STRATEGIES AND RECOMMENDATIONS FOR INTEGRATING UTILITY AND ENVIRONMENTAL PROCESSES AT TXDOT: WORKSHOP MATERIALS

by

Cesar Quiroga, P.E.
Research Engineer
Texas Transportation Institute

Edgar Kraus, P.E.
Assistant Research Engineer
Texas Transportation Institute

and

Jerry Le
Software Applications Developer
Texas Transportation Institute

Product 0-6065-P1
Project 0-6065

Project Title: Integrating Utility Conflict Elimination and Environmental Processes

Performed in cooperation with the
Texas Department of Transportation
and the Federal Highway Administration

August 2009
Published: May 2010

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

TABLE OF CONTENTS

Page

TABLE OF CONTENTS iii

LIST OF FIGURES iv

CHAPTER 1. PROJECT SUMMARY 1

CHAPTER 2. INSTRUCTIONAL MATERIALS 3
- INTRODUCTION 3
- INSTRUCTIONS 3
- PRESENTER NOTES 5
- PARTICIPANT HANDOUT 65

CHAPTER 3. TXBPE INSTRUCTION MANUAL 87
- TXDOT PROJECT DEVELOPMENT PROCESS 87
- TXBPE STRUCTURE 88
  - Level 1 – Process Overview 88
  - Level 2 – Process Details 89
  - Level 3 – Activity Description 90
- TXBPE INTERFACE 91
  - Access to TxBPE 91
  - Navigation 92
- LEVEL 2 GRAPHICAL ELEMENTS IN TXBPE 95
  - Business Process Model Notation 95
  - TxBPE Graphical Elements 96
  - TxBPE Activity Codes 98
  - TxBPE Color Codes 98

LIST OF FIGURES

Page

Figure 1. Current Project Development Process at TxDOT. 88
Figure 2. Level 1 Process Overview. 89
Figure 3. Activities of Activity Group "Construction Funding Identification" on Level 2..... 90
Figure 4. Activity Description of Activity "PDP 1400: Review scope, cost,…" on Level 3. 91
Figure 5. Navigation Bar and Business Process Area in TxBPE..... 94
Figure 6. Swim Lane Business Process Model for Process "Approval of a Utility Agreement." 95
Figure 7. TxBPE Elements. 96
Figure 8. Other Graphical Elements in TxBPE. 97
Figure 9. TxBPE Activity Structure and Examples. 98
Figure 10. Activity Color Code. 99
Figure 11. Sequence Flow Color Code. 99

CHAPTER 1. PROJECT SUMMARY

Two sources of delay during the project development process are utility adjustments and the environmental review and clearance process. There are several efforts underway at the Texas Department of Transportation (TxDOT) to optimize these processes, including recently finished and active research projects. Despite these efforts, the interaction between utility coordination/conflict elimination activities and the environmental process is one that has not received proper attention over the years. One of the reasons is that, although the collection of data regarding existing and abandoned utility installations is part of the environmental data gathering process, in practice, the collection of detailed underground utility-related data normally starts in the design phase, which typically occurs after the environmental process is complete.

The purpose of Research Project 0-6065 was to determine whether it was feasible to:

- obtain better existing utility data during the schematic development phase as opposed to the design phase; and
- increase the level of definition of design components such as horizontal alignment, vertical alignment, and drainage requirements during the schematic development phase.

The research project developed strategies for integrating the utility coordination/conflict elimination process and the environmental process. The strategies, and recommended changes to TxDOT manuals, are summarized in the form of instructional materials in Chapter 2. The instructional materials include a presentation file as well as presenter notes and handouts.

To address the objectives of the project, the researchers analyzed the TxDOT project development process with a focus on environmental and utility activities. The researchers produced a model of the environmental process at TxDOT using numerous resources including TxDOT manuals and conducted interviews with stakeholders. This model shows activities of the TxDOT project development process from the planning phase until the beginning of Plans, Specifications, and Estimate (PS&E) development (detailed design) and the sequence flow between activities, including new activities recommended by the researchers. To facilitate access to the model (the printed version of the model at 100 percent scale was 14 feet by 5 feet), the researchers developed a standalone web-based application called TxDOT Business Process Explorer (TxBPE) that replicates the model contents and provides additional functionality such as search and links to specific TxDOT manual chapters. Chapter 3 provides an introduction to TxBPE including general structure, interface, and the graphical elements used in the application.

CHAPTER 2. INSTRUCTIONAL MATERIALS

INTRODUCTION

The companion compact disk (CD) includes Research Products 0-6065-P1 (educational materials) and 0-6065-P2 (swim lane diagram). The CD is organized as follows:

- Folder 0-6065-P1 Educational Materials, which includes the following documents:
    - File 0-6065 Workshop Presentation.ppt (57 slides – Microsoft® PowerPoint® format)
    - File 0-6065 Workshop Presenter Notes.pdf (57 pages – PDF)
    - File 0-6065 Workshop Handout.pdf (19 pages – PDF)
    - File 0-6065 Instructional Materials.pdf (this file, 100 pages – PDF)
    - Folder TxBPE, which contains the TxBPE application as follows:
        - File TxBPEhome.htm (the TxBPE starting page)
        - File backgroundInfo.htm (a TxBPE resource file)
        - File MainHeader.htm (a TxBPE resource file)
        - Folder img (containing TxBPE resource files)
        - Folder BusinessProcess (containing TxBPE resource files)
- Folder 0-6065-P2 Swim Lane Diagram, which includes the following documents:
    - File 6065 Overview BPM.pdf (1 page – PDF)
    - File 6065 Detailed BPM.pdf (1 page – PDF)
- File readme.txt, which contains an overview of the CD contents.

INSTRUCTIONS

The workshop is designed to last for 2 hours. During the first hour, the presenter describes the various strategies developed during the research. Following a 5-minute break, the presenter describes the TxBPE application, conducts a demonstration, and, if desired, provides attendees with the opportunity to experiment with it (which requires attendees using a computer equipped with access to the Internet).

PRESENTER NOTES

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

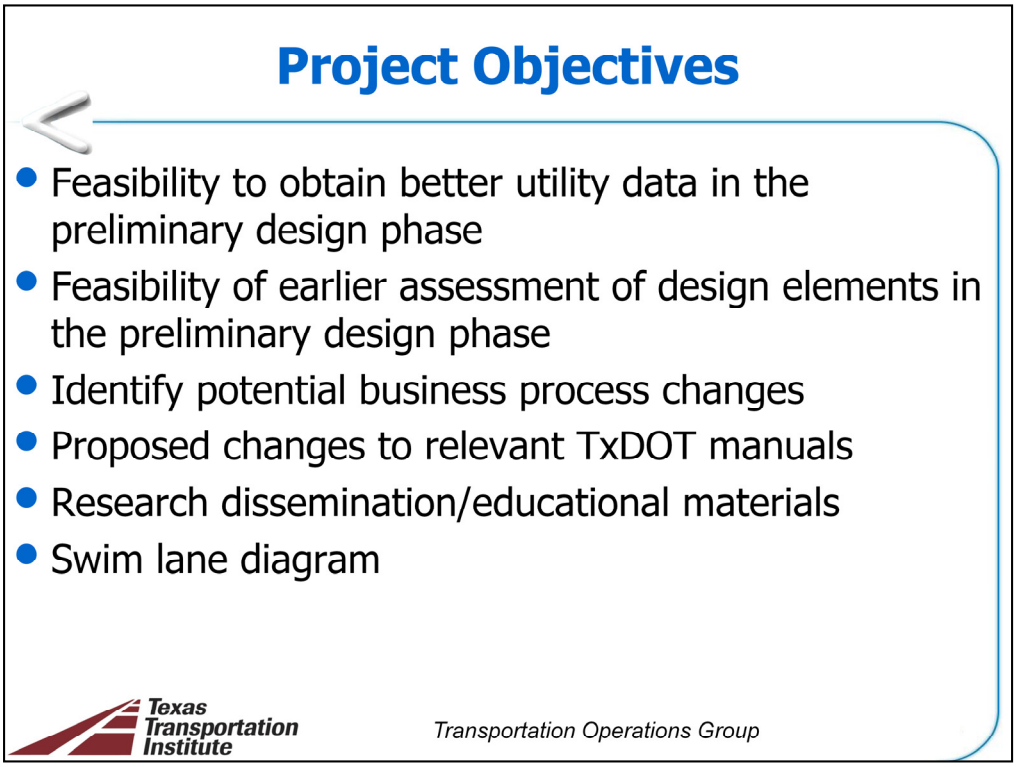
Workshop Overview

- Project objectives and workshop materials
- Recommended strategies and changes to TxDOT manuals
- Break
- Introduction to TxDOT Business Process Explorer (TxBPE)
- TxBPE live demonstration
- General discussion and feedback

Texas Transportation Institute

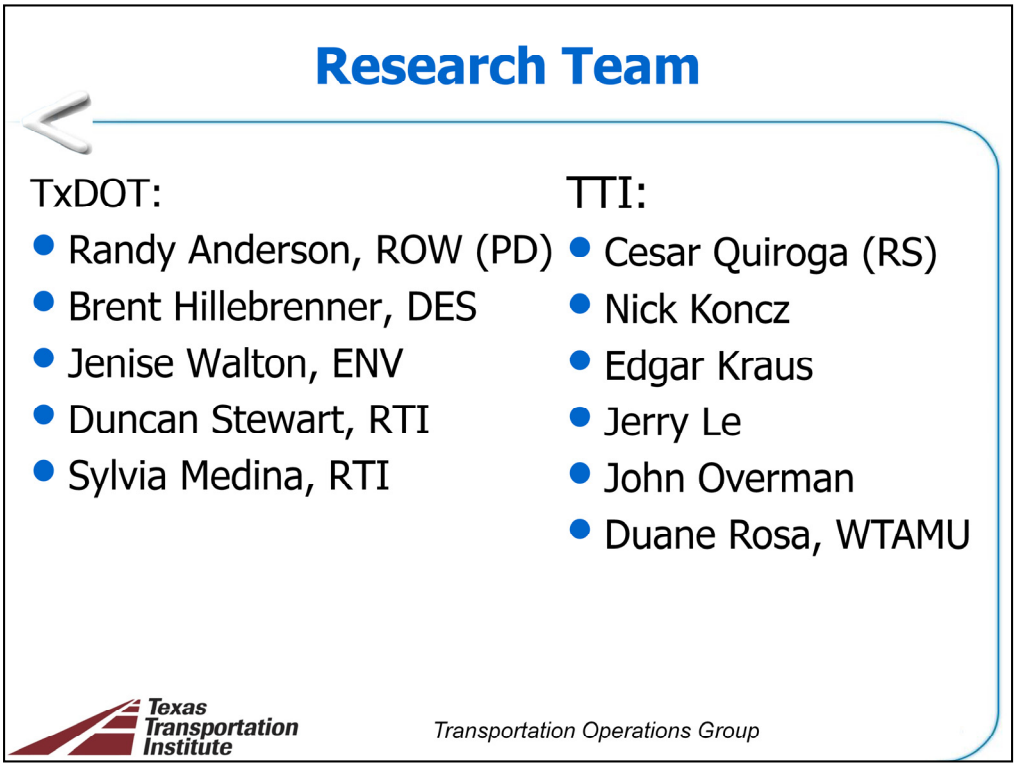
Transportation Operations Group

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.



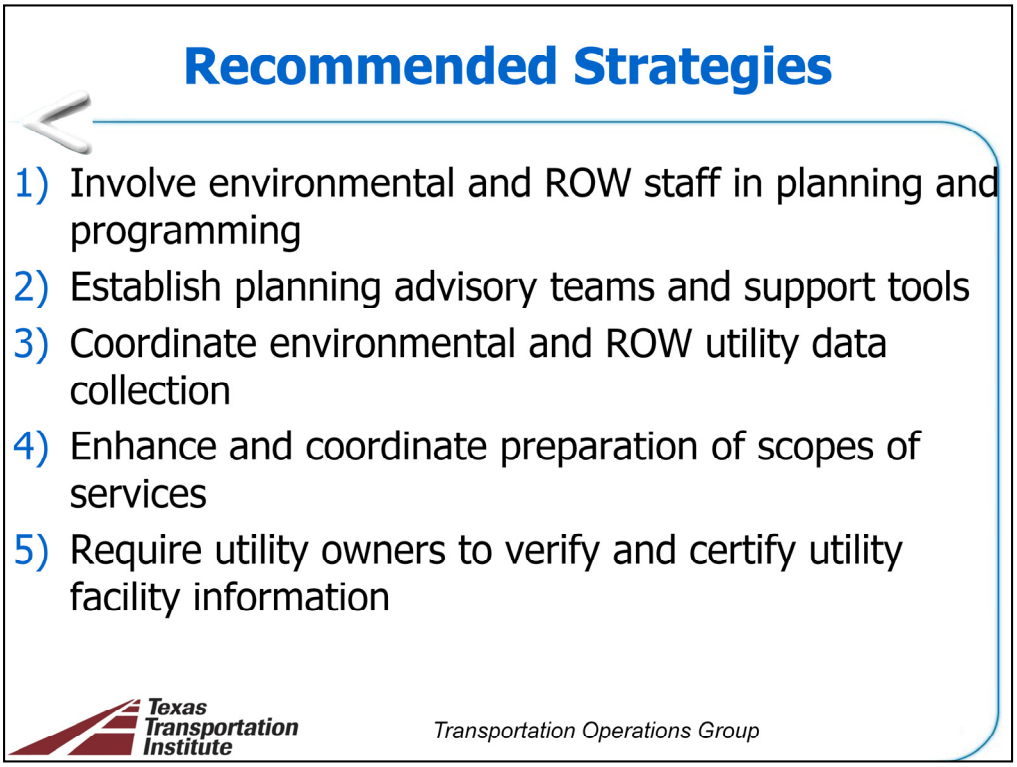
The objectives of Research Project 0-6065 were to:

- 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.



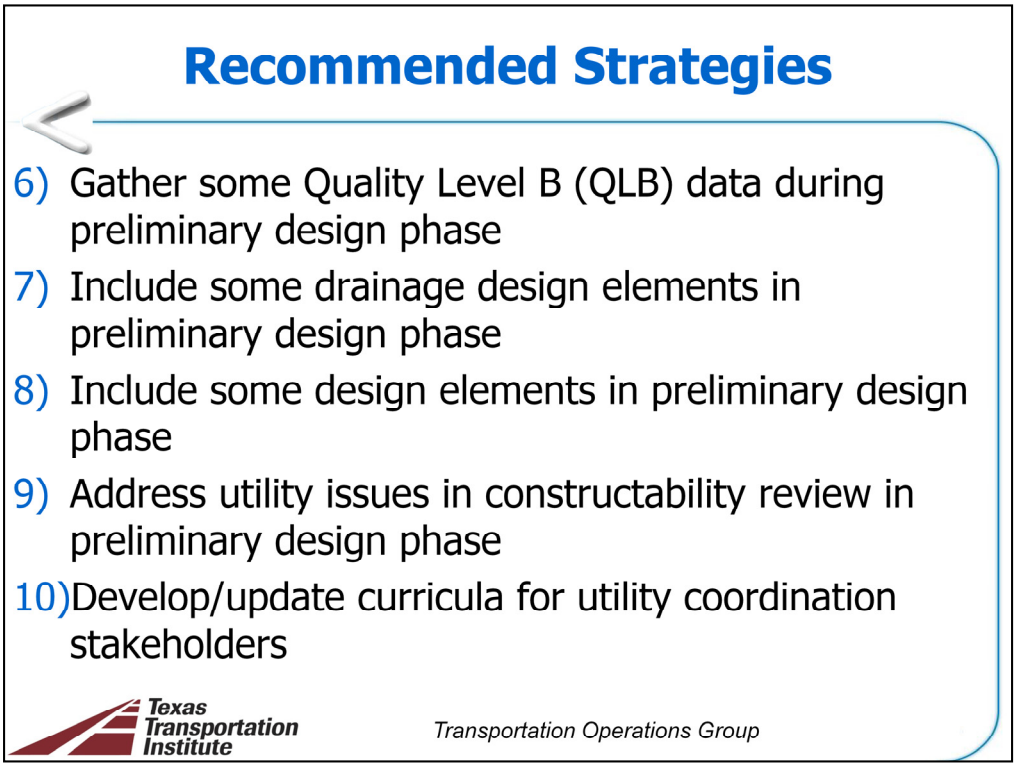
Randy Anderson was the Project Director at TxDOT.

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.

1) Involve Environmental/ROW Staff in Planning and Programming

- Purpose: Identify "fatal flaw" issues
  - ✓Utilities, pipelines
  - ✓Potential contamination sites
  - ✓Sensitive receptors
- Preliminary feedback to advance planning
- Annual meeting with utilities
- Preliminary cost estimate
- Issue: Allocation of resources

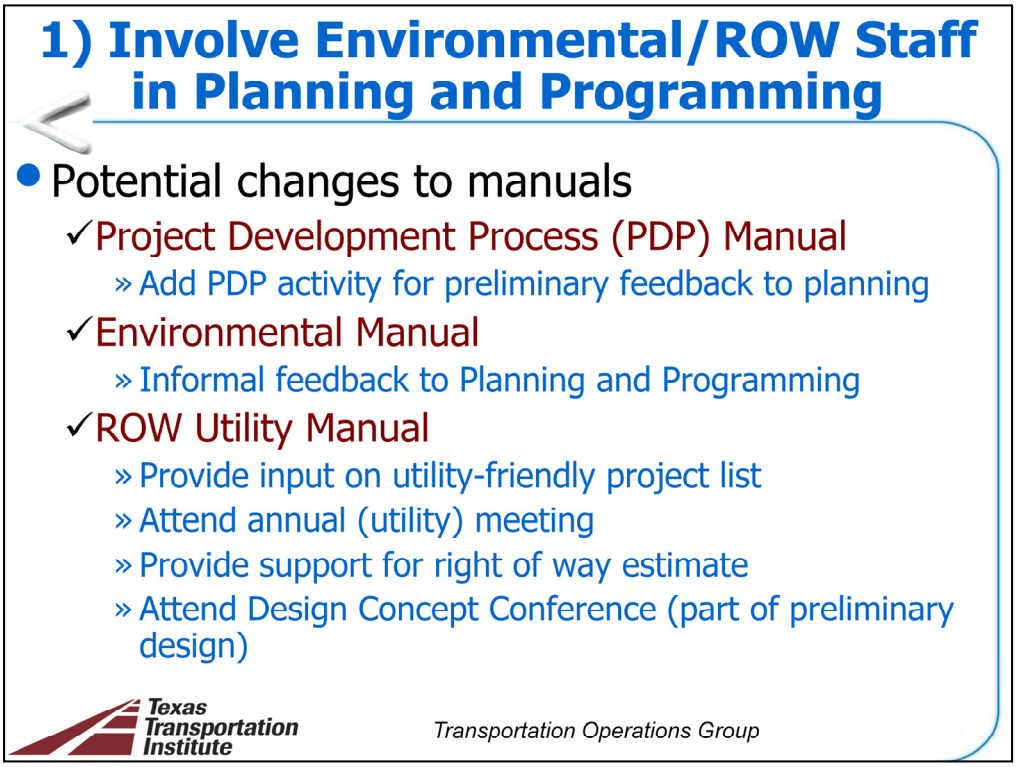
Texas Transportation Institute

Transportation Operations Group

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.

2) Establish Planning Advisory Teams and Support Tools

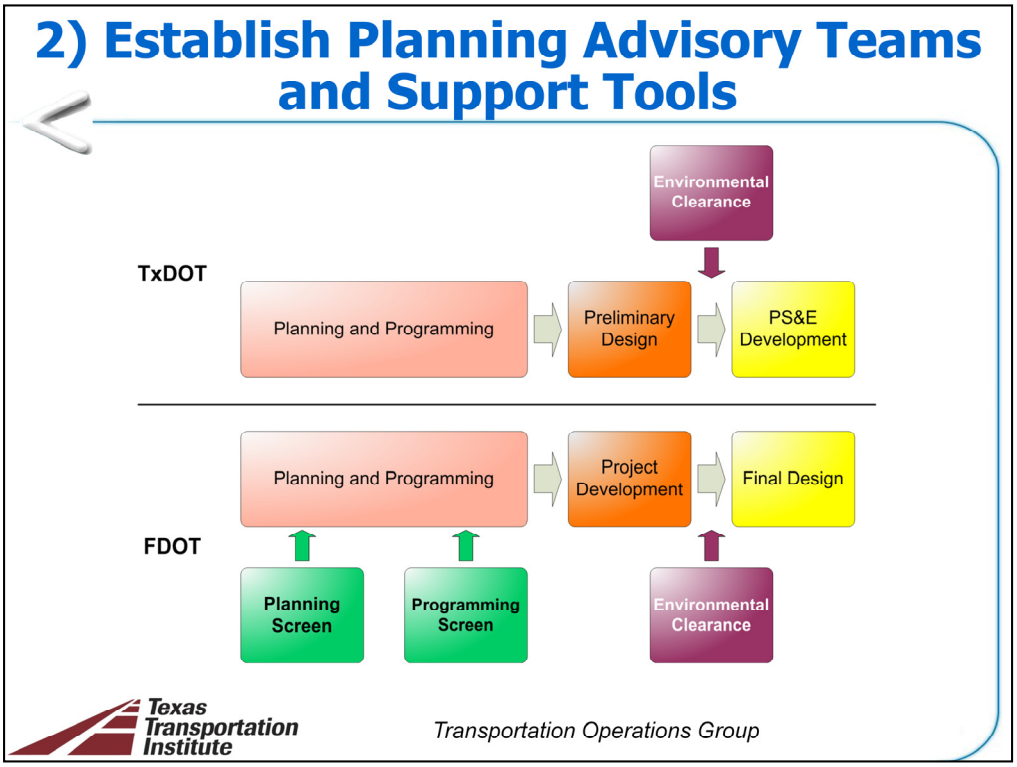
- Purpose: Use environmental data in transportation planning and programming
- Memoranda of Understanding (MOUs) with TCEQ, TPWD, THC, and GLO
- FDOT ETDM process
  - ✓ Environmental Technical Advisory Teams (ETAT)
  - ✓ Environmental Screening Tool (EST)
- Implement ETAT and EST
- Expand MOUs with resource agencies
- Cooperative Utility Planning System (CUPS)

Texas Transportation Institute — Transportation Operations Group

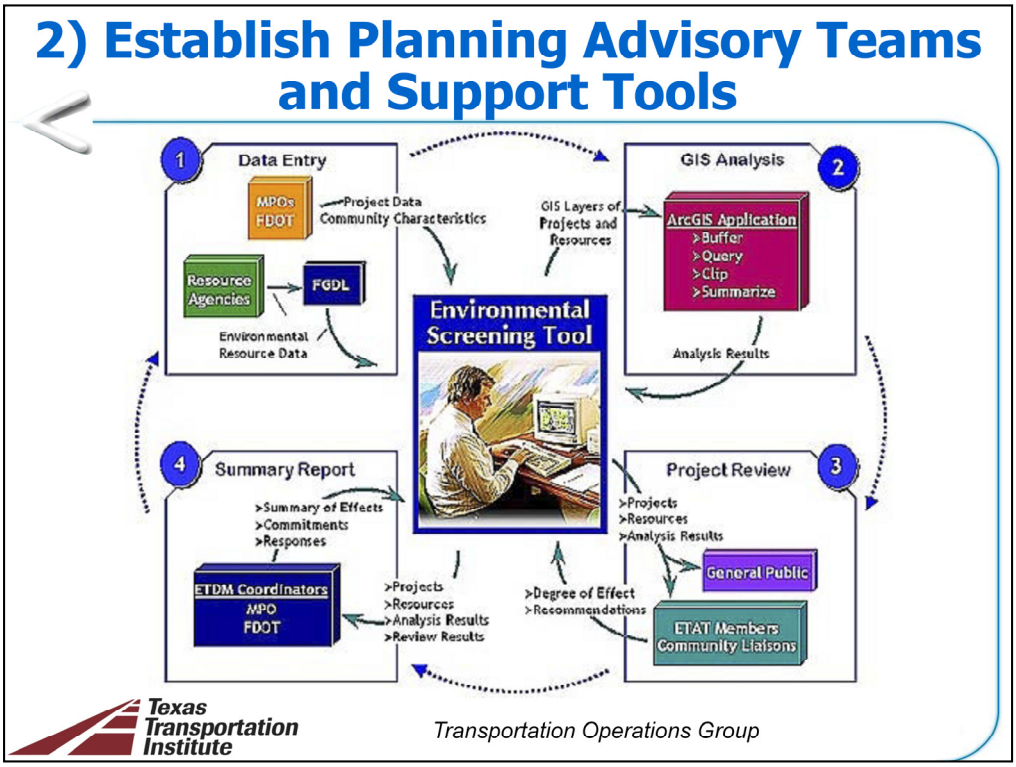
As part of the environmental process, TxDOT has MOUs with resource agencies such as the Texas Commission on Environmental Quality (TCEQ), the Texas Parks and Wildlife Department (TPWD), the Texas Historical Commission (THC), and the Texas General Land Office (GLO), which outline the roles and responsibilities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

2) Establish Planning Advisory Teams and Support Tools

- Potential changes to manuals
  - ✓PDP Manual
    - » PDP 3100 (Perform early coordination with review/resource agencies): Clarify "early coordination"
    - » New activities "Review planning screen data," "Review programming screen data"
  - ✓Environmental Manual
    - » Changes to chapters "Interagency Coordination" and "Permitting"
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute

Transportation Operations Group

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."

3) Coordinate Environmental/ROW Utility Data Collection

- Purpose: Improve coordination between groups regarding utility data collection activities
- Initial Site Assessments (ISA) vs. utility site investigations (QLD and QLC)
  - ✓Surface observations
  - ✓Review of existing records
- Start utility investigations concurrent with initial environmental site investigations
- Share investigation results

Texas Transportation Institute — Transportation Operations Group

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.

3) Coordinate Environmental/ROW Utility Data Collection

- Potential changes to manuals
  - ✓ PDP Manual
    - » Add coordination activities
  - ✓ Environmental Manual
    - » Notify ROW of pending ISA initiation and completion
  - ✓ ROW Utility Manual
    - » Notify environmental staff of utility investigation and completion
  - ✓ Both Environmental and ROW Utility Manual
    - » Exchange results of investigation and relevant information
    - » Attend annual utility meeting

Texas Transportation Institute — *Transportation Operations Group*

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.

4) Enhance and Coordinate Preparation of Scopes of Services

- Purpose: Identify utility facilities earlier, reduce redundancy, and reduce utility conflict impact
- Professional services (SUE) vs. scientific services (environmental)
- SUE: Design phase (QLB and QLA)
- Environmental work: Preliminary design phase
- Many consultants offer both services
- Identify scopes of services earlier

Texas Transportation Institute

Transportation Operations Group

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.

4) Enhance and Coordinate Preparation of Scopes of Services

- Potential changes to manuals
  - ✓PDP Manual
    - » Include scope of work coordination to PDP 1000 (Identify project need and scope) and PDP 2000 (Conduct Design Concept Conference)
  - ✓Environmental Manual
    - » Include scope of work coordination
  - ✓ROW Utility Manual
    - » Include scope of work coordination to "Exchange of Preliminary Information: Annual Meeting"

Texas Transportation Institute

Transportation Operations Group

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.

5) Require Utility Owners to Verify and Certify Utility Facility Information

- Purpose: Increase quality of information from utility owners during preliminary design phase
- Utility owners mark up geometric schematics
- Request utility owner verification and certification
  - ✓Completeness of known records, ground markings
- Use One Call during preliminary design phase
- Challenge: Include "Preliminary design locate ticket" in Texas Utilities Code

Texas Transportation Institute — Transportation Operations Group

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.

5) Require Utility Owners to Verify and Certify Utility Facility Information

- Potential changes to manuals
  - ✓ PDP Manual
    - » New activity after QLD: "Verify major utility installations on project alternatives"
    - » New activity after preferred alternative: "Provide preliminary design locate ticket to One Call center"
    - » New activity after QLC: "Verify location of utility installations on preferred alternative." Include request for verification certification
  - ✓ Environmental Manual
    - » None
  - ✓ ROW Utility Manual
    - » None

Texas Transportation Institute

Transportation Operations Group

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.

6) Gather Some QLB Data during Preliminary Design Phase

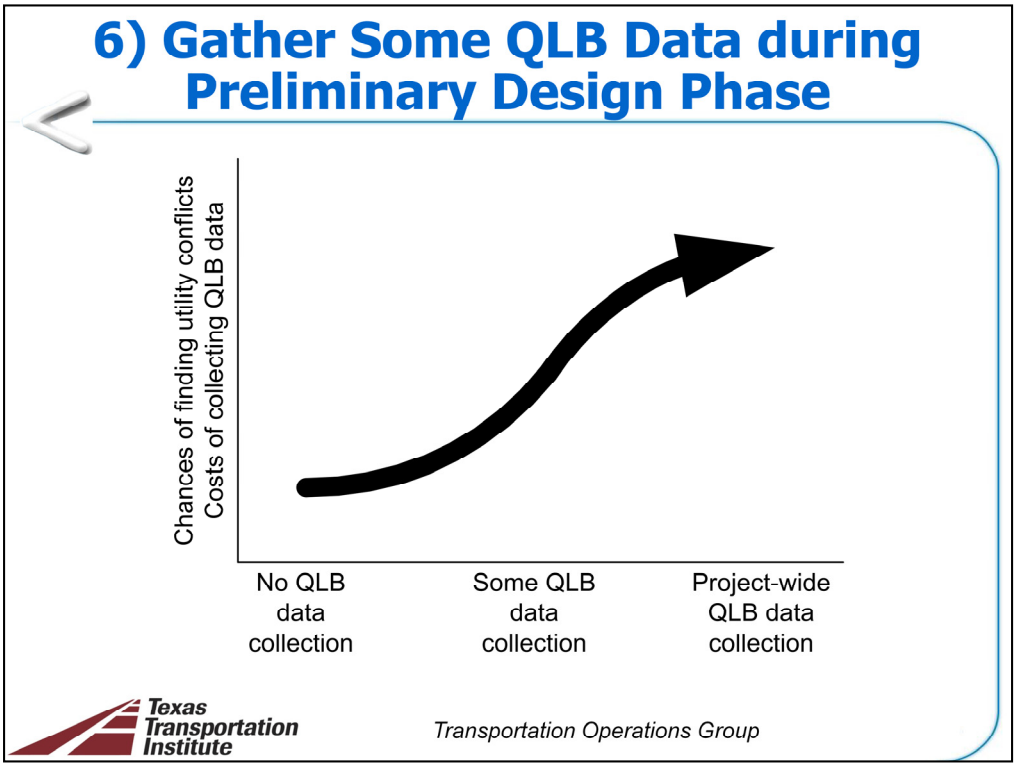
- Purpose: Reduce uncertainty about underground utility facilities earlier in the PDP
- QLB completed in design phase (if done)
- Collect QLB data earlier if:
  - ✓Right of way stays the same, e.g., for road widening or adding lanes within available space
  - ✓Important to know utility locations
- Utilities do not favor private easements
- Issue: Costs vs. benefits

Texas Transportation Institute — Transportation Operations Group

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

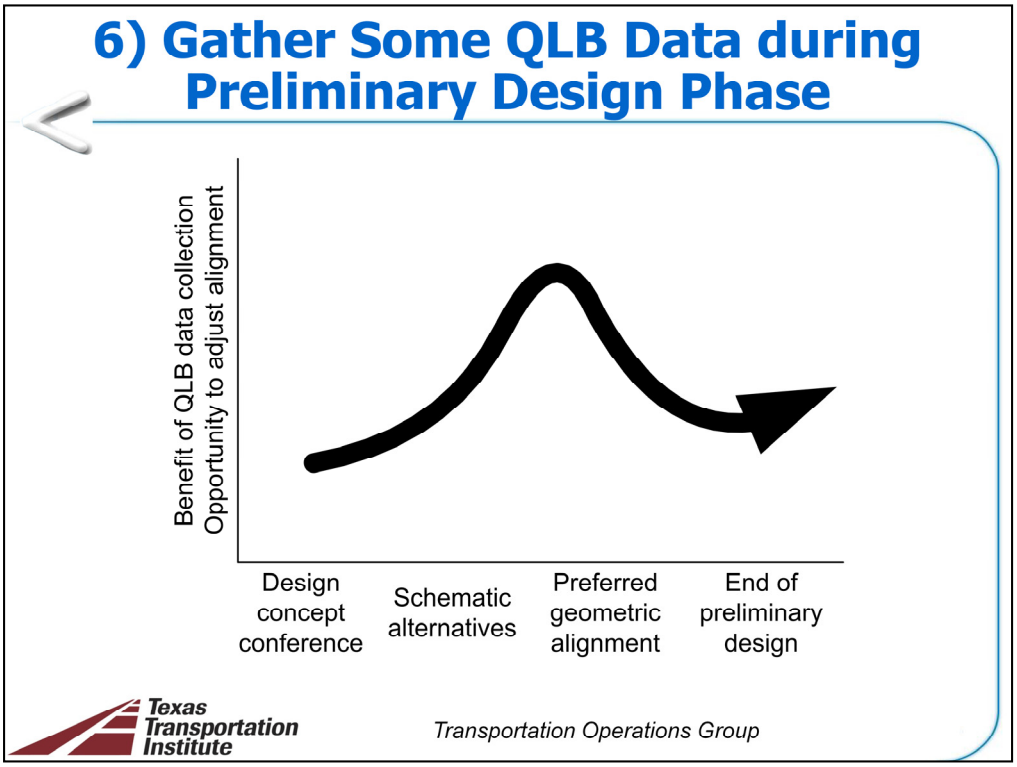
Normally, QLB is conducted during the design phase. Several national studies have documented the net benefits of using QLB in the design phase. Nonetheless, the benefit is not always immediately evident to project managers.

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.

6) Gather Some QLB Data during Preliminary Design Phase

- Potential changes to manuals
  - ✓ PDP Manual
    - » Rename PDP 4200 as "Conduct QLB and QLA utility investigations"
    - » Reword PDP 4200 to eliminate confusion about locate, designate, and SUE
    - » Use SUE terminology consistent with American Society of Civil Engineering/Construction Institute (ASCE/CI) Standard 38-02
  - ✓ Environmental Manual
    - » None
  - ✓ ROW Utility Manual
    - » None

Texas Transportation Institute

Transportation Operations Group

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.

7) Include Some Drainage Design Elements in Preliminary Design Phase

- Purpose: Encourage earlier participation by utilities
- Many/most utility conflicts are drainage-related
- Drainage design typically completed at 60% design
- Approx. elevation, sizes of cross drainage structures
  - ✓ Sizing depends on district's time availability
  - ✓ Focus on preliminary calculations
- Outfalls (must be cleared by environmental process)
- Appropriate for cases where cross section is "stable"
- High res/low altitude aerial photography can facilitate high accuracy vertical data in preliminary design

Texas Transportation Institute — Transportation Operations Group

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.

7) Include Some Drainage Design Elements in Preliminary Design Phase

- Potential changes to manuals
  - ✓PDP Manual
    - » Expand PDP 2620 (Perform preliminary hydraulic analysis) to cover risk analysis and preliminary sizing of structures other than cross drainage structures
    - » Include references to environmental regs in PDP 2620
    - » Include references to PDP 2620 in PDP 5150 and 5540
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute

Transportation Operations Group

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

8) Include Some Design Elements in Preliminary Design Phase

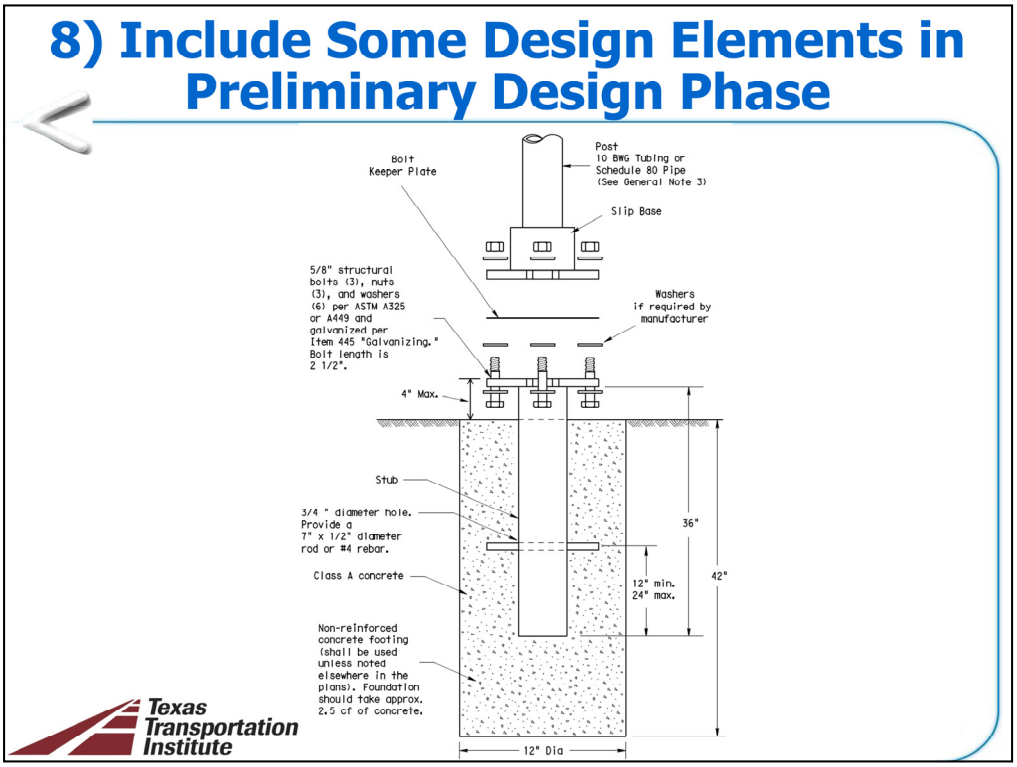
- Similar principles as for drainage design
  - ✓Horizontal and vertical alignments needed
  - ✓Cross sections needed
- Certain design elements possible
  - ✓"Preliminary/standardized" foundations
    - » Guide signs, overhead sign bridges
    - » Signal poles, high-mast illumination poles
    - » Plan view with annotated "preliminary" depth
  - ✓Access control
  - ✓Noise walls

Texas Transportation Institute

Transportation Operations Group

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.

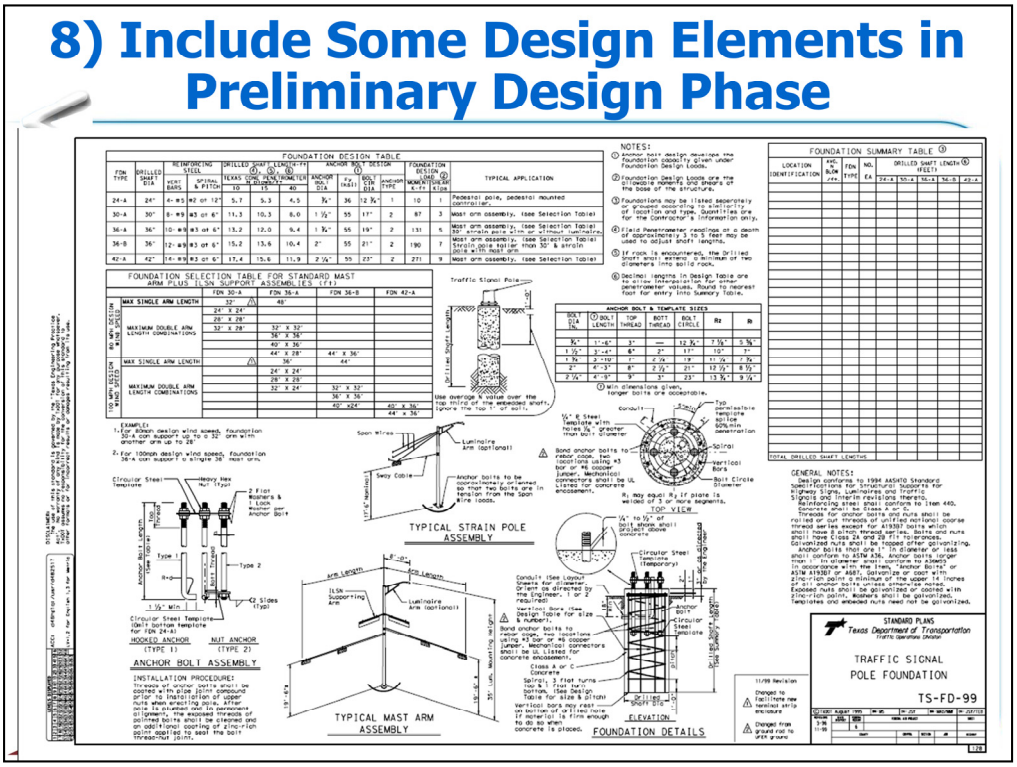
It should be possible to show information about certain standardized foundations on preliminary schematics, including guide signs, overhead sign bridges, and sign poles, because those foundations tend to be standardized. In fact, utilities and other stakeholders (including environmental stakeholders) 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).

8) Include Some Design Elements in Preliminary Design Phase



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

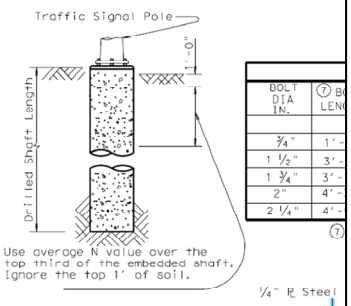
8) Include Some Design Elements in Preliminary Design Phase

FOUNDATION DESIGN TABLE

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL: VERT BARS	REINFORCING STEEL: SPIRAL & PITCH	DRILLED SHAFT LENGTH ft ④, ⑤, ⑥ — TEXAS CONE PENETROMETER N blows/ft: 10	15	40	ANCHOR BOLT DESIGN ①: ANCHOR BOLT DIA	Fy (ksi)	BOLT CIR DIA	ANCHOR TYPE	FOUNDATION DESIGN LOAD ②: MOMENT K-ft	SHEAR Kips	TYPICAL APPLICATION
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'



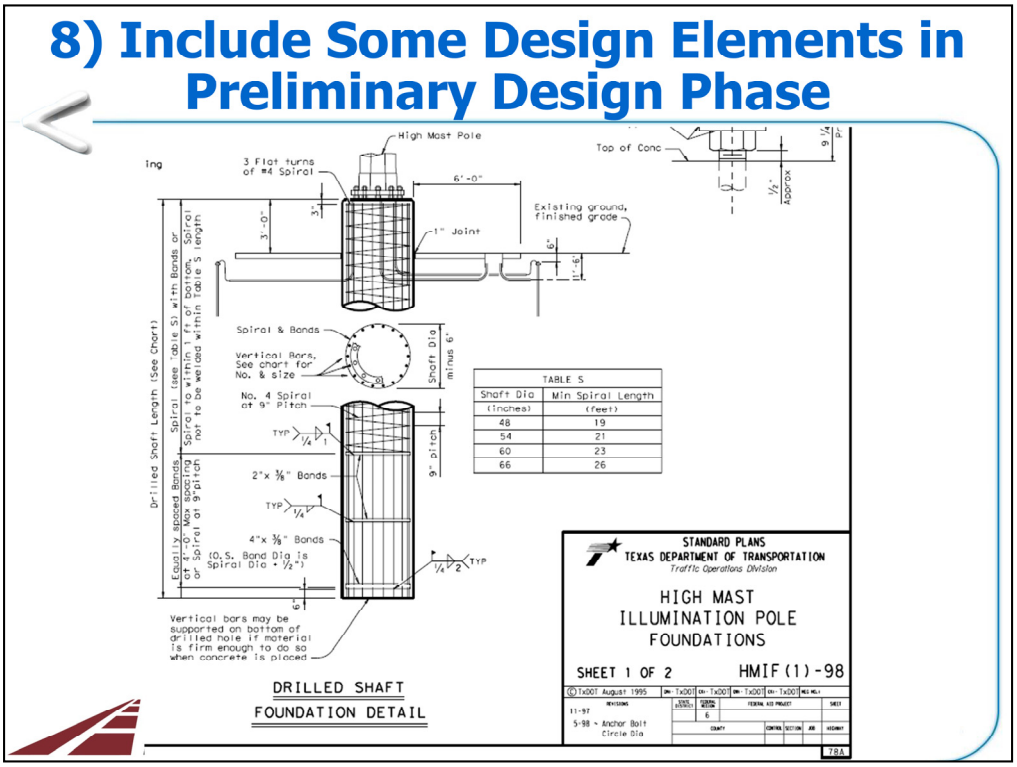
BOLT DIA IN.	⑦ BO LENG
¾"	1'-
1 ½"	3'-
1 ¾"	3'-
2"	4'-
2 ¼"	4'-

⑦

Texas Transportation Institute

Transportation Operations Group

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.

8) Include Some Design Elements in Preliminary Design Phase

- Potential changes to manuals
  - ✓Roadway Design Manual
    - » Update schematic layout requirements to include elements listed in PDP 2350
    - » Plan views: Add typical foundation footprints and depths
  - ✓PDP Manual
    - » None (already provides refs. to Roadway Design Manual)
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute — Transportation Operations Group

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.

9) Address Utility Issues in Constructability Review in Preliminary Design Phase

- Purpose: Include utilities in constructability review
- PDP 2670, National Cooperative Highway Research Program (NCHRP) 391 do not mention utility issues in constructability review
- Examples of utility issues
  - ✓Impact of utilities on construction phasing
  - ✓Trench section and protection
  - ✓Temporary pole bracing
  - ✓Utility conflicts

Texas Transportation Institute — Transportation Operations Group

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:

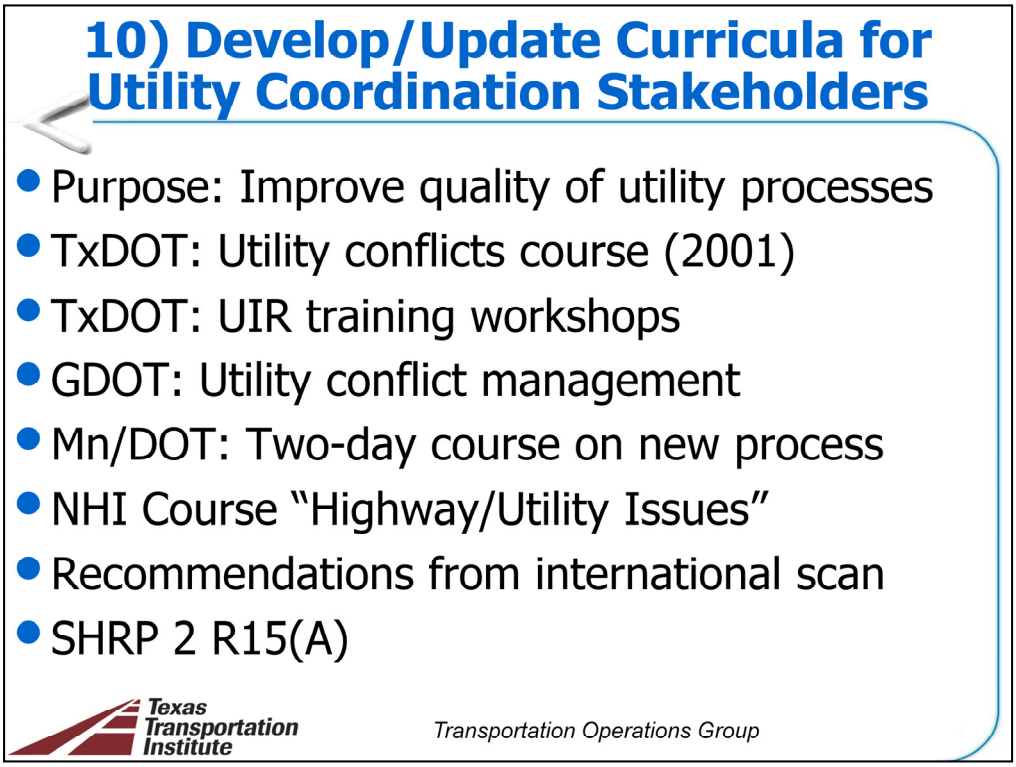
- impact of utilities on construction phasing,
- trench section and protection,
- temporary pole bracing, and
- utility conflicts.

9) Address Utility Issues in Constructability Review in Preliminary Design Phase

- Potential changes to manuals
  - ✓PDP Manual
    - » Include references to utility issues in PDP 2670 "Conduct constructability review" such as:
      - Impact of utilities on construction phasing
      - Trench section and protection
      - Temporary pole bracing
      - Utility conflicts
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » Insert activity "Preliminary design utility coordination"

Texas Transportation Institute — *Transportation Operations Group*

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.

TxDOT Manual Structure Recommendations

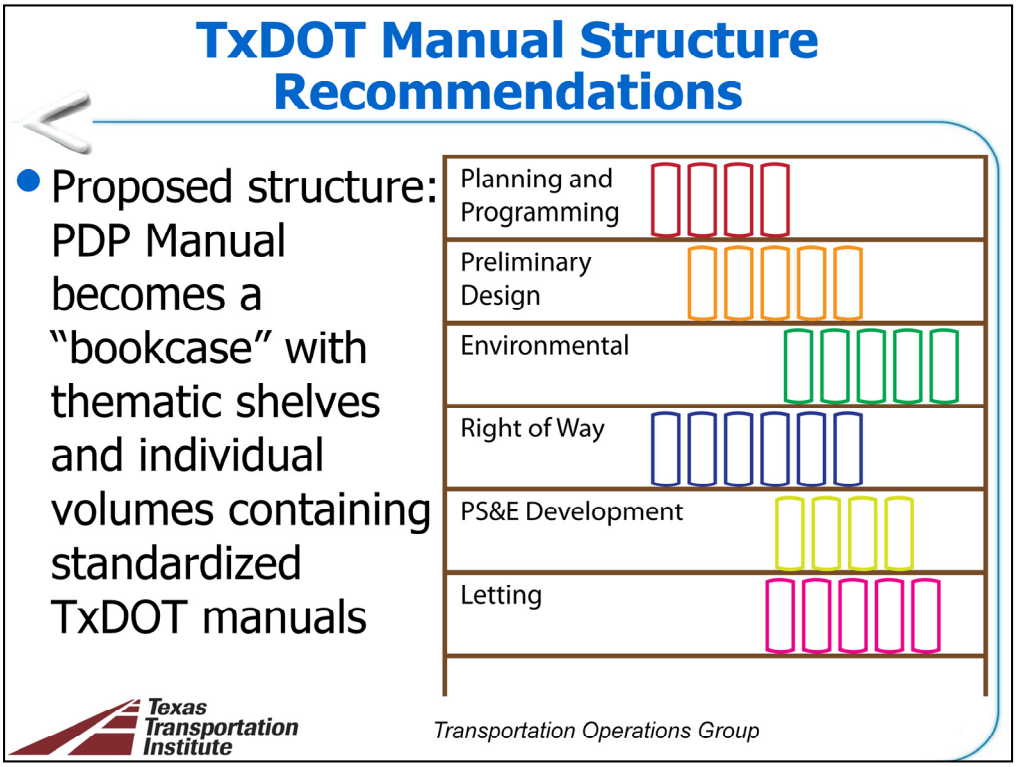
- Simplify project development process
- Harmonize/remove inconsistencies between manuals
  - ✓Differences in activity descriptions
  - ✓Inconsistencies in level of aggregation
  - ✓Redundancy in content
  - ✓Inconsistent flowcharts
  - ✓Some manuals are modular, some are not
  - ✓Some manuals use activity codes

Texas Transportation Institute — Transportation Operations Group

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.

Business Process Modeling Approaches

- Informal, ad hoc "flowcharting"
- Inconsistent, incompatible approaches across manuals
- Level of detail varies
- Typically high level
- Loose flowchart/manual mapping
- No TxDOT business process modeling standard

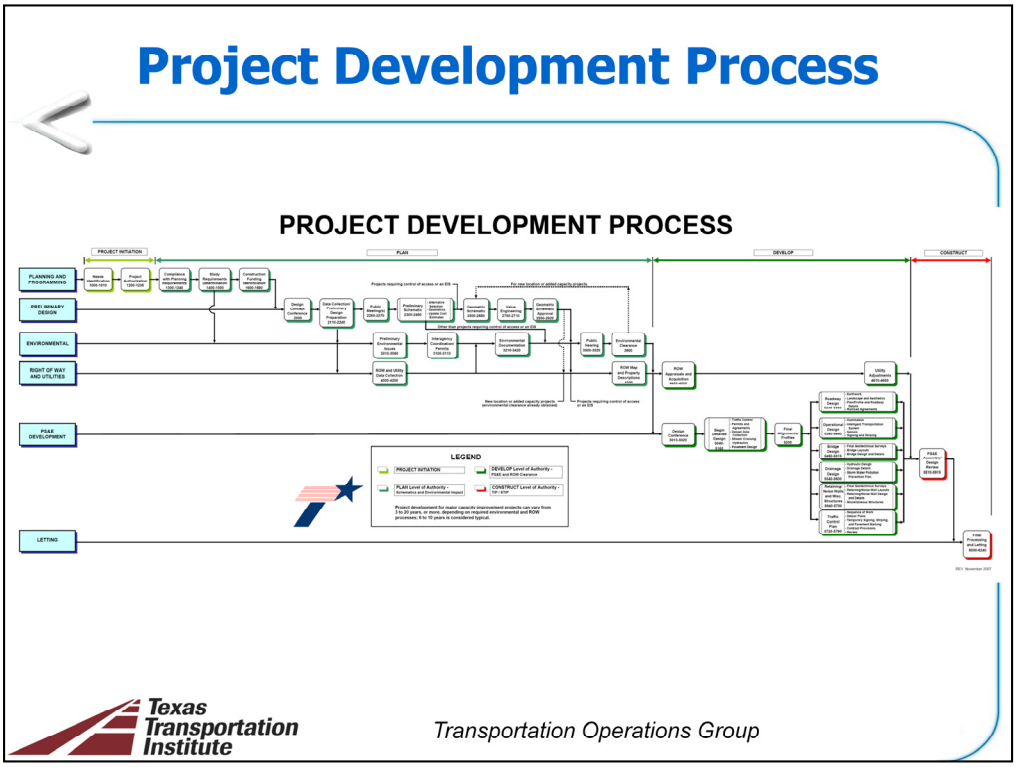
Texas Transportation Institute

Transportation Operations Group

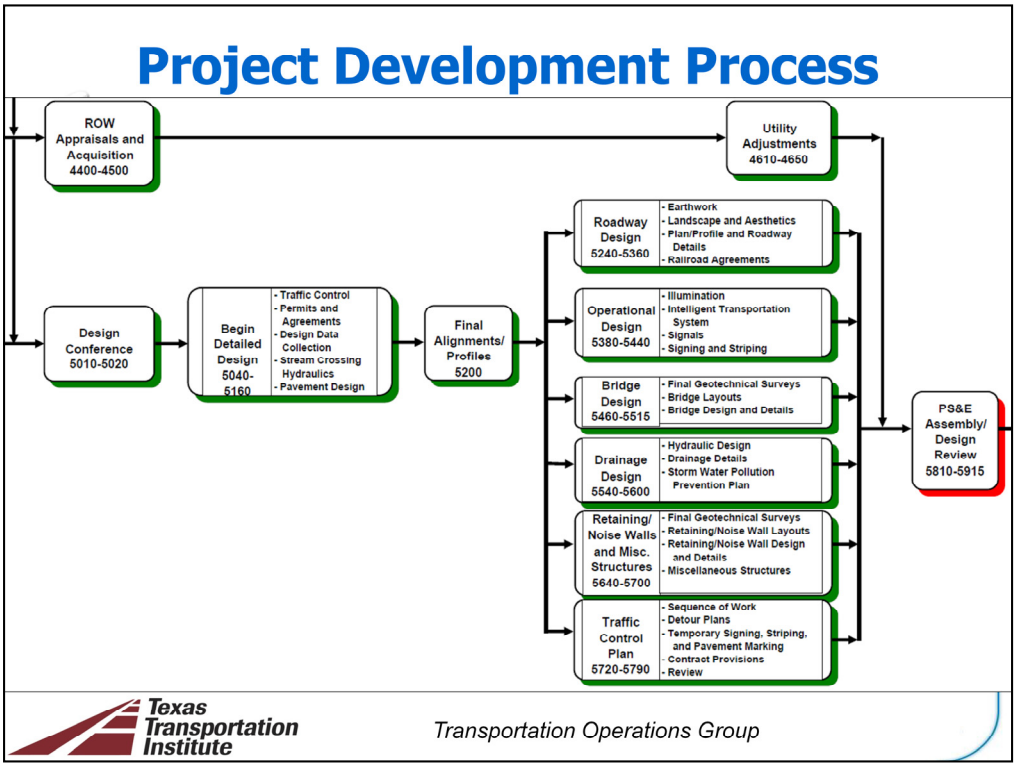
This slide starts the second half of the workshop. The purpose of this second half is to describe a business process explorer application that encourages interaction between the environmental and utility processes at TxDOT.

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

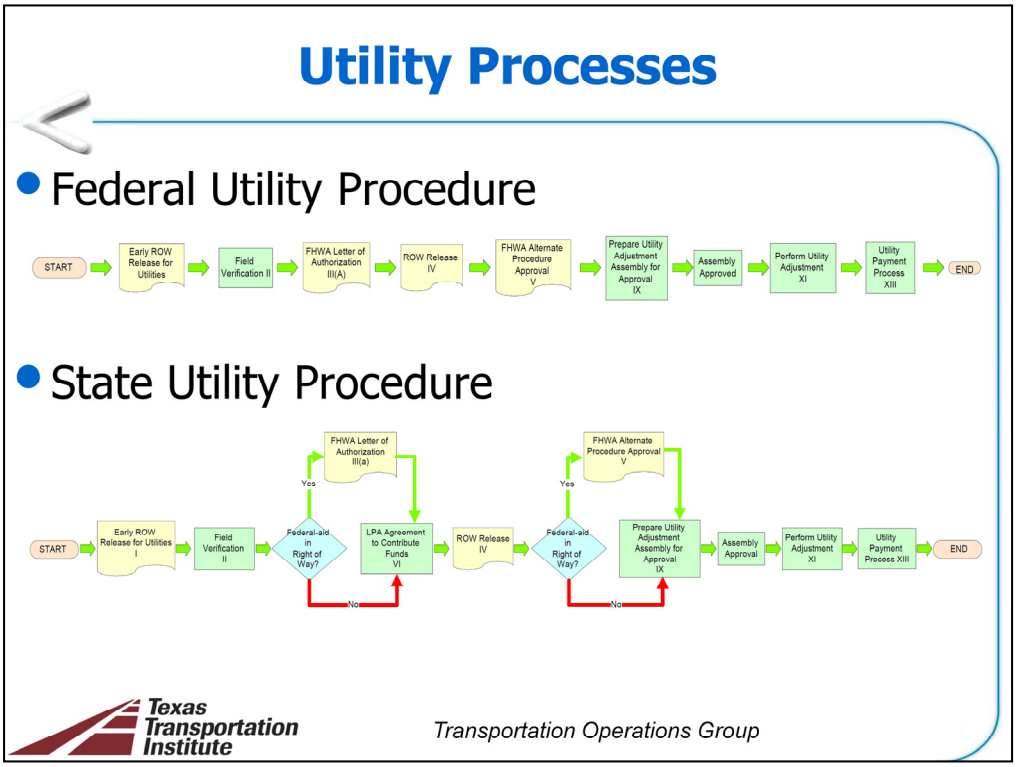
- Most business process diagrams are somewhat informal, following ad hoc flow charting procedures.
- Flowcharts from different organizational units tend to use inconsistent, incompatible approaches.
- Flowcharts are typically at a high level of aggregation that does not provide much detail about activities 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.



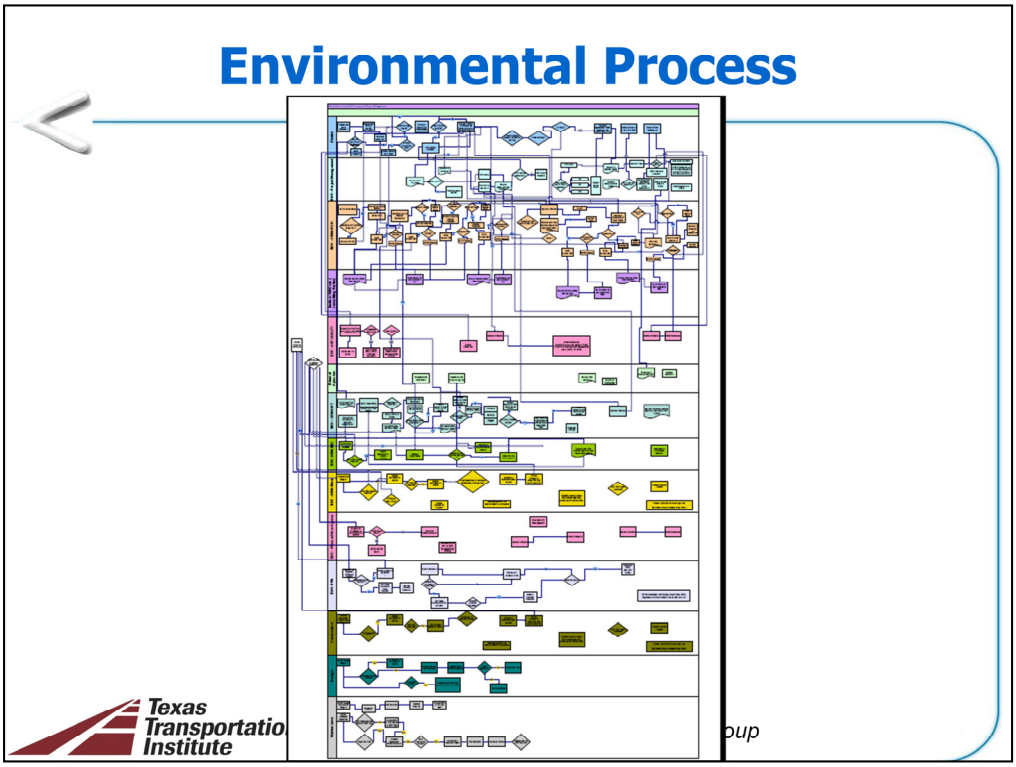
Here are some examples of current TxDOT flowcharts. This widely used chart of the project development process (which is part of the PDP Manual) appears to be a swim lane diagram. However, in reality, the "swim lanes" do not represent organizational units at TxDOT but chapters in the PDP Manual. Notice 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.



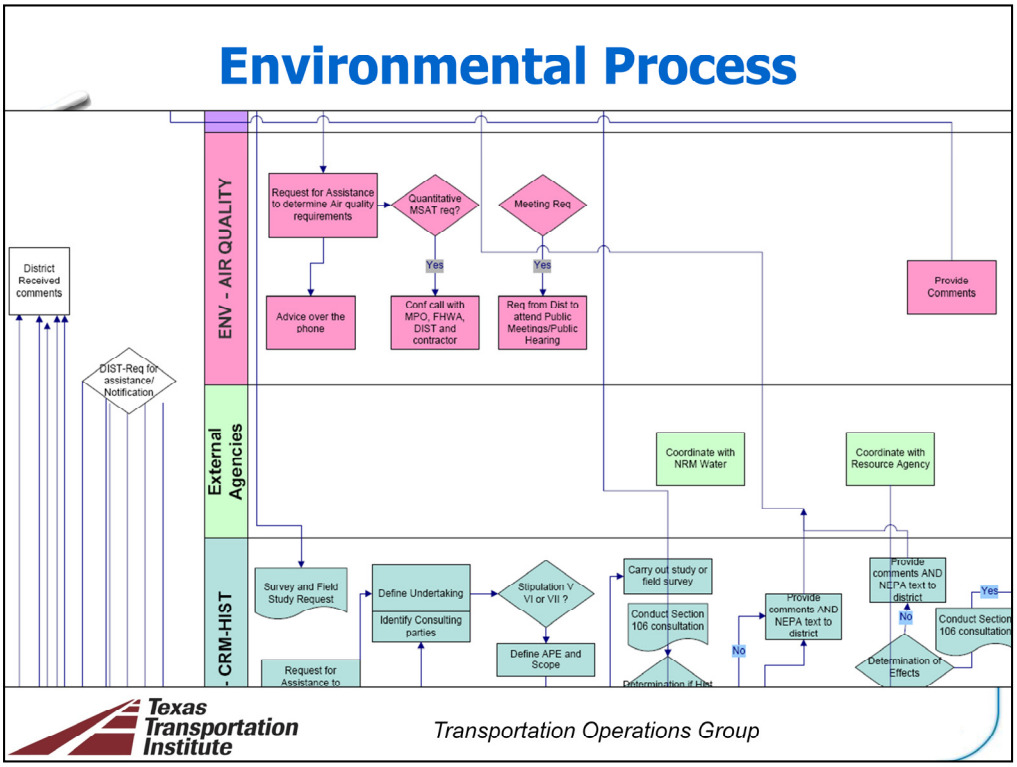
This is a zoomed in view of the PDP diagram that focuses on the design phase. Notice that "ROW Appraisals and Acquisition" is represented by an activity group that occurs roughly at the same time as the "Design Conference" activity. Both "activities" are shown with similar durations, although, in reality, 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).



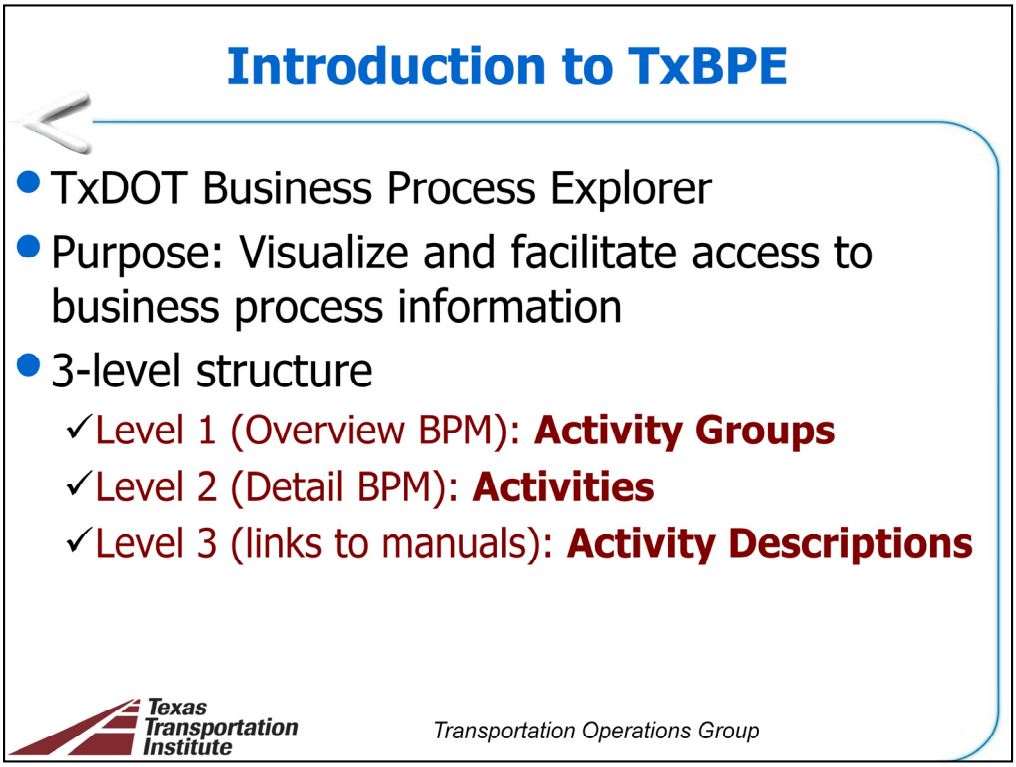
The Utility Cooperative Management Process of the ROW Utility Manual includes flowcharts in which activities feed into documents and then these documents feed into other activities. From a business process modeling perspective, it would be more appropriate to replace those documents with activities that 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.



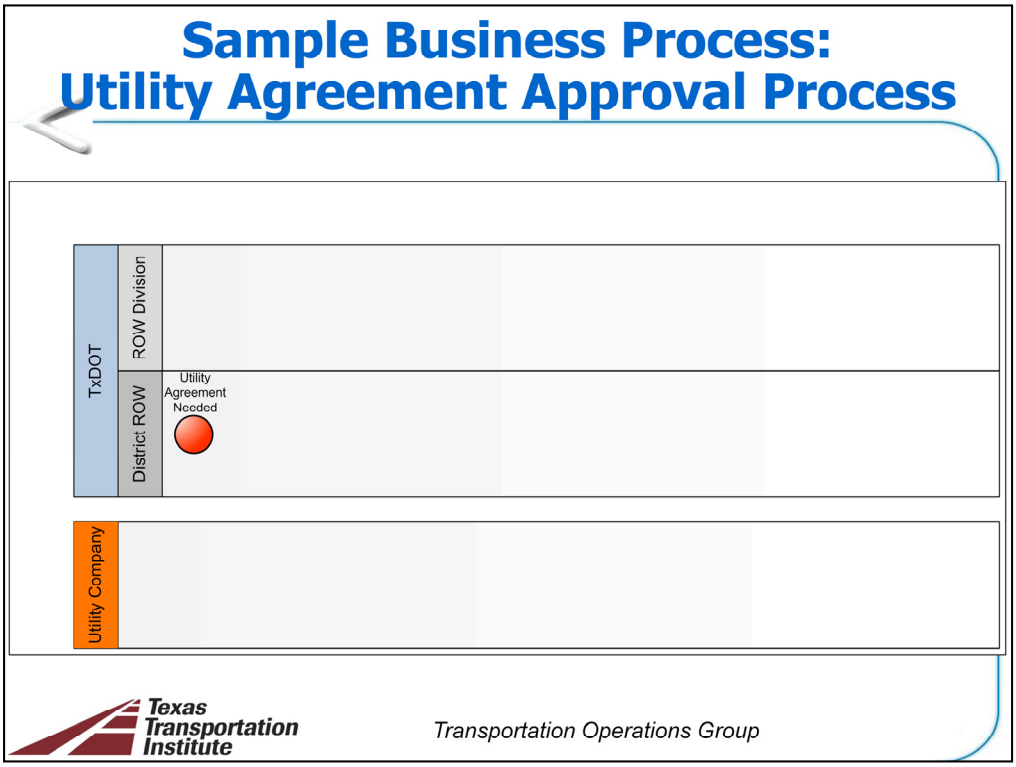
This is a zoomed in view of the middle section of the diagram on the left-hand side. Notice a decision box with no input and only one output ("Yes") and activities with no input or output, which makes it difficult to understand how these activities are part of the work flow.



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.

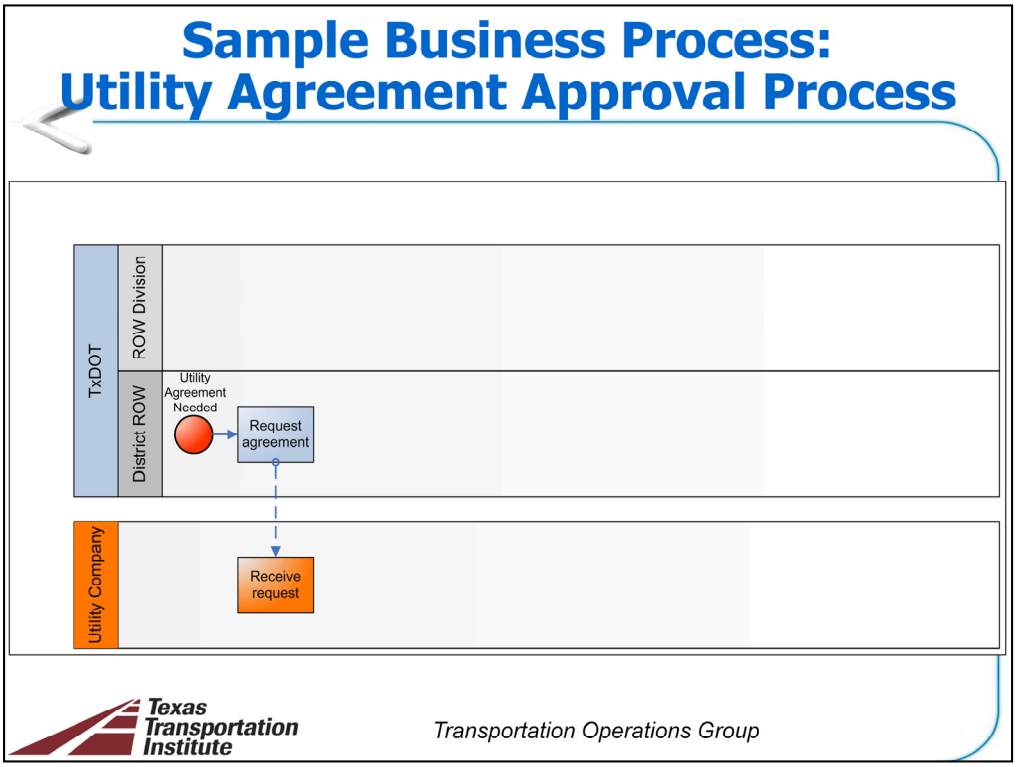
TxBPE is an application that presents information at three levels of activity disaggregation:

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

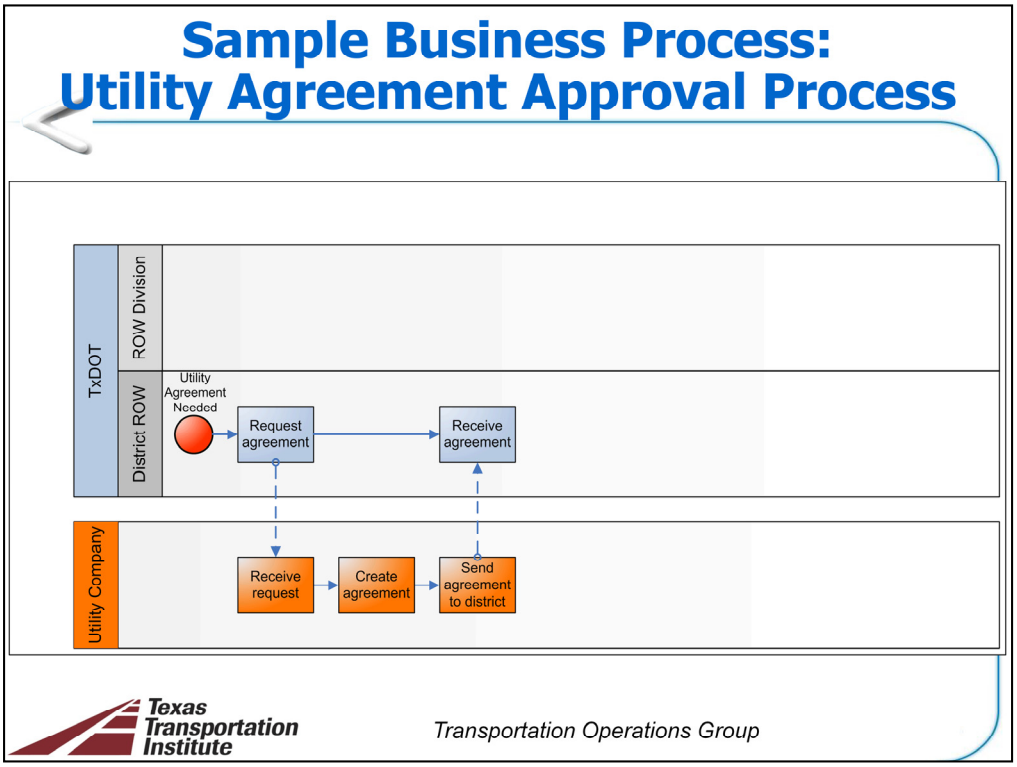


The business process modeling standard used is called Business Process Modeling Notation (BPMN), which is a modeling standard designed to present business process information in a simple, intuitive way (as opposed to other, more traditional BPM notations that are not as user friendly).

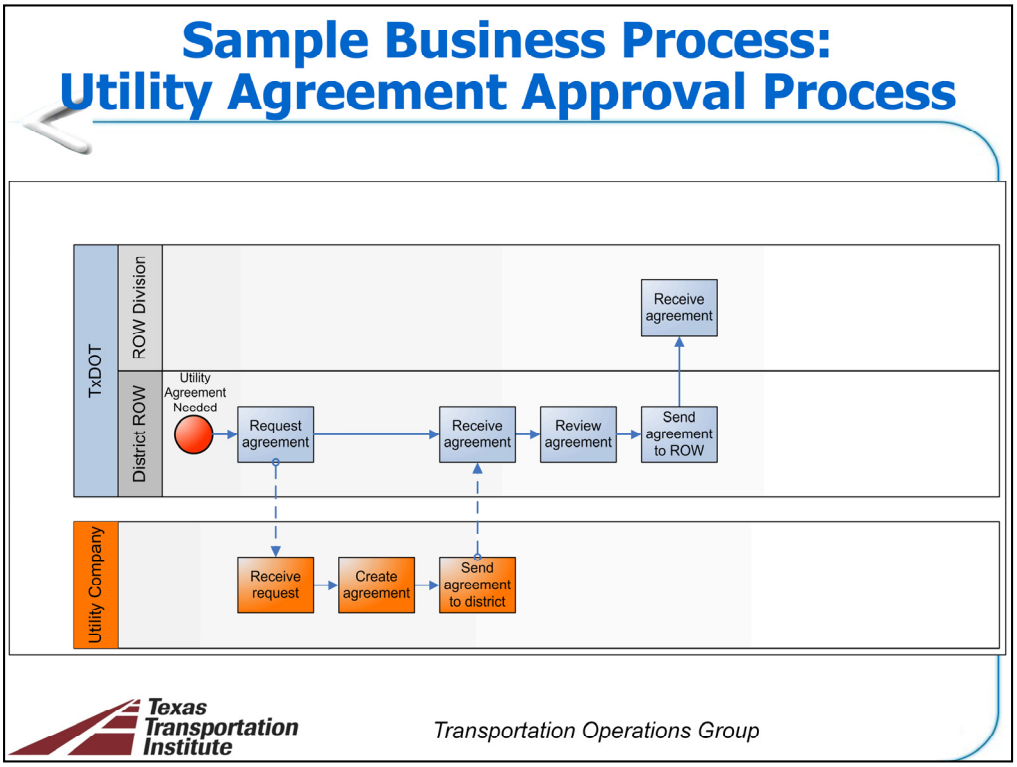
This slide shows the process to build a business process model using BPMN. For illustration purposes, the example is a highly simplified ("ideal," i.e., probably not realistic) version of the utility agreement approval process. The diagram shows two organization units (TxDOT and utility company) and 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.



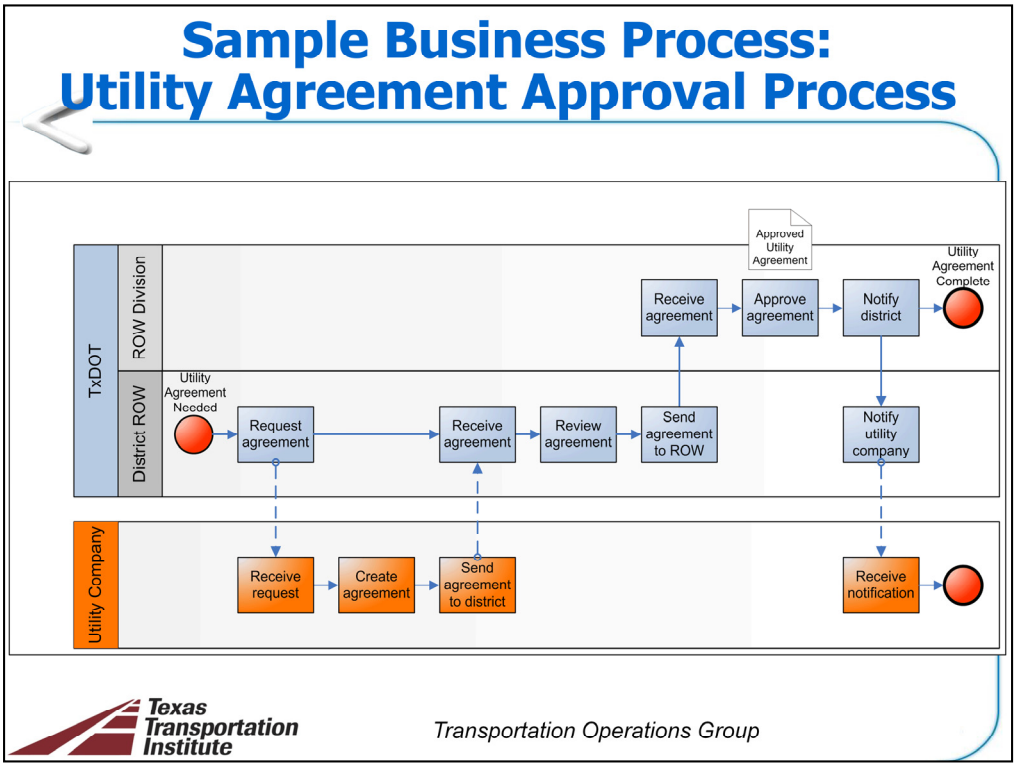
The district right of way section requests an agreement from the utility company, and the utility company receives the request.



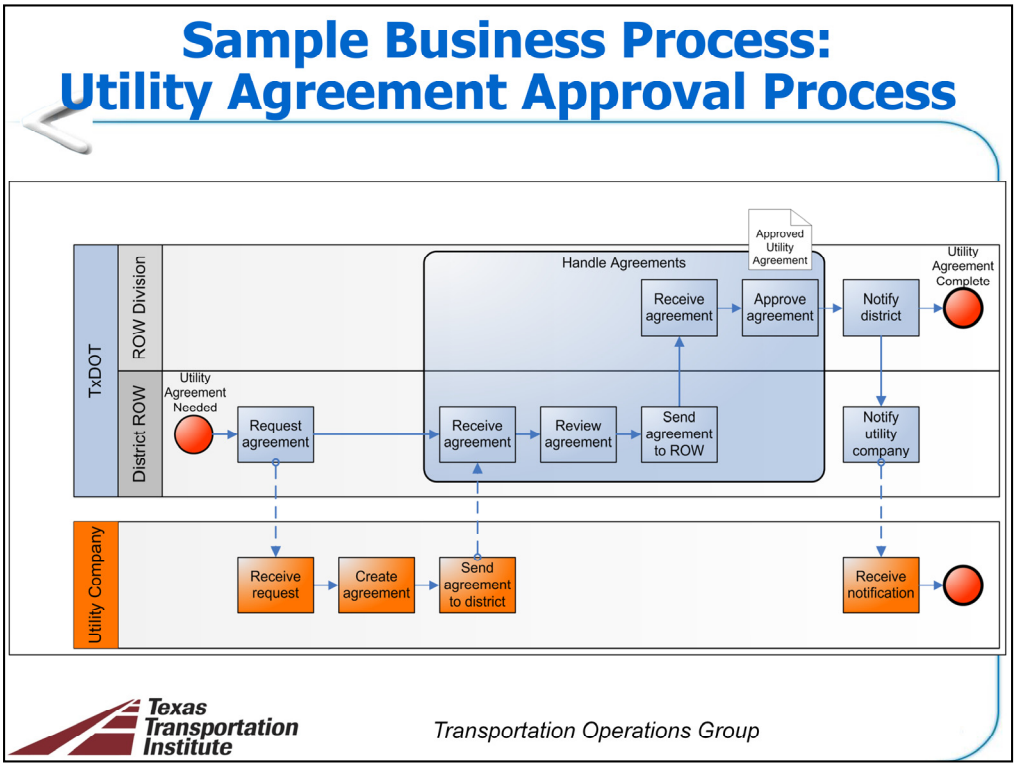
The utility company creates an agreement draft, sends the agreement to the district right of way section, and the district receives the agreement.



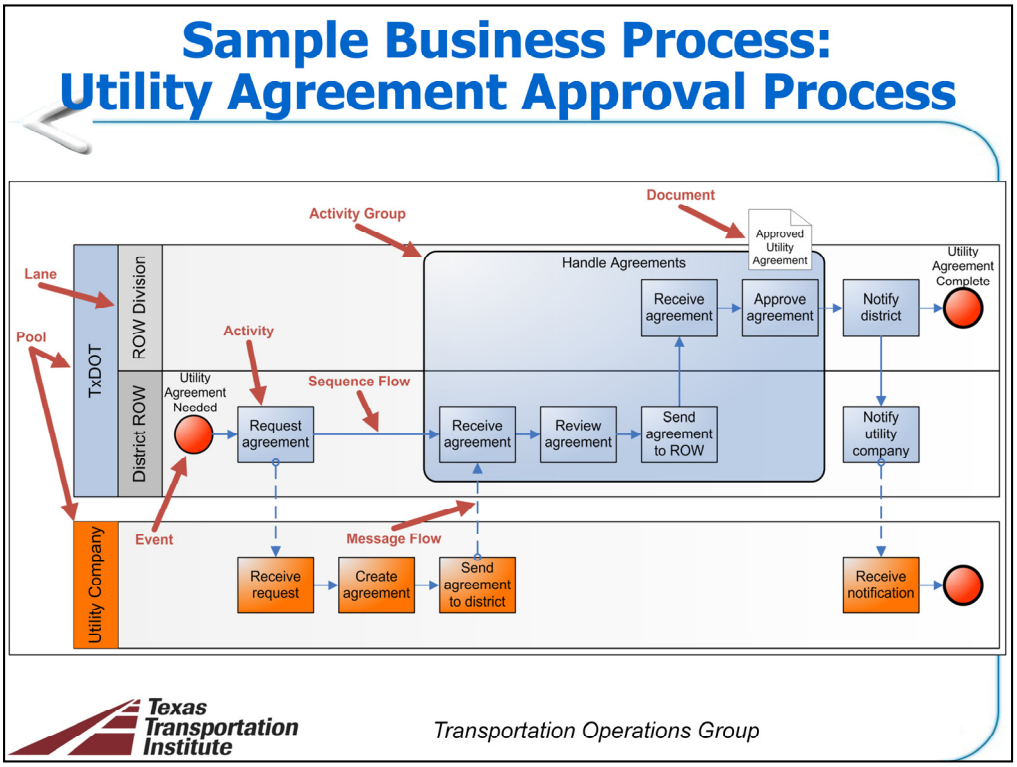
The district reviews the agreement and sends it to the Right of Way Division, and the division receives the agreement.



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."

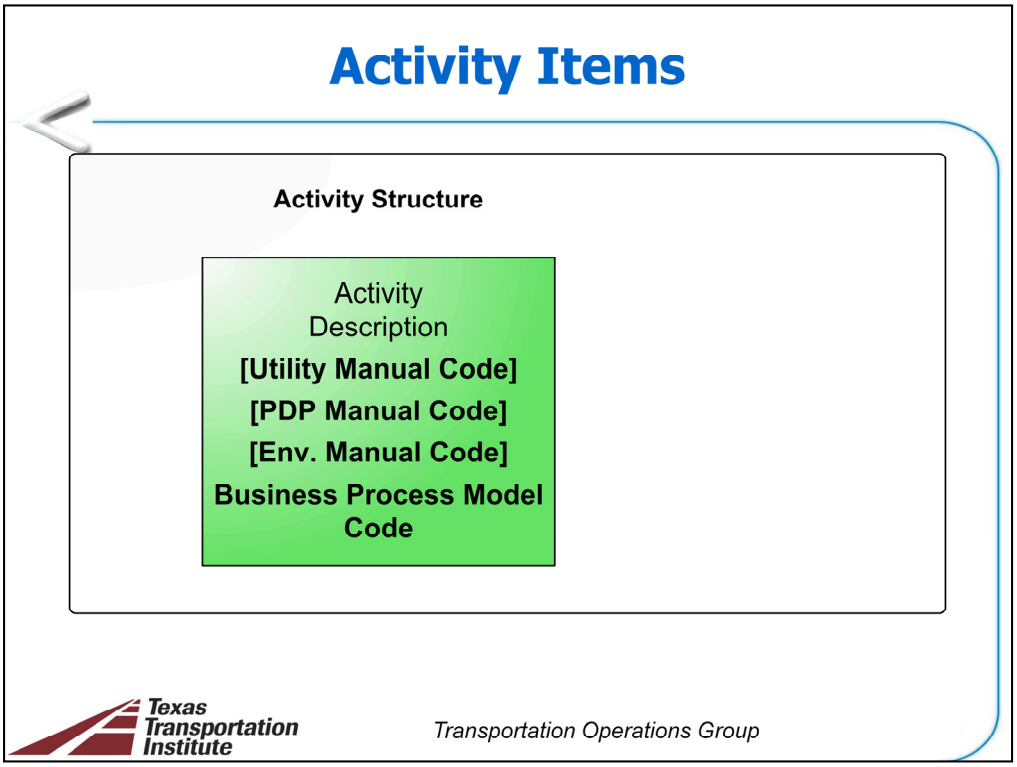


It is also possible to group activities into activity groups (e.g., activity group "Handle Agreements"). For consistency, the shape of the activity group is slightly different from individual activities (rounded corners as opposed to straight corners).

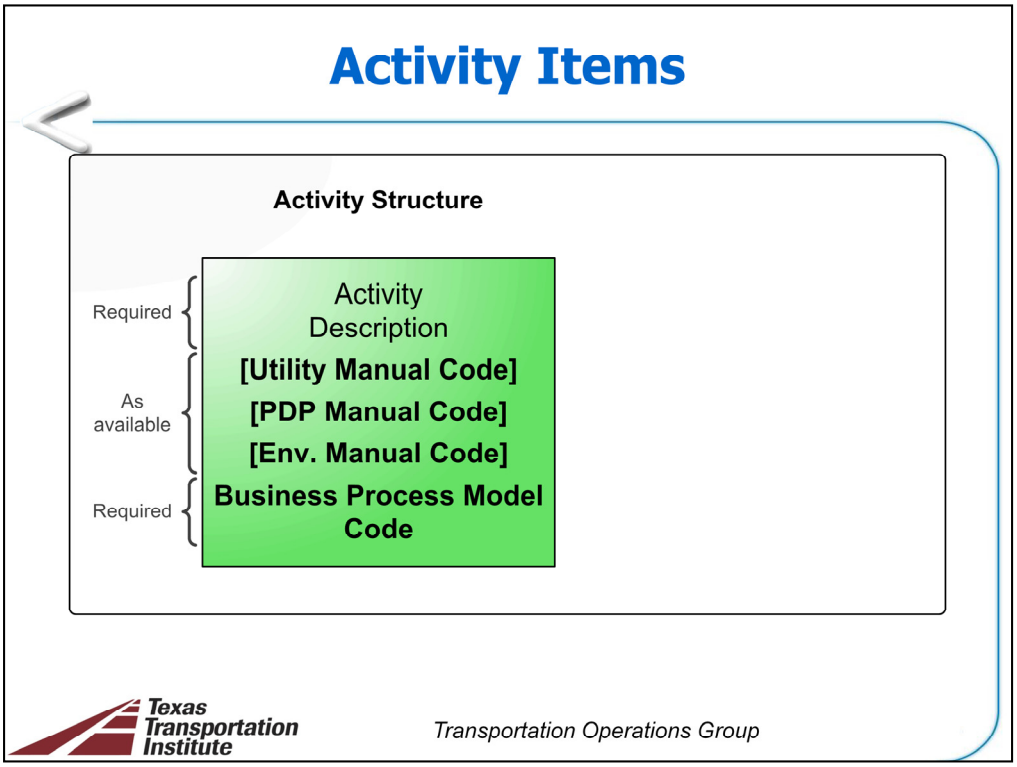


This simple example shows all the major elements of the business process model developed in TxBPE, including the following:

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

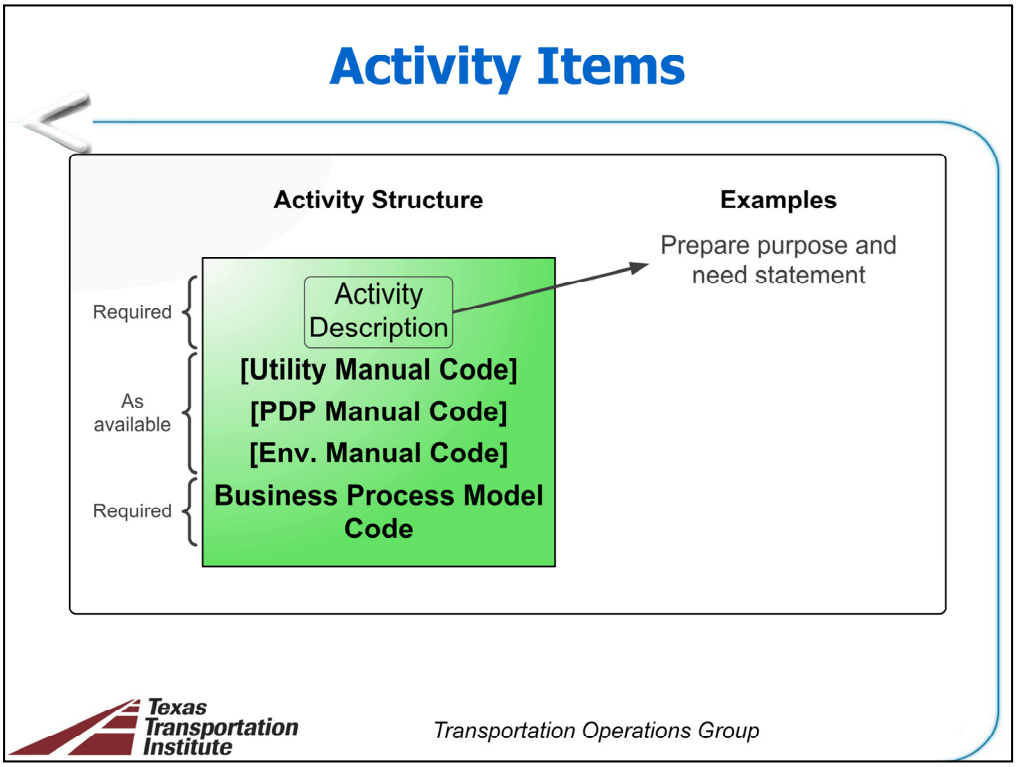


The integrated environmental/utility business process model (as well as TxBPE) provides an explicit representation of the origin of each activity in relation to the TxDOT manual(s) that describe that activity. Because activities are frequently mentioned in more than one manual, it became necessary to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

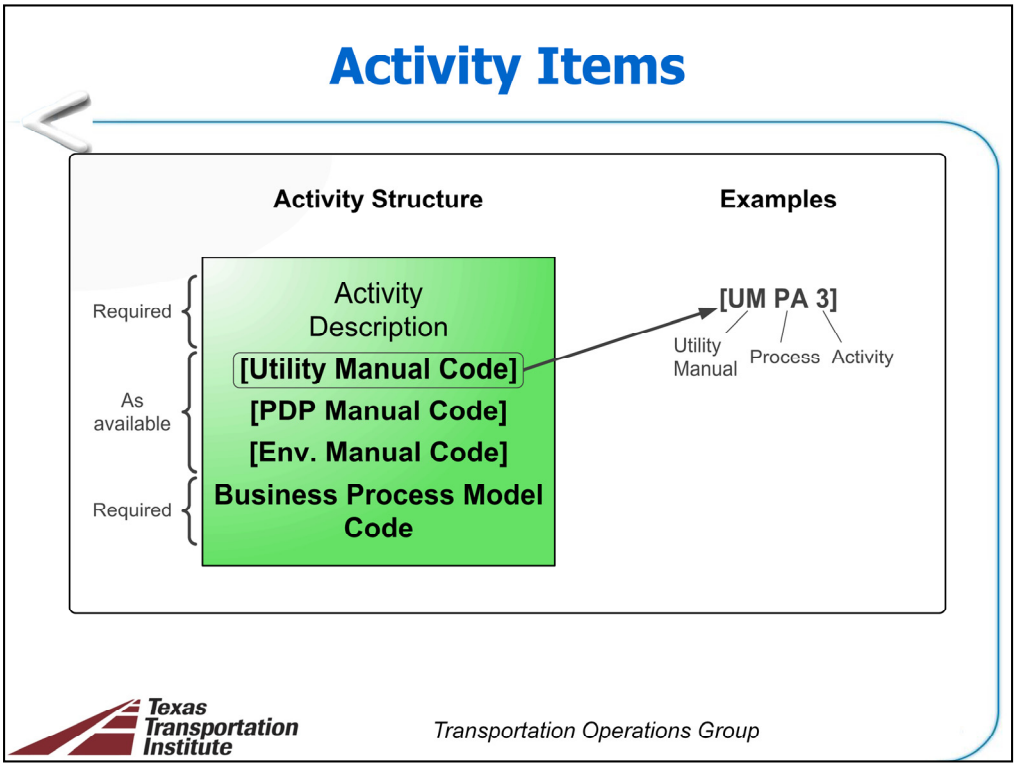


In general, all activities have an activity description at the top and a business process model code at the bottom. This business process model code was used to uniquely identify activities in the model.

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.

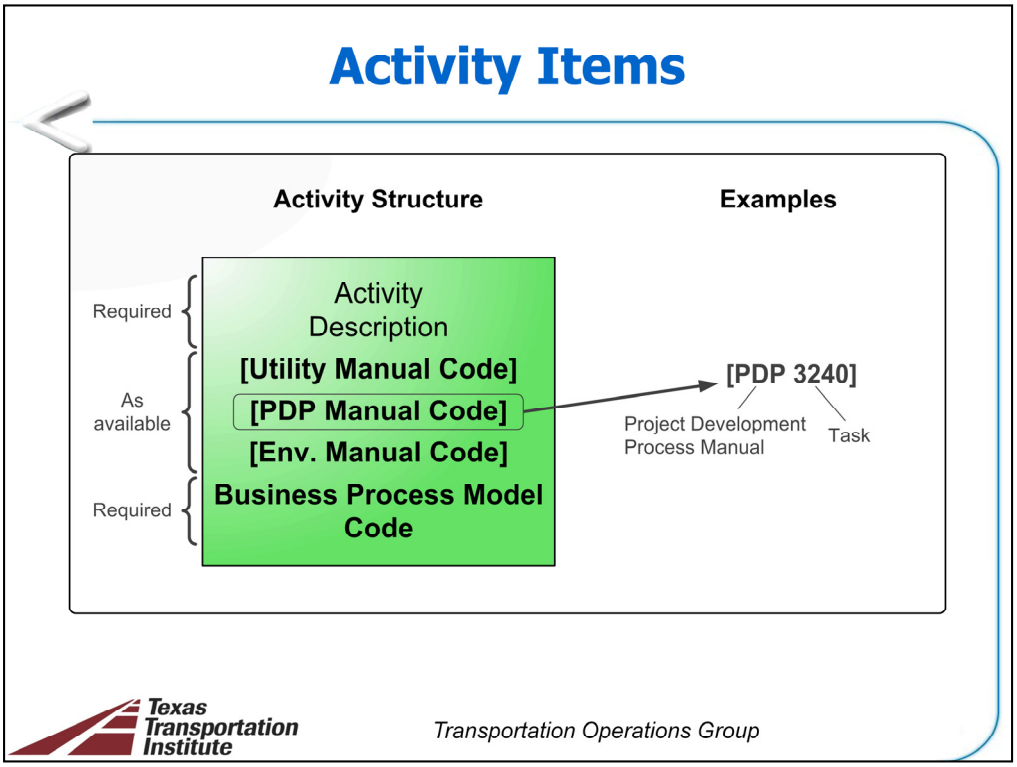


For example, an activity description could be "Prepare purpose and need statement."



A Utility Manual code entry could be UM PA 3:

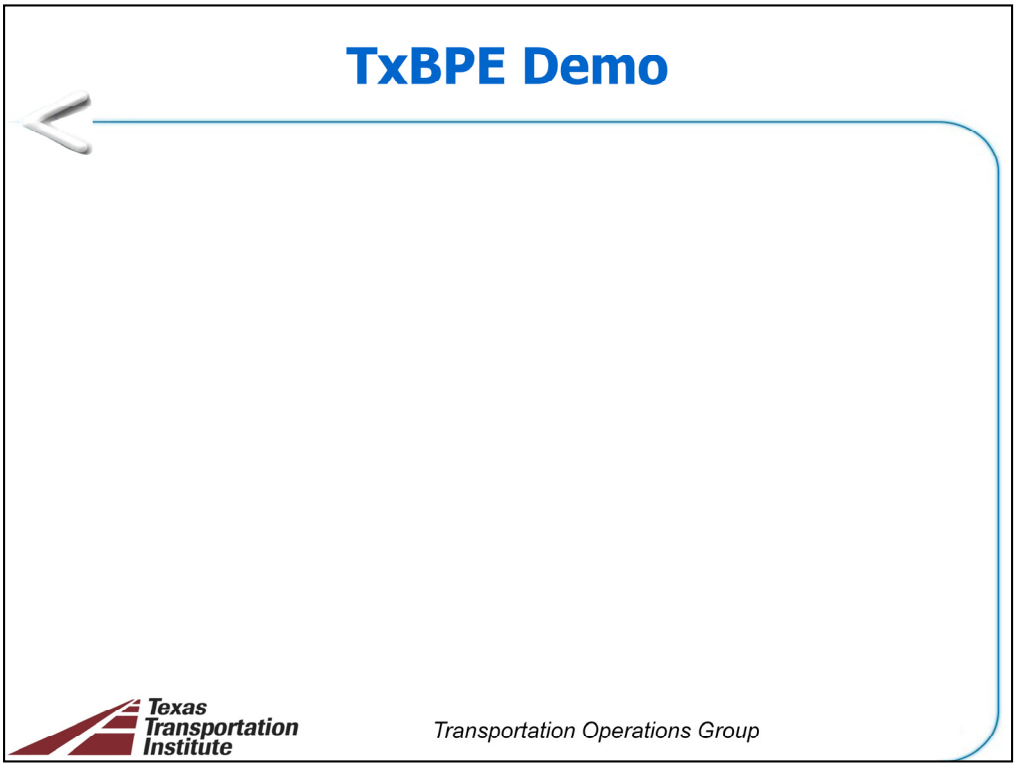
- UM: Utility Manual
- PA: Process Activity
- 3: Activity number



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

Texas Transportation Institute

Transportation Operations Group

PARTICIPANT HANDOUT

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*

Workshop Overview

- Project objectives and workshop materials
- Recommended strategies and changes to TxDOT manuals
- Break
- Introduction to TxDOT Business Process Explorer (TxBPE)
- TxBPE live demonstration
- General discussion and feedback

Texas Transportation Institute — *Transportation Operations Group*

Project Objectives

- Feasibility to obtain better utility data in the preliminary design phase
- Feasibility of earlier assessment of design elements in the preliminary design phase
- Identify potential business process changes
- Proposed changes to relevant TxDOT manuals
- Research dissemination/educational materials
- Swim lane diagram

Texas Transportation Institute — *Transportation Operations Group*

Research Team

TxDOT:
- Randy Anderson, ROW (PD)
- Brent Hillebrenner, DES
- Jenise Walton, ENV
- Duncan Stewart, RTI
- Sylvia Medina, RTI

TTI:
- Cesar Quiroga (RS)
- Nick Koncz
- Edgar Kraus
- Jerry Le
- John Overman
- Duane Rosa, WTAMU

Texas Transportation Institute — Transportation Operations Group

Recommended 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

Texas Transportation Institute — Transportation Operations Group

Recommended Strategies

6) Gather some Quality Level B (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

Texas Transportation Institute — Transportation Operations Group

1) Involve Environmental/ROW Staff in Planning and Programming

- Purpose: Identify "fatal flaw" issues
  - ✓Utilities, pipelines
  - ✓Potential contamination sites
  - ✓Sensitive receptors
- Preliminary feedback to advance planning
- Annual meeting with utilities
- Preliminary cost estimate
- Issue: Allocation of resources

Texas Transportation Institute — Transportation Operations Group

1) Involve Environmental/ROW Staff in Planning and Programming

- Potential changes to manuals
  - ✓Project Development Process (PDP) Manual
    - » Add PDP activity for preliminary feedback to planning
  - ✓Environmental Manual
    - » Informal feedback to Planning and Programming
  - ✓ROW Utility Manual
    - » Provide input on utility-friendly project list
    - » Attend annual (utility) meeting
    - » Provide support for right of way estimate
    - » Attend Design Concept Conference (part of preliminary design)

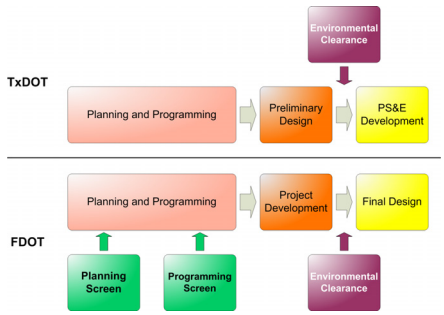
Texas Transportation Institute — Transportation Operations Group

2) Establish Planning Advisory Teams and Support Tools

- Purpose: Use environmental data in transportation planning and programming
- Memoranda of Understanding (MOUs) with TCEQ, TPWD, THC, and GLO
- FDOT ETDM process
  - ✓Environmental Technical Advisory Teams (ETAT)
  - ✓Environmental Screening Tool (EST)
- Implement ETAT and EST
- Expand MOUs with resource agencies
- Cooperative Utility Planning System (CUPS)

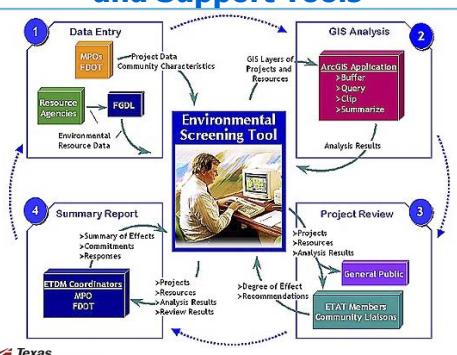
Texas Transportation Institute — Transportation Operations Group

2) Establish Planning Advisory Teams and Support Tools



Texas Transportation Institute — Transportation Operations Group

2) Establish Planning Advisory Teams and Support Tools



Texas Transportation Institute — Transportation Operations Group

2) Establish Planning Advisory Teams and Support Tools

- Potential changes to manuals
  - ✓PDP Manual
    - » PDP 3100 (Perform early coordination with review/resource agencies): Clarify "early coordination"
    - » New activities "Review planning screen data," "Review programming screen data"
  - ✓Environmental Manual
    - » Changes to chapters "Interagency Coordination" and "Permitting"
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute — Transportation Operations Group

3) Coordinate Environmental/ROW Utility Data Collection

- Purpose: Improve coordination between groups regarding utility data collection activities
- Initial Site Assessments (ISA) vs. utility site investigations (QLD and QLC)
  - ✓Surface observations
  - ✓Review of existing records
- Start utility investigations concurrent with initial environmental site investigations
- Share investigation results

Texas Transportation Institute — Transportation Operations Group

3) Coordinate Environmental/ROW Utility Data Collection

- Potential changes to manuals
  - ✓PDP Manual
    - » Add coordination activities
  - ✓Environmental Manual
    - » Notify ROW of pending ISA initiation and completion
  - ✓ROW Utility Manual
    - » Notify environmental staff of utility investigation and completion
  - ✓Both Environmental and ROW Utility Manual
    - » Exchange results of investigation and relevant information
    - » Attend annual utility meeting

Texas Transportation Institute — Transportation Operations Group

4) Enhance and Coordinate Preparation of Scopes of Services

- Purpose: Identify utility facilities earlier, reduce redundancy, and reduce utility conflict impact
- Professional services (SUE) vs. scientific services (environmental)
- SUE: Design phase (QLB and QLA)
- Environmental work: Preliminary design phase
- Many consultants offer both services
- Identify scopes of services earlier

Texas Transportation Institute — Transportation Operations Group

4) Enhance and Coordinate Preparation of Scopes of Services

- Potential changes to manuals
  - ✓PDP Manual
    - » Include scope of work coordination to PDP 1000 (Identify project need and scope) and PDP 2000 (Conduct Design Concept Conference)
  - ✓Environmental Manual
    - » Include scope of work coordination
  - ✓ROW Utility Manual
    - » Include scope of work coordination to "Exchange of Preliminary Information: Annual Meeting"

Texas Transportation Institute — *Transportation Operations Group*

5) Require Utility Owners to Verify and Certify Utility Facility Information

- Purpose: Increase quality of information from utility owners during preliminary design phase
- Utility owners mark up geometric schematics
- Request utility owner verification and certification
  - ✓Completeness of known records, ground markings
- Use One Call during preliminary design phase
- Challenge: Include "Preliminary design locate ticket" in Texas Utilities Code

Texas Transportation Institute — *Transportation Operations Group*

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: _____

5) Require Utility Owners to Verify and Certify Utility Facility Information

- Potential changes to manuals
  - ✓PDP Manual
    - » New activity after QLD: "Verify major utility installations on project alternatives"
    - » New activity after preferred alternative: "Provide preliminary design locate ticket to One Call center"
    - » New activity after QLC: "Verify location of utility installations on preferred alternative." Include request for verification certification
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » None

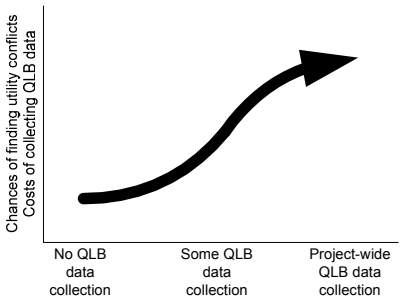
Texas Transportation Institute — Transportation Operations Group

6) Gather Some QLB Data during Preliminary Design Phase

- Purpose: Reduce uncertainty about underground utility facilities earlier in the PDP
- QLB completed in design phase (if done)
- Collect QLB data earlier if:
  - ✓Right of way stays the same, e.g., for road widening or adding lanes within available space
  - ✓Important to know utility locations
- Utilities do not favor private easements
- Issue: Costs vs. benefits

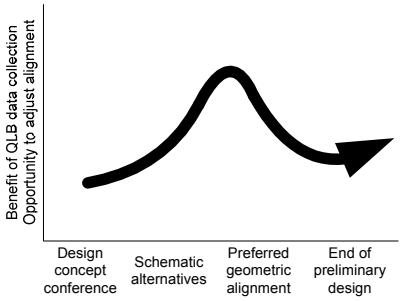
Texas Transportation Institute — Transportation Operations Group

6) Gather Some QLB Data during Preliminary Design Phase



Texas Transportation Institute — Transportation Operations Group

6) Gather Some QLB Data during Preliminary Design Phase



Texas Transportation Institute — *Transportation Operations Group*

6) Gather Some QLB Data during Preliminary Design Phase

- Potential changes to manuals
  - ✓ PDP Manual
    - » Rename PDP 4200 as "Conduct QLB and QLA utility investigations"
    - » Reword PDP 4200 to eliminate confusion about locate, designate, and SUE
    - » Use SUE terminology consistent with American Society of Civil Engineering/Construction Institute (ASCE/CI) Standard 38-02
  - ✓ Environmental Manual
    - » None
  - ✓ ROW Utility Manual
    - » None

Texas Transportation Institute — *Transportation Operations Group*

7) Include Some Drainage Design Elements in Preliminary Design Phase

- Purpose: Encourage earlier participation by utilities
- Many/most utility conflicts are drainage-related
- Drainage design typically completed at 60% design
- Approx. elevation, sizes of cross drainage structures
  - ✓ Sizing depends on district's time availability
  - ✓ Focus on preliminary calculations
- Outfalls (must be cleared by environmental process)
- Appropriate for cases where cross section is "stable"
- High res/low altitude aerial photography can facilitate high accuracy vertical data in preliminary design

Texas Transportation Institute — *Transportation Operations Group*

7) Include Some Drainage Design Elements in Preliminary Design Phase

- Potential changes to manuals
  - ✓PDP Manual
    - » Expand PDP 2620 (Perform preliminary hydraulic analysis) to cover risk analysis and preliminary sizing of structures other than cross drainage structures
    - » Include references to environmental regs in PDP 2620
    - » Include references to PDP 2620 in PDP 5150 and 5540
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute

Transportation Operations Group

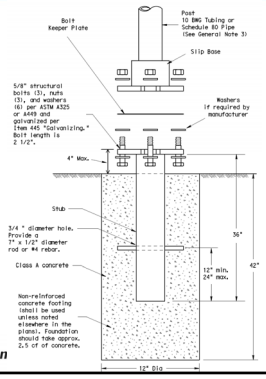
8) Include Some Design Elements in Preliminary Design Phase

- Similar principles as for drainage design
  - ✓Horizontal and vertical alignments needed
  - ✓Cross sections needed
- Certain design elements possible
  - ✓"Preliminary/standardized" foundations
    - » Guide signs, overhead sign bridges
    - » Signal poles, high-mast illumination poles
    - » Plan view with annotated "preliminary" depth
  - ✓Access control
  - ✓Noise walls

Texas Transportation Institute

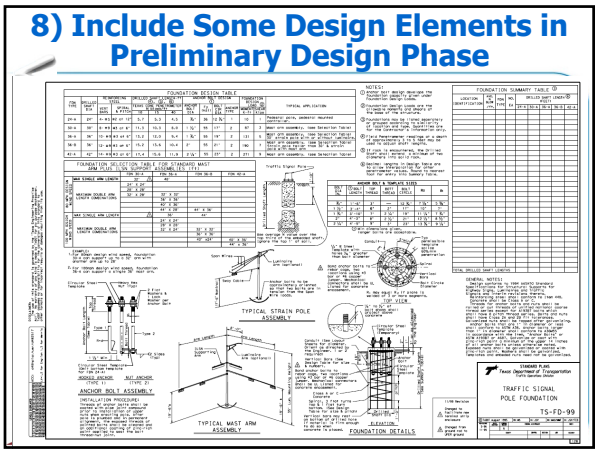
Transportation Operations Group

8) Include Some Design Elements in Preliminary Design Phase



Texas Transportation Institute

8) Include Some Design Elements in Preliminary Design Phase



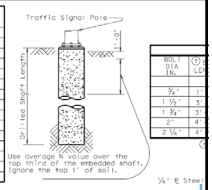
8) Include Some Design Elements in Preliminary Design Phase

FOUNDATION DESIGN TABLE

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL: VERT BARS	REINFORCING STEEL: SPIRAL & PITCH	DRILLED SHAFT LENGTH (ft) (4), (5), (6): TEXAS CONE TO	PENETROMETER 10 blows/ft 15	PENETROMETER 10 blows/ft 40	ANCHOR BOLT DESIGN: ANCHOR BOLT DIA	ANCHOR BOLT DESIGN: Fy (ksi)	ANCHOR BOLT DESIGN: BOLT CIR DIA	ANCHOR BOLT DESIGN: ANCHOR TYPE	FOUNDATION DESIGN LOAD (2): MOMENT K-ft	FOUNDATION DESIGN LOAD (2): SHEAR Kips	TYPICAL APPLICATION
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
90 MPH RESISTANT WIND SPEED	MAX SINGLE ARM LENGTH	32'	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 RESISTANT WIND SPEED	MAX SINGLE ARM LENGTH		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'

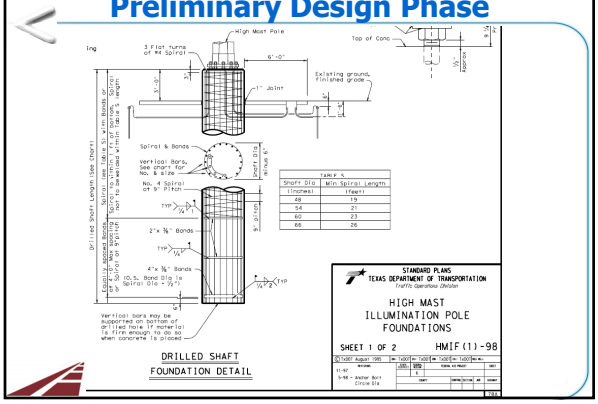


BOLT DIA IN.	(7) LEN
¾"	[illegible]
1 ½"	3'
1 ¾"	3'
2"	4'
2 ¼"	4'

Texas Transportation Institute

Transportation Operations Group

8) Include Some Design Elements in Preliminary Design Phase



Shaft Dia (inches)	Min. Spiral Length (feet)
48	19
54	21
60	23
66	26

8) Include Some Design Elements in Preliminary Design Phase

- Potential changes to manuals
  - ✓Roadway Design Manual
    - » Update schematic layout requirements to include elements listed in PDP 2350
    - » Plan views: Add typical foundation footprints and depths
  - ✓PDP Manual
    - » None (already provides refs. to Roadway Design Manual)
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » None

Texas Transportation Institute — Transportation Operations Group

9) Address Utility Issues in Constructability Review in Preliminary Design Phase

- Purpose: Include utilities in constructability review
- PDP 2670, National Cooperative Highway Research Program (NCHRP) 391 do not mention utility issues in constructability review
- Examples of utility issues
  - ✓Impact of utilities on construction phasing
  - ✓Trench section and protection
  - ✓Temporary pole bracing
  - ✓Utility conflicts

Texas Transportation Institute — Transportation Operations Group

9) Address Utility Issues in Constructability Review in Preliminary Design Phase

- Potential changes to manuals
  - ✓PDP Manual
    - » Include references to utility issues in PDP 2670 "Conduct constructability review" such as:
      - Impact of utilities on construction phasing
      - Trench section and protection
      - Temporary pole bracing
      - Utility conflicts
  - ✓Environmental Manual
    - » None
  - ✓ROW Utility Manual
    - » Insert activity "Preliminary design utility coordination"

Texas Transportation Institute — Transportation Operations Group

10) Develop/Update Curricula for Utility Coordination Stakeholders

- Purpose: Improve quality of utility processes
- TxDOT: Utility conflicts course (2001)
- TxDOT: UIR training workshops
- GDOT: Utility conflict management
- Mn/DOT: Two-day course on new process
- NHI Course "Highway/Utility Issues"
- Recommendations from international scan
- SHRP 2 R15(A)

Texas Transportation Institute — Transportation Operations Group

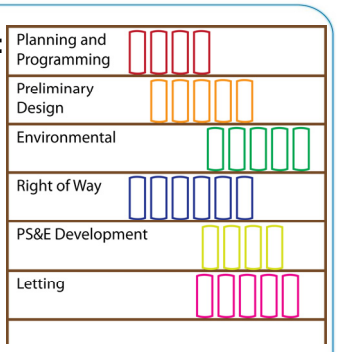
TxDOT Manual Structure Recommendations

- Simplify project development process
- Harmonize/remove inconsistencies between manuals
  - ✓Differences in activity descriptions
  - ✓Inconsistencies in level of aggregation
  - ✓Redundancy in content
  - ✓Inconsistent flowcharts
  - ✓Some manuals are modular, some are not
  - ✓Some manuals use activity codes

Texas Transportation Institute — Transportation Operations Group

TxDOT Manual Structure Recommendations

- Proposed structure: PDP Manual becomes a "bookcase" with thematic shelves and individual volumes containing standardized TxDOT manuals



Texas Transportation Institute — Transportation Operations Group

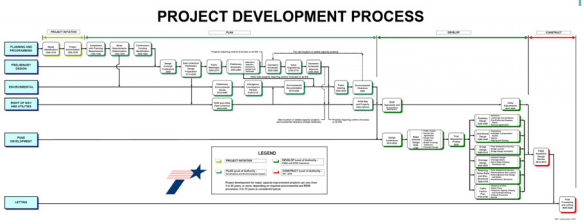
Business Process Modeling Approaches

- Informal, ad hoc "flowcharting"
- Inconsistent, incompatible approaches across manuals
- Level of detail varies
- Typically high level
- Loose flowchart/manual mapping
- No TxDOT business process modeling standard

Texas Transportation Institute

Transportation Operations Group

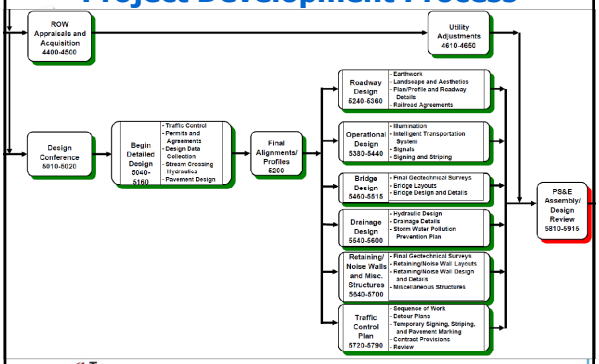
Project Development Process



Texas Transportation Institute

Transportation Operations Group

Project Development Process



Texas Transportation Institute

Transportation Operations Group

Utility Processes

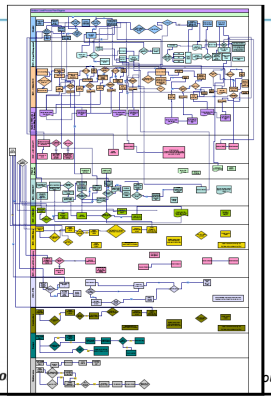
- Federal Utility Procedure

- State Utility Procedure

Texas Transportation Institute

Transportation Operations Group

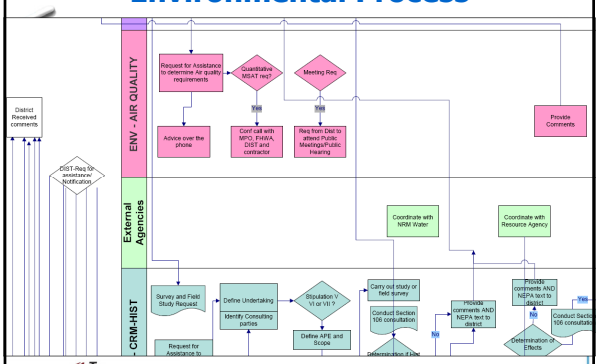
Environmental Process



Texas Transportatio Institute

oup

Environmental Process



Texas Transportation Institute

Transportation Operations Group

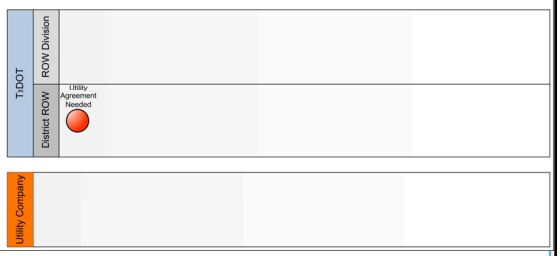
Introduction to TxBPE

- TxDOT Business Process Explorer
- Purpose: Visualize and facilitate access to business process information
- 3-level structure
  - ✓Level 1 (Overview BPM): **Activity Groups**
  - ✓Level 2 (Detail BPM): **Activities**
  - ✓Level 3 (links to manuals): **Activity Descriptions**

Texas Transportation Institute

Transportation Operations Group

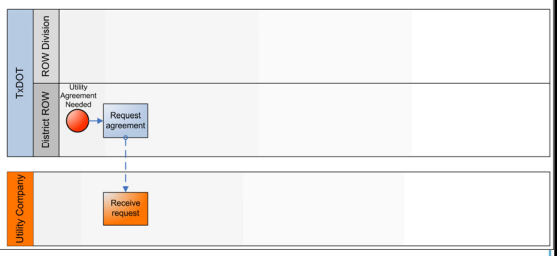
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

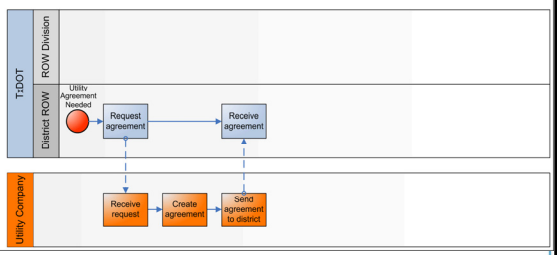
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

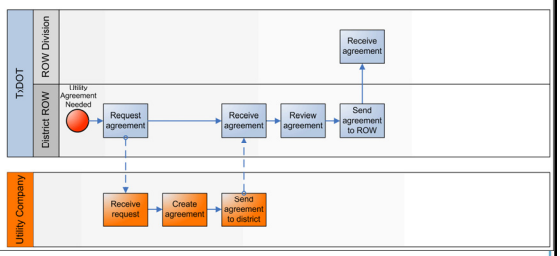
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

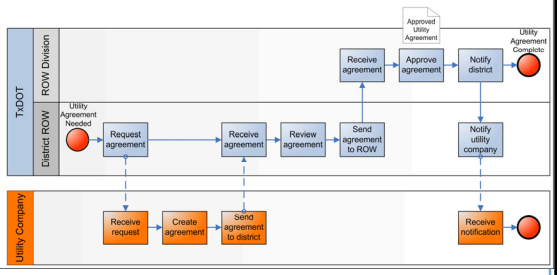
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

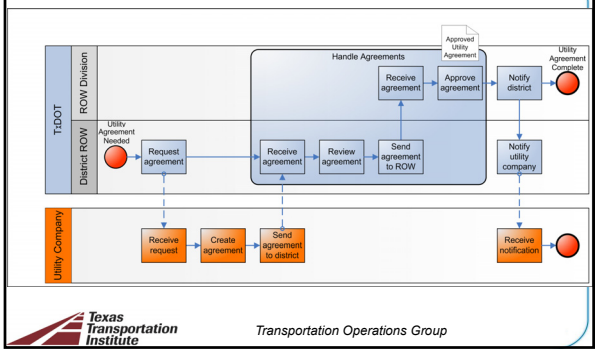
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

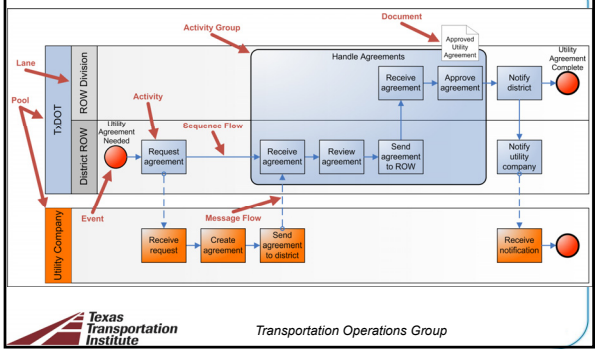
Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

Sample Business Process: Utility Agreement Approval Process



Texas Transportation Institute

Transportation Operations Group

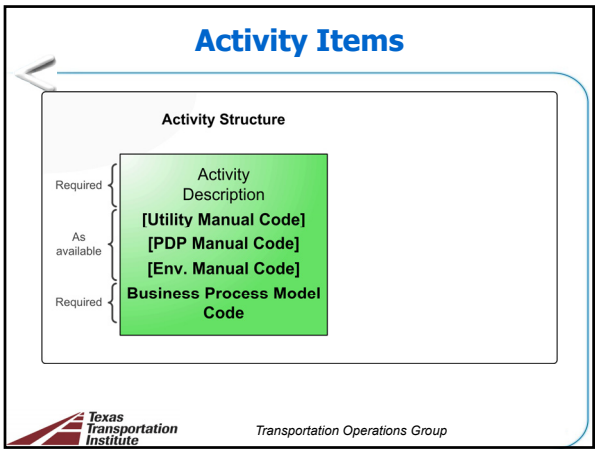
Activity Items

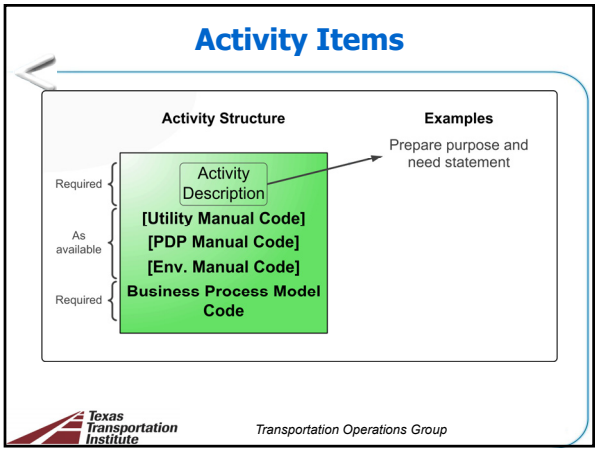
Activity Structure

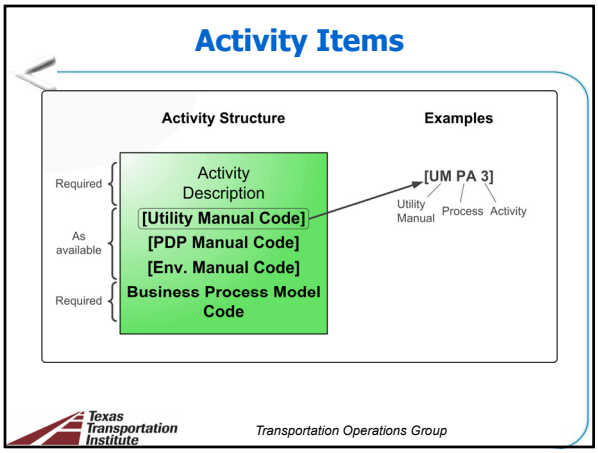
Activity Description
[Utility Manual Code]
[PDP Manual Code]
[Env. Manual Code]
Business Process Model Code

Texas Transportation Institute

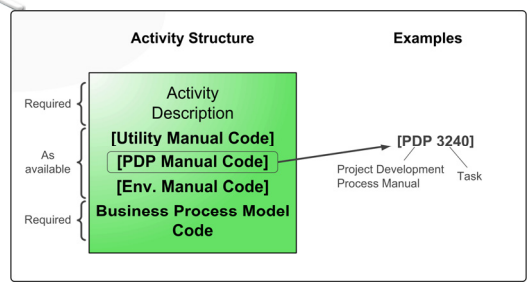
Transportation Operations Group


Activity Items
Activity Structure
Required
Activity Description
As available
[Utility Manual Code]
[PDP Manual Code]
[Env. Manual Code]
Required
Business Process Model Code
Texas Transportation Institute
Transportation Operations Group


Activity Items
Activity Structure
Examples
Prepare purpose and need statement
Required
Activity Description
As available
[Utility Manual Code]
[PDP Manual Code]
[Env. Manual Code]
Required
Business Process Model Code
Texas Transportation Institute
Transportation Operations Group


Activity Items
Activity Structure
Examples
Required
Activity Description
[Utility Manual Code]
As available
[PDP Manual Code]
[Env. Manual Code]
Required
Business Process Model Code
[UM PA 3]
Utility Manual
Process
Activity
Texas Transportation Institute
Transportation Operations Group

Activity Items



Texas Transportation Institute

Transportation Operations Group

TxBPE Demo

Texas Transportation Institute

Transportation Operations Group

Discussion

Texas Transportation Institute

Transportation Operations Group

CHAPTER 3. TXBPE INSTRUCTION MANUAL

TxBPE is a web-based application that provides access to models of TxDOT business processes. The structure of TxBPE allows the application to be accessed through the Internet, the TxDOT intranet, or a local installation. The purpose of TxBPE is to provide access to TxDOT business processes so that processes can be visualized, analyzed, and ultimately improved. The current version of TxBPE focuses on a portion of the TxDOT project development process that covers environmental and utility process activities.

TXDOT PROJECT DEVELOPMENT PROCESS

The project development process at TxDOT includes six general groups of activities, as follows:

- planning and programming,
- preliminary design,
- environmental,
- right of way and utilities,
- PS&E development, and
- letting.

A common way to display the TxDOT project development process is by means of a swim lane diagram, which is a type of business process model that arranges activities in lanes representing responsibility or functional association (Figure 1).

Although the swim lane diagram is useful to provide a general sense of sequence and involvement of participants, it does not show activities and, therefore, does not provide enough detail to understand the project development process. As a result, the researchers created a similar swim lane diagram at an increased level of detail using numerous resources including TxDOT manuals and stakeholder interviews. The focus of that swim lane diagram was the TxDOT environmental/utility process. The researchers started by creating a model of the "existing" environmental/utility process and then expanded the model using feedback from stakeholders and TxDOT's plans for regionalization to create a "recommended" environmental/utility process model. The resulting model was large (about 14 feet by 5 feet) and turned out to be difficult to print and handle effectively. As a result, the researchers developed the TxBPE application to facilitate access to the model's information. The following sections provide an introduction in how to access and use the information provided by TxBPE.

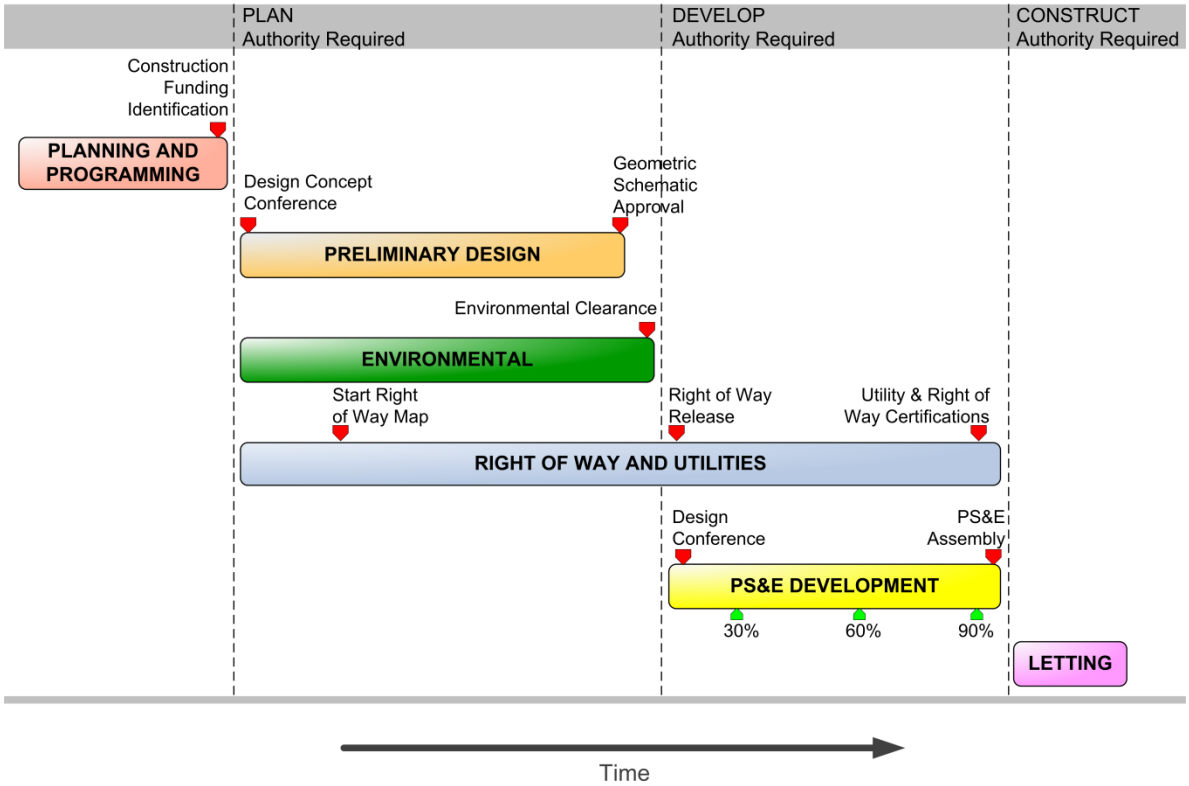


Figure 1. Current Project Development Process at TxDOT.

TXBPE STRUCTURE

TxBPE presents business process information at three levels:

- Level 1: Process overview,
- Level 2: Process details, and
- Level 3: Activity details (activity descriptions and sample documents).

Level 1 – Process Overview

Level 1 provides an overview of the TxDOT project development process from advance planning to letting (Figure 2). Graphical elements in the overview diagram are limited to swim lanes, activity groups, major milestones, and major sequence flows that are approximated by input/output arrows. Note that the process overview diagram in Figure 2 resembles Figure 1 in a way that each swim lane in Figure 1 is broken down into several groups of activities in Figure 2. Access to Level 2 of the model is provided by links that can be accessed by clicking on an activity group.

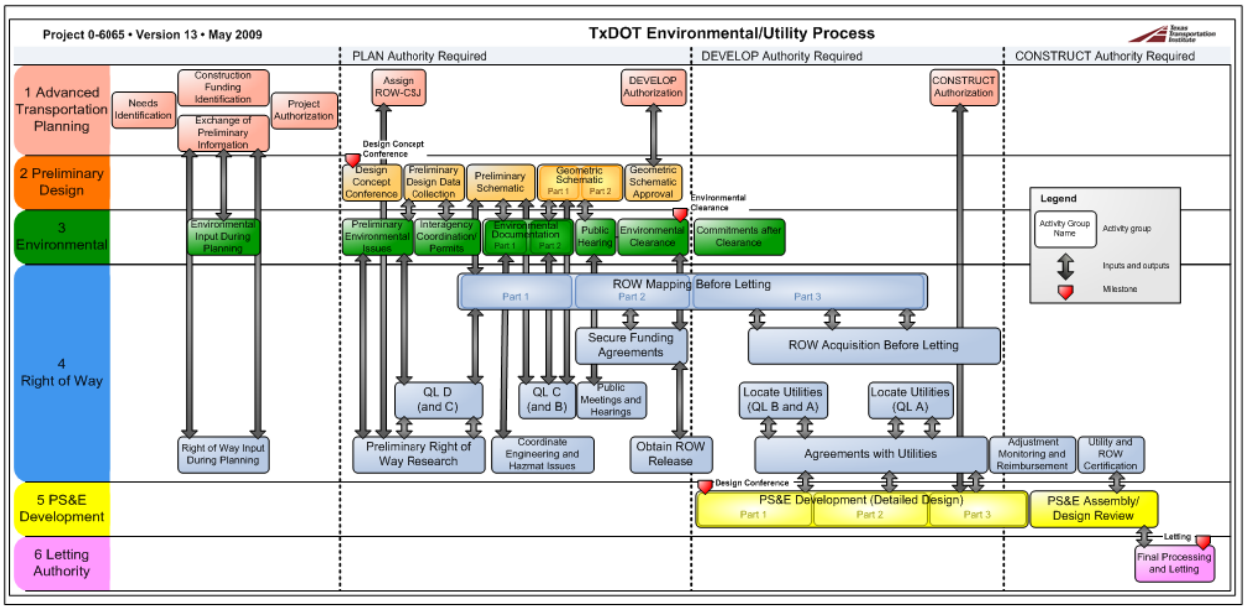


Figure 2. Level 1 Process Overview.

Level 2 – Process Details

Clicking on an activity group in Level 1 displays Level 2, a zoom-in of the activity group with underlying activities. For example, Figure 3 shows the activities of activity group "Construction Funding Identification" on Level 2. Level 2 uses graphical elements including activities, data items, and comments and displays required documents and outcomes for selected milestones.

In theory, Level 2 represents the complete business process model of the environmental/utility process. However, displaying the full model on one web page would have resulted in a model difficult to read and navigate. For implementation purposes, the researchers broke down the model into several submodels that users can access through clicking on activity groups on Level 1. Each submodel presents only a portion of the complete environmental/utility process that is typically limited to the activities of the activity group selected at Level 1 and surrounding activities. The reader should also keep in mind the following that applies to all Level 2 submodels:

- Submodels only show a swim lane if it has an activity in that portion of the model. For example, the PS&E Development swim lane does not have any activities prior to Develop authorization, so it is not included in most submodels that focus on portions of the model before Develop authorization.

- A few activity groups contained a large number of activities, which made it necessary to divide them into several parts on Level 1 to create separate submodels for each part on Level 2. For example, the activity group "ROW Mapping before Letting" in Figure 2 has three parts on Level 1 and three separate submodels on Level 2.

- Several activity groups to the right of the Develop authority divider were not part of the scope of Research Project 0-6065 and are included in the Level 1 process overview only.

Access to Level 3 of the model is provided by clicking on an activity or a data item such as a document.

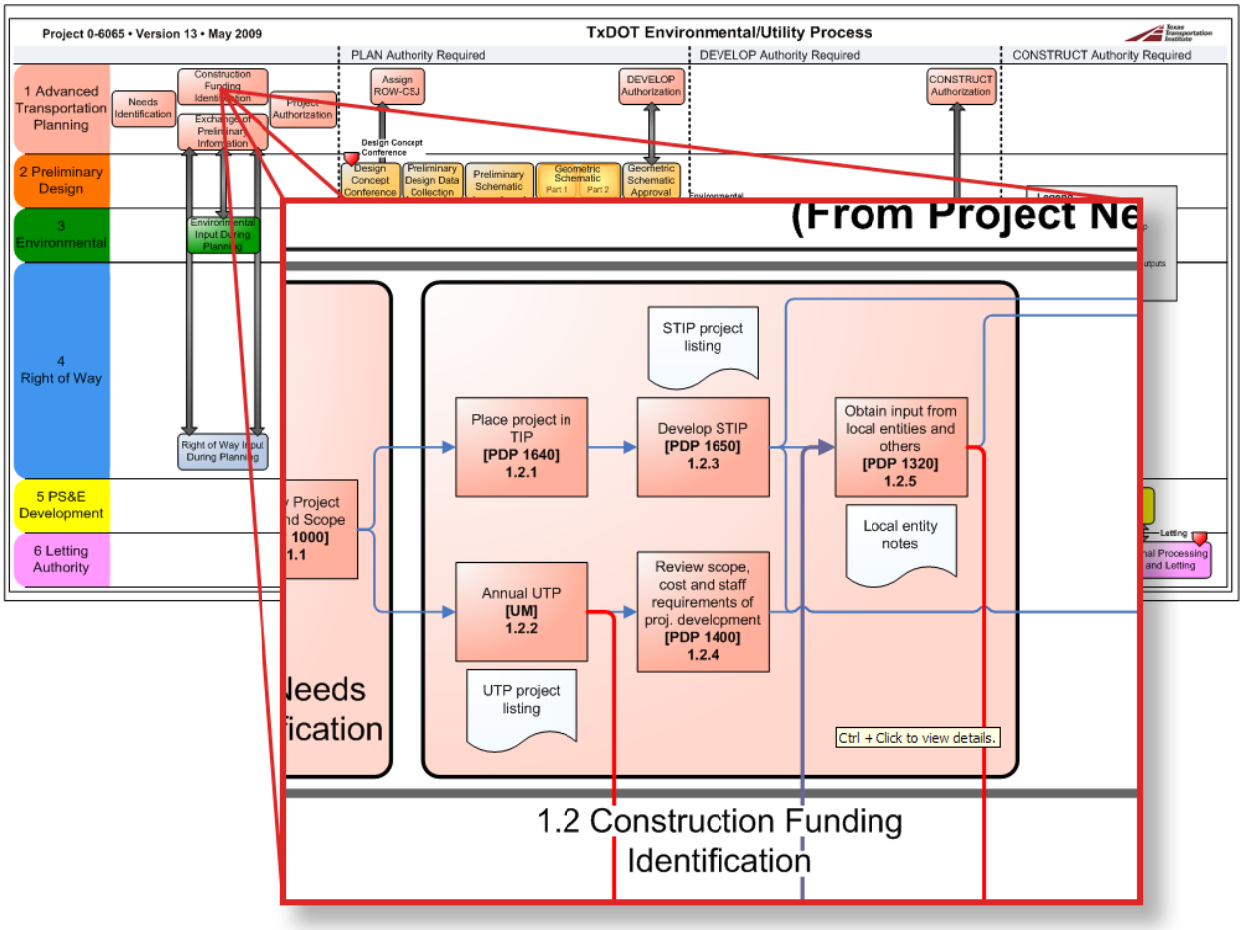


Figure 3. Activities of Activity Group "Construction Funding Identification" on Level 2.

Level 3 – Activity Description

Clicking on an activity on Level 2 displays the activity description from the associated online version of the TxDOT manual. For example, Figure 4 shows the activity description of activity "PDP 1400: Review scope, cost and staff requirements of project development." Activity descriptions open in a new window so that a user can read the description while studying the context of the activity in TxBPE. The reader should also keep in mind the following that applies to all activities:

- Recommended process additions added by the researchers are currently not documented by TxDOT manuals. Therefore, TxBPE will not display an activity description for these activities.

- If an activity includes multiple reference codes (e.g., a Project Development Process Manual code and a Utility Manual code), clicking on the activity will open all referenced descriptions in multiple browser windows.

- Clicking on a data item such as a document will display a sample document from the TxDOT web server.

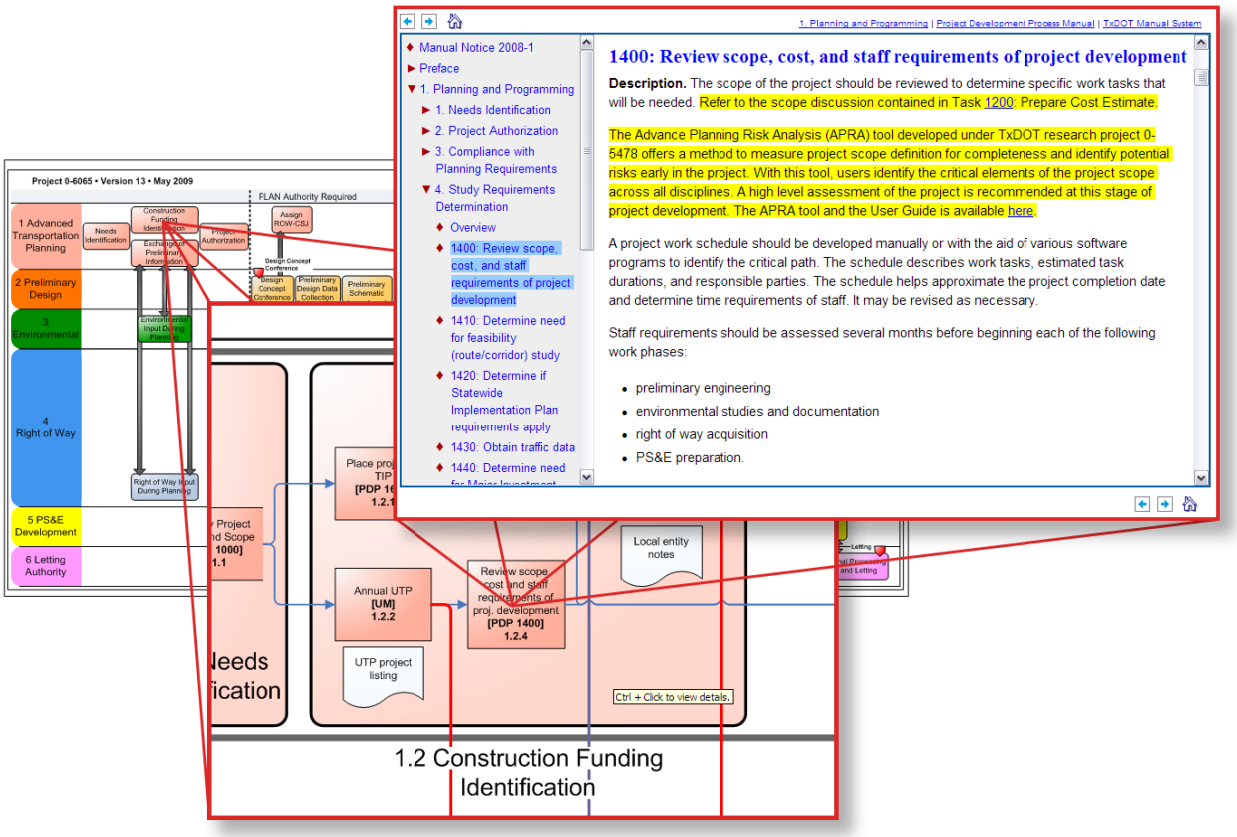


Figure 4. Activity Description of Activity "PDP 1400: Review scope, cost,…" on Level 3.

TXBPE INTERFACE

Access to TxBPE

TxBPE is a compact, standalone web-based application that only requires access to a web browser and a PDF reader. Specific minimum requirements to run TxBPE are as follows:

- Internet Explorer® version 7 or higher (older versions of Internet Explorer may work but have not been fully tested),
- Adobe® Acrobat® Reader® version 5 or higher, and
- Internet or intranet access.

Other than giving permission to run a Microsoft ActiveX® component to display Visio® drawings and enabling pop ups to display Level 3 activity descriptions, users do not need to make any changes to their Internet Explorer environment. The researchers implemented Level 3 pop-ups as a convenient mechanism to compare text descriptions to activities and process charts. However, the pop-up behavior is not a requirement and could be disabled if necessary.

Users could access TxBPE from a designated web server location (either on the Internet or within the intranet). In this case, the only requirement is to copy the TxBPE folder to a designated location on the web server and provide an appropriate hyperlink to users. Note: As a standalone application, TxBPE does not require installing any special components on the web server. Alternatively, the TxBPE folder could be placed on any drive (either local or networked), and users could access the application by simply navigating to the folder 0-6065-P1 Educational Materials\TxBPE and double clicking file TxBPEhome.htm. Users could also run TxBPE from a CD or a flash drive. In either case, users need access to the Internet to display Level 3 activity descriptions. The researchers did not have access to the TxDOT intranet and, therefore, all Level 3 links currently point to the Internet versions of the TxDOT manuals. During implementation, it may be possible to update the existing Level 3 links to the corresponding TxDOT intranet locations (by updating the web addresses in file \TxBPE\BusinessProcess\TxBPE8_files\XML\ModelLink.xml). This solution would allow TxDOT users who do not have access to the Internet to access all TxBPE features, including Level 3.

Navigation

TxBPE consists of two main areas, as shown in Figure 5: (a) the navigation and information bar on the left and (b) the business process model area on the right.

Unless the user hides the navigation bar using the "Hide" button, the navigation bar remains visible on all pages. The navigation bar has five sections that can be collapsed by clicking on "Collapse all" at the top of the navigation bar, as follows:

- **Return to Overview Button.** Click the Return to Overview button to return to the Level 1 start page. This button is available on every page of TxBPE. Alternatively, select the "Level 1 – Overview" page in the Go to Page section of the navigation bar and click the green arrow.

- **Go to Page (Direct Page Access).** Select a Level 1 or Level 2 model in the drop-down menu and click the green arrow to access the model directly.

- **Pan and Zoom.** Click the plus (+) button to zoom in, the minus (-) button to zoom out, and whole page button (above the +) to display the whole page. Click-and-drag on the mini map to create a zoom window, and click-and-drag inside the red rectangle on the mini map to pan to a different area of the page.

- **Search Pages.** Enter text in the search box, and click on the green arrow to search text of any graphical element in TxBPE at Level 1 and 2. Search results are displayed below the search box. Click on a search result to display the page where TxBPE found the search term. Note that TxBPE displays an arrow to indicate the location of the search term. Click on the plus (+) button next to "Advanced" to modify search options such as search by shape name or shape text.

- **Other Resources.** Click on a link to download a business process model in PDF, access a TxDOT manual, or open an online resource.

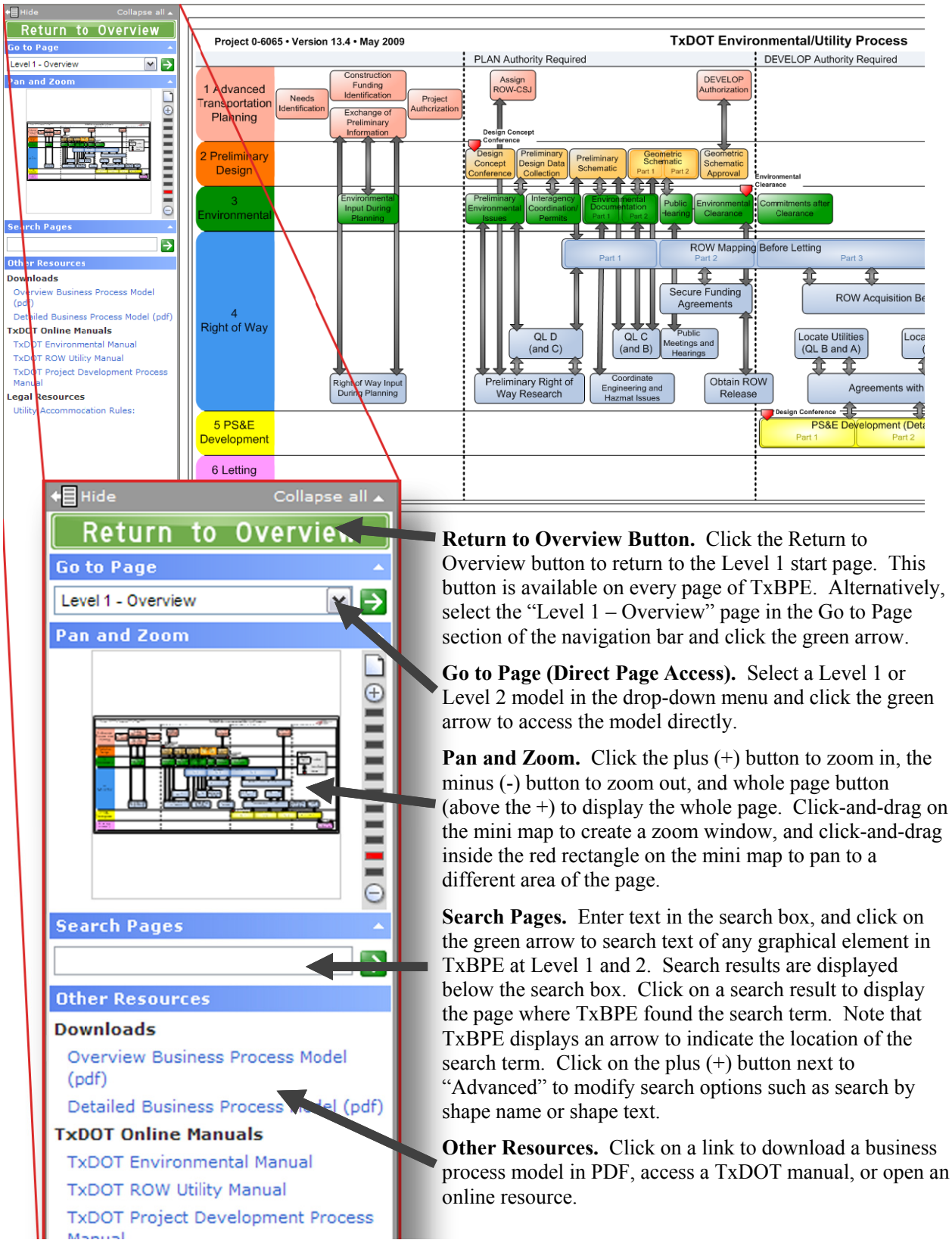


Figure 5. Navigation Bar and Business Process Area in TxBPE.

LEVEL 2 GRAPHICAL ELEMENTS IN TXBPE

Business Process Model Notation

TxBPE uses the Business Process Modeling Notation (BPMN), which allows the use of swim lanes to visualize details of the TxDOT project development process. Typical graphical elements used in BPMN are the following:

- Swim lane: Either a pool or a lane;
- Pool: The representation of a process participant. A pool is a container for lanes, activities, sequence flows, and other BPMN elements;
- Lane: A sub-partition of a pool to organize activities;
- Activity: A square box used to show units of work that a process participant performs;
- Activity Group: A round box used to arrange a set of related activities into a group;
- Sequence Flow: A solid line used to show the order in which activities are processed;
- Message Flow: A dashed line used to show message between process participants;
- Event: A round or oval element indicating the beginning or end of a process; and
- Data Object: An element associated with an activity that provides information about data that the activity uses or produces.

For example, Figure 6 shows a BPMN swim lane diagram for the (simplified) TxDOT process "Approval of a utility agreement" that involves two participants (TxDOT and a Utility Company) and two separate organizational units within TxDOT (the ROW Division and the district right of way section).

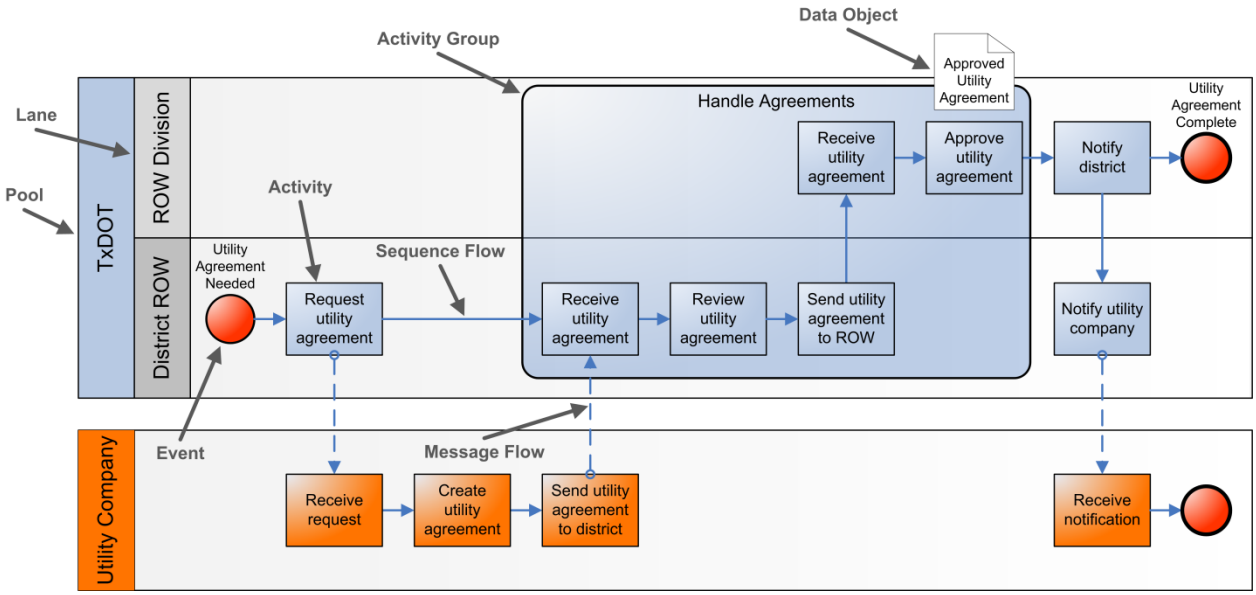


Figure 6. Swim Lane Business Process Model for Process "Approval of a Utility Agreement."

The researchers used a swim lane to model the TxDOT environmental/utility process due to the familiarity of TxDOT officials with swim lane diagrams and the traditional use of swim lane diagrams to represent the project development process. More information about business process modeling practices and business process notations can be found in the research report.

The current version of TxBPE displays a business process model with a focus on the environmental process and interaction with right of way activities. The process focuses on the first half of the project development process, from advance planning to the beginning of PS&E development.

TxBPE Graphical Elements

TxBPE uses the same basic elements to display activity groups, activities, sequence flows, and data objects as the example in Figure 6. In addition, TxBPE provides further information by providing subactivity information for selected activities, where researchers found the additional information beneficial to understanding the process. For example, activity "Annual (Utility) Meeting" in Figure 7 displays two subactivities.

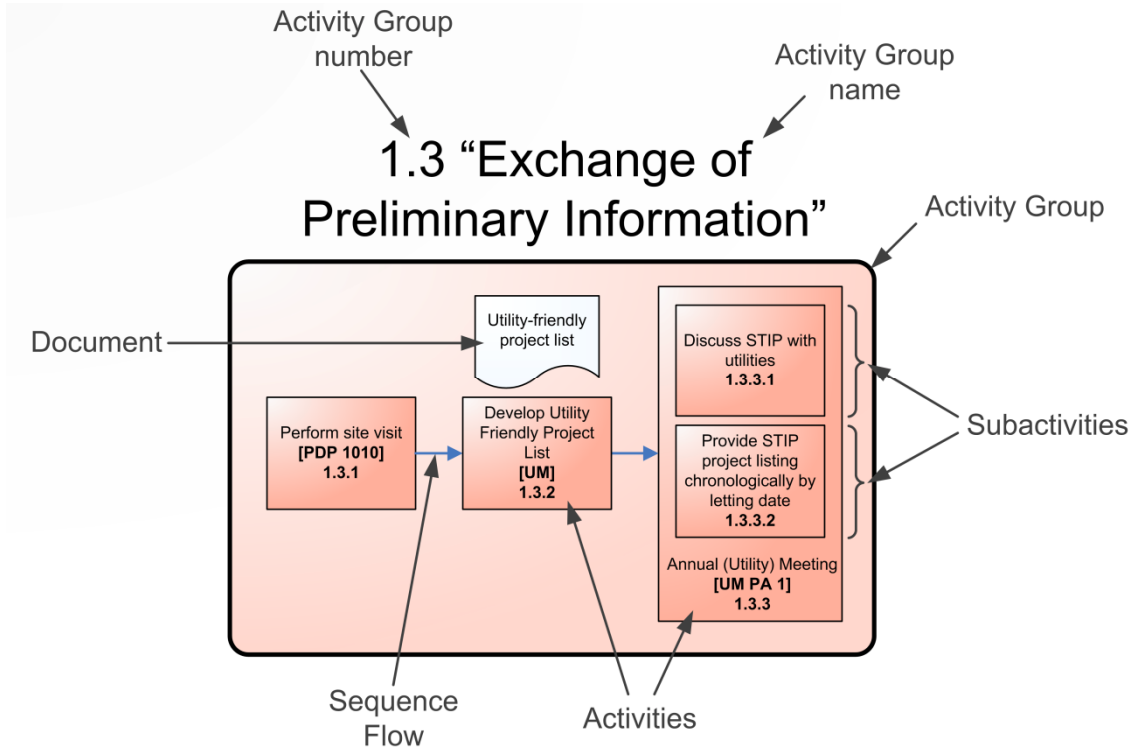


Figure 7. TxBPE Elements.

TxBPE also uses several other graphical elements. Figure 8 provides an overview along with a definition of these elements.

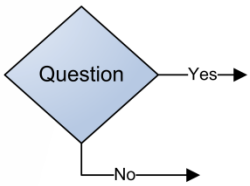
TxBPE Element	Definition
Summary Activity	A summary activity is an indicator of multiple activities that have been combined into one activity. Summary activities are used when there is a need to aggregate activities to save space and/or reduce the complexity of the model.
Milestone	A milestone is a marker that indicates the end of a subprocess or completion of a set of activities. Milestones typically feature the completion or signing of an important document.
Start/End Marker	A start or end marker is an indicator of the beginning or end of a process.
Decision Point (Gateway) 	A decision point is an element that provides alternate sequence flows for a process based on the outcome of a question.
PDP Manual info on timing/sequencing Text description in pink	Text colored pink provides additional information from the Project Development Process Manual on the timing or sequence of an activity in the project development process.
PDP Manual info on related tasks Text description in dark blue	Text colored dark blue provides additional information from the Project Development Process Manual on related tasks of an activity in the project development process.
PDP Manual activity comment Text description in red	Text colored red provides comments from the Project Development Process Manual about an activity.
Researcher's comment Text description in black	Text colored black provides comments from the researchers.
PLAN/DEVELOP/ CONSTRUCT Authority Divider	A thick, dashed line indicates the requirement for a certain authority (PLAN, DEVELOP, or CONSTRUCT) from the Texas Transportation Commission to perform an activity.
Major Swim Lane Divider	A thick continuous line indicates the boundary of a major swim lane such as major function groups within TxDOT.
Minor Swim Lane Divider	A thin continuous line indicates the boundary of a minor swim lane such as district, division, or regional support center within a major swim lane.

Figure 8. Other Graphical Elements in TxBPE.

TxBPE Activity Codes

Each activity in TxBPE includes a description and, as available, several codes that reference the source of the activity. Possible codes include a utility manual code, a project development process manual code, and an environmental manual code. Each activity also includes a code that identifies the activity in the model, called business process model code. Figure 9 shows how the codes appear on activities and provides examples. For additional information on activity codes, please refer to the research report.

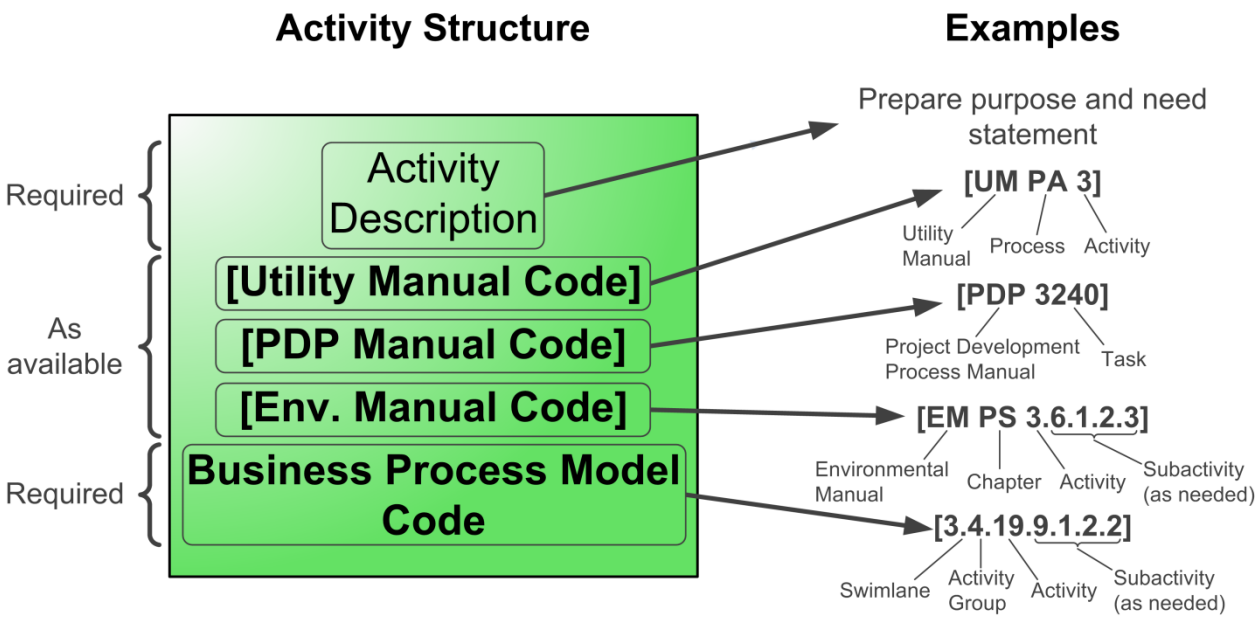


Figure 9. TxBPE Activity Structure and Examples.

TxBPE Color Codes

All activities (and activity groups) in TxBPE are color-coded to indicate the swim lane or functional group in which the activity is located (Figure 10).

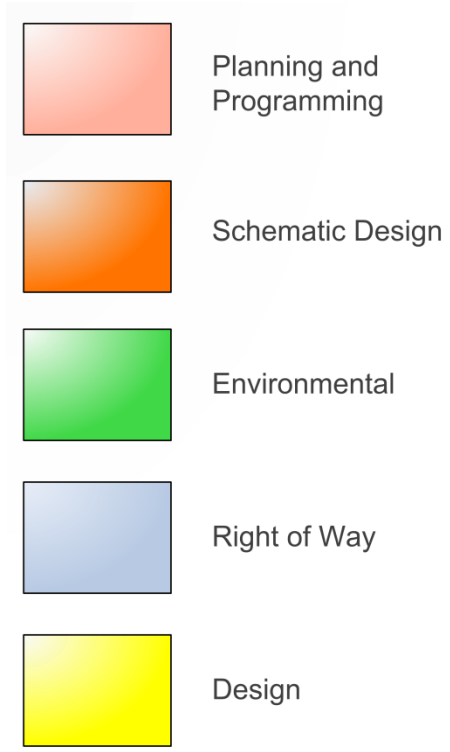


Figure 10. Activity Color Code.

Similarly, sequence flows that cross swim lanes are color-coded to indicate the swim lane of the source activity without the need to browse to the source activity. Sequence flows that cross swim lanes are also thicker than sequence flows within a swim lane. Sequence flows that connect activities within the same swim lane always use the standard blue color (Figure 11).

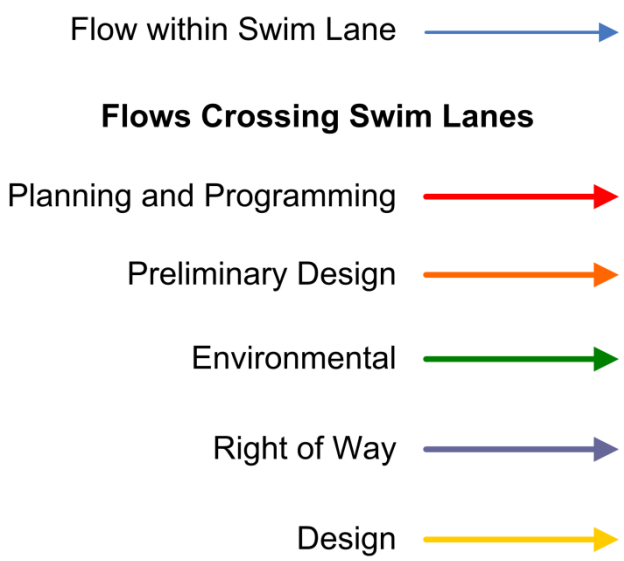


Figure 11. Sequence Flow Color Code.