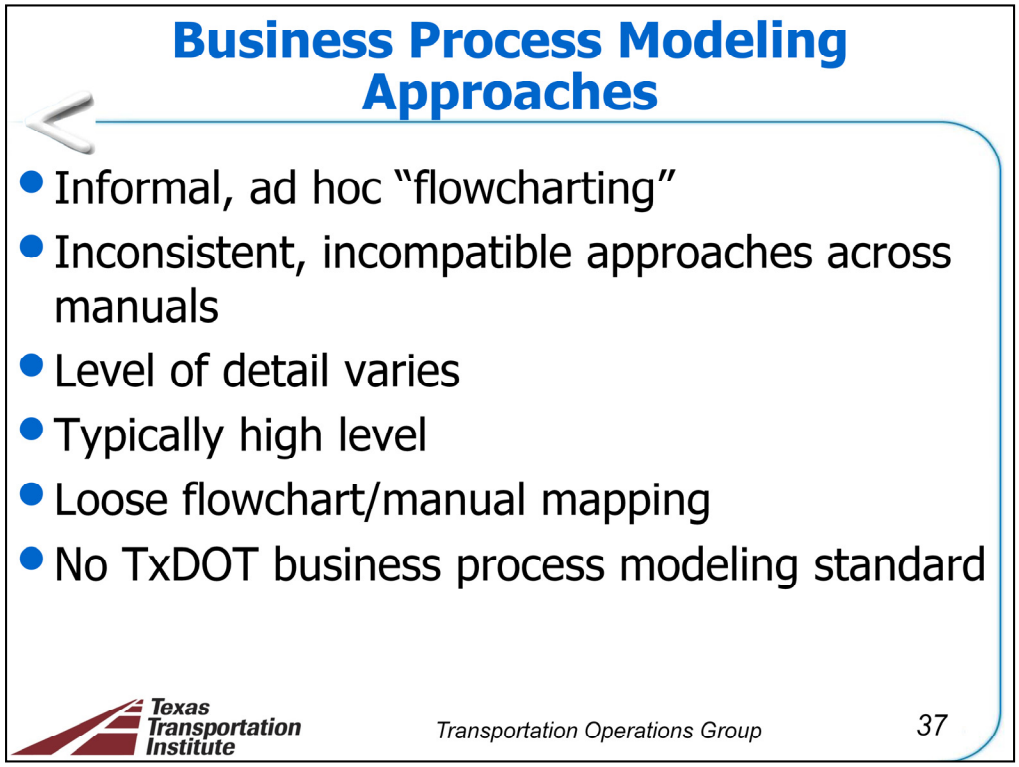
A review of several TxDOT manuals during the research led to observations such as redundancy in activity descriptions and inconsistencies in information aggregation levels, both of which can make it difficult to relate information across manuals. There are also inconsistencies in supporting documentation such as flowcharts. Some manuals are modular (e.g., the ROW Manual has separate volumes, and each volume is a separate document), but other manuals are not. Some manuals use codes to describe activities (e.g., the PDP Manual and to some degree the ROW Utility Manual), which facilitates creating references for individual activities, but other manuals do not provide this type of information. Eliminating these sources of inefficiency should contribute to a better understanding (and simplification) of the project development process at TxDOT.



Removing redundancy and inconsistencies across manuals could be eliminated by modifying the TxDOT manual structure as follows.

The PDP manual would become a "bookcase" with thematic shelves (e.g., planning and programming, environmental, right of way, utilities, and design). Depending on the specific theme, one or more separate volumes could be used to describe activities that pertain to that theme. Each volume would be a separate PDF file that can be easily updated as needed without having to impact other volumes or the rest of the "shelf" or "bookcase" structure. Following current TxDOT manual practice, each shelf would be managed by a designated office of primary responsibility.

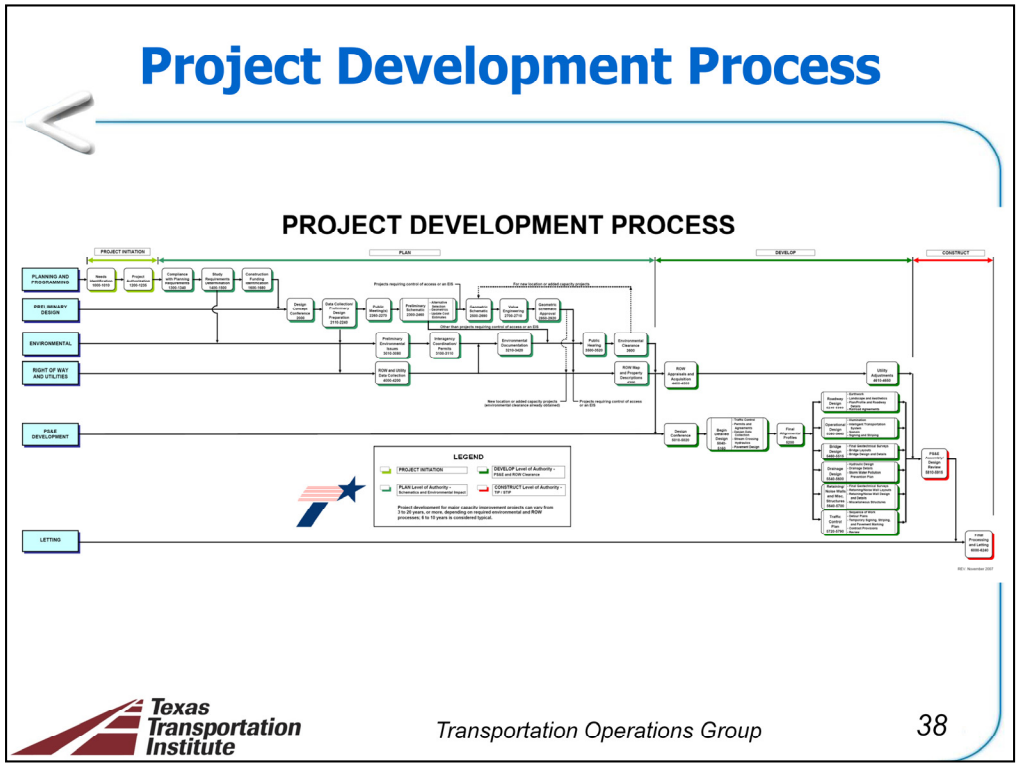
To eliminate confusion and encourage standardization, each volume would have activities identified by unique activity codes (e.g., following the current PDP 4-digit structure) that are not repeated across shelves. Information disaggregation could vary across volumes and shelves but would be as uniform as possible to facilitate adequate understanding of the PDP. Redundancy would be greatly reduced or eliminated by only presenting information related to a topic once (in its corresponding shelf and volume), instead of having similar information at different disaggregation and currency levels in different manuals, which is the current practice.



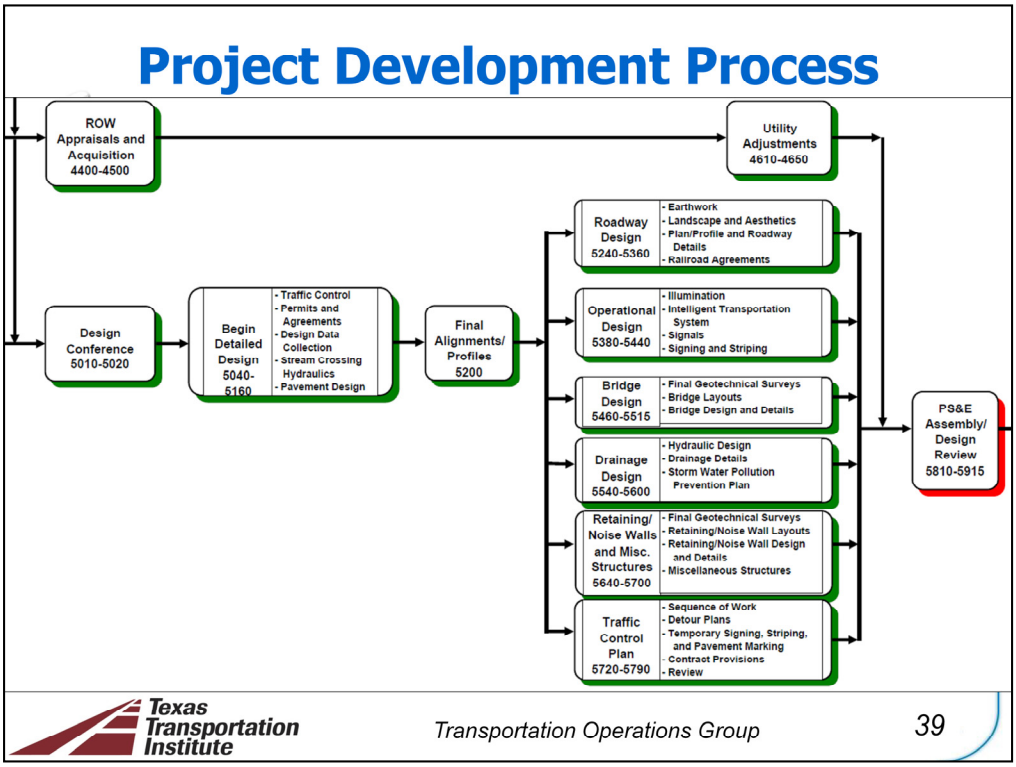
This slide starts the second half of the workshop. The purpose of this second half is to describe a business process explorer application that encourages interaction between the environmental and utility processes at TxDOT.

A review of current TxDOT business process modeling approaches resulted in several observations:

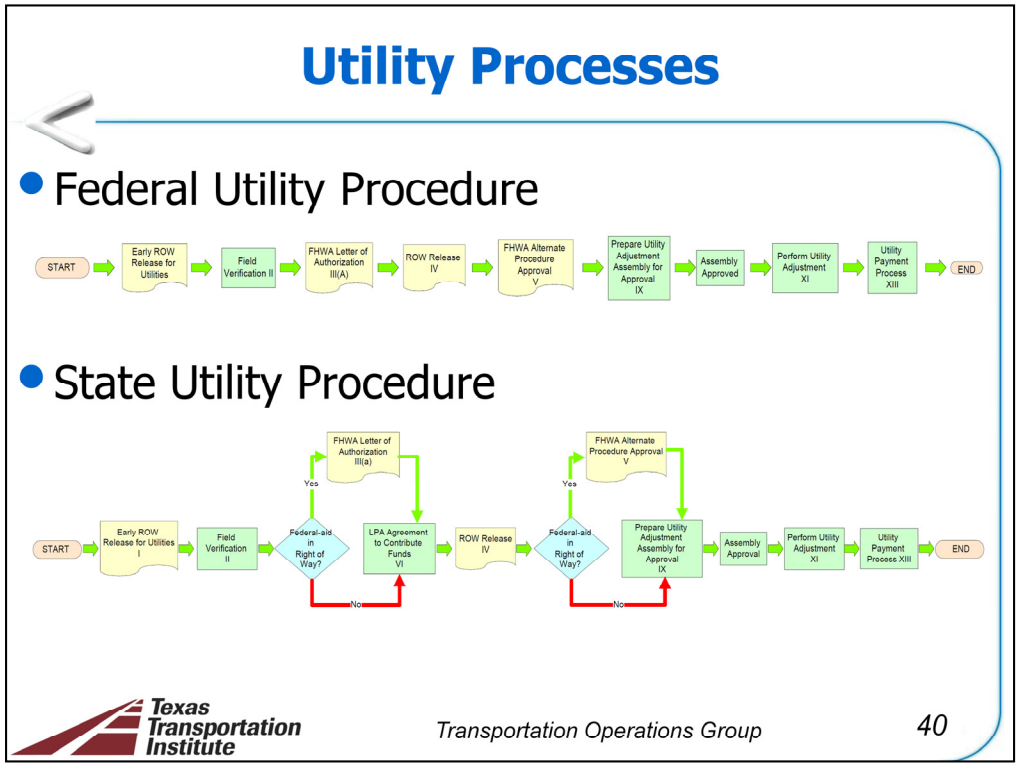
- Most business process diagrams are somewhat informal, following ad hoc flow charting procedures.
- Flowcharts from different organizational units tend to use inconsistent, incompatible approaches.
- Flowcharts are typically at a high level of aggregation that does not provide much detail about activities and is only loosely mapped to existing manuals.
- TxDOT has detailed data modeling standards (see TxDOT's Technology Services Division [TSD] Data Architecture document) but no standards for business process modeling.



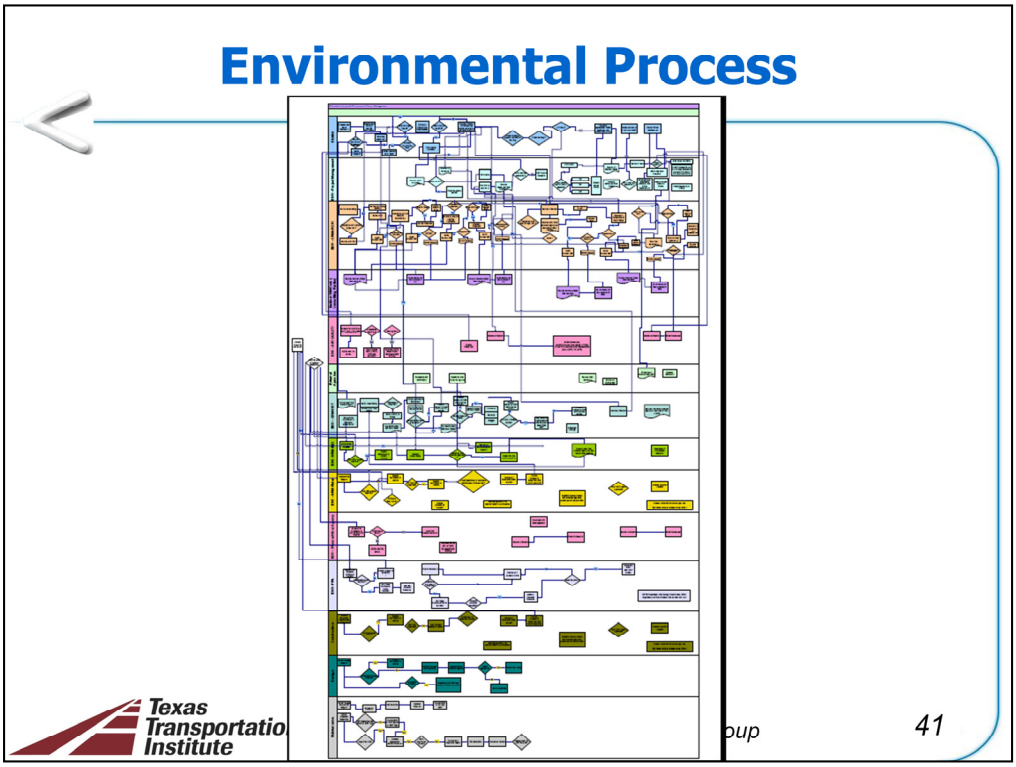
Here are some examples of current TxDOT flowcharts. This widely used chart of the project development process (which is part of the PDP Manual) appears to be a swim lane diagram. However, in reality, the "swim lanes" do not represent organizational units at TxDOT but chapters in the PDP Manual. Notice that chapter titles on the left feed into the next group of activities to the right (suggesting precedence), and all activity groups have more or less the same length regardless of duration.



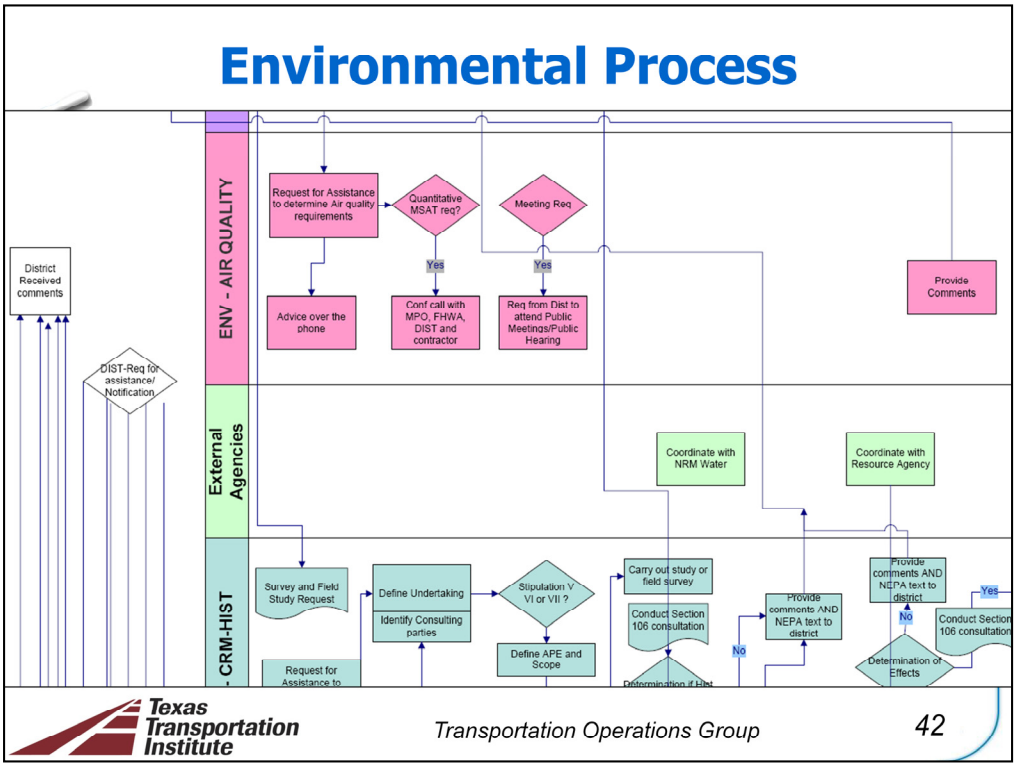
This is a zoomed in view of the PDP diagram that focuses on the design phase. Notice that "ROW Appraisals and Acquisition" is represented by an activity group that occurs roughly at the same time as the "Design Conference" activity. Both "activities" are shown with similar durations, although, in reality, the right of way acquisition process can be a very lengthy process over many months or years. Further, the "Utility Adjustments" activity group is shown at the end of the design phase, following the right of way acquisition process (which is not true in many cases).



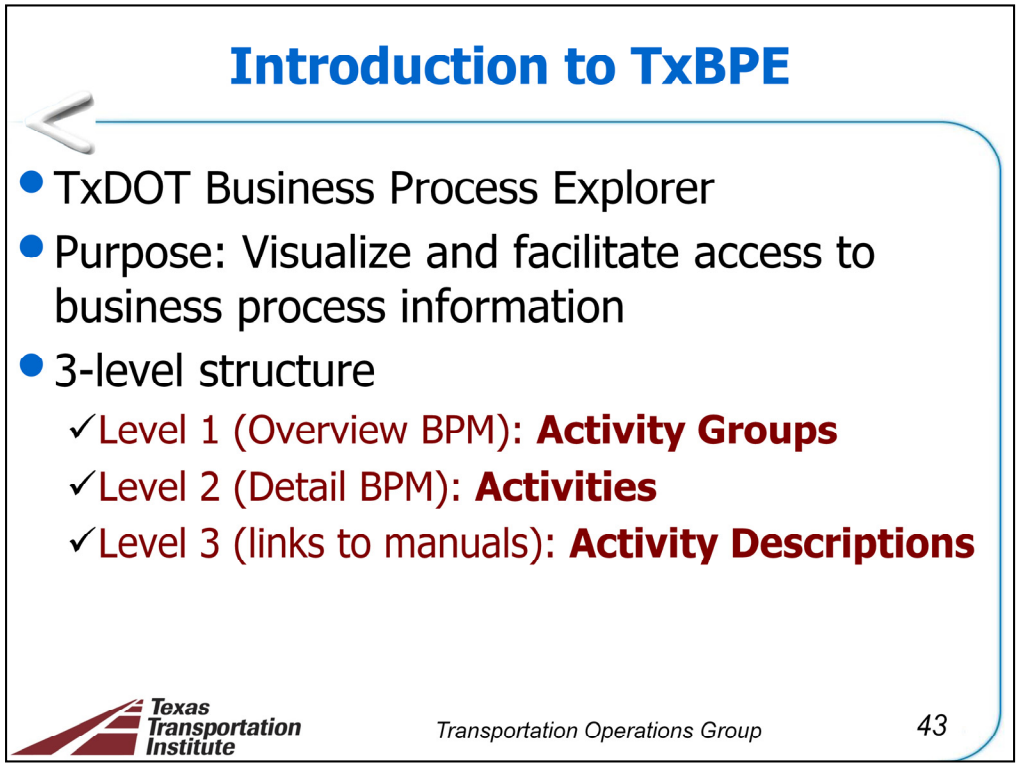
The Utility Cooperative Management Process of the ROW Utility Manual includes flowcharts in which activities feed into documents and then these documents feed into other activities. From a business process modeling perspective, it would be more appropriate to replace those documents with activities that produce or modify documents, and having activities connect to other activities. Notice also that activities such as field verification, which can span weeks or months and should actually be conducted throughout the process in parallel with other activities, are shown only at the beginning of the process.



This is an example of an environmental process diagram, which is clearly not a finished product. The diagram has good features, such as organization of activities into several swim lanes. However, several issues make this chart difficult to use in practice, including frequent activity loop-backs, missing relationships, and isolated activities.



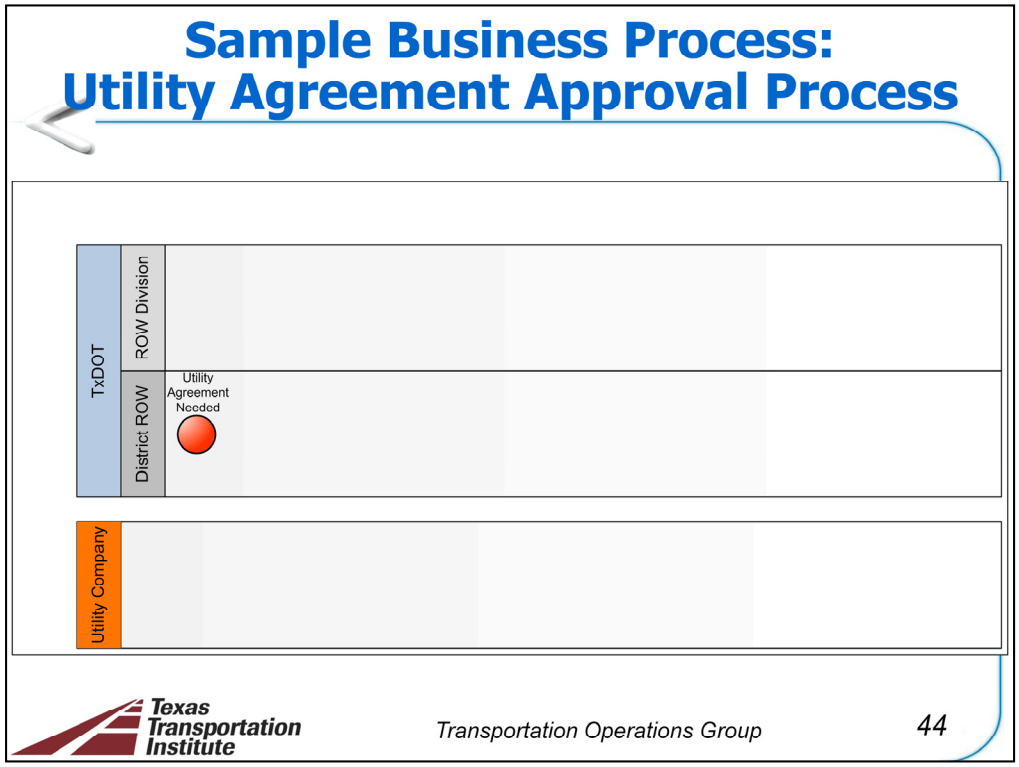
This is a zoomed in view of the middle section of the diagram on the left-hand side. Notice a decision box with no input and only one output ("Yes") and activities with no input or output, which makes it difficult to understand how these activities are part of the work flow.



The development of an integrated environmental/utility business process diagram as part of the research (see research product 0-6065-P2) motivated the development of a prototype web-based application called TxDOT Business Process Explorer (TxBPE) to make the business process diagram (and associated information in the model) accessible to users.

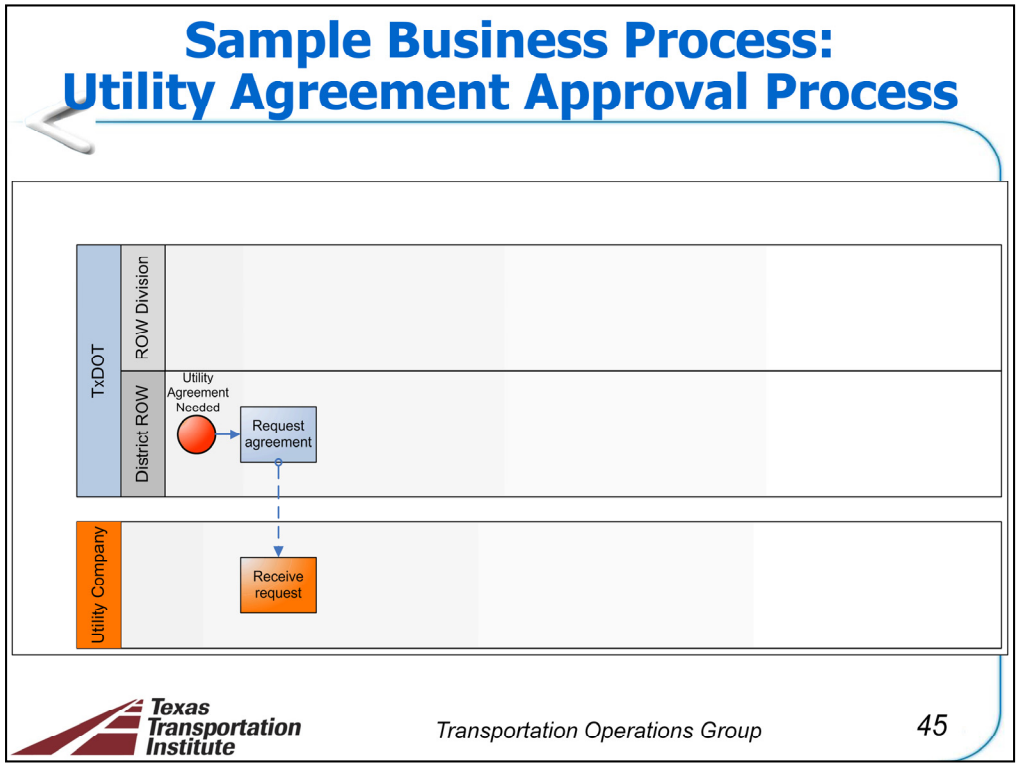
TxBPE is an application that presents information at three levels of activity disaggregation:

- Level 1 contains groups of activities.
- Level 2 contains actual activities.
- Level 3 links activities to activity descriptions in (online versions of) TxDOT manuals.

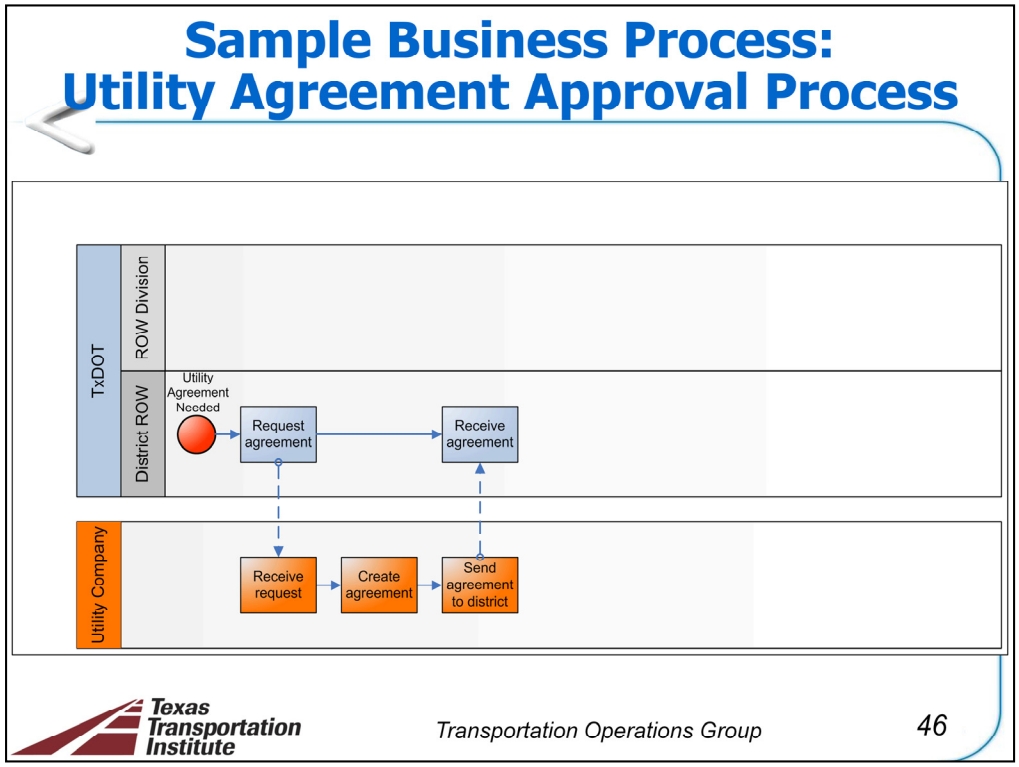


The business process modeling standard used is called Business Process Modeling Notation (BPMN), which is a modeling standard designed to present business process information in a simple, intuitive way (as opposed to other, more traditional BPM notations that are not as user friendly).

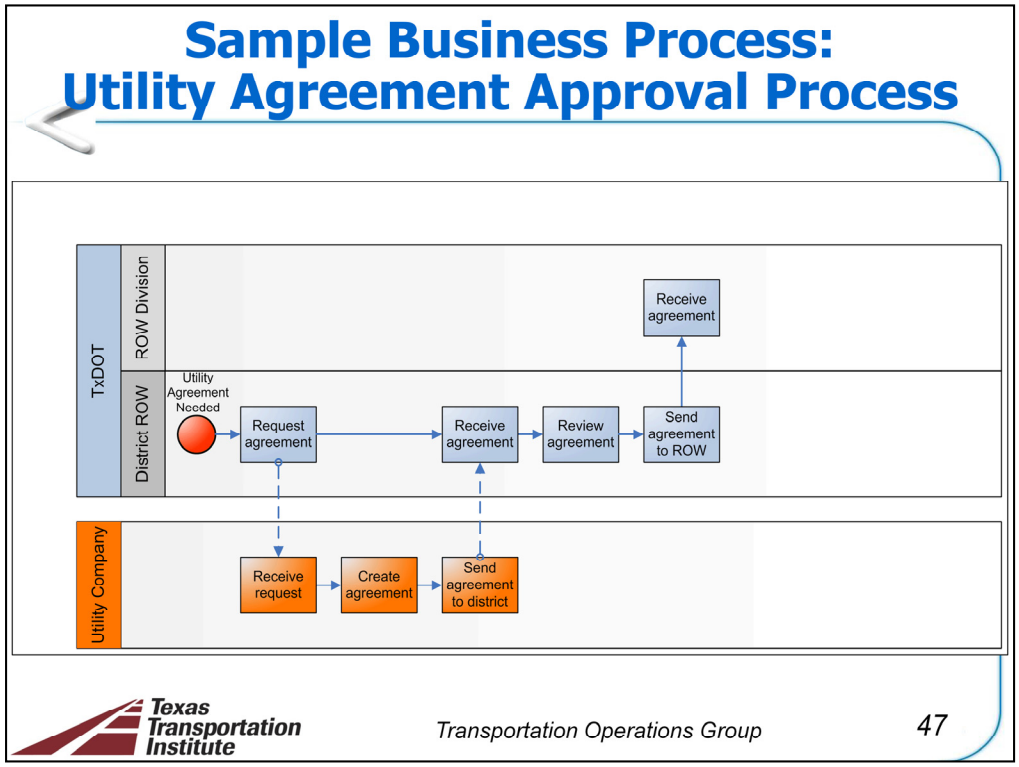
This slide shows the process to build a business process model using BPMN. For illustration purposes, the example is a highly simplified ("ideal," i.e., probably not realistic) version of the utility agreement approval process. The diagram shows two organization units (TxDOT and utility company) and two organizational units within TxDOT (Right of Way Division and district right of way section). The process begins with an event, i.e., the district right of way section needing a utility agreement from the utility company.



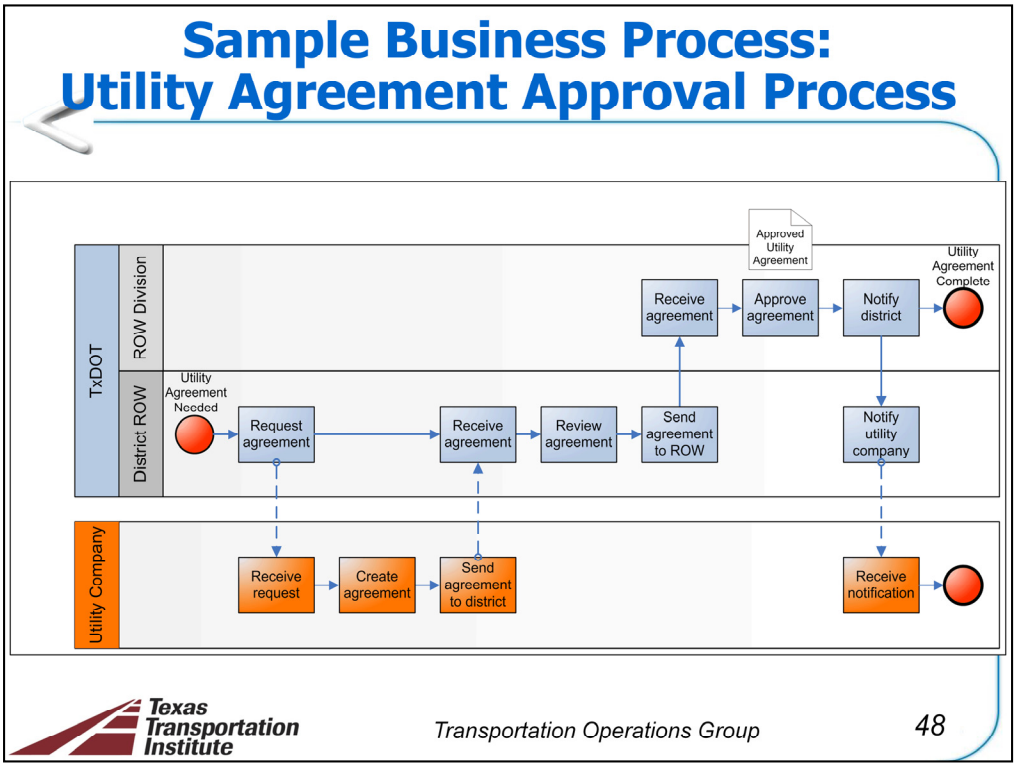
The district right of way section requests an agreement from the utility company, and the utility company receives the request.



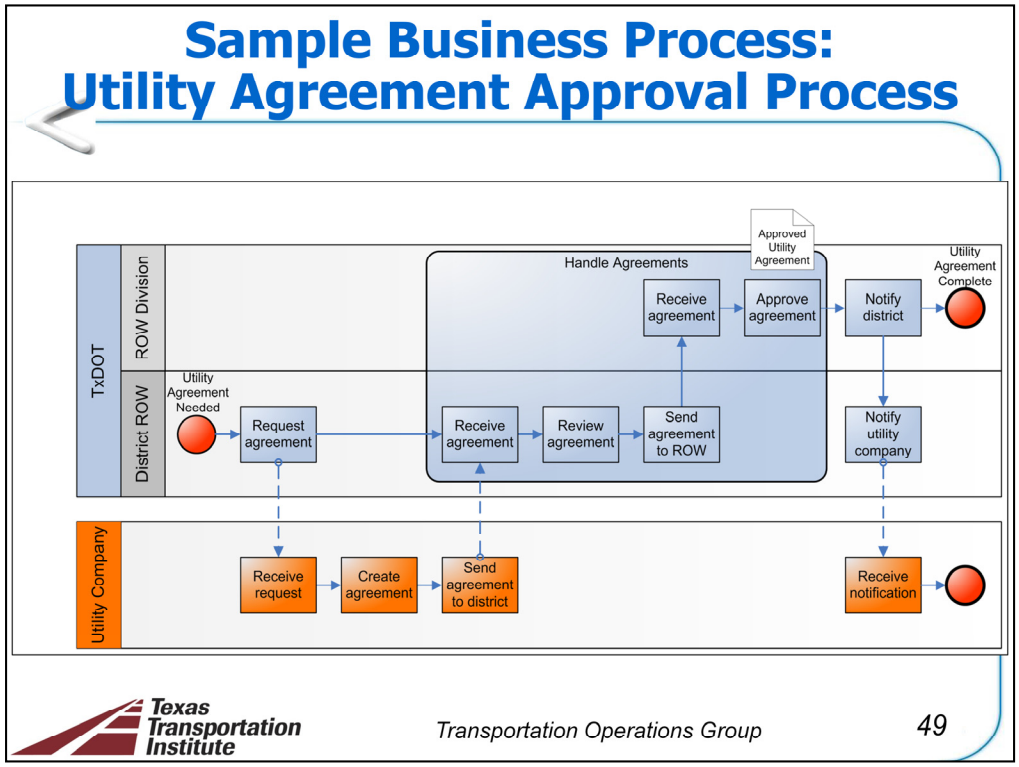
The utility company creates an agreement draft, sends the agreement to the district right of way section, and the district receives the agreement.



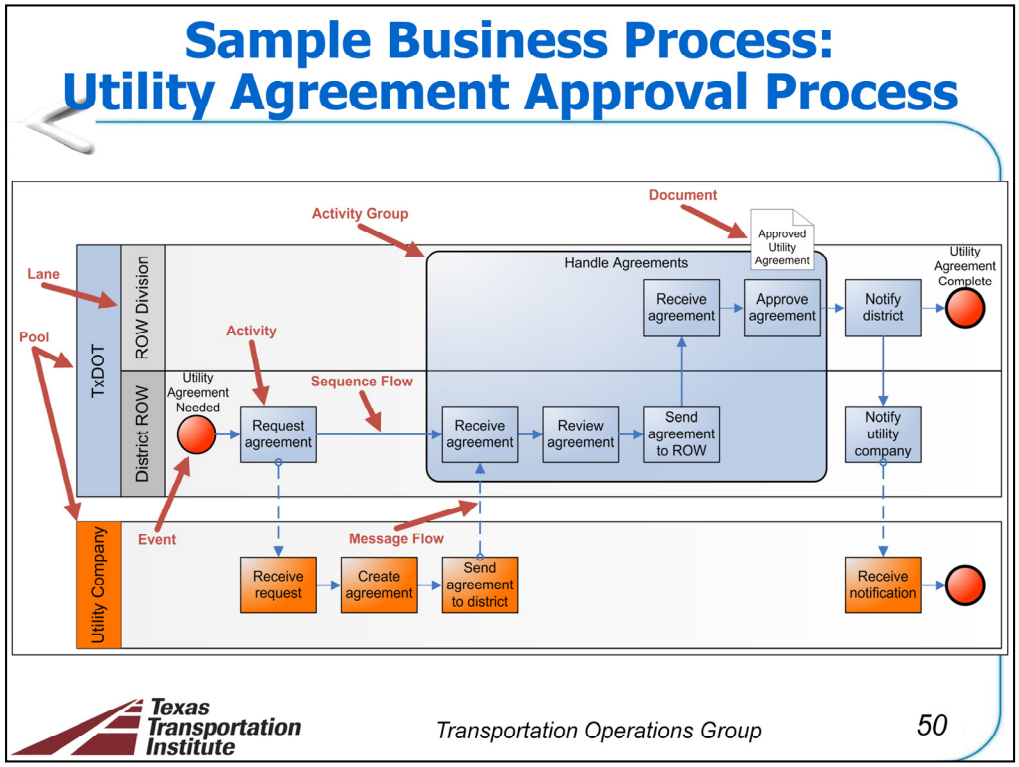
The district reviews the agreement and sends it to the Right of Way Division, and the division receives the agreement.



The division approves the agreement, notifies the district, which in turn notifies the utility company. The utility company receives the notification, therefore completing the process. Note that the activity "Approve agreement" creates a document called "Approved Utility Agreement."

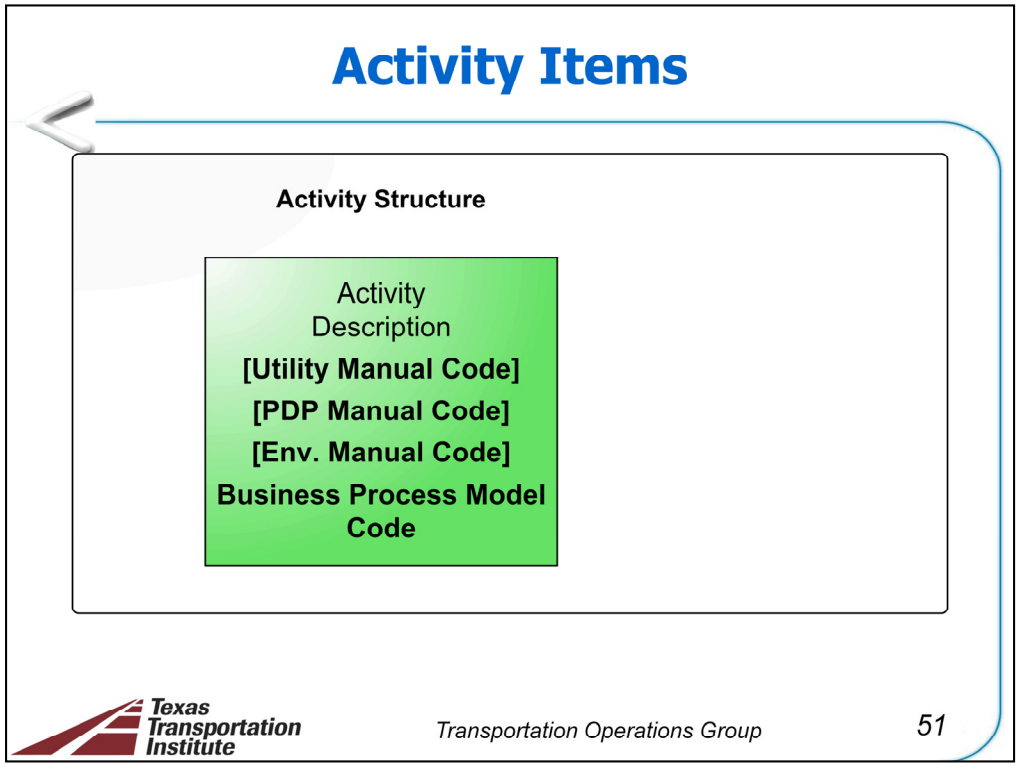


It is also possible to group activities into activity groups (e.g., activity group "Handle Agreements"). For consistency, the shape of the activity group is slightly different from individual activities (rounded corners as opposed to straight corners).

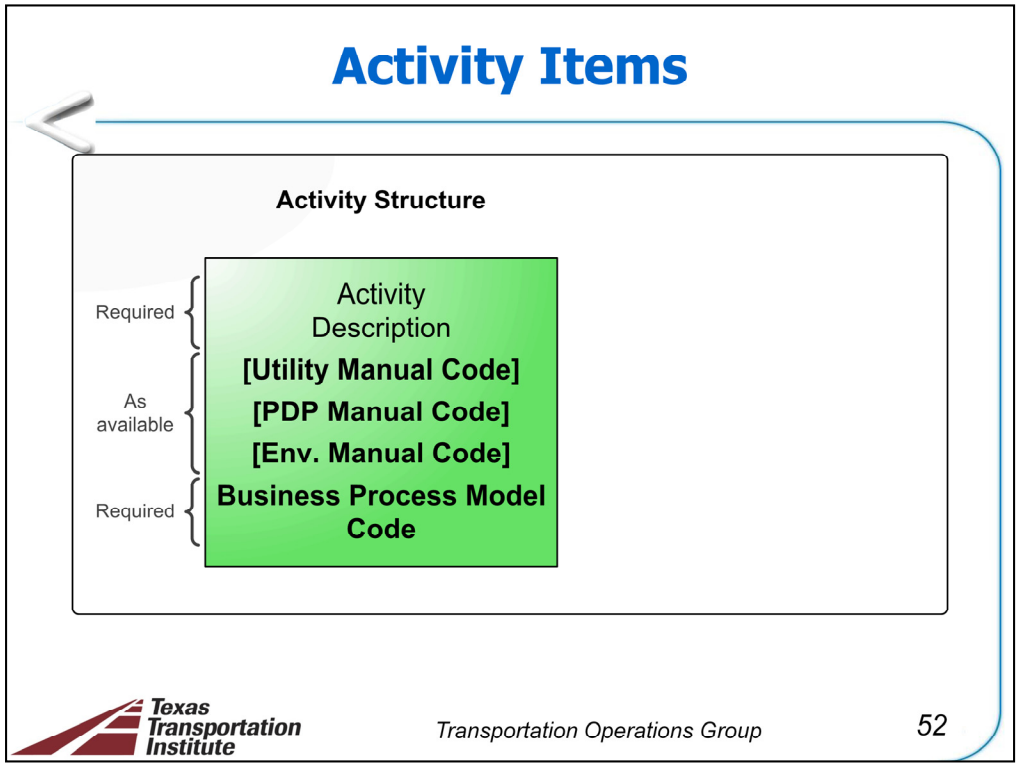


This simple example shows all the major elements of the business process model developed in TxBPE, including the following:

- pools, displaying distinct organizations or companies;
- lanes, which represent organizational units within an organization;
- events;
- activities;
- activity groups;
- sequence flows;
- message flows; and
- documents.

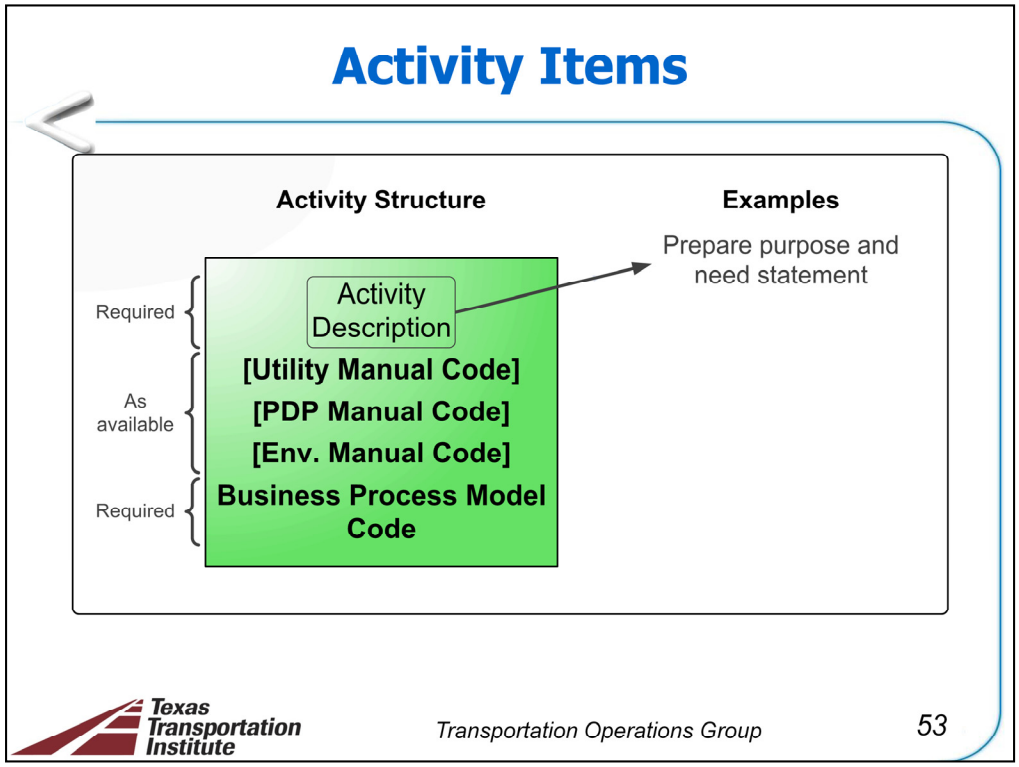


The integrated environmental/utility business process model (as well as TxBPE) provides an explicit representation of the origin of each activity in relation to the TxDOT manual(s) that describe that activity. Because activities are frequently mentioned in more than one manual, it became necessary to adopt a protocol using codes and labels for providing references to those manuals.

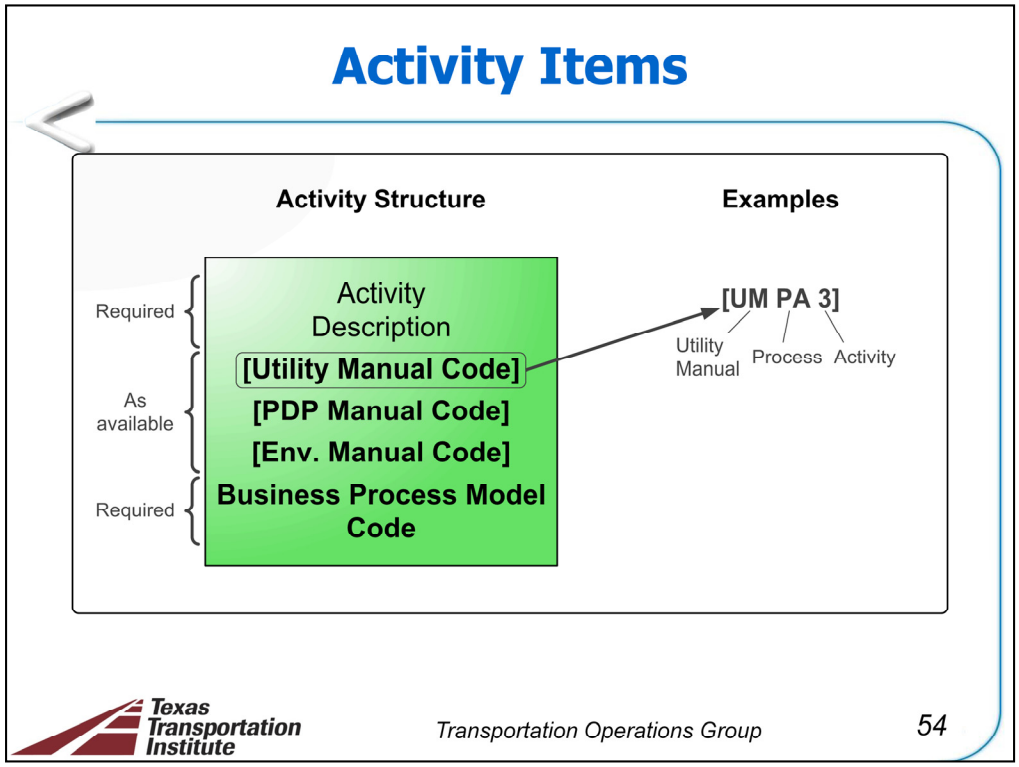


In general, all activities have an activity description at the top and a business process model code at the bottom. This business process model code was used to uniquely identify activities in the model.

Utility Manual code, Project Development Process Manual code, and Environmental Manual code appear whenever a particular activity is described in the corresponding manual. Activities described in several manuals include multiple code entries.

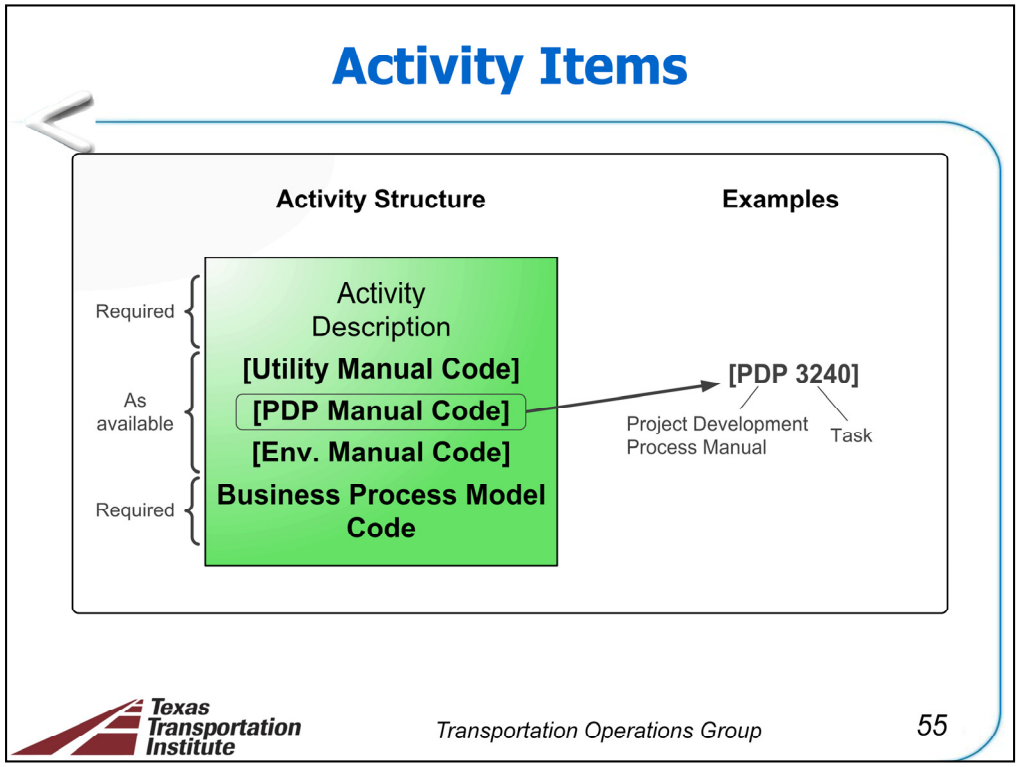


For example, an activity description could be "Prepare purpose and need statement."



A Utility Manual code entry could be UM PA 3:

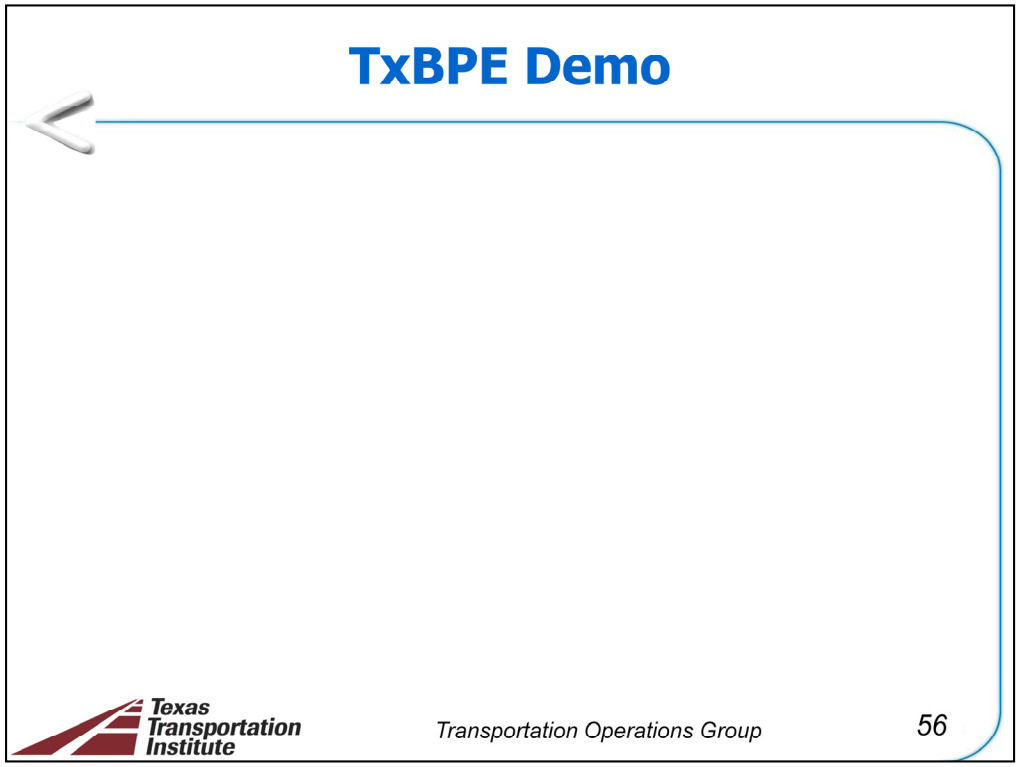
- UM: Utility Manual
- PA: Process Activity
- 3: Activity number



A PDP Manual code could be PDP 3240:

- PDP: Project Development Process Manual
- 3240: Task number

The Environmental Manual does not use codes do identify tasks or activities, which made it necessary to develop a coding system. See TxDOT Research Report 0-6065-1 for additional information. The report also includes information about the methodology used for business process model codes.



This slide is a placeholder for the online TxBPE demonstration.

Discussion