Technical Report Documentation Page

<table>
<tr><td>1. Report No.
FHWA/TX-08/0-5478-1</td><td>2. Government Accession No.</td><td colspan="2">3. Recipient's Catalog No.</td></tr>
<tr><td colspan="2" rowspan="2">4. Title and Subtitle
Identifying Right-of-Way Requirements during the Project Development Process</td><td colspan="2">5. Report Date
October 2007</td></tr>
<tr><td colspan="2">6. Performing Organization Code</td></tr>
<tr><td colspan="2">7. Author(s)
Carlos H. Caldas, Tiendung Le, G. Edward Gibson Jr., and Michael Thole</td><td colspan="2">8. Performing Organization Report No.
0-5478-1</td></tr>
<tr><td colspan="2" rowspan="2">9. Performing Organization Name and Address
Center for Transportation Research
The University of Texas at Austin
3208 Red River, Suite 200
Austin, TX 78705-2650</td><td colspan="2">10. Work Unit No. (TRAIS)</td></tr>
<tr><td colspan="2">11. Contract or Grant No.
0-5478</td></tr>
<tr><td colspan="2" rowspan="2">12. Sponsoring Agency Name and Address
Texas Department of Transportation
Research and Technology Implementation Office
P.O. Box 5080
Austin, TX 78763-5080</td><td colspan="2">13. Type of Report and Period Covered
Research Report,
September 2005–August 2007</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code</td></tr>
<tr><td colspan="4">15. Supplementary Notes
Project performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.</td></tr>
<tr><td colspan="4">16. Abstract
The determination of right-of-way requirements during the project development process depends on many factors including proposed alignment, typical sections, access control, and accommodation for construction, drainage, clear zone, highway access maintenance, accessible pedestrian design, and environmental mitigation. Right-of-way, as a function of project development, is not isolated and independent of other functions. It will be highly advantageous to the project development team to have a method that can help incorporate and control, in a systematic and efficient way, the factors affecting the determination of right-of-way and other functional requirements. The Advance Planning Risk Analysis (APRA) was developed to meet exactly this need. Associated with a computer tool, the APRA is a method that, if used properly can: 1) help optimize the identification of project requirements during the project development process in all functions, including Planning and Programming, Preliminary Design, Environmental, ROW, Utilities, and Detailed Design; 2) help the project development team control and manage critical project issues during project development; 3) provide a platform for project participants to cooperate and coordinate project activities and responsibilities; 4) help reconcile participants' difference through discussions; 5) be a means for training new personnel; and 6) be used to anticipate project performance after a certain period of using time. This document reports in detail the entire process of developing the APRA method and its computer tool and the complete explanation of the method, how to use it, and its potential benefits.</td></tr>
<tr><td colspan="2">17. Key Words
Right-of-Way, Project Development Process, Advance Planning, Risk Analysis, Project Scope, Transportation</td><td colspan="2">18. Distribution Statement
No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161; www.ntis.gov.</td></tr>
<tr><td>19. Security Classif. (of report)
Unclassified</td><td>20. Security Classif. (of this page)
Unclassified</td><td>21. No. of pages
224</td><td>22. Price</td></tr>
</table>

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Identifying Right-of-Way Requirements during the Project Development Process

Carlos H. Caldas
Tiendung Le
G. Edward Gibson Jr.
Michael Thole

CTR Technical Report:	0-5478-1
Report Date:	October 31, 2007
Project:	0-5478
Project Title:	Optimizing the Identification of Right-of-Way Requirements during the Project Development Process
Sponsoring Agency:	Texas Department of Transportation
Performing Agency:	Center for Transportation Research at The University of Texas at Austin

This project was performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration.

Center for Transportation Research
The University of Texas at Austin
3208 Red River
Austin, TX 78705

www.utexas.edu/research/ctr

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Research Supervisor: Carlos H. Caldas

Acknowledgments

The authors wish to express gratitude to the following members of the Project Monitoring Committee from the Texas Department of Transportation: John Campbell, Tommy Jones, Dale Booth, Kristy Gardner, and Travis Henderson, The authors also want to thank Tom Yarbrough and Sylvia Medina, as well as all the other members of the Texas Department of Transportation that participated and supported this research.

Table of Contents

List of Figures

List of Tables

Chapter 1. Introduction

1.1 Research Needs and Motivation

One of the five major objectives set by the Texas Department of Transportation (TxDOT) and reported in its 2005-2009 strategic plan is to streamline project delivery from conception to ribbon cutting by 15 percent within five years. Reducing the time from planning to construction of a project can ensure that the benefits of the project are available sooner to the traveling public. This will, in turn, greatly facilitate public commerce and reduce adverse traffic problems and their associated costs.

Among others, “Right of Way and Utilities” are two functions in the project development process and they will always be on the critical path if is part of the process. Improving the right-of-way (R/W[1]) process would be of great benefit for delivering project in a more-timely manner. This process will be enhanced significantly if critical issues are identified and addressed early the development process so that the determination of R/W requirements can be performed faster and more accurately.

The determination of R/W requirements during the project development process depends on many factors including proposed alignment, typical sections, access control, and accommodation for construction, drainage, clear zone, highway access maintenance, accessible pedestrian design, and environmental mitigation. In most cases, R/W survey and acquisition cannot begin until a design schematic has been completed and approved as well as receiving an approved environmental document giving authority for TxDOT to release the project for survey and acquisition of the R/W. However, a sufficient level of preliminary work must be accomplished by the design team to make an adequate R/W needs determination. Therefore, a method that can incorporate factors that affect the determination of R/W needs and can help accelerate and optimize this determination would be of great advantage to the project development team.

However, Right-of-Way (ROW) is not a stand-alone, independent process. It requires careful and detailed coordination with other functions in the project development process. Also, the determination of R/W requirements cannot be performed in isolation with the determination of requirements from other functions. For example, preliminary design and detailed design (Plans, Specifications, and Estimates—PS&E) provide input for R/W requirements while the R/W acquisition will provide the design process with real conditions of the site so that the design can be adjusted; changes in design tend to affect R/W requirements and vice versa. Therefore, a method that can help facilitate and accelerate the requirements determination of all function in the entire project development process, including Planning and Programming, Preliminary Design, Environmental, ROW, Utilities, and PS&E Development, would provide practical benefits to the improvement of project delivery. This method needs to take into account the broad range of issues across disciplines while emphasizing the interactions among them. It should provide sufficient details on the requirements while maintaining a big picture of the entire project development process.

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[1] The acronym “R/W” will be used to designate right-of-way when used as a common noun. “ROW” will be used when referring to the TxDOT Division or when used as a proper noun/adjective.

1.2 Research Objectives

With the focus on advance planning and the entire project development process, this research investigation has four main objectives, as follows:

- To develop a Best Practice model for identifying, controlling and managing critical issues and project scope definition during the project development process;
- To determine the requirements of related processes, including Planning and Programming, Preliminary Design, Environmental, ROW and Utilities, PS&E Development and preparation for Letting;
- To develop a tool to perform sensitivity analysis of the certainty associated with the determination of the project development requirements;
- To synthesize data-driven findings into recommended strategies and tactics for expediting the project development process.

In order to accomplish these objectives, the research team focuses on:

- Documenting related TxDOT processes and sources of information;
- Determining consistency and practices for project development at selected TxDOT districts and divisions;
- Synthesizing data and findings into a draft process and a tool;
- Developing a draft tool and Best Practice model;
- Testing the Best Practice model and tool on real projects; and
- Developing recommendations on implementation.

1.3 Research Scope

In order to obtain a broad applicability of the method and tool developed in this research while providing focus on the specific needs of the Texas Department of Transportation, this research:

- Investigates thoroughly TxDOT's related processes while incorporating findings from studies of other agencies and institutions;
- Focuses on the requirements of the project development process only, from needs assessment to letting;
- Aims at developing a method and a tool that are well applicable to the following types of projects:
    - Convert Non-Freeway to Freeway
    - Widen Freeway
    - Widen Non-Freeway
    - New Location Freeway

- New Location Non-Freeway
- Interchange (New or Reconstruct)
- Bridge Widening or Rehabilitation
- Bridge Replacement
- Upgrade to Standards—Freeway
- Upgrade to Standards—Non-Freeway

1.4 Report Structure

This report has eight chapters. The first chapter provides an overview of the research and this report, including the research needs, objectives, and scope. Chapter 2 reviews studies in relevance to this research such as those related to the project development process or performed for other types of construction projects. The third chapter elaborates the methodology used throughout this research. It provides scientific background of research activities and their descriptions of work; the envisioned Best Practice model, Advance Planning Risks Analysis (APRA), is also presented in this chapter. Next, Chapter 4 details the processes of the identification and synthesis of critical elements during project development. The immediate following chapter focuses on how the elements identified are weighted and how the Best Practice model is actually developed. This chapter also addresses the analysis and interpretation of the APRA elements' scores. Chapter 6 is dedicated to describing the process of testing the Best Practice model on select real projects and discussing the test results. The entire Chapter 7 is for describing the use of the developed APRA method and its computer tool. Finally, conclusions of the research and the recommendations for implementation and research generated from the entire research effort are presented in Chapter 8.

Chapter 2. Background

This chapter provides a review of basic concepts and studies related to the research. Due to the nature of this research, much of the literature needs to be reviewed to fulfill one of the major research tasks. Thus, more on the literature is reviewed and discussed in Section 4.1 "Documentation of Related Processes & Sources."

2.1 Project Life Cycle

A transportation infrastructure project's life cycle has six main phases, as shown in Figure 2.1. These phases are relatively sequential but much of the work can be overlapping.

Figure 2.1 Project Life Cycle

A project starts with an assessment of needs, which could be initiated by virtually anyone, including area office staff, district staff, maintenance supervisor, local officials, developers or the traveling public[1]. The next phase is feasibility study and scoping in which issues related to purpose, need, alternatives, scope are analyzed and determined. Preliminary design is the next step that involves collecting data and developing schematics. In detailed design, all most details about project elements are developed for the project to be ready for construction phase. In parallel to these two phases, a transportation infrastructure project usually has environmental and R/W and utilities processes. Construction phase involves the actual physical construction of project structures and facilities. After construction, the project moves to operation and maintenance phase, which marks the end of the project, and the new facility becomes an asset that must be managed.

2.2 Project Development Process and Advance Planning

The project development process is the period that covers all of the four first project phases, from needs assessment to detailed design. In traditional design-bid-build project delivery method—one still widely used in public sector for transportation projects—detailed design is under the direct supervision of the owner and is either done by the in-house design team or outsourced to design consulting firms. A term that is closely related to the project development process is "advance planning." This term refers to the process that includes all three first phases (needs assessment, feasibility/scoping, and preliminary design). Advance planning has several acronyms; the most frequently used ones are front end planning, pre-project planning, and conceptual planning. It is defined by CII[2] as "the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project." It is an important subset of project planning and it is typically the responsibility of the owner[3]. The early intensive involvement of project major stakeholders (e.g. Design, Planning, ROW, and Construction) is required if the project's objectives are to be effectively met. The advance planning and project development process in relation with the entire project life cycle are illustrated in Figure 2.2.

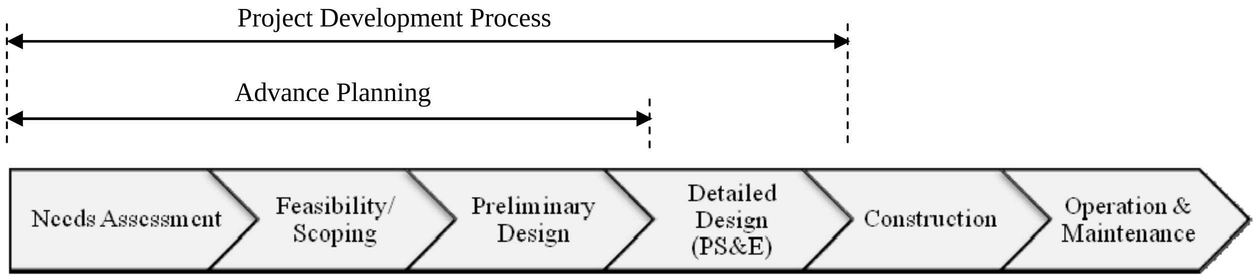


Figure 2.2 Project Development and Advance Planning Processes in Project Life Cycle

2.3 Studies and Best Practices in Advance Planning for Building and Industrial Facilities

There have been various studies on the project scope definition during the advance planning phase. One of the first methods developed is probably that of Hackney[4]. In argument for the need for a quantitative method for rating the state of project definition, Hackney proposed a method using checklists. In developing this method, Hackney focused on improving the accuracy of the estimation for process-type facility projects such as chemical plants. This checklist can also be considered a tool for defining project scope. It includes 27 items that are organized in the following six categories: 1) general project basis, 2) process design status, 3) site information, 4) engineering design status, 5) detailed design, and 6) field performance. Although much of this method is for estimating projects in early phases, its intended use also included detailed design. Each of the items was assigned a weight based on the experience of the author on how important that item is to the project. A category's score is the sum of scores of all items in that category. Scores of all categories add up to the project's score. The project score represents how much is known about the project. In an extreme case when very little is known about a project, it has a maximum score of 4525.

This checklist was later revised in 1992 to include 29 items, still organized into 6 categories[5] using the similar approach. Apart from this checklist, Hackney also proposed a checklist specifically for hazardous waste projects. Hackney's method based on these checklists is comprehensive in calculation while taking into account experience of a limited group of experts in determining the items' weight. The methods are therefore cumbersome and difficult to use. They are more appropriate for use with projects of closely related types and in an environment similar to that of the author and require good understanding of the methods in order to effectively us.

The most notable tool developed for managing scope of building and industrial projects during advance planning is probably the Project Definition Rating Index (PDRI) first developed by the Construction Industry Institute (CII) in 1996. PDRI is a weighted checklist of project scope definition elements that facilitates assessment of a project during advance planning. Two versions of the tool exist—one for industrial (process) facilities first developed in 1996 and one for building facilities first developed in 1999. Each of these tools was developed with funding from the Construction Industry Institute and they are used extensively by organizations worldwide[6, 7]. These tools have since been revised and updated by CII in 2006[8, 9].

The PDRI is a risk management tool that can help the advance planning team assess and measure project scope definition risk elements and then develop mitigation plans for specific types of projects. Each of the risk elements has a detailed description and they are weighted relative to one another to give the user an indication of importance. The tool provides several benefits, including use as a[6, 7]:

- Checklist that a project team can use to determine the necessary steps to follow in defining the project scope;
- List of standardized project scope definition terminology;
- Standard for rating the completeness of the project scope definition to facilitate risk assessment, prediction of escalation, evaluation of the potential for disputes, etc.;
- Means to monitor progress at various stages during the pre-project planning effort and to focus efforts on high risk areas that need definition;
- Tool that aids in communication between project participants by highlighting poorly defined areas in a scope definition package;
- Means for project team participants to reconcile differences by providing a common basis for project evaluation.

The PDRI for Building Projects is used when the primary designer of the new facility is an architect. It consists of 64 elements that are grouped into 11 categories and further grouped into three main sections. The 64 elements are arranged in a score sheet format and are supported by 36 pages of detailed descriptions and checklists. Figure 2.3 shows a portion of the score sheet and Figure 2.4 shows the description of one of the scope definition elements. The scoring mechanism shown in Figure 2.3 was developed through input of experienced project management professionals and correlates to project success. The project team evaluates each of the elements versus the current scope definition level of the project and an overall score for all elements is developed giving an understanding of the project's current sensitivity to project performance[6, 7].

CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
G. EQUIPMENT (Maximum Score = 36)							
G1. Equipment List	0	1	5	8	12	15	
G2. Equipment Location Drawings	0	1	3	5	8	10	
G3. Equipment Utility Requirements	0	1	4	6	9	11	
CATEGORY G TOTAL							

Definition Levels
0 = Not Applicable 2 = Minor Deficiencies 4 = Major Deficiencies
1 = Complete Definition 3 = Some Deficiencies 5 = Incomplete or Poor Definition

Figure 2.3 Example PDRI-Buildings Score Sheet for Category G

Research in the building and industrial construction sectors has determined a strong correlation between the level of effort in the advance planning phase of projects and the project's success. There are different ways to measure project success, all depending to varying degree on different perspectives and purposes, the industry domain of the project, and the time of evaluation, among other factors. In the construction industry, the success of a project is most commonly assessed against cost, schedule, quality, and change order value performance. Using PDRI as a tool for evaluating the level of definition of a project, CII studied a sample of 129 industrial projects worth $6.7 billion and 108 building projects worth $2.3 billion.[8-10] It concluded that the differences between a well-defined project and a not-as-well-defined project amount to a 19 percent cost saving, a 13 percent schedule reduction, and a 6 percent change order value for industrial projects. For building projects, these differences appeared as a 5 percent cost saving, a 9 percent schedule reduction, and a 3 percent change order value.

G2. Equipment Location Drawings

Equipment location/arrangement drawings identify the specific location of each item of equipment in a project. These drawings should identify items such as:

- ❑ Plan and elevation views of equipment and platforms
- ❑ Location of equipment rooms
- ❑ Physical support requirement (e.g., installation bolt patterns)

Figure 2.4 Example PDRI-Buildings Element Description

2.4 Studies in Advance Planning for Highway Projects

A research effort in 2006 by Shane[11] has aimed at developing a scope definition index for use in early project planning on highway projects that are executed using design-build project delivery method. Shane developed a list of 45 attributes through a content analysis of current project definition rating indices including the PDRI, state highway agency documents, and other sources related to attributes that may influence highway project outcome. An evaluation model was developed by interviewing industry leaders from state highway agencies and design and construction firms. The results of the model include importance levels of the identified attributes. This model was meant to evaluate scope definition of a highway project. Lastly, a database was developed using case histories to help determine the scope that is necessary to achieve a higher likelihood of a successful project[11]. In this research, Shane focused on projects executed under design-build project delivery method while aiming at the applicability of projects all over the United States.

In an effort to help improve the project development process, the Center for Transportation Research at the University of Texas at Austin has performed a research on durations and delays in highway project R/W acquisition and utility adjustments. The results of this research include the successful development of a comprehensive work process model and duration metrics for both R/W acquisition and utility adjustments. The research results would help the project development team to focus on highly important issues, especially in the domains of R/W acquisition and utility adjustments that have biggest impacts on the durations of a project. Some of the most important issues are[12]:

- Pricing Compensation and Impact on Remainder Delays;

- Title Curative and Ownership Delays;
- Third Party Delays;
- Parcel Characteristic/Improvement Delays;
- Legal Activity and Litigation Delays;
- Utility Delays;
- Environmental Sensitivity and Expert Witness Delays;
- Design Change and Revision Delays; and
- Resource and Manpower Delays.

In other research CTR has recommended best practices in R/W valuations and negotiation for TxDOT to reduce time and cost of the R/W acquisition process. The recommendations include[13]:

- Regularly train, monitor, and evaluate the expertise of R/W staff, fee appraisers, and review appraisers;
- Involve and contact the property owner personally early in the acquisition process;
- Streamline the valuation process to maximize production time, cost, and efficiency benefits;
- Simplify value determinations, reporting protocols, and review procedures;
- Inform property owners of what will take place at each step about the entire acquisition process;
- Promote frequent communications with property owners for better coordination and to minimize time;
- Use simplified and efficient negotiation processes in order to reduce time/cost and enhance quality of negotiation process;
- Encourage agent to perform negotiations in a manner that inspires owner confidence;
- Minimize the possibility of proceeding to condemnation; and
- Emphasize the significance of providing property owners with all the information required by law.

In line with research on improving the ROW and Utilities functions of the project development process, American Association of State and Highway Transportation Officials (AASHTO) has published “Right of Way and Utilities Guidelines and Best Practices” in 2004 that provides recommended guidelines and best practices for major functional areas in R/W and utilities process[14]. The document addresses eight areas in this process, that are project development, appraisal and appraisal review, acquisition, relocation, property management, utilities, management practices, and training. There are a total of 43 guidelines in these eight areas. Each guideline is associated with a number of best practices that can help implement the guideline. This is an excellent resource for improving the R/W and utilities process by disseminating the best into practice. Detailed discussions on this document can be found in Section 4.1 "Documentation of Related Processes & Sources."

Federal Highway Administration (FWHA) has also performed a scanning study that gathers best practices in R/W and utilities in select European countries that can be applied in the U.S. and published a report called "European Right-of-Way and Utilities Best Practices."[15] The report divides the process into five areas, appraisal and acquisition, compensation and relocation assistance, training, utilities relocation and accommodation, and project development. For each area, the report discusses primary findings and observations obtained through the visit in the European countries. Having discussed the findings and observations, the report provides recommendations and implementation activities for each of the area. The document uniquely investigates R/W and utilities process in the European countries. Again, more detail on this publication can be found in Section 4.1.

The National Cooperative Highway Research Program (NCHRP) also published "Innovative Practices to Reduce Delivery Time for Right-of-Way in Project Development."[16] In this document, instead of dividing the process into different areas, the report discusses the state of the practice pertaining to R/W. It emphasizes the importance of positioning and tasking R/W in close relation with other functions such as planning, environment, design, and law. The report then discusses the influence that laws, regulations and policy has on R/W delivery. And finally, the document provides an overview and discussions of innovative project management models in several states. Among valuable findings from this study, there is a list of factors that are considered contributing highly to success in expediting delivery of R/W. These factors are[16]:

- Include R/W in setting and revising project schedules;
- Perform R/W activity as much as possible in parallel with other functions, rather than wait for a "hand-off" from an upstream function;
- Delegate authority for project decisions to project personnel, rather than retaining authority at a more remote level;
- Encourage a collaborative atmosphere, where actions that affect more than one discipline would receive full consideration from all affected parties;
- Train in new project development roles and relationships that extend beyond their traditional core job competencies.

In addition to all of these publications, each State Department of Transportation maintains a system of procedures, maps, and manual on the project development process and its functions. They, on one hand, necessitate the need for this research since none of them has synchronized the requirements of all major functions in project development into a single method that enables sensitivity analysis of risk and scope definition for a transportation project, regardless of project delivery type. In addition, they serve as a foundation for the investigation to develop products of the research. The next chapter will discuss further how these sources of information, among others, are utilized during the whole research process.

Chapter 3. Reseach Methodology

3.1 Research Overview

This chapter describes the research process and steps conducted to accomplish the objectives of this project as documented in Chapter 1. It provides an overview of the process as depicted in the flowchart in Figure 3.1.

The research project began with a research proposal submitted to TxDOT. In this proposal, the research team proposed a research methodology that was designed to fulfill TxDOT's requirements. The next major step in the research process was identifying and synthesizing the advance planning elements, which included 1) documentation of related processes and sources, 2) investigation of division- & district-level process consistency, and 3) synthesis and categorization of identified elements. The process then continued with weighting the identified elements, comprised of two main steps: conducting weighting workshops and analyzing workshop data. After weighting the elements, the research team developed a draft method and tool for managing risk during advance planning and project development. This method was named "Advance Planning Risk Analysis" (APRA) by the research team and TxDOT's project monitoring committee members. Next, the draft method and tool were tested on real projects that were identified by different districts throughout TxDOT. Each test was organized in the setting of a meeting. The data collected from the test meetings were then analyzed to draw conclusions about the method and tool and develop recommendations for implementation and further advancements. The research ended with the finalization of research products including the APRA method, its tool, and the research report.

3.2 Advance Planning Risk Analysis (APRA) Envisioned

The APRA method was first envisioned during the proposal development and research design. It was envisioned as a method that:

- can help the project development team incorporate all major work elements from all functions during the project development process into a single simple method using a checklist;
- has the elements detailed with descriptions related to the current project development process in state departments of transportation;
- could be used at multiple times throughout project development;
- helps the project development team identify and manage risk in a structured yet flexible manner;
- enables benchmarking across different projects;
- has an associated computer tool that can be used easily by the practitioners;
- serves as a Best Practice model whose development integrates expertise and practical knowledge, providing the best values to those who are actually performing project development;
- can be used for various types of transportation projects; and
- is flexible enough to be revised to fit specific needs of an organization.

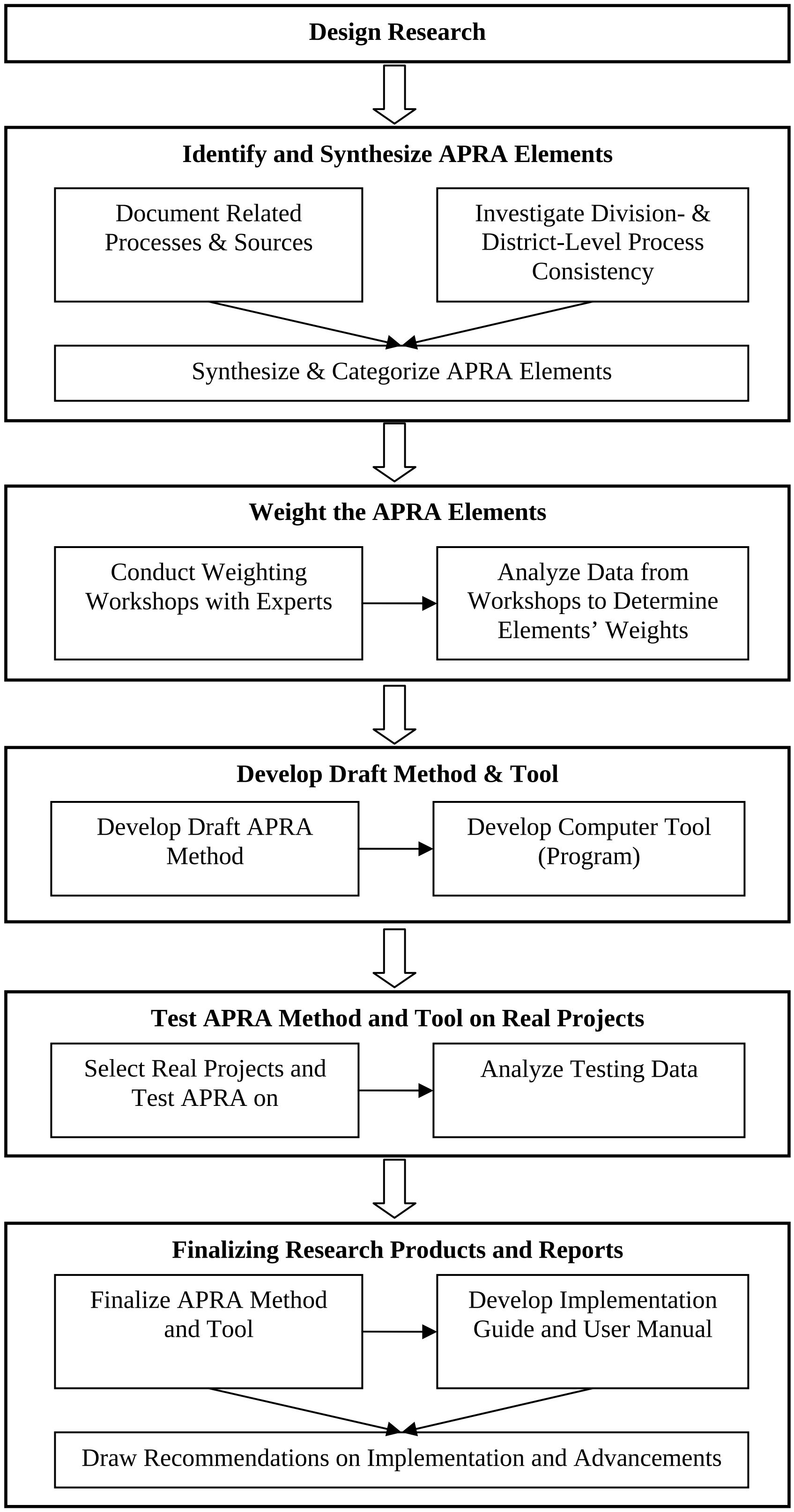


Figure 3.1 Research Process Flowchart

All of these characteristics were taken into consideration throughout the development of the APRA method and its tool. These were refined and revised while the research proceeded and more information was obtained. The characteristics would be revisited and reported at the end of the research.

3.3 Identification and Synthesis of APRA Elements

The very first step of the research is to identify the elements that the project team needs to address during the entire project development process. The best approach to this identification is probably investigating current processes and literature related to transportation project development and direct interactions with experts who have extensive experience in this process. This section will elaborate these efforts.

3.3.1 Documentation of Related Processes & Sources

A formal listing of publications and sources of information related to practices in R/W development was initiated in the 0-5478 project proposal. Additional sources of information were made available at the Project Monitoring Committee (PMC) kickoff meeting, held on October 23, 2005. These sources included extensive access to the TxDOT Online Manual System, project development flowcharts, the DES 110: Right-of-Way Considerations in Project Development training course, and interviews with division and district planning members.

Literature Review

Various publications, both internal and external to TxDOT, were utilized as reference materials in this research study. Section 4.1 summarizes the relevant data that are included in these materials and addresses their impact on the overall goals of this study. Sources of literature included in this review consist of a variety of procedural manuals issued by TxDOT and information published by other State Departments of Transportation. In particular, information was obtained from similar databases of procedural manuals hosted by the Minnesota Department of Transportation (MDOT) and the California Department of Transportation (CalTrans.) Moreover, the previously completed TxDOT project 0-4617 report offered information related to R/W needs. Additionally, FHWA, AASHTO, and CII documents were used as national sources on R/W development and advance planning. This literature review, which is described in more detail in Section 4.1, took place simultaneously with the evaluation of TxDOT division and district process consistency. In this way, the former task supplemented the team's understanding of TxDOT's typical planning processes, thereby simplifying the identification of those practices that are locally unique.

TxDOT Right-of-Way Considerations Training Course

The TxDOT Training and Development Programs Division enabled two project 0-5478 team members to participate in its DES 110: Right-of-Way Considerations in Project Development course. This training course took place February 3-6, 2006 in Austin, Texas, and was taught by individuals with prior experience working as both TxDOT employees and consultants. The course was intended to introduce design engineers to the planning requirements that are often transferred to ROW Division personnel via project documentation. Nonetheless, attendees at the course came from various divisions, including ROW, Design, and Transportation Planning and Programming. A number of topics related to pre-release and post-release practices were discussed as part of the course curriculum. The information that was obtained from this training course, with emphasis on the remarks issued by attendees in the form of concerns or questions, became a good basis for further development of the interview guide that is discussed later in "Interview Guide Development" of Section 3.3.2.

TxDOT Meetings

Table 3.1 provides an overview of the Project Monitoring Committee (PMC) meetings that were held. Three first meetings were held before the completion of documenting related processes and sources and provided input into the identification and synthesis process. The PMC meetings provided the research team with the added benefit of obtaining sources of information directly from TxDOT members. Moreover, feedback from these meetings aided the collection of information, particularly when determining applicable R/W requirements for incorporation into the requirements tool. The members of the Project Monitoring Committee included Tommy Jones and Kristy Gardner of the Abilene District, Dale Booth of the Tyler District, and Travis Henderson of the Dallas District.

Table 3.1: 0-5478 Project Monitoring Committee Meetings

Date	Attendees	Location	Purpose
11/04/2005	PMC, RMC-3	TxDOT RTI Office (Austin, TX)	Project Kickoff Meeting
3/28/2006	PMC	TxDOT Tyler District Office (Tyler, TX)	Project Status Update
5/23/2006	PMC	TxDOT ROW Division Office (Austin, TX)	Project Status Update
4/04/2007	PMC	TxDOT Dallas District Office (Dallas, TX)	Project Status Update and Preliminary Products Demonstration
8/31/2007	PMC RMC-3	TxDOT ROW Division Office (Austin, TX)	Project Status Update and Products Demonstration

3.3.2 Investigation of Division- & District-Level Process Consistency

A major portion of this research study rests on defining the process inconsistencies between development operations at the division and district levels. These inconsistencies are prime indicators of the activities and planning requirements that often go overlooked and, therefore, extending the timeline for project development. Similarly, the dynamics that characterize the actions of TxDOT divisions responsible for project development must be addressed. In order to perform studies in this area, the 0-5478 research team decided to conduct interviews with representatives from various TxDOT organizational groups and locations.

Interview Guide Development

Upon review of the project work plan at the initial PMC meeting, a contact list was created of potential interviewees working in multiple divisions. These contacts were recommended by members of the PMC, and included a number of TxDOT employees that participated in previous research projects' activities. In developing the requirements for interview candidates, significant attention was placed on each individual's level of experience, not only within their respective division, but also in intra-organizational capacities.

The format of these interviews would be a face-to-face discussion of topics related to each individual's prior experiences during the project development process. The research team believed it could collect the most beneficial and candid responses in this manner, as topics of conversation could be redirected accordingly. Nonetheless, in order to obtain the necessary data from these interviews in an efficient manner, a structured interview guide was developed, incorporating questions along various thematic topics. The interview guide was developed to:

- Assess each interviewee's personal participation and responsibilities as a member of TxDOT project development teams;
- Characterize the current processes, tools, and techniques utilized by each interviewee's division or district;
- Gather information on the problems and inconsistencies resulting from current project development practices;
- Define key stages characterizing the project development process;
- Obtain information on the organizational dynamics within the interviewee's division or district during the development process; and
- Obtain formatting input on the development of an R/W requirements tool.

Appendix A includes the interview guide that was developed for this study. The research team utilized the interview guide at each division and district interview. As the team gained more insight from completed interviews, the guide was used more informally as a thematic tool for generating a targeted discussion.

TxDOT Division and District Interviews Conducted

Upon completion of the interview guide, a number of TxDOT division and district employees were contacted. Indications from the ongoing literature review highlighted a variety of divisions that influenced project development decisions. To this end, the research team decided to conduct interviews at multiple divisions including, but not limited to, ROW. In particular, the Design, Environmental Affairs, and Transportation Planning and Programming Divisions directly impacted R/W processes throughout the development stage.

In addition to focusing on a broad scope of divisional input, the research team conducted interviews at various district locations. In this manner, the team's studies reflected a broader array of typical projects and project execution strategies. Feedback from the district interviews was supported by the diversity of members on the Project Monitoring Committee, who, themselves, offered fact-based data from differing district perspectives. Altogether, the summation of interview results from varying divisions and districts was meant to benefit the comprehensiveness of the research and eventual project deliverables. A discussion of the interview results relating to project development practices and organizational dynamics follows in Section 4.2.

3.3.3 Synthesis and Categorization of APRA Elements

While carrying out the literature review and interviews, a number of R/W requirements necessary for parcel acquisition were identified. These requirements consisted of planning elements related to design issues, R/W issues, management strategies, contractual agreements, and environmental issues, among others. Initially, these requirements were characterized by specific functional areas and were documented in matrix fashion. However, throughout the interviews, the research team realized that many project development processes required shared responsibility among multiple divisions. As a result, strategic categorization of R/W planning requirements would play an integral role in the development of the requirements tool. The determination of key planning element categories was done in accordance with the following objectives:

- Key planning elements would be categorized in a manner that followed the chronology of phasing in TxDOT's previously established project development process.
- Categories would promote interaction among TxDOT divisions and/or disciplines, as opposed to assigning groups of elements to one division or another.
- Categories would promote interaction among TxDOT and external project stakeholders, including consultants and utilities.
- Key planning elements would be grouped according to some thematic relationship—not based on functional areas, but on project phase objectives.

The research team had a series of internal organizational meetings to categorize the key planning elements that were derived from study findings. Moreover, members of the Project Monitoring Committee provided feedback on the structure of these classifications during project update meetings. Each element was given a detailed description regarding its use and purpose within the project development process. This included a list of sub-elements that defined the scope of each element and the basic requirements that needed to be performed as part of the project team's efforts in controlling that element. Specific TxDOT deliverables, management strategies, and compliance requirements were additionally linked to most of the planning elements. The results of this methodology is presented document "Element Description" as in Appendix B. A more lengthy discussion on the categories and element descriptions follows in Section 4.3.

3.4 Weighting the APRA Elements

Although all elements are critical to the planning of a project, they have different relatively impacts on the project. An element with higher impact would have higher risk to the project's success if it is not addressed properly. Therefore, more attention should be paid to those with higher relative impacts. This is not to say concentrating on only high impact elements suffices. In view of the interconnectedness of all elements, all applicable elements should be taken into account when planning a project.

Relative impacts of elements are not obvious. These impacts should reflect the practices of project development, thus expertise from experienced experts in project development should be utilized to weight the elements. Among the considered methods for weighting the elements, the research team determined using workshops to tap expertise of experienced professionals as the most suitable way to evaluate the elements' relative importance. Workshops have the advantage of directly interacting with the participants without too much attention, which may lead to influence on response. Multi-participant workshops allow maximizing the homogeneity of the information conveyed to the participants that hardly can be obtained using other methods such as interview or mail survey. Workshops are also a great method in improving the response rate. This method has also been proven successful and effective for this type of work in a number of previous research efforts at CII[17, 18]. More detail on the weighting of APRA elements is presented in Chapter 5.

3.4.1 Conducting Weighting Workshops

In order to involve experts from different geographic areas disciplines, the research team chose to organize workshops in different districts across Texas to enable participation from as many districts and offices as possible. With the help and support from the PMC members, the research team contacted districts to request for their interest in participation in one of the workshops. Many districts expressed interest in participation; and 51 people from 12 districts were actually able to attend in one of the six workshops. Chapter 5 will provide further detail on weighting workshops conducted.

3.4.2 Analysis of Workshop Data

The next job after organizing the workshops is to analyze the data collected. There are two types of data collected: qualitative and quantitative. During the workshops, the participants were asked to provide any comments about, suggestions for, and critiques of any aspects of the research, including, but not limited to, the APRA method, the list of elements, the elements' descriptions, the data collection method, and the workshop questionnaire. This qualitative input was then summarized and used to improve the method, especially with respect to terminology and contents in the elements' descriptions.

As for the quantitative data, answers from the participants were input into Microsoft Excel and SPSS 13.0 software programs for data analysis. Preliminary data were performed to discard any obviously inappropriate answers. Further data screening discarded extreme outliers whose inclusion in the data analysis may affect incorrectly the interpretation of the results. After all, the normalization and interpolation processes were conducted to generate the final relative weights of the elements. The elements' weights are the data core of the APRA method and tool that would be later developed. Details of this data analysis process are presented in Chapter 5.

3.5 Development of Draft Method and Tool

The completion of the workshops and data analysis enabled the development of APRA method and a computer tool that can help use the method more effectively. The method and tool development culminated in the "TxDOT Best Practices Model and Implementation Guide for Advance Planning Risk Analysis for Transportation Projects" and the "User Guide for the Advance Planning Risk Analysis Tool for Transportation Projects"[18, 19].

3.5.1 Development of Draft APRA Method

Having developed the APRA element list, descriptions, and weights, major part of the APRA method has been established. However, numerous questions have not been answered with regards to the use of the method, including who should use the method, at what points in time during project development process the method should be used, how to use to the method for a project and statewide. An implementation guide was therefore developed to answer these questions, among others.

The implementation guide is the result of the research team's experience and discussion and borrows heavily from the PDRI user guide.[8, 9] The research team had to make it clear who, among the project stakeholders, should use the method. Even though many stakeholders can benefit from the use of the method, it was determined that owners (such as Texas Department of Transportation), designers, and constructors are three main beneficiary groups. When during the project development process should the method be used was under discussion by the research team as well. The method could be used virtually any time during this process; however, there are some distinct points in time its use is recommended. Furthermore, the team had to provide clear guide on how to use the method each time it is used. And finally, a guideline on how to interpret the results from each use of the method as well as along the timeline of a project and across the entire organization was needed. During this entire implementation guide development, apart from internal members' expertise, the research team took into account the comments and suggestions from TxDOT experts who had been participating in various meetings, interviews, and workshops.

The first chapter of the guide is an introduction to the APRA method. The second chapter discusses major benefits the APRA method can bring to the user. The third chapter is dedicated to when and how to use the method, at both project and organization levels. The interpretation of the results of the use of the APRA is explained in Chapter 4 of the guide. Final chapter provides some recommendations on the use of the method and conclusions on the guide[18]. More detail on how the method and its implementation guide were developed can be found in Chapter 6.

3.5.2 Development of Computer Tool

While the method can be used without a computer tool, an easy-to-use computer software could help facilitate the use of the method and better meet the needs and requirements of different users. A user-friendly computer tool was developed based on the Microsoft Excel software program. This tool incorporate all the materials necessary to use the method, including a scoring mechanism, data input sheets, element list, element descriptions, and reports. During the development of this tool, much input from the PMC members and other TxDOT experts was obtained and used to improve the tool. By using Microsoft Excel as the platform, the team has developed a tool that can be used in any personal computers that have Microsoft Excel installed without requirements of further investing on software. Further information on how the tool was developed and how to use it is presented in Chapter 7.

3.6 Testing APRA Method and Tool on Real Projects

A great deal of input from experts and the research team members was incorporated into the development of the draft APRA method and the computer tool. It was still necessary to test the APRA method and its computer tool on real projects with the people who are potential users. The testing would allow for generating potential benefits of the method, collecting more comments and critiques on the method and the tool to revise and improve them, and familiarizing the potentially future users with the method. This APRA test process is elaborated in Chapter 6.

3.6.1 Selection of Projects for Testing the APRA on

The first task in testing the APRA is to select proper sample projects. A sample project selected can be either completed (including construction phase) or ongoing, preferably prior to the letting. The project needs to have a total budget, which is final if the project was completed and current estimate if ongoing, of about $3 million or more. If the project is completed, it is preferred to have been completed within the last 5 years by the time the test was conducted. This is however not a strict criterion. A project should be performed using traditional design-bid-build method and of one of the types listed below:

- Convert Non-Freeway to Freeway
- Widen Freeway
- Widen Non-Freeway
- New Location Freeway
- New Location Non-Freeway
- Interchange (New or Reconstruct)
- Bridge Widening or Rehabilitation
- Bridge Replacement
- Upgrade to Standards—Freeway
- Upgrade to Standards—Non-Freeway

The research team contacted a number of districts, mainly those who participated in the weighting workshops, to request their interests in providing projects for testing the APRA and hosting test meetings. As a result, eleven districts expressed interests and actually participated. A total of seventeen projects were tested; nine of them were completed and eight of them were ongoing.

3.6.2 Analysis of Test Data

The testing provided the research team not only quantitative data on how each project scored in an assessment using the APRA but also qualitative data on the proceedings of the projects, the project development process in general, and comments on the APRA method and its use. Due to the limited number of projects tested, it has not been possible to draw conclusions on the relationship between the performance of project development and the project outcome. The test data have however enabled initial understanding of a score range for transportation projects. More importantly, this testing process has involved 32 experts from various districts to test the method and give feedback. Many insightful comments and highly positive responses on the use and benefits of the method were received. This fact reaffirms the needs for this APRA method and its potential benefits to the user. Details on the analysis and interpretation of its results can be found in Chapter 6.

3.7 Finalizing Research Products and Reports

The input from the testing process, especially the comments from test participants, was taken into account in finalizing the APRA method and its computer tool. At the same time a document, called implementation guide, to instruct the implementation of the APRA was developed to help apply the APRA in both district and state levels. A user manual for the computer tool with step-by-step details was also developed. These two documents are companion to each other in using the APRA. Finally, in parallel with finalizing the method and the tool and the development of the guideline documents, recommendations on implementation and advancements of the method were summarized to be included in the final research report. This final research report includes details on all activities, tasks, findings, products, and recommendations. The delivery of the research report marks the end of this research project.

Chapter 4. APRA Elements Identification and Synthesis

This chapter provides details on how the APRA elements were identified, synthesized, and categorized. It starts with the investigation of processes and sources in relevance to the research topic. It then reports on how the research team studied the process consistency at both district and division levels. Finally, this chapter presents the synthesis and categorization processes of the APRA elements and their descriptions. The results from the synthesis and categorization serve as the basis of the APRA method.

4.1 Documentation of Related Processes & Sources

In an effort to obtain information sources on processes related to TxDOT advance planning of R/W projects, the 0-5478 research team conducted a literature review consisting of TxDOT programming manuals and external agencies' reference materials. The following sections portray an overview of the project development process and policy issues associated with the requirements in different divisions. Information is included from the DES 110: Right-of-Way Considerations in Project Development training course, as well as the Center for Transportation Research, California and Minnesota Departments of Transportation, the American Association of State Highway and Transportation Officials (AASHTO), the Federal Highway Administration (FHWA), and the Construction Industry Institute (CII) publication libraries. This literature review presents elements that have significant influence on R/W development, and potentially on the development of the 0-5478 requirements tool.

4.1.1 TxDOT Project Development Process and Manual Systems

TxDOT follows a sequence of planning phases and strategies when preparing for the acquisition of R/W and construction of a transportation facility. The project development process, depicted in Figure 4.1, is an organized methodology for handling tasks that are presented during the stages of a project prior to actual letting. The process is split into four chronological stages, including Project Initiation, Long-Range Projects, Priority 2 Projects (which include Plans, Specifications, and Estimate (PS&E) development along with R/W appraisals), and Priority 1 projects (those already included in the Transportation Improvement Program). For the purposes of this research study, attention is only focused on the tasks that are part of Project Initiation and Long Range Projects. As is evident from the flowchart, responsible parties during these stages of development include Transportation Planning and Programming Division, the Design Division, the Environmental Affairs Division, and the ROW Division. In addition to the Project Development Process Manual that is incorporated in the TxDOT online manual database, each of the aforementioned divisions maintains a programming manual or series of manuals that indicate practices during project planning.

The Project Development Process Manual is organized according to flowchart activities. It includes chapters on Programming and Planning, Preliminary Design, Environmental work, ROW and Utilities functions, PS&E development, and Letting. As a whole, the manual[1]:

- Functions as a technical manual that covers the "who," "what," and "when" of the project development process;

- Provides references and online links to the procedural ("how to") information contained in TxDOT procedures manuals;
- Is written primarily for TxDOT personnel;
- Describes "tasks" or steps involved in developing a transportation construction project—from inception to letting;
- Provides very basic information on a broad range of topics, written in a simple manner, for users with varying experience levels and specialty areas.

By clearly showing the sequence of project development tasks, the manual provides the benefits of preventing project delays, avoiding rework in development, and improving communication between different functional groups[1].

As part of planning and programming, the manual lists five topics that broadly cover early planning processes. These include needs identification, project authorization, compliance with planning requirements, study requirements determination, and construction funding identification[1]. These functions are representative of collaborative efforts early in the planning process, as they typically require input from more than one division or functional group. In many cases, these tasks must be performed prior to obtaining placement of the project in the State Transportation Improvement Program (STIP) or long-range project funding databases.

Preliminary design functions included in the project development process consist of data collection and preliminary design preparation, public meetings, preparing the preliminary schematic, geometric schematic approval, and value engineering[1]. The preparation of design drawings and the determination of design elements occur in a staged process. Project development meetings, including the Project Concept Conference and Project Design Conference, offer opportunities for the various divisions to indicate design requirements in preparation of the Design Summary Report. Furthermore, information related to these practices can be obtained from the Roadway Design Manual, which is also included in the TxDOT online database.

Additionally, environmental components needed to be defined include preliminary environmental issues, interagency coordination/permits, environmental documentation, the public hearing, and environmental clearance[1]. Beyond determining impacts of the project on air quality, noise, and wildlife habitats, the Environmental Affairs Division is responsible for social welfare of the displaced public. This means that relocation requirements and public involvement strategies are included in the Division's scope of development activities as well. According to the manual, "This activity should be conducted concurrently with developing the preliminary schematics (see Preliminary Schematic) and determining utility and right of way ownership."[1] More information is also included in TxDOT's Environmental Manual.[20]

From a R/W standpoint, project development processes include R/W and utility data collection, map and property descriptions, appraisals and acquisition, and utility adjustments.[1] The ROW Division has a series of internal manuals that document procedures in various portions of the development process. These include the Procedures Preliminary to Project Release Manual, the Real Estate Acquisition Guide for Local Public Agencies, the Acquisition Manual, the Relocation Assistance Manual, and the Utility Manual.

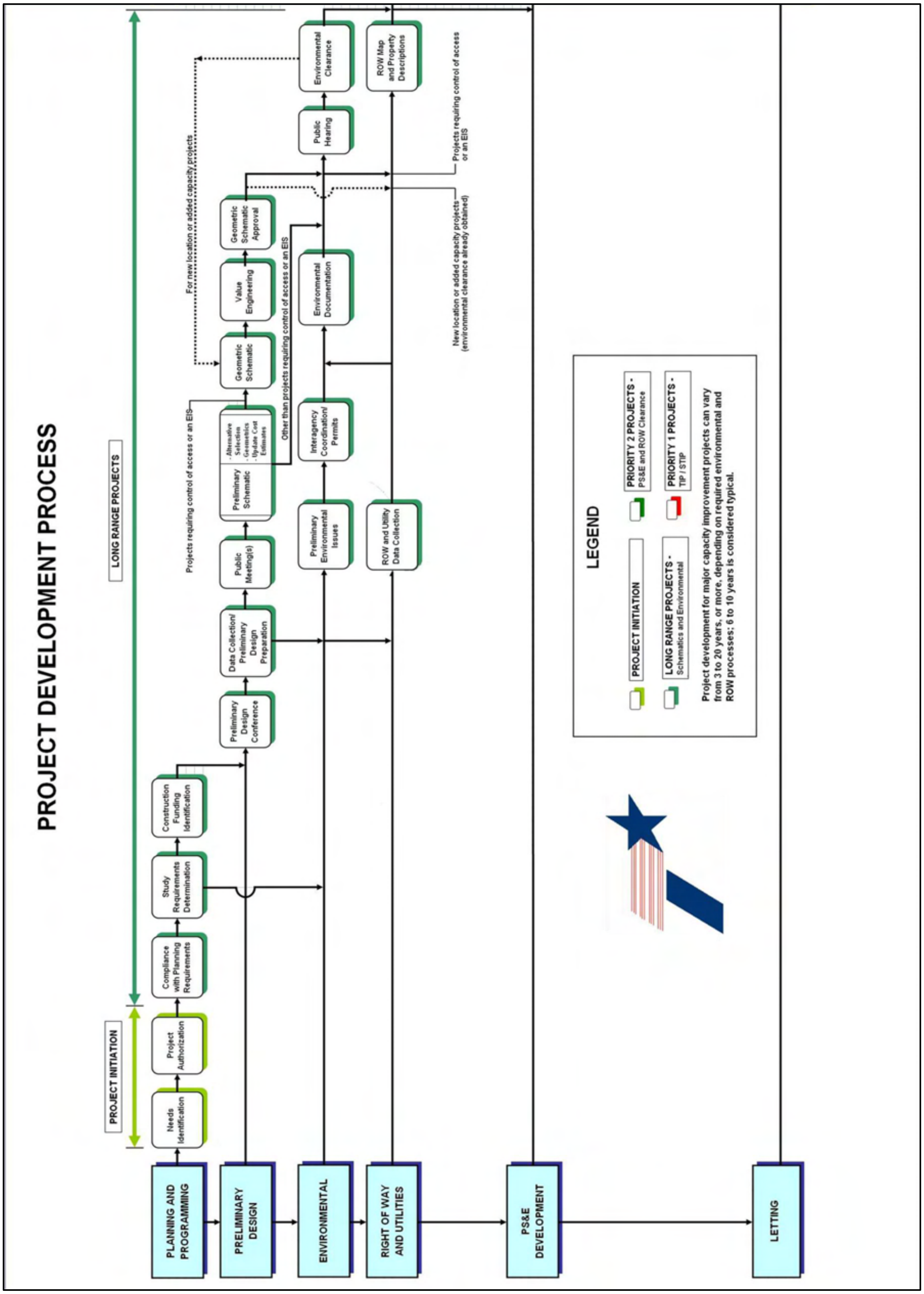


Figure 4.1 Project Development Process Flowchart

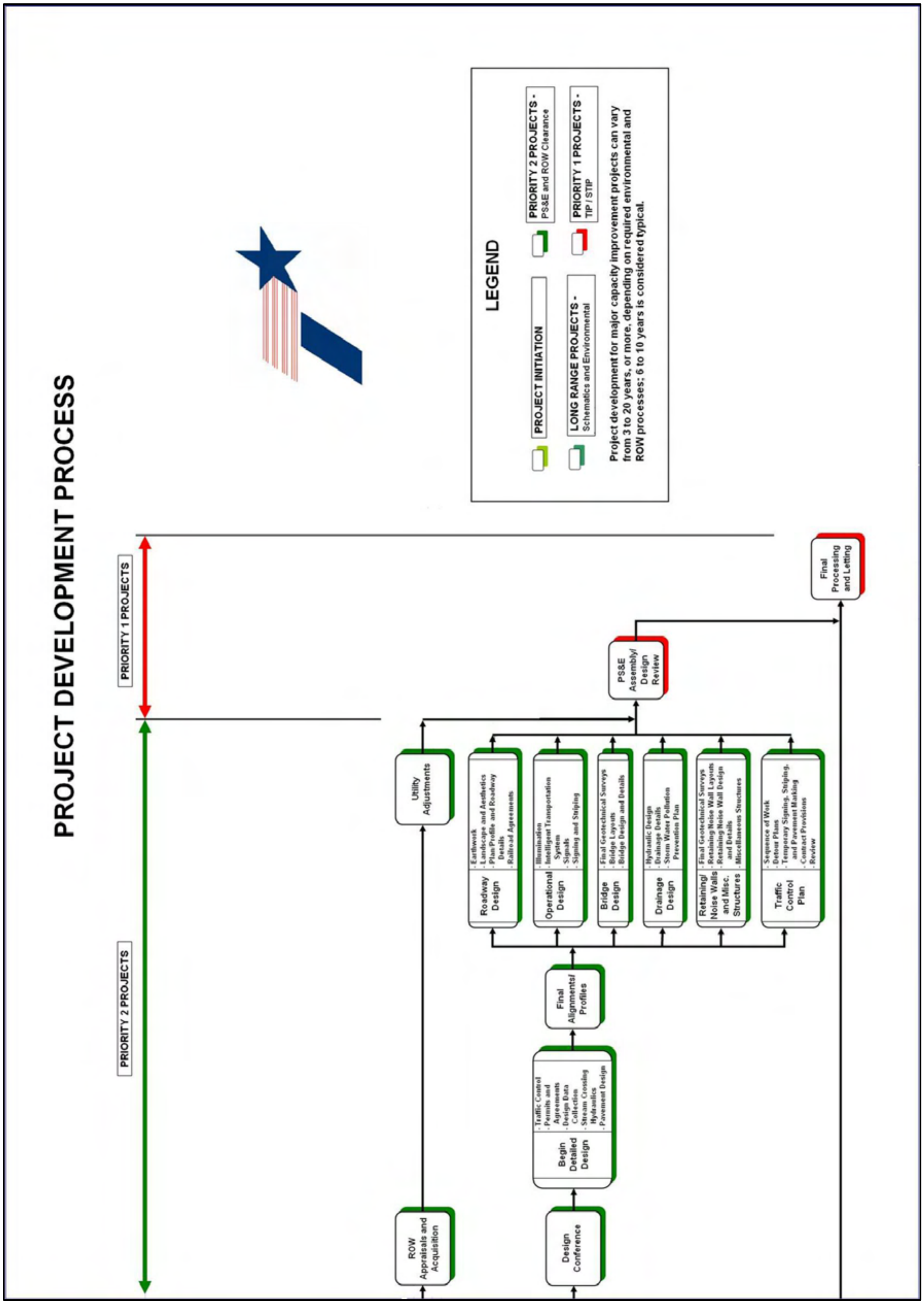


Figure 4.2 Project Development Process Flowchart (cont'd.)

4.1.2 TxDOT Right-of-Way Considerations Training Course

To obtain further information on ROW functions as they relate to the TxDOT project development process, members of the CTR research team attended a 36-hour training course entitled *Right-of-Way Considerations during the Project Development Process*. As part of course instruction, the team members received a manual consisting of materials discussed over the duration of the course. This manual was divided into fifteen chapters that identify high-level tasks that must be included during R/W development. Rather than emphasize policy constraints, the chronologically-based chapters informally bring together elements from various TxDOT divisions. The main objective of the training program included the need to "identify and explain the importance and impact that many of the typical design decisions that are made during a typical TxDOT transportation project will have on the process of R/W acquisition."[21] For the purposes of this literature review, the team has focused on the chapters that relate to R/W functions that take place prior to setting the letting date and those that occur prior to release of R/W. The former category consists of an overview of the investment studies and feasibility scoping meetings that dictate letting requirements, while the latter refers to the project meetings, utility impact investigations, R/W maps, schematics, and boundary determinations that result as part of further development.

Initially the manual identifies important factors that address questions relating to how much R/W is required for a project, how much time it will take to acquire, and how much funding it would necessitate. Considerations mentioned at this point include relocation costs of utilities and displaces, and preliminary environmental impacts. The manual notes that "utility companies should be brought into the process long before this time," referring to the period of utility adjustment. "According to the Utility Cooperative Management Process as adopted by the Department, utility accommodation considerations will be included in the project planning, design, and construction functions at the district level."[21] Moreover, in terms of habitant relocations, the text describes differences between business, residential, and non-profit relocations, citing the Uniform Relocation Assistance and Real Property Acquisition Policies of 1970. This law "gives displacees a minimum of 90 days from the date of notice to remain on the property. If this 90 day window were violated, the State would suffer the threat or loss of Federal funding in construction."[21] Early physical inspections performed by the Environmental Division include a review of relocation requirements. Similarly these inspections take into account a number of environmental considerations, such as:

- PCB transformers or electrical equipment;
- Above ground/underground storage tanks;
- Dumping, stockpiling, production, disposal, spills, or release of hazardous chemicals, substances, materials, or wastes;
- Unlabeled storage drums;
- Activities that generate, store, transport, or dispose of hazardous substances or waste;
- Oil and gas wells, pipelines, or refinery operations.

To facilitate the requirements identification process, a number of investment studies are discussed within the literature and are performed at early stages of project development. Major

Investment Studies, which are required for TxDOT projects cumulating in over $10 million of cost, utilize benefit-cost ratios to perform economic, social, environmental, land use and development, and financing reviews. Later in the development process, Feasibility or Route Studies provide greater input on the social and economic impacts that characterize specific project corridors. A final Program Assessment is conducted prior to R/W release. This study results in a "multi-page request that includes, among other requirements, a description of the project, the estimated cost, the R/W requirements, and the environmental concerns."[21]

In conjunction with the investment studies, the training manual refers to a series of internal planning meetings that occur at different stages during the TxDOT project development process. These meetings are summarized in Table 4.1. In order to promote communications, both internally and with project consultants and private-sector participants, the meetings are meant to establish trust, avoid misinformation, and facilitate decision-making. While these meetings are not performed for all projects, they enable identification of requirements to develop more rapidly and assist in developing project scope.

Table 4.1: Project Development Meetings Summary[1, 21]

Type of Meeting	Definition	Topics of Discussion
Feasibility & Scoping Meeting (FSM)	An FSM is a corridor oriented meeting in which broad issues related to the project's purpose, need, and alternatives are discussed. The meeting is really the starting point for detailed project work. A major investment study often begins with a meeting like a FSM.	• Design Characteristics • Hydraulics • Abutting Properties • Controlled Access Highways • Regulations for Access to State Highways • Environmental and Cultural Issues • Right-of-Way Issues • Utility Corridors
Preliminary Design (Project Concept) Conference (PDC)	The PDC is a route-oriented meeting where usually more detail is known about the proposed project than at the FSM stage. An FSM will already have been conducted and a Feasibility Study or Major Investment Study prepared for all new projects entering the Long Range Plan of the project development cycle.	• Typical Section • Hydraulic Structures • Environmental Impacts • Utilities • Alternative Routes • Noise Abatement • Encroachments • Railroad Agreements • Land Areas to Avoid
Design Conference (DC)	The focus of the DC is on specific design, environmental, and R/W issues. Decisions are made that will determine final design and project development. The purpose of this meeting is to define in detail specific design considerations, finalize R/W requirements, and evaluate and consider public input.	• Right-of-Way Map and Parcel Acquisition • Public Involvement • Utility Accommodation Policy • Utility Cooperative Management Process • Alignment Details • Detailed Design Issues • Alignment-Specific Issues • Environmental Mitigation Plans

Particular considerations that are necessary for the development of conceptual schematics and environmental documentation were also noted within the training program. These considerations include project boundary requirements for provisional R/W maintenance and design constraints. To this extent the literature cites that "width of the R/W will be controlled by the proposed design. Examination of the typical cross-section will indicate those elements of design affecting the width of the proposed R/W."[21] Additional needs include development of planimetrics, preliminary schematics, R/W determinations, and owner/affected corridor maps. The inclusion of environmental mitigation locations within these maps is critical to clarifying the impacts to parcel acquisition. "Two impacts that could be significant include wetland mitigation and environmental contamination remediation. Both can be costly and have the potential to delay the project."[21] In developing a completed R/W map, TxDOT planners account for the environmental concerns, as well as whole property inserts, legal property descriptions, course, bearing, distance, property lines and corner ties, roadway configuration, utilities, improvements, and control of access. Prior to release, these maps require approved, along with a funding agreement and environmental documentation.

Lastly, a significant number of considerations are depicted that relate to property rights and reimbursement eligibility of utility companies operating within the TxDOT R/W. Utility reimbursement "could be stated as the cost to restore the utility facility to its previous service capacity. Reimbursement of the cost of such work shall be in accordance with the provisions of Texas law, federal regulations, Minute Orders of the Texas Transportation Commission, and TxDOT's policies."[21] This cost is picked up by the ROW Division as part of acquisition, while "the determination of eligibility for reimbursement should remain with the district and division ROW groups."[21] Therefore, there is a documented need for the designer to work cooperatively with the utility facility to prevent unnecessary relocation processes.

4.1.3 Sources from other State Departments of Transportation

In addition to information collected from TxDOT literature databases and training programs, sources from other State Transportation Departments proved valuable in recommending practices for early R/W development. Each State Transportation Department utilizes a suite of procedural manuals that is very similar to TxDOT's. Furthermore, each state also has a specific, but rather generic, checklist for approval and review of R/W plans. However, research and implementation programs in these State Transportation Departments have led to the creation of checklists and process charts that present project development requirements in unique formats, and include information based on lessons learned. Although there is a significant lack of checklists related to early development factors or R/W scoping, some identify elements necessary to perform preliminary R/W functions.

The California Department of Transportation (CalTrans) issued a checklist in 1995 to facilitate R/W acquisition by identifying a number of issues that often impact the development process. This checklist incorporates the following indicators of R/W issues:[22]

- Design requires all or a portion of property for the construction of the project (acquisition);
- Project design eliminates access to or from an individual's real property;
- Need for a temporary right to cross the property during construction of the project (temporary construction easement);

- Need to relocate utility service lines or facility outside of the project area (utility relocation);
- Need to purchase or build a replacement structure for an occupant being displaced by the project (relocation assistance);
- Owner wanting to privately develop their own property and the jurisdiction requires some part of the property be dedicated for future R/W;
- Owner wanting to assist the local jurisdiction by providing property for the public project and is willing to do so for little or no payment (donation);
- Environmental process requires the investigation of possible Native American burial sites, hazardous wastes, or endangered animals on private property (permit);
- Need to construct driveways or other approaches onto the property of adjoining owners (permit to enter);
- Need to investigate and/or remove hazardous materials and waste;
- Operating railroad facility needs to be moved or crossed or modified;
- Need to enter onto property for a limited period of time (right of entry); and
- Project as determined by a court ruling only after an occupant filed an inverse condemnation or a relocation assistance appeal.

Additional information was acquired from the Minnesota Department of Transportation (MnDOT), which created a Program Delivery Streamlining Task Force in 2001. As part of a research study on "initiatives to expedite the project delivery process," the Streamlining Task Force explored initiatives and recommendations in three focus areas, namely environment, design, and R/W. The product of this study was a report published in February of 2002, entitled *Project Delivery Streamlining: Design, Right-of-Way, and Environmental Focus Areas*. Beyond documenting recommendations in the three key areas, the report further categorizes R/W process streamlining recommendations according to the following four sections:[23]

- Those recommendations being implemented by the Office of Land Management for immediate incorporation and guidance;
- Those recommendations requiring coordination between the Office of Land Management, District ROW Offices, and other District functional groups.
- Those recommendations requiring work, direction, or resources as directed by Commissioner's Staff;
- Those recommendations that will improve the R/W process but will require implementation by groups outside the Office of Land Management.

Many of these recommendations and initiatives are unique to the MnDOT system, incorporating dollar values and terminology that relates to State of Minnesota legislation and transportation policies. Nonetheless, a number of initiatives are included that could benefit project development in TxDOT and are summarized in Table 4.2.

Table 4.2: Right-of-Way Process Streamlining Recommendations (MnDOT 2002)

Recommendation Type	Recommendation	Rationale
Those implemented for immediate incorporation and guidance	Give Districts the flexibility to do Final Plats, Descriptions, and Orders.	The work identified above can create backlogs and bottlenecks in the overall R/W and project development process.
	Allow the Districts to do their own Appraisal Reviews.	This gives them an option to internally handle one or more components of the overall process.
Those needing coordination between the Office of Land Management, District ROW Offices, and other District functional groups	Modify the Design Project Scoping Process so a review and discussion of R/W Scoping and Staging are included.	Project scoping is a critical process in identifying and planning for issues surrounding project development by minimizing project surprises and preparing functional groups for future work.
	Identify minimum strategic staffing, recruitment, and retention needs in Districts and Offices.	R/W staffing is decreasing across the state.
	After the construction limits have been established, any changes to those construction limits that affect R/W must be approved by the District Engineer.	Changes before construction limits have been established weren't as critical as after the construction limits have been established.
Those requiring work, direction, or resources as directed by Commissioner's Staff	Create a one to two-day informational workshop to develop and identify interest among consultants to do R/W work.	Consultants may not be fully informed on what the future R/W workloads will be, what work is involved in R/W projects, and what staffs will be required.
	Educate non-ROW personnel on the tasks and activities required in the R/W process.	Because of the position of R/W activities in the project timeline, this process is usually not seen by staff in other functional groups.
Those that will improve the R/W process but will require implementation by groups outside the Office of Land Management	Keep actual durations and duration dates. Maintain a record of actual durations to be used for improving future schedules.	This information is advertised to the public and used to make promises to agencies, municipalities, and other groups.

4.1.4 Previous Studies by Center for Transportation Research (CTR)

Beyond information that is included in TxDOT manuals and databases, the Center for Transportation Research (CTR) at the University of Texas at Austin has published a number of studies related to R/W and utilities. Particularly TxDOT project 0-4617, entitled "Durations for Acquiring Roadway Right-of-Way and Assorted Expediting Strategies," links many of the requirements performed as part of the project development process with characteristics that often are indicators of schedule concern.[12] A number of issues are addressed, including:

- Pricing Compensation and Impact on Remainder Delays;
- Title Curative and Ownership Delays;
- Third Party Delays;
- Parcel Characteristic/Improvement Delays;
- Legal Activity and Litigation Delays;
- Utility Delays;
- Environmental Sensitivity and Expert Witness Delays;
- Design Change and Revision Delays;
- Resource and Manpower Delays.

The study presents a variety of reasons for the above delays, including a number that should be directly addressed in advance planning. For instance, many of the physical issues—such as uneconomic remainders, improvements, existing alignments and terrain, split parcels, and environmental concerns—require significant attention dependant on project characteristics.[12] This may entail particularly extensive advance planning techniques to sort out these issues. Similarly, concerns related to public relations and organization of parties that influence the project, such as title commitment companies, utility companies, outsourced firms, and legal parties, all should be made aware of circumstances that effect planning for the acquisition of R/W.[12] In this manner, the specific types of commitments that are required from these parties can be obtained with limited schedule impact.

Of particular interest is the category of Design Change and Revision Delays. As this thesis looks to facilitate the interaction of design and R/W, these issues become increasingly important in preparation of the 0-5478 deliverables. The project delivery process requires design engineering to precede the acquisition of R/W. As a result, changes to the R/W that is required or special project provisions must be related between members of the R/W and design teams. Additionally, design of hydraulics and drainage systems occurs late in the development of Plans, Specifications, and Estimates (PS&E), resulting in impacts on the acquisition of R/W.[12] Having this information earlier also benefits the production of high-quality maps at the environmental clearance stage.

While a great deal of information related to R/W project development came from internal TxDOT and State Transportation Department literature, external sources provided additional insight on requirements that characterize best practices during the development period. Documents issued by the Federal Highway Administration (FHWA), American Association of State Highway Transportation Officials (AASHTO), and Construction Industry Institute (CII) define a number of practices that, if implemented during early planning stages, could potentially lead to significant project development improvement. The most beneficial and applicable results of research performed by these nationally recognized industry sponsors is included in the following literature review.

4.1.5 Federal Highway Administration (FHWA) Publications

The Federal Highway Administration's (FHWA) Office of Real Estate Services developed a Project Development Guide (PDG) that highlights necessary steps in completing R/W acquisition, particularly in Federal-aid projects. Rather than focusing on the policy requirements of the process, the Project Development Guide includes "plain talk and common sense ways to deal with developing a R/W project in addition to mini-case studies to demonstrate how others have handled a variety of R/W problems."[24] The guide disclaims that many processes are unique to agencies that plan for R/W acquisition. Thus, "consultation between the State and the Federal Highway Administration (FHWA) or State Transportation Department, and the State and local public agency (LPA) is critical to assure full understanding of Federal law, regulations, etc."[24]

The objectives in creating this Project Development Guide include: improving program delivery, emphasizing the flexibility in existing procedures, presenting best practices in State agencies, sharing innovative concepts, and discussing new policy areas. In regards to advance planning of R/W projects, the guide reviews the following five categories of processes and work activities:

- <u>Environmental Impacts and Public Involvement</u>: As approval of environmental documentation remains a requirement for acquisition release, it serves the purpose to perform early coordination among groups requiring environmental assessments. Incorporating the requirements of National Environmental Policy Act (NEPA) legislation, three particular classes of environmental documentation are discussed.
    - Class I – Environmental Impact Statements (EIS) are prepared for important Federal-aid highway projects having significant environmental impacts, or—to use the words of the National Environmental Policy Act of 1969 (NEPA)—for "major Federal actions significantly affecting the quality of the human environment."
    - Class II – Categorical exclusions (CE's) include the majority of highway projects. "Actions that do not individually or cumulatively have a significant environmental effect." (23 CFR Part 771.115(b)). These actions, from an R/W perspective, typically involve roadway repairs and reconstruction on existing R/W, or involving very minor amounts of environmental involvement or additional R/W. Typically these result in a Finding of No Significant Impact (FONSI) determination.
    - Class III – Environmental Assessments (EA's) are "actions in which the significance of the environmental impact is not clearly established." All actions that are not Class I or Class II are automatically Class III. Further study in this interim category determines whether the project will be processed as a Class I or Class II.
- <u>Lead Time</u>: Schedule concerns during the acquisition and relocation processes need to be addressed by managers early in the development process so that enough time is made available to accomplish program functions. For R/W this involves: estimating time required to do the job, marshalling necessary resources,

applying R/W process streamline techniques, and delivering quality R/W product/service.

- Title Documents: Highway agencies need to obtain title information prior to acquisition and must review that it is clear of liens or other obstructions. These title documents include the abstract, opinion, title insurance, and the Certificate of Title. Additionally, the Project Development Guide discusses additional recommended techniques, such as obtaining temporary easements, minor acquisitions, and preparing low-value parcel acquisitions.
- R/W Plans: R/W plans are the paper drawings which show the project alignment, its centerline, existing and proposed R/W, construction limits, terrain features, property lines, and property and other principal above ground improvements among other things. These plans are vital to the development, explanation, and selling of the project.
- Certification Requirements: The R/W certification procedure for federally-assisted highway projects essentially identifies the acquisition status of necessary R/W for the purpose of advancing a project to construction, sometimes referred to as Plans, Specifications, and Estimates (PS&E). Key points to remember in certifications include:
    - All R/W is clear, or if not, appropriate notification has been included in bid proposals of any work concurrent with highway construction.
    - All people relocated to decent, safe, and sanitary housing.
    - R/W acquired in accord with FHWA directives
    - Relocation assistance and payment rules are followed

More recently, as part of an international scanning study, members from FHWA teamed together with researchers from AASHTO, and the Transportation Review Board (TRB) to conduct an investigation on R/W development processes in European nations. While performing process reviews in Norway, Germany, the Netherlands, and England, the team documented a number of best practices that would "help ensure timely procurement and clearance of highway R/W and adjustment of utilities" if implemented in the United States. The European ROW and Utilities Best Practices publication[15] that resulted from this investigation included strategies for appraisal and acquisition, relocation compensation, training, utilities relocation and accommodation, and project development. For the purposes of this literature review, the best practices linked to project development are summarized in Table 4.3. Notice that each best practice is linked to a series of benefits for implementation during project development.

The best practices that are summarized in Table 4.3 are suggestive elements for promoting the determination R/W requirements in the Project Development Process. Many of these elements characterize the existence of extensive planning practices, particularly ones that include significant input from project team members, utilities, and consultants early in development. Moreover, the FHWA team identified a number of recommendations for project development, including "incorporation of R/W and utilities functions in the design-build process, corridor preservation, right-of-entry and early acquisition methods, and creating an information clearinghouse of R/W and utilities databases."[15]

Table 4.3: European Right-of-Way and Utilities Best Practices in Project Development[15]

Best Practice	Proposed Benefits
Multidisciplinary Team Approach	• Shift in employee loyalty from functional units to the project as a whole • Better communication and coordination among disciplines • More realistic scheduling • Easier problem identification and solution
Design-Build	• Expanding the contract scope to include some or all R/W services
Multidimensional and Inclusive Planning Processes	• Broad ability to make thoughtful and comprehensive decisions about future needs, including appropriate land use and transportation infrastructure • Improves project quality and public support • Creates the opportunity to save considerable time in the project development process
Definition of Problems and Solution	• Prevent scope creep, unnecessary work, and late plan changes
Planning Stage Feasibility Analysis	• Consider items that include land use, environmental effects, financing, and engineering
Land Consolidation	• Reduce the number of highway crossings needed to service parcels separated by the road. • Improve land use and property operating characteristics after a highway project is completed.
Realistic R/W Budgets and Schedules	• Leads to an owner-oriented process, including broader use of flexible acquisition benefit and property management practices. • Settlement rates and abutter satisfaction rates are high, which helps to avoid project delays.
External Communication, Coordination, and Participation	• Helping to identify issues and incorporate needs and solutions into the original project design • Avoids late plan changes and improves relationships with affected property owners, municipalities, and other parties.
Flexible Early Acquisition Tools	• Save significant project development time • Develop a system of early acquisition that protects the integrity of the project decision-making process.
User Friendly R/W Plans	• Standardized mapping, land registration, and survey systems • Cost savings and simplification
R/W Databases and GIS Systems	• Opportunities for developing a system for their use

4.1.6 American Association of State Highway & Transportation Officials (AASHTO) Publications

The American Association of State Highway and Transportation Officials' (AASHTO) Standing Committee on Highways (SCOH) developed a Strategic Plan to survey R/W development activities that are implemented within the United States. Upon conclusion of this research, the Highway Subcommittee on ROW and Utilities published a document entitled Right-of-Way Utilities Guidelines and Best Practices. In documenting their research, members of the subcommittee were determined to "develop and advocate guidelines and best practices to assure timely procurement, clearance of rights-of-way and adjustments of utilities."[14] This report was performed in conjunction with the aforementioned FHWA research on international practices. Nonetheless, the best practices included in the AASHTO document propose recommendations that would be of greater value to national transportation agencies. Included in this report are comments from consultants in the R/W and utilities industries as well.

The ROW and Utilities Guidelines and Best Practices publication is structured with multiple chapters that describe particular phases and work functions within the development of R/W and utilities. These include project development, appraisal and appraisal review, acquisition relocation, property management, utilities, management practices, and training. Each topic is characterized by a subset of guidelines, which describe innovative and successful processes that benefit development related to that topic. Although the project development process incorporates information related to each of these topics to some extent, the literature that was most beneficial to this study focused on events and practices specifically defined during the early stages of planning. The following is a list of topics, guidelines, and descriptions that are included in various portions of the AASHTO document. Notice that the topics are highlighted in bold font, guidelines are underlined, and best practice descriptions are bulleted.

Topic: Project Development

<u>Guideline 1</u>: Effective communication and coordination must be established between all disciplines, including ROW and Utilities, during the scoping, project development and design phases.

- Assign a project manager to coordinate the feasibility assessment activities with the appropriate unit responsible for project scope development. Feasibility assessment should serve as a "fatal flaw analysis" to screen candidate projects prior to the initiation of final scope development.
- Assign a project manager to assemble a cross-functional project scoping team to ensure the involvement of the correct disciplines necessary for effective project screening and scope development. The team must be sized to ensure effective communication without accumulating excessive "soft" costs. R/W should play a vital role during the scoping process, providing guidance in assessing the social and economic impact of proposed schemes.
- Informational meetings should be scheduled to acquaint the public with project proposals and to generate a dialogue with affected property owners. A special meeting with property owners and relocatees may also be helpful, if circumstances warrant it. "States are encouraged to consult impacted property owners in advance of the completion of project design to assess the impact of the

proposed design and to determine if a design revision is warranted. Selective use of this practice could result in more timely purchases and reduce damages to the properties impacted."[15]

- An R/W agent or other appropriate R/W staff member should attend all public meetings/hearings on projects which involve R/W acquisition. The agent should answer questions and communicate information about the acquisition process and assist affected property owners in resolving acquisition related impacts.
- R/W should provide comparative, preliminary cost estimates to be utilized in the selection of the preferred alternative. R/W input is critical at this juncture in assessing the impact of design features on directly affected or abutting properties, to determine if property impacts may be lessened by modification of design. R/W expertise should be available to assess the potential cost of design decisions. Advance acquisition of property can be initiated at this phase to alleviate hardship or for protective buying. Impacts upon utilities and railroads as well as environmental issues must be addressed early in the design and plans development process.
- Major utility companies should be identified early in the project development phase. The impact of the proposed project on existing utility facilities should be evaluated. The cost to mitigate conflicts with these utilities should be evaluated when alternative designs are considered. If there are major conflicts, the utility owner should be contacted and encouraged to develop and evaluate alternative design proposals.
- A multi-disciplinary team, including ROW and Utilities Divisions, should review plans at key completion milestones during the final design process in order to timely assess and resolve any developing problems.

Topic: Appraisal and Appraisal Review

Guideline 6: Encourage and foster teamwork in the appraisal, appraisal review, acquisition, and litigation process.

- Assign and involve the appraisal reviewer in project scoping, plan review and other pre-acquisition meetings on a project.

Topic: Acquisition

Guideline 1: Encourage frequent coordination and communication with the property owner as well as between staff to reduce costs and time and improve quality.

- Consider using rights-of-entry to achieve early entry onto property, where rights-of-entry are permissible under law, to obtain early access to property to initiate construction. It must be cautioned that the agency must still be careful to properly execute all required deeds, comply with all Uniform Act requirements, and document all files for the project. Rights-of-entry should be used only in appropriate circumstances to facilitate early entry onto property and do not serve as a substitute for required acquisition processes.

- Ensure that the acquisition and negotiating agent is made a party to, or advised of, discussions about the project and the parcels during project development, plans review and appraisal preparation.
- Conduct a project overview meeting, including assigned acquisition agents, outlining the essential information about the project, the design, special features (e.g., number of lanes, sewer and waterline locations), upcoming decisions, and date(s) of future public hearings or public meetings. This meeting should be held early in the project development process for all property owners. This early information sharing eliminates confusion and assists in decisions still to be made before design becomes final. Promoting trust and a sense of cooperation and shared ownership of the project with the public expedites the acquisition process.

Guideline 10: Use corridor protection techniques to reduce costs of future rights of way.

- Consider using early or advance R/W acquisition or coordinating with local governments in their comprehensive planning process to protect needed transportation corridors from costly real estate development. This technique is used successfully in Europe. "A major benefit of strong local planning systems in the countries visited is the broad ability to make thoughtful and comprehensive decisions about future needs, including appropriate land use and transportation infrastructure. The system also improves project quality and public support, and creates the opportunity to save considerable time in the project development process. The success of European practices suggest that re-examination of corridor preservation is warranted in the United States, using the 2002 Report of the AASHTO Task Force on ROW and Utilities Best Practices.

Topic: Relocation

Guideline 2: Develop a detailed plan for providing relocation assistance early in the project development process.

- Develop conceptual relocation plans for each possible corridor during the planning phase.
- Begin development of detailed needs assessment as soon as the parcels to be acquired have been identified.
- Compile needs assessment results into a detailed plan for providing relocation assistance on the project.

Guideline 8: Use innovative technology to the greatest extent possible to provide efficient relocation services.

- Use digital cameras to take photographs and electronically store them for the relocation history and documentation. Multiple uses can be made of the photographs by different individuals or offices throughout the R/W and project development process.

Topic: Utilities

Guideline 1: Use current available technology to the greatest extent possible.

- Ensure utilities are depicted at appropriate quality levels on all highway plans. Collect Subsurface Utility Engineering (SUE) information early in the development of all highway projects, and use it to:
  - o Encourage the Federal Highway Administration (FHWA) to continue its support of SUE. The FHWA's efforts to document cost savings, demonstrate benefits, allow Federal funds to be used, and to continually encourage the use of SUE has proved helpful to State transportation departments that are trying to establish and maintain SUE programs.

Guideline 3: Encourage frequent coordination and communication with utility companies to reduce delivery time, reduce costs, and improve quality in the utilities process.

- Consider providing earlier preliminary notice to utility companies in order to allow the Utilities companies to budget for relocations and have sufficient manpower available to do the work. Provide utility companies with a notice of proposed highway improvements and preliminary plans as early in the development of highway projects as possible.
- Reduce conflicts with utility companies that occur after design is complete by involving utility companies in the design phase of highway projects where major relocations are anticipated.
  - o Department of Transportation project engineers should meet individually with representatives from every utility company in order to minimize the possibility the Department of Transportation will reject utilities' relocation plans and require them to redesign the relocation. Early involvement can decrease the cost and impact of projects by identifying conflicts that can be avoided.
  - o Involve utility companies in the R/W design phase to assure utility companies have room between the construction limits and the new R/W in which to relocate facilities.

Topic: Management Practices

Guideline 5: Assign staff as project managers responsible for coordinating and managing primary consultants and sub-consultants.

- Assist and coordinate consultant and sub-consultant interaction through production status reports, group meetings, established milestones, programmed time lines, and active involvement in the project review process.

4.1.7 Construction Industry Institute (CII) Publications

The Construction Industry Institute has published two unique tools that aid in the development of building and industrial projects—and can have significant impact on the proposed deliverable of this research study. The Project Definition Rating Index (PDRI) "identifies and precisely describes each critical element in a scope definition package and allows a project team to quickly predict factors impacting project risk. It is intended to evaluate the completeness of scope definition at any point prior to detailed design and construction."[8, 9] The buildings version includes 64 elements that are critical to front-end planning, while the industrial version includes 70 scope definition elements. The tool attaches predetermined weights to each element to account for its relative importance compared to others. In addressing the definition levels of each element, the project development team that conducts a PDRI workshop allocates a score to each planning element. The total score of all elements are later totaled to create a cumulative project score. This score then characterizes the project and depicts how well management is performing development functions, along with the potential success of the end-product.

The proposed benefits of the PDRI are numerous. According to the document that accompanies this tool, some of the main benefits include:[8, 9]

- A checklist that a project team can use for determining the necessary steps to follow in defining the project scope.
- A listing of standardized scope definition terminology for building projects.
- An industry standard for rating the completeness of the project scope definition package to facilitate risk assessment and prediction of escalation, potential for disputes.
- A means to monitor progress at various stages during the front end planning effort.
- A tool that aids in communication and promotes alignment between owners and design contractors by highlighting poorly defined areas in a scope definition package.

Among the elements included in both PDRI versions, a number can potentially affect the advance planning of infrastructure projects as well. Particular items include elements that fall under a category titled Owner Philosophies. Development needs related to the design, maintenance, and operating philosophies are indicative of requirements that TxDOT must assume on all its transportation facilities. Additionally, equipment needs that are necessary for the project—and often impact the R/W that is required—are identified in the PDRI.

The PDRI includes a great amount of detail in planning for construction and execution of the project. Current TxDOT literature that defines the project development process only goes into limited depth on this matter. Nonetheless, early incorporation can greatly benefit project success and reduce a project's overall costs. The PDRI has 4 specific categories related to Procurement Strategy, Deliverables, Project Control, and the Project Execution Plan.[8, 9] Some of the elements that are defined within these categories can impact the TxDOT project development process as well. Examples include:[8, 9]

- Identifying long-lead critical equipment and materials
- Computer-aided drafting and model requirements
- Documentation and deliverables

- Project quality assurance and control
- Project cost control
- Project schedule control
- Safety procedures
- Project delivery method
- Substantial completion requirements

4.2 Investigation of Division- & District-Level Process Consistency

4.2.1 Division and District Interviews

Table 4.4 provides information on the timing and location of these interviews. As indicated in the table, the interviews were conducted over a period of 5 months, from January to May, 2006. At each interview, a particular effort was made to obtain information relating to the interaction between TxDOT's various functional areas in completing the processes required for R/W development.

One of the most pertinent objectives in conducting the interviews was to assess the use of project development tools in various districts and divisions. Obtaining information on these applications and the purpose they serve in alleviating planning concerns was a first step in determining requirements for the deliverables that result from this research study. By interviewing planners in various districts and divisions, the research team hopes to evoke beneficial information about practices that are currently implemented with consistent success, as well as those that serve little purpose at all. The eventual deliverable will be modeled so as to reflect prior successful tools, and be easily integrated into the current planning system. The interviews focused on three areas related to this topic—namely the types of tools and techniques currently used, the key stages surrounding implementation, and the potential for utilizing a newly created 0-5478 requirements tool.

Table 4.4: Project 0-5478 Division and District Interviews Conducted

Date	Attendees	Title	Division	Location
1/25/06	Pat Moon	Education Support Coordinator	ROW	ROW Division Office (Austin, TX)
2/15/06	John Campbell	Division Director	ROW	ROW Division Office (Austin, TX)
3/6/06	Diane Noble	Division Director	ENV	Environmental Affairs Division Office (Austin, TX)
3/9/06	Elizabeth Hilton	Project Director	DES	Design Division Office (Austin, TX)
3/28/06	Dale Booth	Advance Planner	ROW	Tyler District Office (Tyler, TX)
	Thomas Doss	ROW Administrator	ROW	
	Todd Pittinger	Survey Coordinator	ROW	
4/24/06	Don Toner	ROW Administrator	ROW	Austin Project Office (Pflugerville, TX)
5/18/06	Stan Hall Gordon Moodie Travis Henderson	Advance Planner Design Engineer ROW	ROW DES ROW	Dallas District Office (Mesquite, TX)

Currently Utilized Tools and Techniques

The ROW, Design, and Environmental Affairs Divisions each have project development applications that intend to accelerate task completion and create reporting efficiency. While some of these tools have the capacity to incorporate elements that span the entire project development process, some are only implemented during later stages of development, and most do not have the ability to integrate with applications utilized in other divisions or districts. Beyond these tools, each division follows policies documented in the procedural manuals discussed in Section 4.2.3 “Critical Process-Related Issues.”

The ROW Division utilizes two computer-based applications for planning and acquisition of parcels: the ROW Information System (ROWIS) and R/W Acquisition of Professional Services (ROWAPS) databases. The former provides users with the ability to organize parcel information, including ownership data. In this manner, the ROWIS database can track the status of parcels from definition through appraisal processes, when offers are made to affected property owners. Included information consists of parcel numbers, environmental clearance data, letting dates, parcel quantities, maps, minute orders, and eminent domain proceedings. Furthermore, the system can be customized through the addition of historical comments to particular project phases and future date reminders. ROWIS simultaneously enables R/W planners to extract information efficiently in the form of reports. ROWAPS, conversely, is utilized as a procurement tool, to handle prequalification of R/W consultants and surveyors. This system tracks contract information and payment, which becomes increasingly important during negotiations. Both

ROWIS and ROWAPS, while standardizing processes related to acquisition, fail to target many of the necessary planning requirements prior to release. As a result, different districts have created in-house planning tools to aid in accomplishing initial planning needs. For instance, the Tyler District instituted schematics and checklists that prioritize parcels for development by their utility adjustment and relocation needs—both elements that can be distinguished prior to release. The Austin District has prepared an even more detailed, Primavera-based flowchart that provides an in-depth view of the project development process. This schedule is created so as to let individuals in the Austin District delegate R/W planning responsibilities among one another. Other than these tools, TxDOT only utilizes one checklist, Form E-49, to track requirements for eminent domain initiation. Again, this form includes elements beyond the scope of this research study, occurring after the release of R/W, such as the nature of the taking.

The Design Division, unlike ROW and Environmental Affairs, rarely tracks the progress of design development on district projects. To this end, the research team discovered during the interviews that the Design Division only controls TxDOT policies. The entire design process, including hiring of consultants and approval of drawings, occurs at the district level. The tools utilized during planning by designers are limited to various computer-aided drafting applications and the Design Summary Report (DSR), which documents general design elements and structural requirements. The identification of the elements listed in the DSR begins at the Preliminary Design Conference (also known as Project Concept Conference,) but is not completed until the start of detailed design. Some districts, such as the Dallas District, have created individual tracking systems for design progress, but most utilize the planning meetings as guidelines for completed design percentages. Furthermore, as most of the design processes are assigned to consultants, the impact of TxDOT contrived planning tools is limited. As a result, the implementation of Value Engineering is often a requirement on many projects, and has achieved acclaim from individuals interviewed by the research team.

In terms of environmental planning, the Environmental Affairs Division has published numerous applications which aid in scheduling and management of information. The Environmental Manual provides a flowchart of project development activities that is similar to the project development process, but incorporates many more elements that are specific to the preparation of environmental documentation. This flowchart is displayed in Appendix C. Furthermore, the Environmental Affairs division maintains a computerized Environmental Tracking System and Database. This application is similar in many respects to the aforementioned ROWIS database. While it does not contain a checklist of activities that must be performed, it serves to advance the preparation of clearance documents. The Environmental Timeline tabulates the type of environmental documentation that is required, specific dates related to public involvement, and deadlines required for document approval. These tools are generic to all projects and, therefore, limit customization functions. Nonetheless, these division-produced tools are still utilized as the main sources of planning applications in the districts.

Key Planning Milestones in Divisions and Districts

The project 0-5478 research team utilized the interview process to simultaneously determine critical milestones in district project development processes. Typically, milestones supplied by district representatives echoed those found in divisional literature and procedural manuals. In R/W planning, the major milestones referred to points at which the TxDOT project development teams approved staged schematic drawings and funding agreements. Three processes that TxDOT cannot legally enable consultants to perform include the arrangement of funding, the stamping of R/W plans, and property value determinations. Each of these, therefore, becomes a milestone in the R/W development process.

In terms of the design process, major milestones occur in conjunction with the project development meetings discussed in Section 4.1.2 “TxDOT Right-of-Way Considerations Training Course.” Typically, the Design Summary Report is developed at a Feasibility and Scoping Meeting and more information is added at each subsequent meeting. Design reviews occur in districts at 30 percent, 60 percent, and 90 percent completion.

Environmental processes follow a tri-phased approach as well. The environmental documentation, which is required for R/W release, cannot be written prior to site assessments. The reconnaissance that must be performed is a first step, and identifies the type of documentation that is necessary. This documentation must then be compiled and submitted to the US Environmental Protection Agency for further review. The final milestone is NEPA approval, which can take many months following submission.

Potential for Process Improvement Tool Development

In addition to discussing the current tools that TxDOT utilizes in R/W, design, and environmental planning, the research interviews gathered opinions on potential implementation of the 0-5478 requirements tool. This feedback would be influential in determining the content and format that is used to create the project deliverable. Altogether, three main points were reiterated during the interview process. First, in order for the deliverable to induce employee support, it would have to resemble a dynamic, electronic format. In this way, the requirements tool can be integrated with ROWIS and ROWAPS. Moreover, the requirements tool should capture planning elements that are not incorporated in these existing databases. This means that the deliverable must retain the capacity to change as standards and requirements change during future periods. Secondly, multiple interviewees were encouraged by the deliverable’s ability to affect decisions made in their individual divisions. In this way, the requirements tool can act as a guide to creating alignment and integration among planners from various facets. Included are consultants and utility companies. Lastly, suggestions were made for the tool to assess risk factors during project development. As a risk assessment tool, the deliverable would focus greater attention on lessons learned from previous projects and form the basis for a new lessons learned system for R/W development in particular. Although a project deliverable is not yet completed, all draft documents support these suggestions and look to incorporate them in the design of the final 0-5478 deliverable.

4.2.2 Critical Team Development Issues

Based on information that was received from various interview sources, many of TxDOT’s current project development problem areas are not solely based on process-related issues, but rather also entail team alignment concerns. As a result, the interaction between project team members does not always promote commonality regarding a project’s purpose. Although the interviews that were conducted only involved individuals representing three different divisions, it was evident that this problem resulted in numerous challenges throughout the project development process. The focus on individual disciplines has sometimes prevented TxDOT planners from expediting critical tasks during project development. Similarly, in many cases planners are unable to follow through on tradeoffs made between cost allocations, schedule requirements, and task prioritization.

Some respondents noted discrepancies that exist when these divisions use unique planning tools, incorporating information that is not readily available to members of the other division. Moreover, the flow of documentation between divisions remains inefficient. For instance, information impacting R/W and utilities that is included within the documentation processed by other divisions may be overlooked by those responsible for acquisition planning. Parcels that generally require greater amounts of time and expenditures to obtain cannot be prioritized in a manner that is beneficial to hastening the development process.

Due to the relative impact that the project design has on the R/W that is required, integration between designers and R/W planners becomes a necessity. Nonetheless, key members from both divisions only meet occasionally during the project development process, at the Project Concept Conference and the Design Concept Conference. From the interview results, this does not seem to allow for the necessary interactions that are required to foster a successful development process.

Additionally, the increased presence of consultants, utility companies, and other external organizations during R/W project development has lead to additional challenges for TxDOT's management of external stakeholders, particularly in regards to their integration within the project development process. Early incorporation of these organizations in advance planning activities is critical to planning, as it exhibits TxDOT's commitment to success, which is needed to gain similar commitments from these external stakeholders. Furthermore, early involvement of affected property owners may reduce the probability of second takes, split parcels, and uneconomic remainders.

4.2.3 Critical Process-Related Issues

In addition to those issues related to team development and organizational alignment, another category of concerns raised during the interviews focused on predicaments caused by process-related functions within project development. In many cases, the tasks that planners in different divisions and districts must perform lack a clear sequence, resulting in project development strategies that intend to avoid obstacles rather than promote project goals. Multiple legal restrictions, contracting strategies, acquisition methods, and utility adjustments have resulted in a planning process with requirements that are often too detailed and repetitive for TxDOT's typical R/W projects.

As discussed earlier, the fundamental techniques that define development in various divisions are documented within procedural manuals housed in TxDOT's online database. These materials are updated quarterly. Currently, there is limited information included in the manuals that handles advance planning prior to the release of R/W. A valid explanation stems from the fact that the ROW Division cannot incur costs until release has been authorized. Therefore, R/W planning is limited to information that is obtained from other divisions and potential site surveys. Further attempts to gather site data, physically assess parcels, and buy property rights cannot be performed as thoroughly as possible during pre-release stages. In this regard, R/W follows the design schematic and environmental documentation as footprints for expenditure at later stages. Nonetheless, this limits the extent to which parcels can be prioritized and limits the amount of influence R/W processes generate in the environmental, Local Public Agency, and letting schedules.

Multiple interviewees questioned the validity of in-depth planning when the total project cost is not overly significant. Instances of planning on rehabilitation, maintenance, and added capacity projects must currently follow the same steps as issued for new construction. While these projects are generally less costly, they typically have fewer physical surprises. Of the individuals the research team interviewed, over half commented on the fact that planning practices are too formalized and inflexible in relation to these projects.

4.3 Synthesis & Categorization of APRA Elements

4.3.1 Analyzing Project Development Process

In processing the information that was collected from the literature review and TxDOT interviews, the research team attempted to delineate critical R/W requirements along a chronological project development path, in addition to a thematic scheme. During multiple internal meetings, the team discussed this issue, forming opinions on the various stages in TxDOT's advance planning of projects. Initially, the stages depicted in the Project Development Process Flowchart of Section 4.1.1 were compared with planning phases discussed in other literature materials including CII's Project Definition Rating Index. As a result, the team identified four phases that illustrate planning processes prior to R/W release and detailed design. These phases—Needs Assessment, Feasibility/Scoping, Preliminary Design, and PS&E (Plans, Specifications, and Estimates; also known as detailed design)—are noted in the diagram depicted in Figure 4.3. Furthermore, the research team utilized the three main planning conferences performed during the Project Development Process—the Feasibility and Scoping Meeting, the Preliminary Design Conference, and the Design Conference—as frames of references for project development milestones. Each of these meetings facilitates the creation of a dynamic environment for generating the necessary consensus to proceed with a new project development phase.

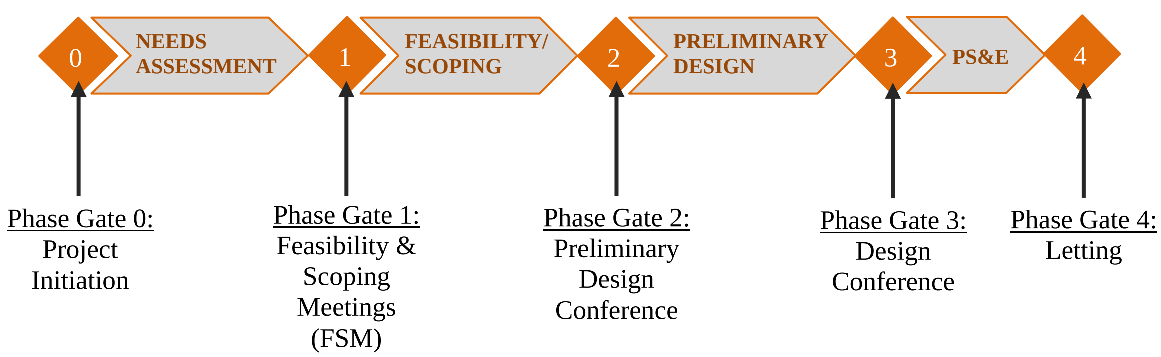


Figure 4.3 Project Development Stages Prior to R/W Release

First, needs for a project should be identified and this identification starts Needs Assessment phase. The project may be initiated by suggestions from maintenance supervisors, area engineers, district staff, local elected officials, developers, and the traveling public.[1] Following the needs, preliminary data in relevance to the project need to be gathered to and site visits should be performed to properly assess the project needs. The second phase in Figure 4.3, Feasibility/Scoping, is meant to define the information that is necessary for understanding project objectives. Feasibility and Scoping Meetings mark the start of this phase. Similar to business planning in capital projects, this phase takes into consideration factors related to the alignment of project stakeholders in R/W development and assesses project alternatives. The Preliminary Design Conference (also known as the Project Concept Conference) concludes this stage by shifting planning focus from identifying project needs to determining viable, preliminary R/W and design detail alternatives. The following list provides three categories which the team believes best describe key planning elements that fall under the Feasibility/Scoping phase. Note that these categories attempt to desegregate activities from division-related connotations:

- Project Strategy
- Owner/Operator Philosophies
- Project Requirements (high level)

The research team identified Preliminary Design as the next phase of project development prior to R/W release. In terms of TxDOT's project development requirements, this stage includes documenting preliminary geotechnical, environmental, hydrological, structural, and other technical design elements that are initiated with the Design Summary Report at the Preliminary Design Conference. At the end of this phase, the Design Conference gathers all stakeholders in an effort to once again revisit the status of the project and approve it for detailed design. The categories that the team utilized to encompass key planning elements within this stage include:

- Site Information
- Location and Geometry
- Structures
- Design Parameters
- Installed Equipment

Lastly, PS&E incorporates planning requirements that chronologically follow the Design Conference and occurs either prior to or concurrently with detailed design but prior to acquisition of R/W, utility adjustments, and construction. It is important to mention that the release of R/W can occur during this phase, and high-priority parcels may be acquired due to their impact on the critical path of TxDOT's project development. The categories that relate key planning elements in this phase include:

- Acquisition Strategy
- Deliverables
- Project Controls
- Project Execution Plans

4.3.2 APRA Elements and Descriptions

After much consideration and many internal meetings, the research team developed a list of 59 elements that are suggestive of planning requirements for any project within TxDOT. Figure 4.4 presents an example of element with descriptions. A summary of these elements appears in Figure 4.5. As stated earlier, a number of these elements involve participation from divisions outside of ROW. Nonetheless, all have impacts on the pre-release, acquisitioning, and execution processes. The element descriptions were revised a number of times, with input from the PMC, to include information specific to TxDOT's planning processes, and to contain information that is directly related from TxDOT's procedural requirements. The following summary thematically lists the key planning elements. Each planning element is represented within its specified category.

Additional information on the sub-requirements that must be fulfilled as part of TxDOT's efforts at defining each element is included in Appendix B.

Determination of Utility Impacts

Infrastructure projects often necessitate the adjustment of utilities to accommodate the design and construction of proposed transportation facilities. Failure to mitigate utility conflicts in the design process or to relocate facilities in a timely manner can result in unwarranted delays and increased project costs. Issues to consider include:

- ❑ Field verification of existing utilities facilities
- ❑ Field verification with proposed alignment
- ❑ Necessary utility facility repair and modernization
- ❑ Action plans for utility adjustments
- ❑ Physical constraints to utility placement
- ❑ Schedule impact of utility relocations and adjustments
- ❑ Determination of utility location in State right-of-way
- ❑ Local ordinances or industry standards
- ❑ Safety clearances requirements
- ❑ Other

Figure 4.4 Example APRA Element with Descriptions

4.3.3 Categorizing APRA Elements

The research team, along with the 0-5478 Project Monitoring Committee (PMC), reviewed the results that were discussed in Section 4.3.2 at multiple project meetings. The key planning element model called the Advance Planning Risk Analysis (APRA) tool—which consists of the elements, element categories, element descriptions, sub-requirements, and TxDOT-specific requirements—was subject to constructive criticism and evaluated for its level of comprehension. Members of the PMC provided feedback at face-to-face meetings and via electronic file-sharing, commenting that this list was rather extensive in nature and included a number of planning elements that were unfamiliar to TxDOT planners as they were not presently performed on all projects, at least not during the project development process. Good examples of such key planning elements are those in the Owner/Operator Philosophies category and a greater amount of those in the Detailed Scoping/Execution Planning phase.

I. BASIS OF PROJECT DECISION

A. Project Strategy
- A1. Need & Purpose Documentation
- A2. Investment Studies & Alternatives Assessments
- A3. Programming & Funding Data
- A4. Key Team Member Coordination
- A5. Public Involvement

B. Owner/Operator Philosophies
- B1. Design Philosophy
- B2. Operating Philosophy
- B3. Maintenance Philosophy
- B4. Future Expansion & Alteration Considerations

C. Project Requirements
- C1. Functional Classification & Use
- C2. Evaluation of Compliance Requirements
- C3. Survey of Existing Environmental Conditions
- C4. Determination of Utility Impacts
- C5. Value Engineering

II. BASIS OF DESIGN

D. Site Information
- D1. Geotechnical Characteristics
- D2. Hydrological Characteristics
- D3. Surveys & Planimetrics
- D4. Permitting Requirements
- D5. Environmental Documentation
- D6. Property Descriptions
- D7. Ownership Determinations
- D8. Right-of-Way Mapping
- D9. Constraints Mapping
- D10. Right-of-Way Site Issues

E. Location & Geometry
- E1. Horizontal & Vertical Alignment
- E2. Control of Access
- E3. Schematic Layouts
- E4. Cross-Sectional Elements

F. Structures
- F1. Bridge Structure Elements
- F2. Hydraulic Structures
- F3. Miscellaneous Design Elements

G. Design Parameters
- G1. Provisional Maintenance Requirements
- G2.Constructability

H. Installed Equipment
- H1. Equipment List
- H2. Equipment Location Drawings
- H3. Equipment Utility Requirements

III. EXECUTION APPROACH

I. Acquisition Strategy
- I1. Long-Lead Parcel & Utility Adjustment Identification
- I2. Long-Lead/Critical Equipment & Materials Identification
- I3. Local Public Agencies Utilities Contracts & Agreements
- I4. Utility Agreement & Joint-Use Contracts
- I5. Project Delivery Method & Contracting Strategies
- I6. Design/Construction Plan & Approach
- I7. Procurement Procedures & Plans
- I8. Appraisal Requirements
- I9. Advance Acquisition Requirements

J. Deliverables
- J1. CADD/Model Requirements
- J2. Documentation/Deliverables

K. Project Control
- K1. Right-of-Way & Utilities Cost Estimates
- K2. Design & Construction Cost Estimates
- K3. Project Cost Control
- K4. Project Schedule Control
- K5. Project Quality Assurance & Control
- K6. Safety Procedures

L. Project Execution Plan
- L1. Environmental Commitments & Mitigation
- L2. Interagency Coordination
- L3. Local Public Agency Contractual Agreements
- L4. Interagency Joint-Use Agreements
- L5. Preliminary Traffic Control Plan
- L6. Substantial Completion Requirements

Figure 4.5 Critical Risk Sections, Categories, and Elements

The value of the elements in the current list, however, results in TxDOT planners acknowledging their impact on the project outcome at an early stage, where a potential change to these elements is less costly. Moreover, the PMC noted that the project planning meetings that frame the categorical phases are not performed on all TxDOT projects, but only those with particular monetary or social value. This fact is counterintuitive to many of the key planning elements, which require decisions to be made among multiple project stakeholder groups and TxDOT departments.

As noted in Section 4.1, Documentation of Related Processes & Sources, TxDOT currently does not have any detailed checklist of project development activities other than the flowcharts that were provided. The potential use of this list of key planning elements, in forming the basis of an R/W Requirements Tool, acts to create both a checklist and benchmark for project development. By utilizing the list of key planning elements, TxDOT can target fallacies and inefficiencies in its project development process prior to them potentially gaining significant impact on the project schedule or budget. Additionally, once a requirements tool is developed in subsequent 0-5478 research, TxDOT will be able to physically implement the key planning element model to create a standardized measure for project development outcomes.

4.4 APRA Element Definition Levels

The description of an element provides the level of detail and work that need to be performed pertaining to the element. Not all of the work is necessarily done and detail known at all time during the entire project development process. Definition level is therefore used to indicate the level each element is defined at a given time in comparison with its full description. This is necessary for later assessing each element's definition as well as project's. A scale of five levels, from 1 to 5, is used for this purpose. Additionally, definition level "0" is used to signify an element's status when it is not applicable to a project. The definition levels are described as follows and are "anchored" as phase gate three, the end of preliminary design:

- Level 1: Completely defined. The element is well defined. All of the work pertaining to the element is performed completely. No more work required.
- Level 2: Minor deficiencies. Only some minor work is needed for several items of the element.
- Level 3: Some deficiencies. There is major work needed for some items or some work needed for most of the items of the element.
- Level 4: Major deficiencies. There is major work needed for most of the items on the element.
- Level 5: Incomplete or poor definition. The element is poorly defined. Major work is needed for (almost) all items of the element.

As described, definition level 1 is the desired status of an element while definition level 5 is least preferred. This preference is not to mean level 5 is bad since it also depends on the time of the assessment to judge an element's definition level.

Chapter 5. Elements Weighting and APRA Development

Different elements, even though all are critical, need to be weighted relatively according to their impact to a project. In this chapter the whole process of choosing the method, organizing, and performing the weighting activities will be elaborated. How the data collected for the weighting were analyzed and the results from this analysis will also presented in details.

5.1 Organization for Weighting Process

Tapping experts' expertise using workshop was selected as the method to do the weighting. The research team wanted to involve as many experts from as many districts as possible to obtain the most practical representative sample of experts from 25 TxDOT districts. Therefore different areas in Texas were selected for organizing the multiple workshops. Each workshop involves people the organizing district and nearby districts.

With help and support from the PMC members, the research team contacted R/W administrators of districts nearby the intended workshop locations and requested for their and their experts' possible participation in one of the workshops. The time for each workshop was selected to fit as many district experts as possible. The next section provides details on the workshops organized, the numbers of attendees at each workshop, and the districts that participated.

In preparation for the workshop series, a workshop package was developed. A workshop would require a well-structured presentation on the method and how to weight each element since a great deal of information needed to be conveyed to the participants in a limited period of time while the participants would have to concentrate on providing input into the weighting of elements. After much preparation, the research team developed a weighting workshop package that is comprised of the following documents, some of which are included in Appendix D:

- <u>Agenda</u>. It provides an overview of tasks planned for each workshop. An example of the workshop agenda is included in Appendix D.
- <u>Introductory presentation</u>. This presentation was designed to be presented in 45 minutes. Included in the presentation are an overview of the research and people involved, an overview of the APRA method, an introduction on how to weight the elements, and the research path forward.
- <u>Introduction to the APRA</u>. This one-page document was prepared to give the participants an overview of the APRA that they can read by themselves before and after the presentation. This document is included in Appendix D.
- <u>Evaluation Instruction</u>. This document gives a detailed instruction how to weight an APRA element. It was prepared to allow for references by the participants at anytime without reliance on the presentation. This document is included in Appendix D.
- <u>Background Information</u>. Each participant was asked to provide some background information regarding their professional experience, such as how long they have been working in different areas of project development, and what types of project they have been involved and in what capacity. Contact information was also

collected through this form so that the research team could follow up with the expert if necessary. Each participant was asked to select a typical project of their organization for their references during the weighting process and provide basic background information of the project in the form. Appendix D includes this background information document.

- Weighting Form. This form is a table with a list of elements with five levels of definition for each element in a row. Participants would provide the elements' weights in the table. For each element, there is a column to the right for the experts to provide comments and suggestions regarding the element. This document is included in Appendix D.
- Element Descriptions. This document contains the list of the elements with their comprehensive descriptions. It was for the experts to refer to while weighting the elements. It is included in Appendix B.
- Project Development Process Flowchart. This flowchart captures a general flowchart of the project development process used by TxDOT. It contains different phases and phase gates during that process. It is to provide the participants a reminder on the overall project development process. It is included in Appendix D.
- Suggestions Form. This document was intended for obtaining the experts' feedback on the elements and their descriptions as well as any comments and suggestions on the APRA method that was being developed.
- Unweighted Score Sheet. This is a blank score sheet that contains elements and levels of definition in the format of a table. It was for the experts to bring back to their work for their references and possible use. It is included in Appendix D.

The documents were color coded for effective communication. The documents that the research team intended to collect back were printed in colors: Background Information sheets in green, Weighting Form sheets in yellow, and Suggestions Form sheets in pink. All other documents were in white and intended for the participants to keep.

5.2 Weighting Workshops

From September 2006 to March 2007, six workshops were organized in five cities in Texas. Two workshops were held in Austin but for different groups of TxDOT districts. As shown in Table 5.1, fifty-one participants from 12 districts attended the six workshops. The participants were from all disciplines in the project development process, including Programming and Planning, Design, ROW, Utility, Environmental, and Survey. The participants' experience ranges from a few years to more than 30 years. Many had held a variety of positions in their districts, including district engineer. This variety ensures a wide range of experts' experience from various disciplinary perspectives be taken into account in calculating the weights of the elements and the expert group be more representative of all TxDOT experts. In statistical terms, the sample represents better the population from which it is selected.

Each workshop was designed for an entire working day, normally from 9am in the morning to 3pm in the afternoon. Lunch was provided in the meeting room to ensure maximum concentration of the participants while saving time since people did not have to leave the room.

Providing lunch between working sections also allowed time for more interactions among the workshop participants and the research team members. It proved to open more discussions since people tend to be willing to discuss more and ask more questions in informal settings. Sometimes, some people were not clear about the weighting process; this was the best time for them to catch up.

Each workshop started with an introduction of the research team and the experts. Each person was asked to give a short introduction on current work and their whole working experience. The introduction was followed with a presentation of the research project team. The presentation started with an introduction to the research project, research objectives, and the research team and TxDOT people who were involved in the project in monitoring roles. The presentation continued with a brief background review on research studies and findings relevant to the topic. This part focused mainly on research efforts by CII to create the Project Definition Rating Indexes for industrial and building projects. Then the workshop participants were introduced to the APRA method, its ongoing development, and its expected benefits, with an emphasis on the element list and descriptions generated. Following the introductions, the APRA weighting method was the main part of the workshop. The final part of the presentation was to provide an overview of research project future steps after the workshop series; this part was presented at the end of each workshop, after element weighting had been done.

Table 5.1: Project 0-5478 Weighting Workshops Conducted

Date	Location	District Participated	Number of Attendees
9/13/2006	Dallas District Office (Dallas, TX)	Dallas Forth Worth Tyler	10
10/25/2006	Abilene District Office (Abilene, TX)	Abilene Childress Odessa Lubbock	19
11/29/2006	TxDOT Austin Project Office (Pflugerville, TX)	Austin	4
01/17/2007	CTR Office (Austin, TX)	Bryan San Antonio	9
2/7/2007	Waco R/W Office (Waco, TX)	Waco	2
3/7/2007	Houston District Office (Houston, TX)	Houston	7
TOTAL		12 districts	51

After the introductory presentation, the experts were asked to select a project among those that they had been involved in and use this as a reference project in the entire weighting process that would follow. This project should be typical in terms of both type and size in their organization (district in this case.) A typical project is more likely to better represent a district’s pool of projects. The experts were reminded that they should not try to choose a successful or a less successful project for consideration but select a typical project. An alternative approach to this selecting a sole project for consideration is using the entire experience of the experts. However, using only a typical project was the choice because of the following reasons:

- Using one project allows for a better evaluation of relative impacts of risk issues within the scenario of only one project. If the entire experience of a person is used, he or she would tend to use the worst case among projects for each element that may result in high impacts of too many elements because different projects have different important issues. This fact would make the weighting inaccurately reflect relative importance of elements.
- One may argue that using only one project could make the evaluation biased and not consider all the experience of the experts. The former concern can be addressed by using many different projects provided by different experts. Having different types of projects will eliminate much bias that may result from using one project. The latter concern is questionable since in considering the weight for each element, an expert would take into account the context of the project but with his or her entire experience on similar issue in similar projects.
- Using a single project for each participant allows for a clearer analysis and inference of relations among variables such as project size, project type, project's level of success, participant's experience, participant's area of work, and element's characteristics.

Weighting Mechanism

At the beginning of the weighting session, the participants were asked to provide background information about themselves as well as about the project they selected in a green form.

Each participant was then asked to assume that he or she is estimating the selected project at the time when project is about to start detailed design process (Plans, Specifications, and Estimates.) One element is considered at a time. For each element there are two scenarios. First, if the element, as described in the Element Descriptions document provided, is poorly or incompletely defined, how much contingency he or she would assign to that element. An element is considered poorly or incompletely defined when, in comparison with its provided description, none or little of the work has been done by the project team.

A contingency is an amount of money to offset uncertainties related to all aspects of project execution. The participant was asked to take into consideration both time and cost effects as the result of poor definition of the element when determining a contingency; both types of effects should be converted to monetary value. The contingency should be put in terms of percentage of project's total installed cost. The contingency selected should be written in the table cell corresponding to the element's definition level 5 in a yellow form.

The second scenario is when the element is completely defined. Logically, when the element is more defined, less contingency should be assigned to it to offset the uncertainties it may bring to the project during the execution. This second value should be written in the cell that corresponds to level of definition one of the element. This process was used for all elements in the list. The participants were all reminded that they can make change at any time on the weights of the elements they had assigned before if they felt necessary; they would also be given some time in the end of the workshop to do the adjustment.

The contingencies assigned for the poorly defined case of an element would be used to calculate the score for definition level 5 of that element. This score is the maximum score an element can have and it denotes the weight of the element. The more weight the element has, the more important it is to a project. Likewise, the contingencies for the well defined case were for calculating the score of definition level 1. Note again that level 1 is the desired level of definition when an element is well defined. However, the score of level 5 determines the importance of an element.

During this whole weighting process, the research team keeps paced all participants to go element by element in a workshop to make sure all questions and concerns are raised and answered before the whole group moves to the next element.

It is not unusual for an element to be not applicable in a project regardless of size. In this case, the expert is asked to write "N/A" in both places for levels of definitions one and five of that element. They are reminded not to write "0" for non-applicable elements because a "0" at a level of definition means an element, which is applicable in the project, at that level of definition does not cause any uncertainties to the projects and thus there is no risk inherent.

If an element was applicable to the project but the participant was not familiar with it, the participant was asked to use their general experience to judge the weight for that element in a project of similar characteristics. Again, this case should be well distinguished from a non-applicable element where the project considered to have no work pertaining to that element.

The final part of the workshop was for the participants to discuss with and provide any feedback to the research team regarding any aspects of the elements, the descriptions, the weighting process, and the APRA method. They were also asked to answer questions and write any comments and suggestions they may have in the provided suggestions form that was in pink. Specifically, they were asked to provide opinions on:

- The completeness and redundancy of the element list;
- The clarity of the element descriptions;
- The instruction to weight the elements;
- How to improve the APRA method;
- Questions asked in forms in the package handed out;
- The method to obtain experts' knowledge and experience used in the workshops;
- Any other general issues.

All of the color forms (green background information, yellow weighting sheets, and pink suggestions form) were collected by the research team. All other documents that are in white paper were for the participants' reference and use.

5.3 Analyzing Workshop Data

Data collected from the workshops are of both qualitative and quantitative types. Qualitative data are from the comments and suggestions the participants made during the workshops, especially in the suggestions form at the end of the workshops. Most of the experts participated in the workshops agreed that the list and descriptions of elements were comprehensive and thorough. There were some suggestions to include some more issues somewhere in the list. The research team has made some appropriate changes to some elements descriptions to accommodate the reasonable suggestions. All the changes of this type were about adding some issues to the list of issues to be considered in several elements.

Some participants suggested combining several elements. However, the research team considered the suggestions and believed that some elements may seem to deal with a similar issue but they address the issue at different points in time during the project development process and from different perspectives. Some level of overlapping among the elements is inevitable and acceptable due to the interrelation and repetition of the work in functions. If the elements were combined, they would not cover the issue completely. The research team, therefore, decided to keep the elements as they were.

There were also some comments on and suggestions for clarify some questions in the forms. Having found these suggestions reasonable, the team has made some changes on the forms. These changes were considered minor and believed not to affect the quality of data intended to be collected.

The majority of data collected from workshops are quantitative and written in the background information sheets and weighting forms. The quantitative analysis of the data is detailed in the following sections.

5.3.1 Preliminary Screening of Data

There were a total of 51 participants in six workshops organized. The terms “participant,” “expert,” and “professional” will be interchangeably used to indicate those experts who participated in this research, in workshops, interviews, or meetings. Their weighted forms were assigned a code based on the workshop location. For each workshop location, the forms received were numbered sequentially. These forms needed to be screened before using for calculating the final weights of the APRA elements. Out of these 51 weighting forms received, two of them were not completed, had a significant amount of missing data, and thus discarded from further use. The 49 forms left were then entered into a data sheet using Microsoft Excel for analysis. Of the 49 forms, three belonged to participants who had less than three years’ experience and were considered unsuitable for use in calculating the elements’ weights. Thus after the preliminary data screening, 46 data sets from 46 experts were qualified for inclusion in further data analysis.

5.3.2 Basic Information on Weighting Workshop Participants

The 46 experts have expertise in all seven major areas in project development: ROW and Utilities, Planning and Development, Environmental Affairs, Design, Project Management, and Surveying Services. Their participation is representative of the expertise areas typically involved in transportation infrastructure projects; Figure 5.1 illustrates distribution of their disciplines. The participants’ experience has a wide range of distribution, from 3 to 31 years with an average of 17.7 years. Five of the participants have less than 10 years of experience, 25 with 10 to 20 years, and 16 with more than 20 years. Figure 5.2 presents the distribution of the experts’ experience; the vertical bar on the right hand side presents the average years’ experience.

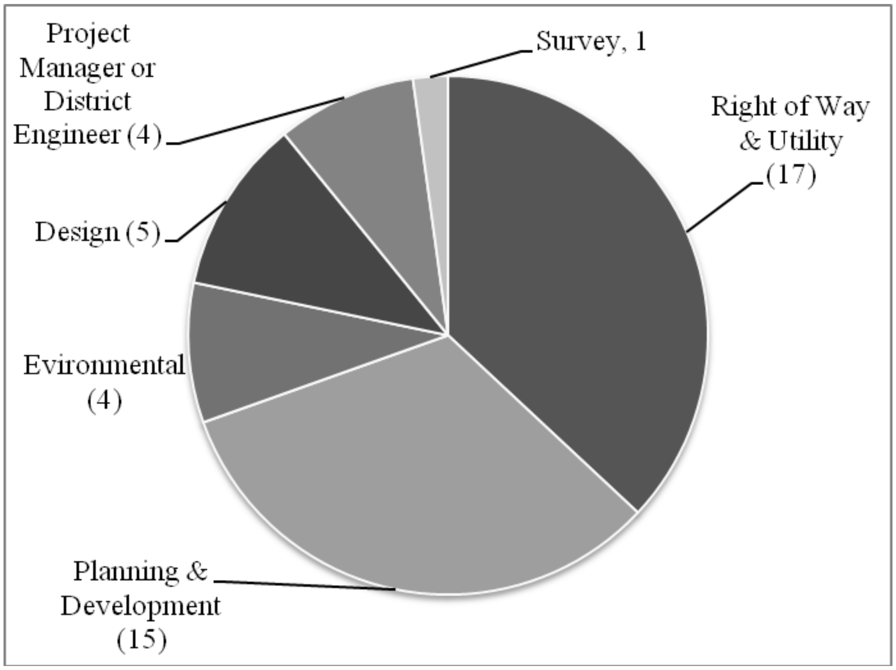


Figure 5.1 Distribution of Participant Disciplines after Preliminary Data Screening

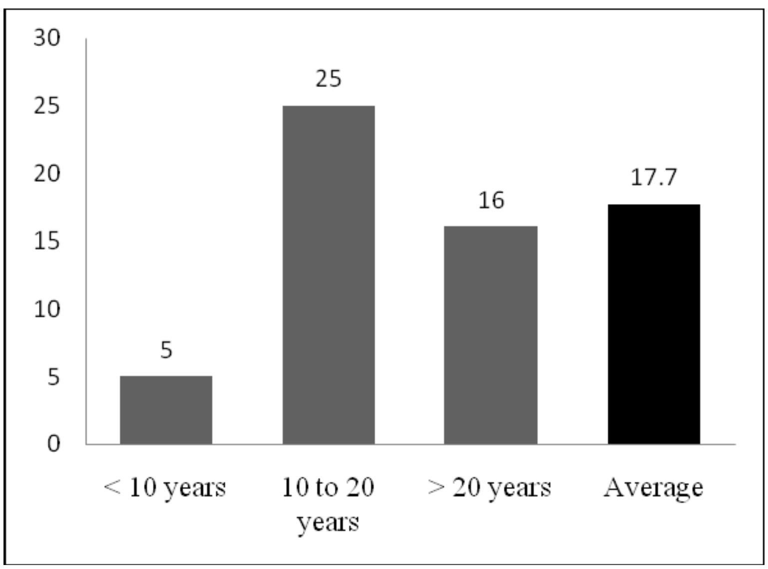


Figure 5.2 Distribution of Participant Years of Experience

5.3.3 Characteristics of Projects Used for Weighting Elements

As aforementioned, each expert was asked to select a typical project in his or her district for reference in weighting elements. Project characteristics were captured in the Background Information sheet in the workshop package. Figure 5.3 shows the distribution of the types of projects used for weighting the elements. It should be noted that the total number of projects in all types shown in Figure 5.3 is 47 instead of 46; this is because one project was characterized as both a rural and urban renovation/expansion project. Most of the projects were renovation or expansion (33 out of 46). There were 14 projects that involved new construction. Thirty one projects were in urban areas while 16 of them were considered rural. This distribution reasonably represents different types of projects in Texas.

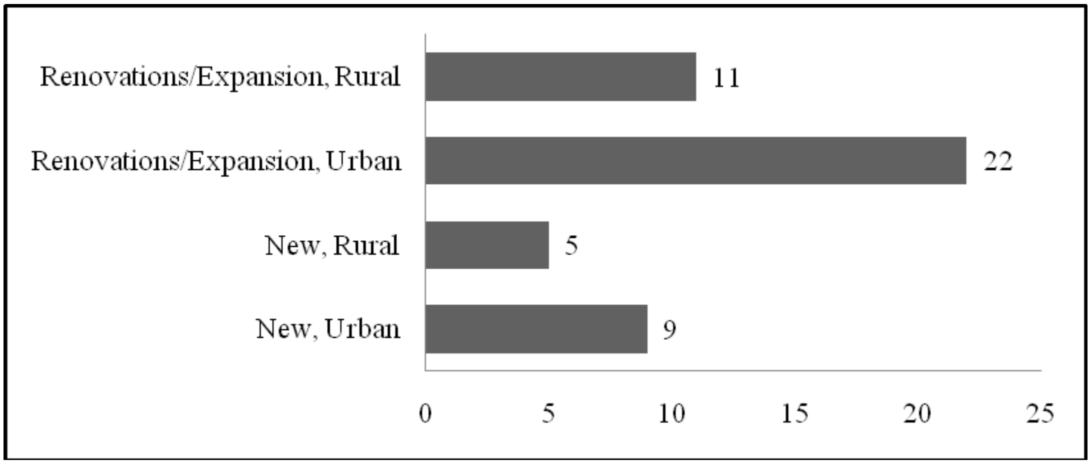


Figure 5.3 Type of Projects Used for Weighting Elements

Figure 5.4 presents the distribution of projects' total installed cost (TIC). The projects' TIC ranges widely from less than $5 million to more than $100 million. This wide distribution was expected and increases the applicability of the weighting results to projects of many sizes.

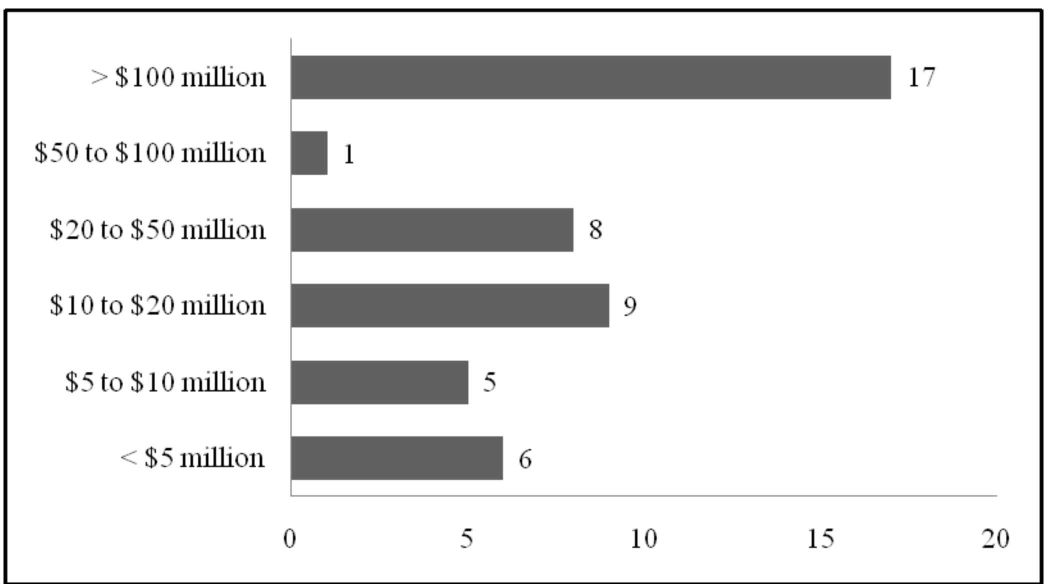


Figure 5.4 Total Installed Cost of Projects Used for Weighting Elements

5.3.4 Normalization of Elements' Weights

At the workshops the participants were asked to assign weights to elements based on the consideration of contingency needed to offset the uncertainties each element may cause to the project later. The elements' weights were considered relative compared to one another. At the end of the weighting process, experts were allowed to adjust the weights. These contingencies are highly subjective to the experts' opinions and were not restrained to any limit. In order to calculate the final elements' weights, a number of steps need to be performed, one of which is normalizing the weights. The purpose of the normalization step is to make scores assigned by all experts comparable so that they can be used for calculating (by averaging) the final weighting of the elements. The total score of all elements' weights by each expert will be scaled to a common level of score with all other experts.

This research was modeled after similar research efforts by CII that led to the creation of PDRI for industrial and building projects. Due to the effectiveness of the PDRI in other sectors and in order to allow for comparative analysis among industrial, building and transportation infrastructure sectors, a similar score range from zero to 1000 was chosen for normalizing the raw weights assigned by experts. This is the score of the whole project and it is obtained by adding up scores of all elements. A score close to or at 1000 denotes a project that is very poorly or incompletely defined. On the other hand, a score of zero or close to zero means a project that is well or completely defined.

The maximum score of 1000 is obtained by adding up maximum scores of all elements. The normalization is done for each data set (weighting form) completed by each participant. For each data set, the normalization process started with adding up scores of all elements corresponding to definition level 5. It should be noted that this is one of the two scenarios that the experts were asked to consider when weighting the elements; the other scenario is when all elements have definition level 1. The result would be a total score that is likely to different to 1000. A normalizing multiplier was calculated by dividing 1000 by the total score just obtained. Each element's score (corresponding to definition level 5) was then multiplied by this normalizing multiplier to obtain a normalized score. The result of adding all normalized scores of all elements is 1000. This process was performed for all data sets and the results were an identical total score of 1000 for all participants.

When an element is not applicable in a project (of a participant), an "N/A" would be marked in the table cells for both definition levels 1 and 5. This element would then be eliminated from normalization process for that particular participant's data set.

Each element has two definition levels, 1 and 5, that were assigned a weight by each participant. The normalization of definition level 5's scores has been explained above. As for definition level 1, the same normalizing multiplier, which was obtained from normalizing definition level 5, was used. The score of each element's definition level 1 was multiplied by the multiplier to obtain a normalized score. Scores of all elements (of each participant) were then added up to get a total score corresponding to definition level 1. These scores should be much lower than 1000 points since it represents the case when all applicable elements are well defined. The normalized scores in both cases (definition levels 1 and 5) will be used for further data screening which is explained in the next section.

Table 5.2 presents an example of how scores assigned by a participant were normalized. First the scores that the participant assigned to the elements with (definition) levels 1 and 5 were entered into the columns under "Original Weight." The elements' scores at level 5 were then added up to make "Total of Level 5 Scores," with the value of 1130. Then 1000 would be divided by this value of 1130 to get a multiplier of 0.885. This multiplier was used to multiply with corresponding scores of all elements at both levels 1 and 5. The new scores were entered into the columns under "Normalized Weight." These are the normalized scores that would be used later for further data screening and calculating elements' final weights. If all scores under level 5 column are added up, the result will be 1000. Total score of those under level 1 column is 114. This last total score is not necessarily identical to those of other participants.

Table 5.2: Normalization Example for a Workshop Participant's Scores

Element	Original Weight		Normalized Weight		Element	Original Weight		Normalized Weight	
	Level 1	Level 5	Level 1	Level 5		Level 1	Level 5	Level 1	Level 5
A1	3	30	2.7	26.5	F3	2	20	1.8	17.7
A2	4	35	3.5	31.0	G1	1	5	0.9	4.4
A3	10	50	8.8	44.2	G2	2	25	1.8	22.1
A4	5	40	4.4	35.4	H1	1	5	0.9	4.4
A5	4	35	3.5	31.0	H2	1	5	0.9	4.4
B1	2	15	1.8	13.3	H3	2	10	1.8	8.8
B2	2	20	1.8	17.7	I1	4	40	3.5	35.4
B3	2	20	1.8	17.7	I2	1	5	0.9	4.4
B4	3	25	2.7	22.1	I3	5	50	4.4	44.2
C1	1	10	0.9	8.8	I4	4	40	3.5	35.4
C2	1	10	0.9	8.8	I5	2	15	1.8	13.3
C3	1	15	0.9	13.3	I6	2	25	1.8	22.1
C4	5	40	4.4	35.4	I7	2	20	1.8	17.7
C5	2	20	1.8	17.7	I8	1	5	0.9	4.4
D1	1	10	0.9	8.8	I9	N/A	N/A	N/A	N/A
D2	4	35	3.5	31.0	J1	0	5	0.0	4.4
D3	3	25	2.7	22.1	J2	1	10	0.9	8.8
D4	1	10	0.9	8.8	K1	4	45	3.5	39.8
D5	2	25	1.8	22.1	K2	2	20	1.8	17.7
D6	3	25	2.7	22.1	K3	1	10	0.9	8.8
D7	3	25	2.7	22.1	K4	3	25	2.7	22.1
D8	3	25	2.7	22.1	K5	2	10	1.8	8.8
D9	1	15	0.9	13.3	K6	1	5	0.9	4.4
D10	2	25	1.8	22.1	L1	1	5	0.9	4.4
E1	3	35	2.7	31.0	L2	1	5	0.9	4.4
E2	1	10	0.9	8.8	L3	1	5	0.9	4.4
E3	2	20	1.8	17.7	L4	1	5	0.9	4.4
E4	1	10	0.9	8.8	L5	1	5	0.9	4.4
F1	2	20	1.8	17.7	L6	1	5	0.9	4.4
F2	2	20	1.8	17.7	∑		**1130**	**114**	**1000**
Total of Level 5 Scores	**1130**								
Multiplier	**0.885**								
Total of Level 5 Normalized Scores	**1000**								
Total of Level 1 Normalized Scores	**114**								

5.3.5 Screening Data Using Boxplot Technique

For a sample to be reasonably representative of the entire population, it is necessary to eliminate values that may seriously skew the distribution of the sample. It is no exception when calculating the weights of the APRA elements. These weights were calculated using the normalized scores obtained from the normalization process described in the previous section. The objective was to eliminate weights from participants who had a significant number of answers (scores) that are outliers in comparison to others'. In order to do that, it was necessary to conduct an analysis on scores assigned by all 46 participants to each element at each level of definition to find out the outliers and who they belonged to. That said, there would be 92 analyses of this type for 46 elements (2 definition levels each.)

Boxplot technique was selected to perform these analyses for two main reasons. First, boxplot technique uses mainly median, upper and lower quartiles that are not affected by extreme values in a distribution [25]. Specifically, values of up to 50 percent of the data points at the two ends (25 percent each) of a distribution do not affect the values of median, upper, and lower quartiles. This makes the three statistics reliable in scanning extreme values in a distribution. Second, with a sample of 46 datum points, it is less likely to have a normal, or nearly normal, distribution so that other methods, such as using mean and standard deviation, can be used effectively; boxplot is a better choice in this case.

Figure 5.5 illustrates concepts associated with the boxplot technique. A boxplot has two hinges, the lower is at lower quartile (25^{th} percentile) and the upper is at upper quartile (75^{th} percentile.) Horizontal line in the boxplot signifies the median value. An interquartile range (IQR) is the difference between upper quartile and lower quartile. A datum point is a mild outlier if it is more than 1.5 times the IQR from either the upper or lower quartiles. An extreme outlier is the value that is more than 3 times the IQR from either the upper or lower quartiles.[26]

Software SPSS version 13.0 was used to perform the analyses using boxplot technique. An analysis is done for definition levels 1 and 5 for each of 46 elements. There would be 92 boxplots to be created. Figure 5.6 presents examples of boxplots for all elements in category A (from A1 to A5) with definition level 5. A boxplot is determined by the median, upper quartile, and lower quartile. Each boxplot for an element may have mild and extreme outliers that are denoted by a circle and an asterisk, respectively. Each of these outliers corresponds to weight that a workshop participant assigned to the element at that definition level. For example, in Figure 5.6, element A5 (at definition level 5) has two outliers, one mild outlier by a person with the ID of AB18, one extreme outlier by a person with the identification number of DL7.

Not all participants who have outliers would be discarded but those with significant number of outliers. In order to screen these participants, an index called a frequency index is used. It is calculated using the formula below. In this formula, extreme outliers are weighted three times as much as mild outliers.

$$Frequency\ Index = 3 \times Number\ of\ Extreme\ Outliers + 1 \times Number\ of\ Mild\ Outliers$$

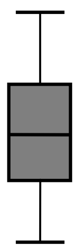
*	Value more than 3 IQR bigger than upper quartile (extreme outlier)
O	Value more than 1.5 IQR bigger than upper quartile (mild outlier)
	Highest value that is within 1.5 IQR from upper quartile Upper quartile (75^{th} percentile) Median Lower quartile (25^{th} percentile) Lowest value that is within 1.5 IQR from lower quartile
O	Value more than 1.5 IQR smaller than lower quartile (mild outlier)
*	Value more than 3 IQR smaller than lower quartile (extreme outlier)

Figure 5.5 Annotated Sketch of Boxplot

After all 92 boxplots had been generated, frequency indexes were calculated for all 46 participants. Outliers in both levels 1 and 5 are included in calculating the index. For example, participant DL1 had one extreme outlier and four mild outliers thus had a frequency index of seven. Seven participants that have frequency index of 20 or higher were discarded. As a result, weights from 39 participants were kept for calculating final element scores. This number of datum points was believed to provide a reasonable representation of the entire expert population. Table 5.3 presents the outlier frequency indexes.

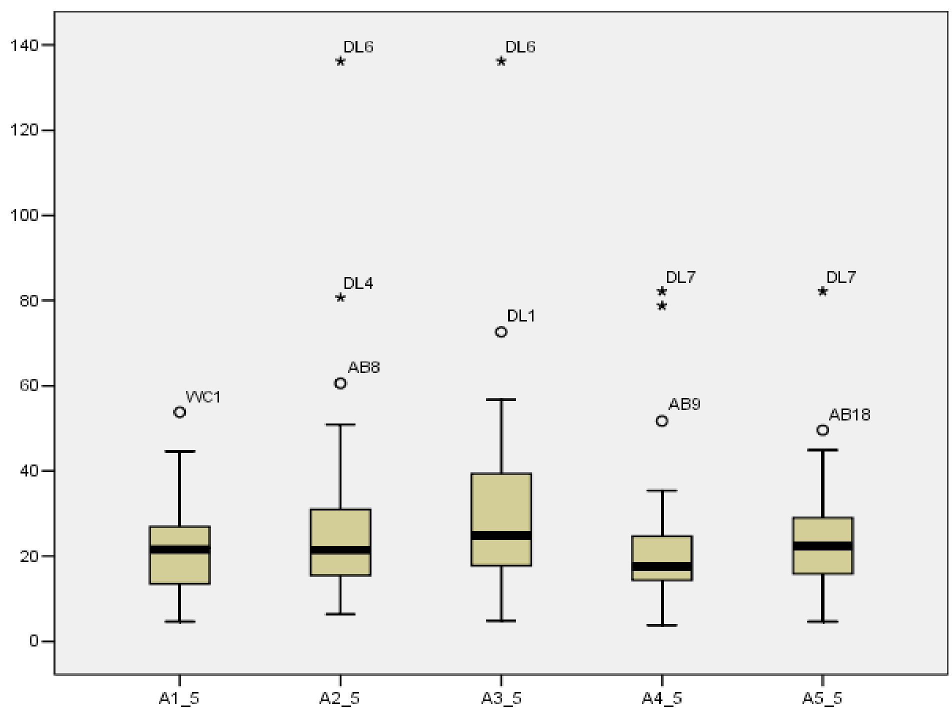


Figure 5.6 An Example for Identifying Mild and Extreme Outliers

Table 5.3: Outlier Frequency Indexes of Workshop Participants

Participant	DL1	DL2	DL3	DL4	DL5	DL6	DL7	DL8	DL9	DL10
Extreme Outliers	1	1	2	6	1	1	0	1	4	6
Mild Outliers	4	4	0	11	1	2	0	1	5	6
Frequency Index	7	7	6	29	4	5	0	4	17	24
Participant	**AB1**	**AB2**	**AB3**	**AB5**	**AB6**	**AB7**	**AB8**	**AB9**	**AB11**	**AB13**
Extreme Outliers	0	0	0	0	0	3	0	9	0	0
Mild Outliers	0	1	1	2	0	4	0	7	1	0
Frequency Index	0	1	1	2	0	13	0	34	1	0
Participant	**AB14**	**AB15**	**AB16**	**AB17**	**AB18**	**AB19**	**AU1**	**AU2**	**AU3**	**AU5**
Extreme Outliers	1	0	3	0	2	0	0	2	1	0
Mild Outliers	4	5	2	1	7	1	1	12	0	1
Frequency Index	7	5	11	1	13	1	1	20	3	1
Participant	**AU6**	**AU7**	**AU8**	**AU9**	**AU10**	**AU11**	**AU12**	**AU13**	**WC1**	**WC2**
Extreme Outliers	1	0	0	0	0	7	3	1	0	0
Mild Outliers	0	3	0	0	1	5	13	2	5	1
Frequency Index	3	3	0	0	1	26	22	5	5	1
Participant	**HT01**	**HT02**	**HT03**	**HT04**	**HT06**	**HT07**				
Extreme Outliers	5	0	0	0	1	3				
Mild Outliers	11	0	1	0	4	7				
Frequency Index	26	0	1	0	7	16				

5.4 Finalizing Element Weights

After the data went through the preliminary data screening and statistical data screening using the boxplot technique, the next step was to actually calculate the weights of the elements that are used for the APRA method. Following sections will provide more details on this process.

5.4.1 Element Weights Calculation for Definition Levels 1 and 5

After the data screening, each element has 39 weight values from 39 participants for each definition level, 1 and 5. Some of these might not have a numeric value because of non-applicable elements in some projects; these would be eliminated from calculation of element weights. The weight of an element at a definition level was obtained by averaging the weights from all 39 (or in some cases fewer) values corresponding to the 39 participants. This is done for both levels 1 and 5. These become the preliminary weights of the elements.

An expected result from summing up all preliminary weights of the elements at definition level 5 was that the total score would be greater than 1000. This is due to the fact that in some cases when averaging the participants' weights to obtain an element's preliminary weight, the denominator is less 39 due to the existence of non-applicable elements (in those participants' projects.) If none of the projects had had non-applicable elements, the result would have been

1000. The total score obtained was 1056. The element weights were re-normalized so that their total score would be 1000 using the similar process that was used in the normalization.

Similar to the selection of 1000-point scale for definition level 5, the selection of scale for definition level 1 was chosen to ensure the comparative analysis among industrial, building and transportation sectors. The total score of a project when all elements have the definition level of 1 was therefore selected to be 70 as used by these CII Indices. The total score of all elements at definition level 1 after the normalization was 139. The same normalization principle was used to renormalize these scores. A multiplier of 0.502 was obtained by dividing 70 by 139. It was used to re-calculate the element scores at definition level 1. The obtained scores for both definition levels were then rounded and adjusted. After this adjustment, the elements' scores at definition levels 1 and 5 were final; they all add up to 70 and 1000, respectively.

The element scores at definition level 2, 3, and 4 were not determined directly from workshop data. They are intermediate values and could be linearly interpolated from the two values at definition levels 1 and 5. The following formulas were used to calculated weights of definition levels 2, 3, and 4:

Level 2 Weight = Level 1 Weight + (Level 5 Weight – Level 1 Weight)/4
Level 3 Weight = Level 2 Weight + (Level 5 Weight – Level 1 Weight)/4
Level 4 Weight = Level 3 Weight + (Level 5 Weight – Level 1 Weight)/4

Each score was then rounded to the closest integer and become final score for use in the APRA method. The results from the calculation for definition levels 1 and 5 and linear interpolation for definition levels 2, 3, and 4 are presented in Table 5.4.

5.4.2 Final APRA Project Score Sheets

The interpolation of element weights for definition levels 2, 3, and 4 completed the APRA element weighting process. Detailed final APRA weighted project score sheets for Sections I, II, and III are presented in Figures 5.7, 5.8, and 5.9, respectively. These weighted project score sheets are repeated in Appendix E for convenient references.

Table 5.4: APRA Element Weights after Linear Interpolation

Element	Definition Level					Element	Definition Level				
	1	**2**	**3**	**4**	**5**		**1**	**2**	**3**	**4**	**5**
A1	1	7	12	18	23	F3	1	4	8	11	14
A2	2	8	14	19	25	G1	1	4	6	9	11
A3	2	9	16	23	30	G2	1	5	10	14	18
A4	1	6	11	16	21	H1	1	3	5	7	9
A5	2	7	13	18	23	H2	1	3	5	6	8
B1	1	7	12	18	23	H3	1	4	7	10	13
B2	1	5	10	14	18	I1	2	8	13	19	24
B3	1	5	9	12	16	I2	1	4	7	9	12
B4	2	6	11	15	19	I3	1	6	10	15	19
C1	1	5	8	12	15	I4	1	6	11	15	20
C2	1	6	10	15	19	I5	1	4	7	10	13
C3	2	8	14	20	26	I6	1	4	8	11	14
C4	2	9	16	23	30	I7	1	3	6	8	10
C5	1	4	7	9	12	I8	1	4	8	11	14
D1	1	5	9	12	16	I9	1	4	6	9	11
D2	1	5	10	14	18	J1	1	3	6	8	10
D3	1	5	10	14	18	J2	1	4	7	10	13
D4	1	5	9	13	17	K1	2	7	12	16	21
D5	2	7	12	17	22	K2	2	7	12	16	21
D6	1	5	8	12	15	K3	1	5	9	13	17
D7	1	4	7	10	13	K4	1	5	9	12	16
D8	1	5	9	12	16	K5	1	3	6	8	10
D9	1	6	10	15	19	K6	1	4	7	10	13
D10	1	6	10	15	19	L1	1	5	8	12	15
E1	1	6	11	15	20	L2	1	5	8	12	15
E2	1	5	9	13	17	L3	1	5	8	12	15
E3	2	8	13	19	24	L4	1	4	8	11	14
E4	1	5	10	14	18	L5	1	4	7	10	13
F1	1	5	9	12	16	L6	1	4	6	9	11
F2	1	5	10	14	18						
						TOTAL	**70**	**310**	**549**	**776**	**1000**

SECTION I - BASIS OF PROJECT DECISION							
	Definition Level						
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**	**Score**
A. PROJECT STRATEGY (Maximum = 122)							
A1. Need & Purpose Documentation	0	1	7	12	18	23	
A2. Investment Studies & Alternatives Assessments	0	2	8	14	19	25	
A3. Programming & Funding Data	0	2	9	16	23	30	
A4. Key Team Member Coordination	0	1	6	11	16	21	
A5. Public Involvement	0	2	7	13	18	23	
CATEGORY A TOTAL							
B. OWNER/OPERATOR PHILOSOPHIES (Maximum = 76)							
B1. Design Philosophy	0	1	7	12	18	23	
B2. Operating Philosophy	0	1	5	10	14	18	
B3. Maintenance Philosophy	0	1	5	9	12	16	
B4. Future Expansion & Alteration Considerations	0	2	6	11	15	19	
CATEGORY B TOTAL							
C. PROJECT REQUIREMENTS (Maximum = 102)							
C1. Functional Classification & Use	0	1	5	8	12	15	
C2. Evaluation of Compliance Requirements	0	1	6	10	15	19	
C3. Survey of Existing Environmental Conditions	0	2	8	14	20	26	
C4. Determination of Utility Impacts	0	2	9	16	23	30	
C5. Value Engineering	0	1	4	7	9	12	
CATEGORY C TOTAL							
Section I Maximum Score = 300 SECTION I TOTAL							

Definition Levels
0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

Figure 5.7 APRA Weighted Project Score Sheet—Section I

SECTION II - BASIS OF DESIGN							
CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
D. SITE INFORMATION (Maximum = 173)							
D1. Geotechnical Characteristics	0	1	5	9	12	16	
D2. Hydrological Characteristics	0	1	5	10	14	18	
D3. Surveys & Planimetrics	0	1	5	10	14	18	
D4. Permitting Requirements	0	1	5	9	13	17	
D5. Environmental Documentation	0	2	7	12	17	22	
D6. Property Descriptions	0	1	5	8	12	15	
D7. Ownership Determinations	0	1	4	7	10	13	
D8. Right-of-Way Mapping	0	1	5	9	12	16	
D9. Constraints Mapping	0	1	6	10	15	19	
D10. Right-of-Way Site Issues	0	1	6	10	15	19	
CATEGORY D TOTAL							
E. LOCATION & GEOMETRY (Maximum = 79)							
E1. Horizontal & Vertical Alignment	0	1	6	11	15	20	
E2. Control of Access	0	1	5	9	13	17	
E3. Schematic Layouts	0	2	8	13	19	24	
E4. Cross-Sectional Elements	0	1	5	10	14	18	
CATEGORY E TOTAL							
F. STRUCTURES (Maximum = 48)							
F1. Bridge Structure Elements	0	1	5	9	12	16	
F2. Hydraulic Structures	0	1	5	10	14	18	
F3. Miscellaneous Design Elements	0	1	4	8	11	14	
CATEGORY F TOTAL							
G. DESIGN PARAMETERS (Maximum = 29)							
G1. Provisional Maintenance Requirements	0	1	4	6	9	11	
G2. Constructability	0	1	5	10	14	18	
CATEGORY G TOTAL							
H. INSTALLED EQUIPMENT (Maximum = 30)							
H1. Equipment List	0	1	3	5	7	9	
H2. Equipment Location Drawings	0	1	3	5	6	8	
H3. Equipment Utility Requirements	0	1	4	7	10	13	
CATEGORY H TOTAL							
Section II Maximum Score = 359 SECTION II TOTAL							

Figure 5.8 APRA Weighted Project Score Sheet—Section II

SECTION III - EXECUTION APPROACH								
CATEGORY Element		**Definition Level**						**Score**
		0	**1**	**2**	**3**	**4**	**5**	
I. ACQUISITION STRATEGY (Maximum = 137)								
I1.	Long-Lead Parcel & Utility Adjustment Identification	0	2	8	13	19	24	
I2.	Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	9	12	
I3.	Local Public Agencies Utilities Contracts & Agreements	0	1	6	10	15	19	
I4.	Utility Agreement & Joint-Use Contracts	0	1	6	11	15	20	
I5.	Project Delivery Method & Contracting Strategies	0	1	4	7	10	13	
I6.	Design/Construction Plan & Approach	0	1	4	8	11	14	
I7.	Procurement Procedures & Plans	0	1	3	6	8	10	
I8.	Appraisal Requirements	0	1	4	8	11	14	
I9.	Advance Acquisition Requirements	0	1	4	6	9	11	
							CATEGORY I TOTAL	
J. DELIVERABLES (Maximum = 23)								
J1.	CADD/Model Requirements	0	1	3	6	8	10	
J2.	Documentation/Deliverables	0	1	4	7	10	13	
							CATEGORY J TOTAL	
K. PROJECT CONTROL (Maximum = 98)								
K1.	Right-of-Way & Utilities Cost Estimates	0	2	7	12	16	21	
K2.	Design & Construction Cost Estimates	0	2	7	12	16	21	
K3.	Project Cost Control	0	1	5	9	13	17	
K4.	Project Schedule Control	0	1	5	9	12	16	
K5.	Project Quality Assurance & Control	0	1	3	6	8	10	
K6.	Safety Procedures	0	1	4	7	10	13	
							CATEGORY K TOTAL	
L. PROJECT EXECUTION PLAN (Maximum = 83)								
L1.	Environmental Commitments & Mitigation	0	1	5	8	12	15	
L2.	Interagency Coordination	0	1	5	8	12	15	
L3.	Local Public Agency Contractual Agreements	0	1	5	8	12	15	
L4.	Interagency Joint-Use Agreements	0	1	4	8	11	14	
L5.	Preliminary Traffic Control Plan	0	1	4	7	10	13	
L6.	Substantial Completion Requirements	0	1	4	6	9	11	
							CATEGORY L TOTAL	
Section III Maximum Score = 341	**SECTION III TOTAL**							

Figure 5.9 APRA Weighted Project Score Sheet—Section III

5.5 Analysis of APRA Element Scores

An element has the highest score when it has definition level of 5. This highest score represents the importance of the element; the higher the score, the more important the element is a project. A category has the maximum score when all of its elements have their maximum scores. This maximum score also illustrates the relative importance of the category when compared with other categories. Likewise, highest scores of all categories in a section will make it have the maximum score. And of course, maximum section scores add up to project maximum score, which is 1000. Figure 5.10 shows the weights of all categories and sections.

SECTION and Category	Weight
SECTION I – BASIS OF PROJECT DECISION	300
Category A - Project Strategy	122
Category B - Owner/Operator Philosophies	76
Category C - Project Requirements	102
SECTION II – BASIS OF DESIGN	359
Category D - Site Information	173
Category E - Location & Geometry	79
Category F - Structures	48
Category G - Design Parameters	29
Category H - Installed Equipment	30
SECTION III – EXECUTION APPROACH	341
Category I - Acquisition Strategy	137
Category J - Deliverables	23
Category K - Project Control	98
Category L - Project Execution Plan	83
TOTAL	**1000**

Figure 5.10 APRA Section and Category Weights (at Definition Level 5)

Interestingly, weights of the three sections are fairly even, from 30 percent total weight for Section I to less than 36 percent total weight for Section II. This implies that in a transportation infrastructure project, basis of project decision, basis of design and execution approach contribute relatively equally to the outcome of the project. Section I, Basis of Project Decision, consists of information necessary for understanding the project objectives. The completeness of this section determines the degree to which the project team will be able to achieve unification in meeting the project's business objectives. Section II, Basis of Design, consists of geotechnical, hydrological, environmental, structural, and other technical design elements that should be evaluated to fully understand impacts on the acquisition of R/W. Similarly, this section includes a number of R/W requirements prior to acquisition, occurring simultaneously with preliminary design. Finally, Section III, Execution Approach, consists of elements that should be evaluated to fully understand the requirements of the owner's execution strategy and approaches for detailed design, R/W acquisition, utility adjustments, and construction.

A closer look at the weights of the categories reveals that category D, Site Information, is the most highly weighted, followed by categories I and A. The category with the lowest weight is category J, Deliverables. While attention should be paid at the highly weighted categories, the project team should not be misled by the low weights of some categories since most of the lowly weighted categories have only a few elements and during the weighting process, it is the elements that were weighted, not the categories.

Another approach is to analyze the most highly weighted elements. Figure 5.11 lists the ten elements with highest weights. Total weight of these elements is 250, equivalent to 25 percent of weight of all elements. These are the elements that need to be paid more attention to by the project team during project development. However, these elements carry only 25 percent of all elements thus by no means should be the only elements that need attention. The rationale is that the 59 elements vary slightly from one element to the next important one and many of them have the same weight. As can be seen in Table 5.5, in which all elements are listed in descending order of their weights, the three next elements after element D5 (the last one in the top ten list) have the same weight, which is only one point smaller than that of D5. Note that element scores range from 8 to 30, with the lowest weight belonging to H2 “Equipment Location Drawings.”

Element ID	Element Name	Weight
C4	Determination of Utility Impacts	30
A3	Programming & Funding Data	30
C3	Survey of Existing Environmental Conditions	26
A2	Investment Studies & Alternatives Assessments	25
I1	Long-Lead Parcel & Utility Adjustment Identification	24
E3	Schematic Layouts	24
B1	Design Philosophy	23
A1	Need & Purpose Documentation	23
A5	Public Involvement	23
D5	Environmental Documentation	22
TOTAL		250

Figure 5.11 Ten Most Highly Weighted Elements

Figure 5.12 includes elements with highest weights in each category. Categories K and have two and three elements, respectively, that have the highest weights. This list may suggest paying greatest attention on the most highly weighted element in each category. However, as with the top 10 elements list, these 15 elements should not be the only ones to be properly addressed.

Category	Element ID	Element Name	Weight
A	A3	Programming & Funding Data	30
B	B1	Design Philosophy	23
C	C4	Determination of Utility Impacts	30
D	D5	Environmental Documentation	22
E	E3	Schematic Layouts	24
F	F2	Hydraulic Structures	18
G	G2	Constructability	18
H	H3	Equipment Utility Requirements	13
I	I1	Long-Lead Parcel & Utility Adjustment Identification	24
J	J2	Documentation/Deliverables	13
K	K1	Right-of-Way & Utilities Cost Estimates	21
	K2	Design & Construction Cost Estimates	21
L	L1	Environmental Commitments & Mitigation	15
	L2	Interagency Coordination	15
	L3	Local Public Agency Contractual Agreements	15
		TOTAL	302

Figure 5.12 Fifteen Most Highly Weighted Elements in Each Category

Table 5.5: APRA Elements Sorted by Weight

Element ID	Element Name	Weight
C4	Determination of Utility Impacts	30
A3	Programming & Funding Data	30
C3	Survey of Existing Environmental Conditions	26
A2	Investment Studies & Alternatives Assessments	25
I1	Long-Lead Parcel & Utility Adjustment Identification	24
E3	Schematic Layouts	24
B1	Design Philosophy	23
A1	Need & Purpose Documentation	23
A5	Public Involvement	23
D5	Environmental Documentation	22
K2	Design & Construction Cost Estimates	21
A4	Key Team Member Coordination	21
K1	Right-of-Way & Utilities Cost Estimates	21
E1	Horizontal & Vertical Alignment	20
I4	Utility Agreement & Joint-Use Contracts	20
D9	Constraints Mapping	19
D10	Right-of-Way Site Issues	19
C2	Evaluation of Compliance Requirements	19
I3	Local Public Agencies Utilities Contracts & Agreements	19
B4	Future Expansion & Alteration Considerations	19
D3	Surveys & Planimetrics	18
D2	Hydrological Characteristics	18
E4	Cross-Sectional Elements	18
B2	Operating Philosophy	18
F2	Hydraulic Structures	18
G2	Constructability	18
D4	Permitting Requirements	17
E2	Control of Access	17
K3	Project Cost Control	17
D1	Geotechnical Characteristics	16
F1	Bridge Structure Elements	16
B3	Maintenance Philosophy	16
K4	Project Schedule Control	16

Element ID	Element Name	Weight
D8	Right-of-Way Mapping	16
L2	Interagency Coordination	15
C1	Functional Classification & Use	15
L3	Local Public Agency Contractual Agreements	15
D6	Property Descriptions	15
L1	Environmental Commitments & Mitigation	15
F3	Miscellaneous Design Elements	14
L4	Interagency Joint-Use Agreements	14
I8	Appraisal Requirements	14
I6	Design/Construction Plan & Approach	14
J2	Documentation/Deliverables	13
L5	Preliminary Traffic Control Plan	13
H3	Equipment Utility Requirements	13
K6	Safety Procedures	13
I5	Project Delivery Method & Contracting Strategies	13
D7	Ownership Determinations	13
I2	Long-Lead/Critical Equipment & Materials Identification	12
C5	Value Engineering	12
I9	Advance Acquisition Requirements	11
L6	Substantial Completion Requirements	11
G1	Provisional Maintenance Requirements	11
J1	CADD/Model Requirements	10
I7	Procurement Procedures & Plans	10
K5	Project Quality Assurance & Control	10
H1	Equipment List	9
H2	Equipment Location Drawings	8

5.6 Interpretation of APRA Element Scores

A low APRA score represents a project scope that is well-defined and, in general, corresponds to an increased probability for project success. Remember, the weights are based on the potential budget and time impacts of the element to the target project. Higher scores signify that certain elements within the project scope lack adequate definition.

The project total score would be approximately 70, 300, 550, 775, and 1000 points if all elements had the definition levels of 1, 2, 3, 4, and 5, respectively. At the beginning of the project development process, during the Needs Assessment phase, the project score can be close to 1000 points. As the project progresses into later phases, the project score should get lower.

The lowest possible score of a project without non-applicable elements is 70, which is the case when all of the elements have a definition level of 1.

Scoring is a subjective process and each organization and sub-unit is unique. Thus, TxDOT may wish to keep its own database of APRA scores for various project sizes and types. As more projects are completed and scored using the APRA, its ability to predict the probability of success on future projects should improve. The APRA may serve as a gauge to assist the organization in deciding whether or not to authorize the development of PS&E and ultimately the construction of a project. TxDOT may also wish to use the database as an external benchmark for measurement against the practices of other organizations.

The APRA is of little value unless the project team takes action based on the analysis and uses the assessment to identify and mitigate risk for the project. Among the potential uses when analyzing the APRA score are the following:

- Tracking project progress during the project development process, using the APRA score as a macro-evaluation tool. Individual elements, categories, and sections can be tracked as well.
- Comparing project-to-project scores over time to identify trends in developing scope definition within your organization.
- Comparing different types of projects (e.g., urban vs. rural; bridge vs. intersection; or new vs. rehabilitation) can allow TxDOT to determine its threshold APRA scores for those projects and identify critical success factors from that analysis. The APRA also can be used to compare projects for organizations or different project sizes with the same organization.
- Looking at weak areas of the project at a section, category, or element level. For example, if an element has a definition level of 3, 4, or 5, the project team should either further define this element or develop a risk mitigation strategy. This provides an effective method of risk analysis since each element, category, and section is weighted relative to the other in terms of potential risk exposure. The identification of the project's weak areas is critical as the project team continues its progress toward execution and should provide the path forward of action items for the project team.
- Another method of evaluation is to look at the score of each Section or Category as a percentage of its maximum score in order to focus attention on critical items for the project. For example, if the score for Section I, Basis of Project Decision, is 150 points, then it is 50 percent of its potential maximum score (300). The elements in this Section need much work.
- Note that the total score is divided fairly evenly among the sections. This implies that attention should be paid to all sections even though at different phases of the project different sections may have different levels of definition.
- Sometimes, project teams are pressured to develop a scope of work in a short period of time. To streamline the process, the team could focus on the top 10 elements, as listed in Figure 5.11. However, this approach should be used with the awareness that weights of all elements are fairly evenly distributed. A description of each of the top 10 elements can be found in Appendix B.

Chapter 6. APRA Testing on Real Projects

Although the expertise from experienced professionals has been tapped in developing the weights of the elements, APRA still needed to be tested on real projects to verify its viability as a method. The testing would allow for the understanding of how the APRA works in real project environment, what benefits it can bring to the project and feedback from practitioners. The testing would be performed on projects from as many areas (districts) as possible to provide a diverse test project portfolio and improve the representativeness of the sample of the project population. Both completed and ongoing projects would be selected for testing the APRA. This chapter will present in detail the APRA test process and its results.

6.1 Organization for Test Process

In order to test the APRA, in parallel with requesting districts' interests in providing projects and hosting meetings, a test document package needed to be developed. Each test meeting was planned to last approximately 2 and ½ hours. During this time, the research team needed to provide an overview on the research project and the APRA method and the computer tool. The meeting participants needed to be informed of what was expected of them and how they could help testing the APRA. Then most of the time would be spent on actual testing the APRA on the selected project and for the participants to provide feedback on the method and the tool. For the testing to accomplish this long list of tasks, the test package needed to be well organized and effective. With help from the PMC members, the package was developed by the research team. Appendix F provides details of the package documents that have not been provided elsewhere in this report. Following are short descriptions for each of the documents:

- Agenda. It provides an overview of the tasks to be fulfilled during the meeting with a planned time frame. An example of the agenda is included in Appendix F.
- Presentation. This presentation was designed to be 45 minutes long. Presentation includes an overview of the research process and its products (the APRA method and the computer tool,) the next research steps, and instructions on how to test the APRA on a project.
- Test Questionnaires. The test questionnaires are the principal tool for the participants to provide information during the entire testing process. There are two versions of questionnaires, one for completed projects and one for ongoing projects, as different background information was needed for each type of project. In both versions, the questionnaires include four parts. The first part is an introduction to the research and its process to familiarize the participants with what they were about to involve in. The second part is for the participants to provide their professional background information and project information including basic descriptive information and data on project costs, time, and change. The third part includes a short instruction on how to assess a project and a project rating information sheet for the participants to enter assessment results into. The final part is for follow-up purposes; the participants should provide information on who participated in the test and how much time they spent on the test. A copy of both questionnaire versions is included in Appendix F.

- Element Descriptions. A copy of Element Descriptions document was included for the participants to use in assessing each APRA element. A copy of the Element Descriptions document can be found in Appendix B.

- Post-Test Questionnaire. This questionnaire was used to obtain the test participants' general comments as well as their opinions on how APRA can be of benefits to the project team during project development. A copy of this questionnaire is included in Appendix F.

6.2 Testing APRA on Real Projects

Both completed and ongoing projects would be selected for testing the APRA. A project was meant to include all phases from the initiation to construction. A completed project is a project that has construction completely finished. An ongoing project is the project that has not been let and can be at any point prior letting.

The research team contacted twenty districts to request for their help in testing the APRA by providing projects for testing and hosting a meeting in a location convenient to them. Fourteen of the contacted districts expressed interest. Eleven districts actually participated in the test while the other three could not participate because the research team and the district could not arrange for meetings. Of the 11 districts, one performed the test on their own due to the involvement in and familiarity of the district's people with the APRA method and its development. From May to August 2007, the APRA was tested on seventeen projects, nine of which were completed projects and eight were ongoing. A total of 32 experts from all disciplines in project development (including ROW, Utilities, Design, Environmental, and Planning) participated in the test of the APRA on the projects. They provided a great deal of insightful comments and feedback on the APRA method during the testing process.

Table 6.1 presents the list of the districts who participated in the test efforts and corresponding number of completed and ongoing projects they provided. Of the seventeen projects provided, one was in the construction phase and thus not qualified to be considered one of the two project types defined. It was discarded from any further data analysis. However, to eliminate the ability to identify which district that project belongs to, all of the seventeen projects and the districts they belong to were included in Table 6.1.

As mentioned earlier, one of the eleven districts performed the test on their own; each of ten other districts held a test meeting with the research team. At each meeting the APRA was tested on one project. As a result, the APRA was tested on ten projects with the direct facilitation of the research team. The districts performed the test on six other projects on their own after getting familiar with the test method at a facilitated test meeting. The ten visits that the research team made to ten districts are presented in Table 6.2 with the time of the visits.

The sections that follow will provide detail on the testing process.

Table 6.1: Districts Participating and Number of Projects Provided for Testing APRA

District	Number of Projects Tested		
	Completed	Ongoing	Total
Abilene	1	1	2
Austin		1	1
Brownwood	2	1	3
Bryan	1		1
Childress	1		1
Corpus Christi	1	1	2
Houston	1		1
Lubbock	1	1	2
Odessa	1		1
Tyler		1	1
Waco		2	2
TOTAL	**9**	**8**	**17**

Table 6.2: APRA Test Meeting Conducted

ID	Date	Location	District Participated
1	5/24/2006	Abilene District Office (Abilene, TX)	Abilene
2	6/20/2007	Odessa District Office (Odessa, TX)	Odessa
3	6/22/2007	Brownwood District Office (Brownwood, TX)	Brownwood
4	6/25/2007	Lubbock District Office (Lubbock, TX)	Lubbock
5	6/27/2007	Childress District Office (Childress, TX)	Childress
6	7/5/2007	Waco R/W Office (Waco, TX)	Waco
7	7/9/2007	Bryan District Office (Bryan, TX)	Bryan
8	8/8/2007	Corpus Christi District Office (Corpus Christi, TX)	Corpus Christi
9	8/16/2007	Houston District Office (Houston, TX)	Houston
10	8/30/2007	TxDOT Austin Project Office (Pflugerville, TX)	Austin
		TOTAL	11 districts

6.2.2 Preparation for Test Meetings

For each test meeting the contact person of the hosting district was asked to invite from two to five people, preferably from different disciplines, who were actually involved in the project to attend the meeting. More people were encouraged to attend the meeting if they could. The contact person was also sent a copy of the test questionnaire and requested to fill in as much project background information as possible prior to the meeting. This part was not necessarily completely filled out since often times the person needed to consult other people for project information, especially information related to project cost and time, and they could finish that part later after the meeting.

6.2.3 Test Meetings

Each test meeting usually started with an introduction of the meeting participants and an overview of the project characteristics and status. The meeting then continued with a 30-to-45-minute presentation by the research team on the APRA method, its development and how to test the APRA on a project. The participants were encouraged to raise any questions they might have on the APRA and how to test it. After the presentation, the actual test of the APRA was performed.

The test was done by assessing the level of definition of each of the 59 APRA elements. Following are the steps for assessing an element for a completed project:

- Read the element's definition in the "APRA Elements Descriptions" document. Some elements have a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists. It should be noted, however, that some of these items may not be applicable for the project.
- Refer to the Project Rating Information form in the questionnaire and locate the element. Discuss and determine how much about the element was known at the beginning of PS&E development. The participants should discuss and build consensus on how much the team knew about the issues pertaining to the element descriptions.
- Choose the appropriate (only one) definition level for the element (0, 1, 2, 3, 4, or 5) and check (√) the corresponding box in the Project Rating Information form. It should be reminded again that the time of determining the definition level is at the beginning of PS&E development. The descriptions of the definition levels are included in the questionnaire
- Repeat the above steps for the next element in the APRA until all elements have been assessed. Be sure to rate each element.

The assessment steps for an ongoing project are slightly different from those above. Instead of recalling back to the beginning of the PS&E, the participants needed to use the current knowledge on the project, which has not been let yet.

This assessment process was very dynamic and the research team had to make sure the elements were assessed correctly by asking factual questions about what was known and what was not known about the element. Sometimes the participants had to consult others who might be more knowledgeable about the issues but could not attend the meeting or had to refer to some project documents as a reference for discussions. The research team also had to avoid influencing the decision of the participants on the definition level of the elements. Notes on the discussions and facts of the projects were captured by the research team while elements' scores were marked in the Project Rating Information sheet and keyed into the computer tool. At the end of the assessment, results were generated using the computer tool. Scores of all elements, categories, sections and the project were presented. A list of highly risk elements was also generated and presented to the meeting participants. The research team presented the results to the participants for their further understanding of the APRA method. This was also the time for the whole meeting to discuss about the project itself as well as the APRA method.

The final part of the meeting was for the participants to provide feedback on the APRA method by answering a one-page questionnaire. They were asked to provide opinion on two propositions: 1) the APRA method helps identify critical risk elements that need to be managed during the project development process; and 2) the APRA method helps improve the advance planning process. They were also asked to provide any general comments and feedback they might have.

Before closing the meeting the participants were asked about the possibility of providing more projects for testing the APRA on. If more projects were to be selected, the experts needed to do the assessment by their own since they were by then already familiar with the testing process.

6.2.4 Test Meeting Follow-up

After each meeting the research team contacted the contact person in the district to obtain the project data that had not been provided prior to the test meeting. Complete project background data are essential for later data analysis. The experience has shown that collecting project background data—especially that on project cost, time and change—was much more challenging that had been expected since many times the data were not recorded properly or the persons who had been involved in the projects have no longer been working for the same district or even TxDOT.

The follow-up was also for assisting the district people who were trying to test the APRA on more projects after the test meeting. This effort resulted in having the APRA tested on six more projects by the experts on their own. Further information about the tested projects and test results will be presented in the following section.

6.3 Analysis of Test Data

This section provides detail on the results of testing the APRA on select projects in 11 districts.

6.3.1 Project Characteristics

At the end of the testing process, the APRA was tested on 17 projects, one of which was considered inappropriate for the test purposes since it was in the construction phase. The 16 projects left were numbered from 1 to 9 for eight completed projects and from 10 to 16 for seven ongoing projects. Of these 16 projects, one (project number 9) did not have sufficient basic background information and thus was eliminated from data analysis. As a result, there were 15 projects for further data analysis, eight completed and seven ongoing.

Table 6.3 provides some characteristics of the completed projects. They were of five different types of projects, interchange, new location freeway, new location non-freeway, widen freeway, and widen non-freeway. All of them were completed less than 6 years by the time the APRA was tested on them. The projects' final total installed costs ranged from more than $3.8

million to nearly $104.7 million with an average of about $20.6 million. This group of projects, though a limited number, represents a wide range of projects types and sizes.

Table 6.4 presents basic information on the seven ongoing projects. These projects were of three different types, interchange, widen freeway, and widen non-freeway. The projects had different statuses, from preliminary design complete to PS&E (detailed design) complete. Their estimated total costs at the time of the test ranged from more than $5.6 million to more than $97.1 million with an average of about $38.8 million. Similar to completed project group, this group also represents various types and sizes of projects.

Table 6.3: Completed Projects Used for Testing APRA

ID	Project Type	Final Cost	Completion Date
1	Interchange	5,156,274	04/2003
2*	Interchange	7,444,231	10/2001
3	Interchange	4,710,195	04/2003
4	Widen Freeway	104,688,724	05/2006
5	New Location Non-Freeway	4,961,388	03/2006
6	Widen Non-Freeway	3,802,490	09/2004
7*	Widen Freeway and New Location Freeway	24,892,672	06/2006
8	Widen Non-Freeway	9,226,408	02/2006
	Minimum	3,802,490	
	Maximum	104,688,724	
	Average	20,610,298	

Notes: Projects denoted by "" had incomplete cost information*

Table 6.4: Ongoing Projects Used for Testing APRA

ID	Project Type	Status	Estimated Cost
10	Widen Freeway	PS&E Complete	97,145,536
11	Widen Non-Freeway	95% PS&E Complete	45,927,440
12	Widen Non-Freeway	Preliminary Design Complete	5,649,805
13	Interchange	70% PS&E	18,250,000
14	Interchange	PS&E Complete	19,162,594
15	Widen Freeway	90% PS&E Complete	10,425,213
16	Widen Non-Freeway	90% PS&E Complete	74,900,000
		Minimum	5,649,805
		Maximum	97,145,536
		Average	38,780,084

6.3.2 Analysis of Project Scores

As mentioned before, elements' definition levels of the projects that had the APRA tested on at meetings facilitated by the research team were keyed into right at the meetings. The test results were also presented to the meeting participants. For those projects that the experts did the test by themselves after a meeting with the research team, the experts keyed their decisions on elements' definition levels into a blank Project Rating Information sheet and sent to the research team. The research team would then key the definition levels into the computer tool to generate test results, including scores of the elements, the 12 categories, the 3 sections, and the project.

After calculation for all projects was completed, it was shown that project 12 had an overall score of 118 out of 917 maximum possible score (equivalent to 12.9 percent), obtained when all elements had definition levels of 5. It should be noted again that if all elements had the definition levels of 1, the project's total score would be 70 points (or 7 percent); if all had definition levels of 2, the score would be 310 points out of 1000 points (or 31 percent). The project's score was almost perfect in practice and unreasonable for a project whose detailed design had not been started yet. The data on this project were considered unreliable thus the project was eliminated from project list for further analysis. As a result, there are eight completed and six ongoing projects left. It should be noted that with this number of projects qualified for analysis, statistical analysis would not be to the extent that is meaningful with a large project sample.

Table 6.5 presents summary of APRA for completed projects and their sections. The first column on the left is the project identification number. The next three columns are actual score, maximum possible score (when all elements had definition levels of 5), and percentage (the score divided by the maximum score,) of the project as a whole. The next three groups of three columns are actual scores, maximum possible scores, and percentages of three sections in the APRA. The bottom three rows contain minimum value, maximum value, mean, and standard deviation of the corresponding columns.

Table 6.5: APRA Scores of Completed Projects and Their Sections

Completed Projects												
Project ID	**Project**			**Section I**			**Section II**			**Section III**		
	Score	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**
1	410	975	0.421	102	288	0.354	162	346	0.468	146	341	0.428
2	277	989	0.280	79	300	0.263	82	359	0.228	116	330	0.352
3	486	984	0.494	100	300	0.333	189	343	0.551	197	341	0.578
4	411	987	0.416	123	300	0.410	123	346	0.355	165	341	0.484
5	441	936	0.471	115	300	0.383	132	295	0.447	194	341	0.569
6	446	989	0.451	93	300	0.310	173	359	0.482	180	330	0.545
7	327	931	0.351	86	288	0.299	125	342	0.365	116	301	0.385
8	459	960	0.478	101	288	0.351	143	342	0.418	215	330	0.652
Min	277	931	0.280	79	288	0.263	82	295	0.228	116	301	0.352
Max	486	989	0.494	123	300	0.410	189	359	0.551	215	341	0.652
Mean	**407**	**969**	**0.420**	**100**	**296**	**0.338**	**141**	**342**	**0.415**	**166**	**332**	**0.499**
St. Dev.	71	24	0.072	14	6	0.047	34	20	0.098	37	14	0.104

The average and maximum scores of the completed projects are 407 and 969 points; the average percentage is 42 percent. To recap: the higher score the less defined the project and thus the less desirable the result. This can be understood as, on average, at the beginning of PS&E (the time the experts used to determine the elements' definitions) the projects had had 42.0 percent scope undefined. The most well defined project had a score of 277 out of 989 (28 percent) while the most poorly defined project had a score of 486 out of 984 (49.4 percent).

A closer look at the average percentages of sections I, II, and III shows that section I, Basis of Project Decision, tends to be more defined than section II, Basis of Design (33.8 percent of the scope undefined versus 41.5 percent.) In turn, section II tends to be more defined than section III, Execution Approach (41.5 percent versus 44.5 percent.) This result was expected since the sections were organized in their relative sequences in the project development process. Issues that are the basis for project decision should be better defined than issues that are the basis for design since a project can move to design phase only when it was decided to move on. Likewise, project is executed after it is designed, at least to some extent, thus the Execution Approach tends to be less defined than the Basis of Design.

APRA scores of ongoing projects and their sections are presented in Table 6.6. The most well defined project had an overall score of 240 out of 923 possible score (equivalent to 26 percent of the scope still undefined) while the least well defined project had a score of 525 out of 988 maximum possible score (equivalent of 53.1 percent undefined scope.) On average, the six ongoing projects had a score of 336 and a definition percentage of 36.4 percent. Similar to completed projects, ongoing projects tend to have section I best defined (30.3 percent undefined,) then section II (34.5 percent undefined,) and section III least defined (44.5 percent undefined.) The possible reason for this is also that the elements were put in sections that are relatively in sequences in the project development process. The section with more elements performed earlier tends to be more defined.

Table 6.6: APRA Scores of Ongoing Projects and Their Sections

Ongoing Projects												
Project ID	**Project**			**Section I**			**Section II**			**Section III**		
	Score	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**
10	332	1000	0.332	106	300	0.353	105	359	0.292	121	341	0.355
11	283	1000	0.283	88	300	0.293	90	359	0.251	105	341	0.308
13	240	923	0.260	53	288	0.184	80	359	0.223	107	276	0.388
14	525	988	0.531	79	288	0.274	235	359	0.655	211	341	0.619
15	417	904	0.461	126	217	0.581	123	346	0.355	168	341	0.493
16	318	1000	0.318	39	300	0.130	105	359	0.292	174	341	0.510
Min	240	904	0.260	39	217	0.130	80	346	0.223	105	276	0.308
Max	525	1000	0.531	126	300	0.581	235	359	0.655	211	341	0.619
Mean	**353**	**969**	**0.364**	**82**	**282**	**0.303**	**123**	**357**	**0.345**	**148**	**330**	**0.445**
St. Dev.	103	44	0.108	32	32	0.158	57	5	0.158	43	27	0.116

It can be noted that the ongoing projects tend to be better defined than the completed projects (36.4 percent versus 42.0 percent undefined) even though most of the ongoing projects did not have PS&E completed as the completed projects had. Thus by the time the ongoing projects have PS&E completed, they would be probably even better defined that they were. This fact may be due to the improvement in TxDOT’s scope definition in project development. It could also be explained that, on one hand when the experts assessed the completed projects’ elements they had to recall to the beginning of PS&E, which was years ago, and they might not have been able to remember all the facts that had been known then. On the other hand, the ongoing projects’ elements were assessed at the real time and the experts might have known better what were known and what were not known regarding each element. However, due to the limited number of projects, it is still unable to conclude on the difference between the two types of projects’ scores.

Table 6.7 provides some basic score statistics of all projects and their sections. As for all projects, the average APRA percentage is 39.6 percent. The best defined section is section I while the least defined section is section III.

Table 6.7: APRA Score Basic Statistics of All Projects and Their Sections

All Projects												
Project ID	**Project**			**Section I**			**Section II**			**Section III**		
	Score	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**	**Score**	**Max**	**%**
Min	240	904	0.260	39	217	0.130	80	295	0.223	105	276	0.308
Max	525	1000	0.531	126	300	0.581	235	359	0.655	215	341	0.652
Mean	*384*	*969*	*0.396*	*92*	*290*	*0.323*	*133*	*348*	*0.385*	*158*	*331*	*0.476*
St. Dev.	87	32	0.090	25	22	0.105	44	17	0.127	39	19	0.109

6.3.3 Analysis of Performance of Completed Projects

Analyzing project performance and its relationship with level of project scope definition would allow for better interpretation of the APRA scores of a project. This analysis will be effective only when a significant amount of projects have been tested using the APRA to generate project scores during the implementation. During the development of the APRA, a number of completed projects have been tested to help mainly understand how the APRA works in a project environment. The number of completed projects was not sufficient for a meaningful analysis of the relationship between project performance and APRA score. In this section, collected data on the completed projects' performance are presented and discussed to provide a closer look at the completed projects that were tested.

Data on four major aspects of project performance were collected for the completed projects; they are schedule, cost, change, and owner satisfaction. Schedule performance information is presented in Table 6.8. Durations were collected, including the initial estimates from the beginning of detailed design (PS&E) as well as actual durations for detailed design and construction. The difference of the estimated and actual durations was calculated and presented in terms of percentages. As shown in the table, there was one project that did not have detailed design and construction time information; one did not have detailed design time information and one did not have construction time information. Three out of six projects that had complete detailed design information had had detailed design completed on time. No project had detailed design completed ahead of schedule and the largest time escalation is 194.5 percent. Altogether they had an average of 34.8 percent detailed design time escalation. Summing up estimated and actual durations of the projects' detailed design shows that the actual time was 3.5 percent higher than estimated time. Similarly for construction time, two projects had the construction completed on time, while the highest time escalation was 60.8 percent and no project had construction completed ahead of schedule. On average, the six projects with complete information had 16.2 percent of construction time increase while the increase of the sum of construction time was 12.8 percent.

Table 6.8: Completed Projects' Schedule Performance

Project	Detailed Design Time			Construction Time		
	Estimated (day)	Actual (day)	Δ (%)	Estimated (day)	Actual (day)	Δ (%)
1	578	608	5.2	518	547	5.6
2	N/A	N/A	N/A	N/A	N/A	N/A
3	2926	2926	0.0	373	373	0.0
4	2855	2855	0.0	1247	1247	0.0
5	38146	38146	0.0	591	650	10.0
6	N/A	N/A	N/A	365	587	60.8
7	1372	1495	9.0	N/A	N/A	N/A
8	752	2215	194.5	1070	1293	20.8
Overall	*46629*	*48245*	*3.5*	*4164*	*4697*	*12.8*
Average	*7772*	*8041*	*34.8*	*694*	*783*	*16.2*

The second performance indicator is cost. Table 6.9 presents the summary of the cost performance of the completed projects. Estimated and actual construction costs of all projects added up more than $93.4 million and $119.1 million, respectively, making the cost escalation of 27.5 percent. The project lowest cost escalation was three percent, while the highest was 363.7 percent. Averaging cost escalation percentages of all projects was 87.0 percent. The estimated and actual total costs (detailed design, utility adjustment, R/W acquisition, and construction) of all eight projects were nearly $116.3 million and $164.9 million, respectively. Average cost escalation was 71.5 percent while the escalation of cost of all projects was 41.8 percent (when comparing estimated costs and actual costs of all projects).

Another aspect of study was change orders. On average, a project had 23 change orders with an average total of about $1.2 million, as displayed in Table 6.10. On average, a project had a change order value of 9.8 percent of estimated construction costs. In terms of percentage of estimated construction costs, the change order values had a wide range of values with 1.5 percent as the lowest and 47.3 percent as the highest.

Table 6.9: Completed Projects' Cost Performance

Project	All Costs			Construction Costs		
	Estimated ($)	Actual ($)	Δ (%)	Estimated ($)	Actual ($)	Δ (%)
1	4,924,910	5,156,274	4.7	4,153,410	4,532,809	9.1
2*	3,142,570	7,444,231	136.9	2,732,900	7,138,231	161.2
3	3,661,295	4,710,195	28.6	3,141,295	4,234,142	34.8
4	76,895,343	104,688,724	36.1	60,514,720	66,022,492	9.1
5	4,697,681	4,961,388	5.6	4,280,010	4,406,841	3.0
6	2,470,000	3,802,490	53.9	2,000,000	3,375,565	68.8
7*	17,970,000	24,892,672	38.5	15,000,000	22,000,000	46.7
8	2,512,000	9,226,408	267.3	1,600,000	7,419,437	363.7
Overall	116,273,799	164,882,382	41.8	93,422,335	119,129,517	27.5
Average	14,534,225	20,610,298	71.5	11,677,792	14,891,190	87.0
Notes: Projects denoted by "" had incomplete cost information*						

Table 6.10: Completed Projects' Change Orders

Project	Change Order		
	Number	Value ($)	Percentage of Estimated Construction Cost
1	12	92,992	2.2%
2	11	107,892	3.9%
3	8	173,919	5.5%
4	70	8,066,539	13.3%
5	6	83,125	1.9%
6	7	30,685	1.5%
7	39	402,731	2.7%
8	31	756,696	47.3%
Overall	184	9,714,579	10.4%
Average	23	1,214,322	9.8%

The last performance indicator studied during the testing of the APRA is owner's satisfaction. The teams who tested the APRA on the projects were asked to provide their opinions on the success of each of the projects. They were asked to provide their evaluations on a scale from 1 to 10 (1 for a very unsuccessful project and 10 for a very successful project) based on the two following queries:

- Based on the original plan/intent of the project set prior to the beginning of PS&E development, rate how the constructed project matches the original plan/intent.
- Reflecting on the overall project, rate how successful you feel the project has been.

As summarized in Table 6.11, all projects were rated on the positive side of meeting project intent and overall success. On the scale from 1 to 10, the average project score for meeting project intent was 8 while the average project overall success was 8.9. It can be understood that, in the APRA test participating teams' opinions, the projects were highly successful.

As discussed earlier, in all three objective project performance indicators (time, cost, and change), the projects had high time and cost escalation and significant value of change order and should probably not be considered successful if being evaluated based on three criteria only. However, the subjective project performance indicators (the APRA test teams' opinions) indicated that all the projects were successful. There must have been other factors beyond time, cost, and change that the participants took into consideration when evaluating the projects' success.

Table 6.11: Owner's Satisfaction of Completed Projects

Project	Satisfaction	
	Meeting Project Intent	Overall Project Success
1	8	10
2	N/A	N/A
3	9	9
4	6	8
5	7	8
6	9	8
7	9	9
8	8	10
Average	8	8.9

6.3.4 Experts' Evaluation of the APRA

The most important objectives of testing the APRA on real projects were to observe how the APRA works in real project environment and to obtain feedback from experts who participated in the testing process. In addition to being requested to provide comments throughout the test, at the end of each test meeting the participants were asked to give opinions on two specific propositions: 1) The APRA method helps identify critical risk elements that need to be managed during the project development process, and 2) The APRA method helps improve the advance planning process. Likert scale was used for both propositions. The experts could choose any level from 1 (strongly disagree) to 7 (strongly agree). Answers from 32 experts were illustrated in Figures 6.1 and 6.2.

As shown in Figure 6.1, all participants agreed that the APRA method helps identify critical risk elements that need to be managed during the project development process. Using as a checklist is the most obvious advantage of the APRA and could be very easy to use and helpful. The list of highly risk elements that is identified at the end of each assessment also provided practical information to the project team. The participants' opinions on the second proposition are presented in Figure 6.2. Most of the experts (27 out of 32) agreed that the APRA could help improve the advance planning process; four of them were neutral on the proposition; and one expert disagreed. This result shows great potential for APRA to be bought into TxDOT's current process. Further discussions with the experts and analysis of their comments revealed the experts' insightful understanding of the method and the project development process. Some have commented that the tool itself was good but having it implemented would have certain difficulties since it could be considered "more work" for the people who were already overloaded. Also, top management needs to support the implementation of the APRA since one of the biggest challenges in the project development process and in utilizing the APRA is getting people from different disciplines collaboratively involved. These facts explain in part why there was some hesitation in agreeing on the helpfulness of the APRA on improving the project development process.

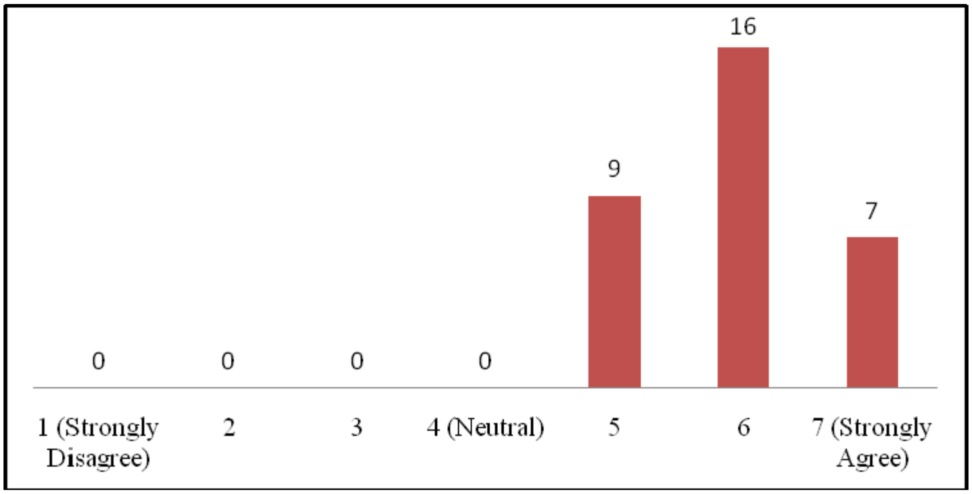


Figure 6.1 Expert Opinions on "APRA Helps Identify Critical Elements during PDP"

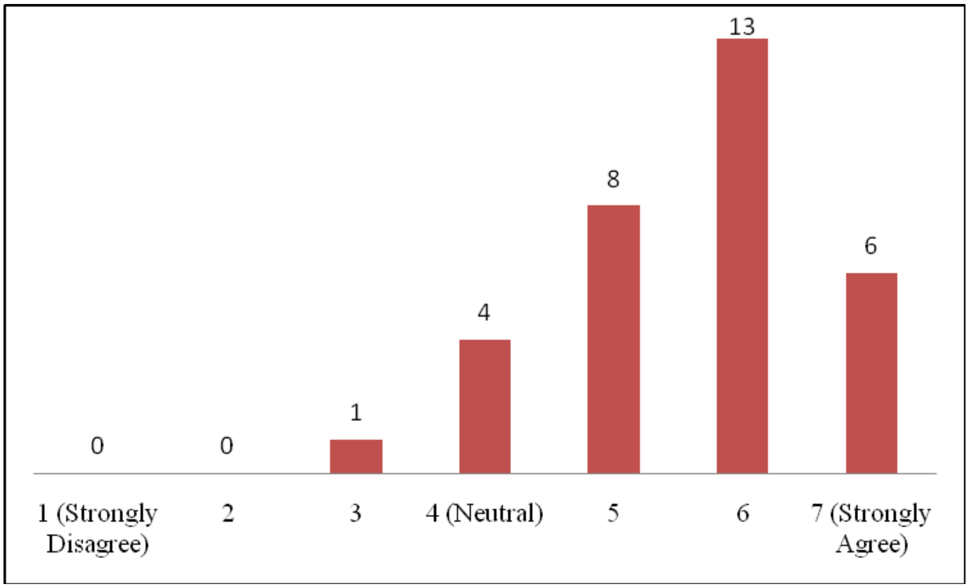


Figure 6.2 Expert Opinions on "APRA Helps Improve the Project Development Process"

6.3.5 Comments on the APRA

Besides quantifying the experts' evaluation of the APRA as explained in the previous section, the test also enabled getting direct comments from the experts. The experts' comments have demonstrated their great insight into the APRA method, the issues it was trying to address, the helpfulness of the tool, and the potential obstacles in using it.

The comments are the illustration of their opinions on the two questions asked at the end of each test meeting and analyzed in the previous section. The comments were of diverse perspectives and most of them were positive to the usefulness and benefits that the tool could offer.

Many of the experts had comments on how the APRA could help in identifying and managing risks during the project development process. And they agreed that properly managing risk was of great advantage for project team, as an expert put "reducing risk would save time and money." Following are some of the comments that are pertaining to risk identification and management:

- "This is a great tool and reminder of items that need to be addressed during the project development process."
- "This should help speed up and identify issues early in the process. This will be a very beneficial program"
- "The APRA appears to be a useful tool for identifying critical elements of a project early in the planning stages. I feel this will be a tool that can be utilized by all of TxDOT's districts in the near future."
- "APRA can give a very good overview of areas in a project that need attention."

One of the major advantages that the experts pointed out is that the APRA could help with improving the communication among the project stakeholders. This awareness must have come from a good understanding of how important communication is for a project, as an expert commented "communication early is key for any project, large or small," or "[I] can see the need to have all parties involved earlier in project development." And after agreeing that the APRA would help with the project development process, an expert stated "any tool that helps transferring communication from one section to the other is a benefit. The more we know about our processes the more we can work to perfect and correct them." However, according to one of the experts, "this process would require a team effort between engineering, environmental, right of way, and construction to be effective." Interestingly, this is exactly what the tool was developed to facilitate.

The experts also agreed that the APRA should be used at various points in time during project development to get more benefits from using it, especially when the APRA could help with monitoring the project progress. The APRA "looks like a great tool. [It] should be used at various stages of a project," an expert noted. Commenting on the progress monitoring benefit and the helpfulness of the APRA to high management, an expert put "this could be a good tool in assessing a project and monitoring the progress of a project. The risk assessment could help upper management to determine time requirements of the project and better understand delays based upon risks."

However, the advantages of using the APRA do not come unconditionally. Proper attention and support from top management and appropriate use of the APRA and results it may provide must be present for the method give of intended benefits. Take interpretation of the APRA score of a project after an assessment meeting as an example: when a project has a high APRA score and a long list of high risk elements, it may indicate that the project has some areas that need more work and concerned people should take actions accordingly while people from other disciplines should cooperate. If the upper management took this opportunities to blame the responsible people on letting the issues be poorly defined or if people from other disciplines took this chance to point where the "problems" are, it would not solve the problems but make the concerned people be reluctant in using the APRA; or even those who are not in the spotlight this time would not be willing to use it, be afraid of being in the similar case. Thus, "for this tool to be effective, administration has to support in. Also all who use it need to understand and practice it."

Not all comments were, however, positive. An expert commented: "I see utility in this program, but it seems to me that many projects will need to be evaluated before the full utility of the program is realized." It is correct that the use of the APRA would be better over time since the more projects the APRA is used on, the more the user can make sense of the APRA scores. However, this does not prevent the user from reaping the other benefits of using the APRA such as helping identifying critical risk elements or improving involvement of project stakeholders, among others.

Another concern on the use of the APRA is "getting project managers and engineers to use the tools and implementing them will be difficult." This concern is understandable since people tend to resist change especially when it seems like they will have more work to do on top of their work that may have been overloaded already. However, investing more on better advance planning may result in better project performances as found out in industrial and building construction sectors.[8, 9]

Given all the potential benefits pointed out, the APRA is just a method with a tool; it does not do, but help do better, the job for the project team. The project team needs to build action plan and act to solve problems, if any, based on results from using the APRA. That is why the following comment was found very insightful: "I believe that the items are identified but it is still up to the individual manager to take these items and clarify and resolve these issues."

6.4 Benefits of the APRA

The APRA allows a project planning team to optimize the identification of the project requirements in all major disciplines (e.g., ROW, Utilities, Environmental, Design, and Planning and Programming) by quantifying, rating, and assessing the level of scope development. It is to be used mainly during the advance planning period and the project development process. A significant feature of the APRA is that it can be utilized to fit the needs of almost any individual transportation project, whether large or small. Elements that are not applicable to a specific project can be zeroed in upon, thus allowing for their elimination from the final scoring calculation.

The APRA is both quick and easy-to-use. It is a best practices tool that will provide numerous benefits to owner organizations such as State Departments of Transportation as well as the transportation industry as a whole. The APRA can be used as:

- A **checklist** that a project team can use for determining the necessary steps to follow in defining the project scope. Using the APRA as a checklist has been well recognized and received by the APRA test meeting participants. In a period as short as two hours, a project team member can get to know the work progress of other functions while keeping the whole team updated on his or her function.

- A listing of **standardized project scope definition terminology** throughout the transportation construction industry. Standardized terminology can help improve communication among different project stakeholders, including professional consultants, the constructor, financers, and the public.
- An industry standard for **rating the completeness of the project scope development** to facilitate risk analysis and prediction of escalation, potential for disputes, etc. Knowing the status of each project development element would allow project team to identify the sources that risk can arise, analyze its probability and consequences, as well as develop an action plan.
- A means to **monitor progress** at various stages during the advance planning phase and the project development process. Using the APRA at different times in project development allows for tracking the progress of each APRA element and developing proper action plan based on the progress.
- A tool to aid in **communication and to promote alignment** between owners (e.g. Texas Department of Transportation), design contractors, and other stakeholders by highlighting poorly defined areas in the project scope. Using the APRA to evaluate project development in a team setting allows for project team members to communicate the issues within their functions to people of other disciplines and probably discuss strategies to tackle the issues. Open communication can help promote team alignment since team members know more of others' concerns and objectives.
- A means through which project team participants can **reconcile differences** using a common basis for project evaluation. Differences among the project team members could be reconciled when they have chance to communicate openly. And project development assessment meeting using the APRA can provide an excellent basis as observed during the APRA testing process performed.
- A **training tool** for organizations and individuals throughout the industry. The APRA could serve as a starting point for TxDOT's new employees to familiarize themselves with the project development process, the tasks involved, the functions inherent, and relative sequences of tasks.
- A **benchmarking tool** for organizations such as TxDOT to use in evaluating the completion of scope development versus the performance of past projects, both within their organizations and without, in order to predict the probability of the success of future projects. This use of the APRA will be enabled after it has been used for sometime, a sufficient number of projects have been evaluated, and the evaluation and project performance data have been recorded for analysis.

Chapter 7. The Use of the APRA and Its Computer Tool

The APRA method has been developed and tested on real projects for its viability as a risk management tool that can help optimize the identification of requirements, including those of ROW, Utilities, Environmental, Design, Programming, during the projects development process. This chapter will be wholly for the instructions of how to use the APRA method in practice. More details on how to implement the APRA can be found in a document called "TxDOT Best Practices Model and Implementation Guide for Advance Planning Risk Analysis for Transportation Projects" that the Center for Transportation Research has submitted to TxDOT.[18]

Individuals involved in the project development process should use the project score sheets shown in Appendices E and F when scoring a project. Note that two score sheets are provided—the first, as part of weighting workshop documents shown in Appendix D, is simply an unweighted checklist. Appendix E contains the weighted values and allows the advance planning team to quantify the level of scope definition at any stage of the project on a 1000-point scale. The unweighted version should be used in the team scoring process to prevent bias in choosing the level of definition and in "targeting" a specific score. The team leader or facilitator can easily score the project during the weighting session using the score sheet in Appendix E.

7.1 When to Use APRA

APRA is a powerful tool that should be used at points throughout the project development process to ensure continued alignment, process checkups, and a sustained focus on the key project priorities. Value can be gained by utilizing this tool at various points in the project development process.

Project size, complexity, and duration will help determine the optimum times that the APRA tool should be used. To aid in the expanded use of this tool, Figure 7.1 illustrates four potential application points where APRA could be useful.

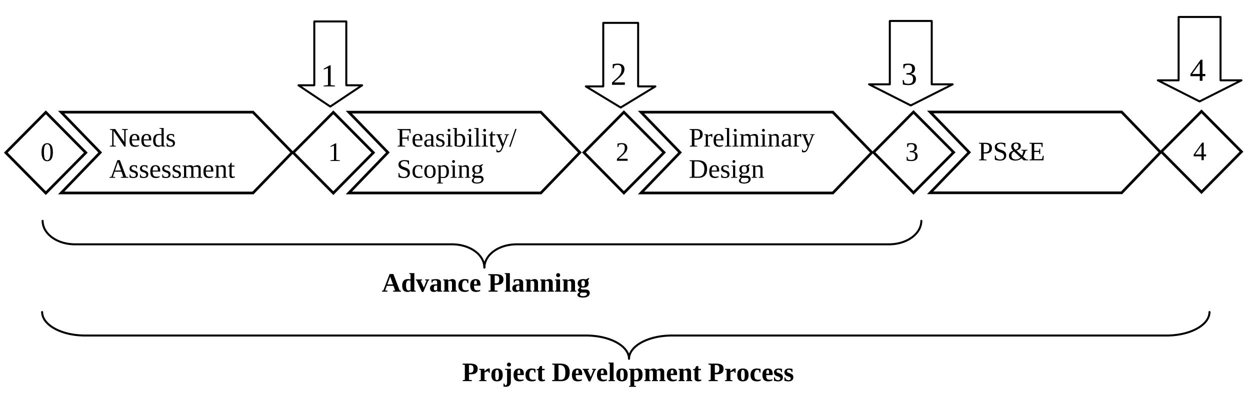


Figure 7.1 Employing the APRA, Application Points

Regardless of the timing of the APRA assessment, the same checklist/descriptions should be utilized and the evaluation should be conducted according to the following guidelines.

APRA 1 Review

This is a high level assessment of the project following Needs Assessment prior to Phase Gate 1 and is part of the decision-making criteria for proceeding to the next phase. This assessment is typically held for projects at the Feasibility and Scoping Meetings, which bring decision makers, resource personnel, stakeholders, and technical personnel together for brain storming to identify alternatives for addressing the identified need. A Feasibility and Scoping Meeting is a corridor-oriented meeting in which broad issues related to purpose, need, and alternatives are discussed. The APRA 1 Review should focus on the following areas:

- Aligning the team with project objectives;
- Ensuring good communication among the decision makers and the project development team; and
- Highlighting stakeholder expectations to facilitate reasonable engineering estimates.

APRA 2 Review

This is a high level assessment of the project following the Feasibility/Scoping phase of the project prior to Phase Gate 2. This assessment is typically held at a Preliminary Design Conference (also known as Project Concept Conference), which is a route-oriented meeting. At this gate more detail is known about the proposed project, and a feasibility study will already have been prepared. The purpose of this meeting is to bring together the project development team to identify the various alternate route locations. APRA Section I, the Basis of Project Decision, should be well-defined (with a low relative APRA score) at this phase gate. For small or simple projects, this assessment may not be necessary. In addition, the APRA 2 Review should focus on the following areas:

- Aligning project objectives and stakeholders' needs;
- Identifying high priority project deliverables that need to be completed;
- Helping to eliminate late-project surprises;
- Facilitating communication across the project development team and stakeholders.

The assessment will highlight the areas that resources need to be focused upon during the next phase of the project development process.

APRA 3 Review

This is typically the assessment of the project before proceeding to the Plans, Specifications, and Estimates development phase, which is initiated by a Design Conference (Phase Gate 3). The APRA 3 assessment should be conducted for all projects. At this stage, risk issues have been identified and mitigation plans are in place or are being developed.

APRA 4 Review

This is typically the final assessment of the project at the end of the Plans, Specifications, and Estimates development phase, prior to letting. The assessment can be done as part of a Final Design and Initial Construction Coordination meeting. At this assessment, all risk elements are thoroughly reviewed again by all stakeholders to make sure the project is ready to proceed to letting. All major issues should have been resolved and any residual risk elements should be closely controlled by this point.

In addition to the four APRA reviews outlined, this tool can also be used at other points. For instance, it can be used early in Needs Assessment as a checklist to help organize work effort, or during the PS&E development phase (after Phase Gate 3) to monitor the progress of the PS&E development and to respond to any emerging issues during this phase.

As noted earlier, the APRA consists of 3 main sections that are broken down into 12 categories. The categories are further broken down into 59 elements. The elements are individually described in Appendix B, Element Descriptions. Elements should be rated numerically from 0 to 5. As indicated in the legend at the bottom of the score sheet, the scores range from 1–complete definition, to 5–incomplete or poor definition, with 0 used for Not Applicable. The elements that are as well-defined as possible should receive a perfect definition level of "one." Elements that are not completely defined should receive a "two," "three," "four," or "five," depending on their levels of definition as determined by the team. Those elements deemed not applicable for the project under consideration should receive a "zero," so as not to affect the final score.

Figure 7.2 outlines a method of assessing the level of definition of an element at a given point in time. For those elements that are completely defined, no further work is needed during the project development process. For those elements with minor deficiencies, no further work is needed during the project development process, and the issue will not impact cost and schedule performance; however, the minor issues identified will need to be tracked and addressed as the project proceeds, especially as the project progresses into the PS&E development phase. For those elements that are assessed as having some or major deficiencies, or are incomplete, further mitigation will need to be performed during the project development process prior to moving through Phase Gate 4. Most of the deficiencies must, however, be addressed prior to Phase Gate 3 if the project requirements are to be identified and managed effectively.

The relative level of definition of an APRA element is also tied to its importance to the project at hand. The flexibility of the APRA allows the project team some leeway in assessing individual element definitions. For instance, if the issues missing from the scope documentation of a particular APRA element are integral to project success (and reduction of risk), the team can rate the issue perhaps at a definition level "three" or "four." On a different project, the absence of definition of these same issues within an APRA element may not be of concern, and the team might decide to rate the element as a definition level "two." As the old saying goes, "do not turn off your brain" when you are using this tool.

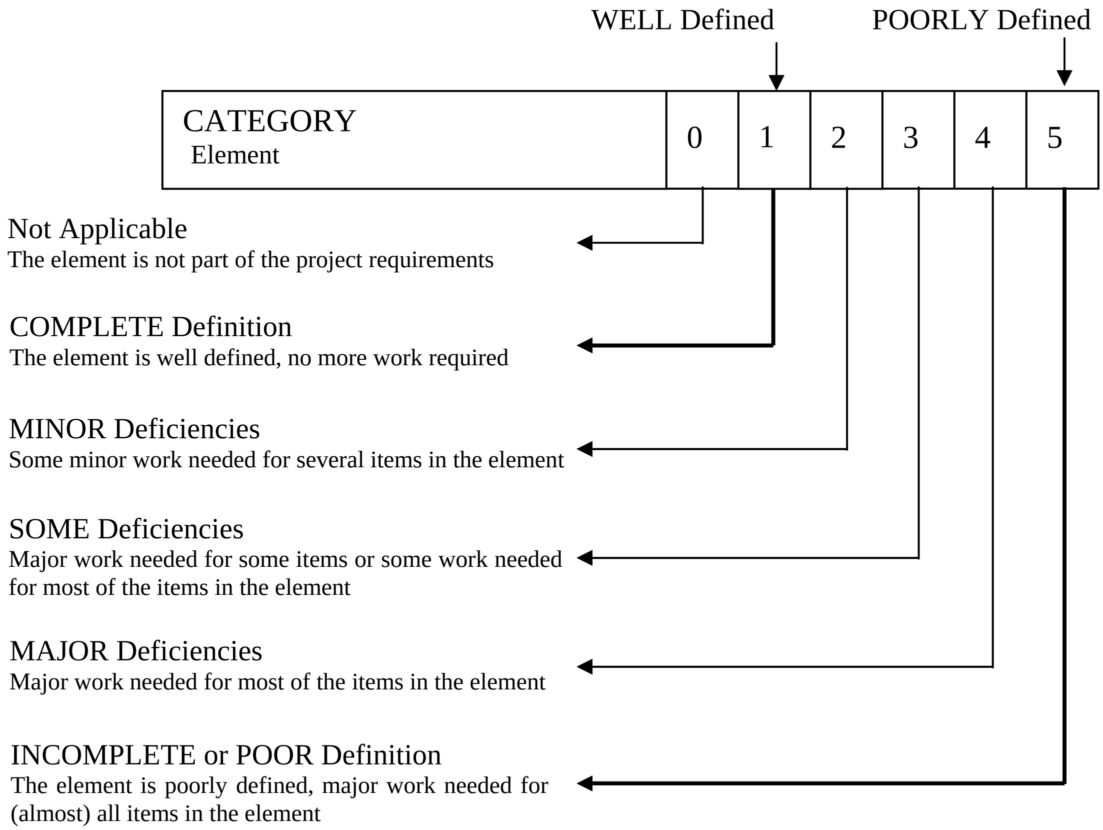


Figure 7.2 APRA Definition Levels versus Further Work Required

7.2 Assessing an APRA Element

To assess an element, one first needs to refer to the Project Assessment Sheet in Appendix D or F then read its corresponding description in Appendix B. Some elements contain a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists. All elements have six pre-assigned scores, one for each of the six possible levels of definition.

Only one definition level (0, 1, 2, 3, 4, or 5) for that element should be chosen based on the perception of how well it has been addressed. The suggested method for making this determination is through open discussion among the project team members. One should ensure the understanding of the element issues by all participants and promote a common understanding of the work required to achieve complete definition. It is important to defer to the most knowledgeable team members (for example, on underground tank issues, defer to the assessment of the civil and environmental discipline leads), while respecting the concerns of the other team members. As the discussion unfolds, one should capture action items or “gaps.” An example action item (gap) list is given in Figure 7.3.

Once the appropriate definition level for the element has been chosen, the value of the score that corresponds to the level of definition chosen should be written in the “Score” column. One should do this for each of the 59 elements in the Project Score Sheet. One should be sure to assess each element.

Each of the element scores within a category should be added to produce a total score for that category. The scores for each of the categories within a section should then be added to arrive at a section score. Finally, the three section scores should be added to achieve a total APRA score.

Project title/date:						
(Sorted in order of APRA element)						
Item #	**APRA Element**	**Level of Definition**	**APRA Element Score**	**Item Description**	**Date Completed**	**Responsible**
1	A1	1	1	Need & purpose document to be sent to team	8/15/200x	Bill C
2	A5	4	18	Public hearings are to be organized	Ongoing	John S
3	F2	2	5	Environmental impact of the open channel system to be double checked	Ongoing	Jennifer T

Figure 7.3 Example Action List

7.3 Example of Assessing an APRA Element

Following is a specific example of how to assess some of the elements as part of a project assessment.

Consider, for example, that you are a member of a project team responsible for developing the scope of work for the construction of a new 2-mile non-freeway roadway. Your team has identified the major milestones throughout the project development process at which you plan to use the APRA to evaluate the current level of "completeness" of the scope definition package. Assume that at the time of this particular evaluation the scope development effort is underway, but is not yet complete.

Your responsibility is to evaluate how well the project's structures have been identified and defined to date. This information is covered in Category F of the APRA as shown here and consists of three elements: "F1, Bridge Structure Elements," "F2, Hydraulic Structures," and "F3, Miscellaneous Design Elements." It is recommended to use the unweighted assessment sheet when evaluating a project in a team setting. Both unweighted and weighted versions are, however, given in this example to illustrate the scoring methodology.

CATEGORY Element	**Definition Level**					
	0	**1**	**2**	**3**	**4**	**5**
F. STRUCTURES						
F1. Bridge Structure Elements						
F2. Hydraulic Structures						
F3. Miscellaneous Design Elements						

To fill out Category F, Structures, follow these steps:

- **Step 1:** Read the description for each element in Appendix C. Some elements contain a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists.
- **Step 2:** Collect all the data that you may need to properly evaluate and select the definition level for each element in this category. This may require obtaining input from other individuals involved in the scope development effort.
- **Step 3:** Select the definition level for each element as described and shown in the following example.
    - o Element F1: Bridge structure locations, safety tolerances, access requirements, and clear roadway width have been well-defined. However, utilities attached to the bridge structures, maintenance of R/W as well as retaining walls and abutments have not been identified and addressed to your satisfaction. You feel that this element has *some deficiencies* that should be addressed prior to the beginning of PS&E. **Definition Level = 3**.
    - o Element F2: Your team decides that this element has been well done. However, you are not sure about the potential environmental impact of the open channel system and decide that the environmental people need to double check this issue. Therefore the team feels the element has *minor deficiencies*. **Definition Level = 2**.
    - o Element F3: Although the team knows other miscellaneous design elements need to be considered, they have not yet been done. This element is therefore *incomplete or poorly defined*. **Definition Level = 5**.

CATEGORY Element	**Definition Level**					
	0	**1**	**2**	**3**	**4**	**5**
F. STRUCTURES						
F1. Bridge Structure Elements				X		
F2. Hydraulic Structures			X			
F3. Miscellaneous Design Elements						X

Be sure to capture action items/comments as the discussion progresses for reference in Step 6. This list is referred to as a “gap” list, in that it identifies those issues that need to be addressed to move the project forward and identifies gaps in the planning activities.

- **Step 4:** For each element, write the score that corresponds to its level of definition in the “Score” column. If the team feels that any or all of the elements were not applicable for this project, they would have had a definition level of “0” and have been zeroed out. The weighted score sheet follows. Circle the chosen definition levels for the assessed elements.

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
F. STRUCTURES							
F1. Bridge Structure Elements	0	1	5	(9)	12	16	
F2. Hydraulic Structures	0	1	(5)	10	14	18	
F3. Miscellaneous Design Elements	0	1	4	8	11	(14)	
CATEGORY F TOTAL							

- **Step 5: Add the element scores to obtain a category score**. Repeat this process for each element in the APRA. Add the category scores to obtain section scores. And finally, add the section scores to obtain a total APRA score.

CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
F. STRUCTURES							
F1. Bridge Structure Elements	0	1	5	(9)	12	16	9
F2. Hydraulic Structures	0	1	(5)	10	14	18	5
F3. Miscellaneous Design Elements	0	1	4	8	11	(14)	14
CATEGORY F TOTAL							28

- **Step 6:** Take Action. In this example, Category F has a total score of 28 (out of 48 total points) and probably needs more work. Use the gap list to identify issues that need additional attention.

7.4 Example of Assessing a Project

This section provides a real example of assessing a project. The assessment was done in July 2007 as part of the APRA testing process. This was an ongoing project that involved widening 2.7 miles of a freeway in Texas. There were 48 R/W parcels to be acquired and 3 utility adjustments to be performed. The status of the major functions in project development was as follows:

- Planning and Programming: completed
- Preliminary Design: completed (Geometric Schematic approved)
- Environmental: completed (EIS approved, re-evaluation approved)
- R/W and Utilities: R/W completed, utilities needed to be done
- PS&E Development: 90% completed

The design conference was held in February 1995. The R/W was released in November 1999. At the assessment time the letting date was planned to be in December 2009 construction completed in December 2012. It was estimated at the time of assessment that PS&E cost would be about $3.3 million, R/W and Utilities costs about $4.4 million, and Construction cost $2.7 million. Total project estimated cost was about $10.4 million.

Each of the elements was assessed using the method explained in the previous section. Scores of all elements in a category were summed to be category score. A section's score is the total of category scores in that section. Finally, project score is the sum of all section scores. Scores of all elements, categories, sections and the project are presented in Figures 7.4, 7.5, and 7.6. It can be noted that there were some non-applicable elements in this project, thus the total maximum possible project score was less than 1000 points.

SECTION I - BASIS OF PROJECT DECISION									
CATEGORY Element	Definition Level 0	1	2	3	4	5	Level	**Score**	Max Score
A. PROJECT STRATEGY (Maximum Score = 122)									
A1. Need & Purpose Documentation	0	1	7	12	18	23	2	**7**	23
A2. Investment Studies & Alternatives Assessments	0	2	8	14	19	25	3	**14**	25
A3. Programming & Funding Data	0	2	9	16	23	30	4	**23**	30
A4. Key Team Member Coordination	0	1	6	11	16	21	3	**11**	21
A5. Public Involvement	0	2	7	13	18	23	0	**0**	0
CATEGORY A TOTAL								**55**	99
B. OWNER/OPERATOR PHILOSOPHIES (Maximum Score = 76)									
B1. Design Philosophy	0	1	7	12	18	23	3	**12**	23
B2. Operating Philosophy	0	1	5	10	14	18	3	**10**	18
B3. Maintenance Philosophy	0	1	5	9	12	16	4	**12**	16
B4. Future Expansion & Alteration Considerations	0	2	6	11	15	19	1	**2**	19
CATEGORY B TOTAL								**36**	76
C. PROJECT REQUIREMENTS (Maximum Score = 102)									
C1. Functional Classification & Use	0	1	5	8	12	15	0	**0**	0
C2. Evaluation of Compliance Requirements	0	1	6	10	15	19	0	**0**	0
C3. Survey of Existing Environmental Conditions	0	2	8	14	20	26	0	**0**	0
C4. Determination of Utility Impacts	0	2	9	16	23	30	4	**23**	30
C5. Value Engineering	0	1	4	7	9	12	5	**12**	12
CATEGORY C TOTAL								**35**	42
Section I Maximum Score = 300							**SECTION I TOTAL**	**126**	217

Figure 7.4 Section I Score of Example Project

SECTION II - BASIS OF DESIGN									
CATEGORY	Definition Level								Max
Element	0	1	2	3	4	5	Level	**Score**	Score
D. SITE INFORMATION (Maximum Score = 173)									
D1. Geotechnical Characteristics	0	1	5	9	12	16	2	**5**	16
D2. Hydrological Characteristics	0	1	5	10	14	18	2	**5**	18
D3. Surveys & Planimetrics	0	1	5	10	14	18	2	**5**	18
D4. Permitting Requirements	0	1	5	9	13	17	2	**5**	17
D5. Environmental Documentation	0	2	7	12	17	22	1	**2**	22
D6. Property Descriptions	0	1	5	8	12	15	1	**1**	15
D7. Ownership Determinations	0	1	4	7	10	13	1	**1**	13
D8. Right-of-Way Mapping	0	1	5	9	12	16	2	**5**	16
D9. Constraints Mapping	0	1	6	10	15	19	2	**6**	19
D10. Right-of-Way Site Issues	0	1	6	10	15	19	2	**6**	19
							CATEGORY D TOTAL	**41**	173
E. LOCATION & GEOMETRY (Maximum Score = 79)									
E1. Horizontal & Vertical Alignment	0	1	6	11	15	20	2	**6**	20
E2. Control of Access	0	1	5	9	13	17	3	**9**	17
E3. Schematic Layouts	0	2	8	13	19	24	2	**8**	24
E4. Cross-Sectional Elements	0	1	5	10	14	18	3	**10**	18
							CATEGORY E TOTAL	**33**	79
F. STRUCTURES (Maximum Score = 48)									
F1. Bridge Structure Elements	0	1	5	9	12	16	3	**9**	16
F2. Hydraulic Structures	0	1	5	10	14	18	2	**5**	18
F3. Miscellaneous Design Elements	0	1	4	8	11	14	1	**1**	14
							CATEGORY F TOTAL	**15**	48
G. DESIGN PARAMETERS (Maximum Score = 29)									
G1. Provisional Maintenance Requirements	0	1	4	6	9	11	4	**9**	11
G2. Constructability	0	1	5	10	14	18	4	**14**	18
							CATEGORY F TOTAL	**23**	29
H. INSTALLED EQUIPMENT (Maximum Score = 30)									
H1. Equipment List	0	1	3	5	7	9	2	**3**	9
H2. Equipment Location Drawings	0	1	3	5	6	8	5	**8**	8
H3. Equipment Utility Requirements	0	1	4	7	10	13	0	**0**	0
							CATEGORY G TOTAL	**11**	17
Section II Maximum Score = 359							**SECTION II TOTAL**	**123**	346

Figure 7.5 Section II Score of Example Project

SECTION III - EXECUTION APPROACH									
CATEGORY	Definition Level								Max
Element	0	1	2	3	4	5	Level	**Score**	Score
I. ACQUISITION STRATEGY (Maximum Score = 137)									
I1. Long-Lead Parcel & Utility Adjustment Identification	0	2	8	13	19	24	4	**19**	24
I2. Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	9	12	3	**7**	12
I3. Local Public Agencies Utilities Contracts & Agreements	0	1	6	10	15	19	1	**1**	19
I4. Utility Agreement & Joint-Use Contracts	0	1	6	11	15	20	2	**6**	20
I5. Project Delivery Method & Contracting Strategies	0	1	4	7	10	13	3	**7**	13
I6. Design/Construction Plan & Approach	0	1	4	8	11	14	4	**11**	14
I7. Procurement Procedures & Plans	0	1	3	6	8	10	5	**10**	10
I8. Appraisal Requirements	0	1	4	8	11	14	1	**1**	14
I9. Advance Acquisition Requirements	0	1	4	6	9	11	1	**1**	11
							CATEGORY L TOTAL	**63**	137
J. DELIVERABLES (Maximum Score = 23)									
J1. CADD/Model Requirements	0	1	3	6	8	10	1	**1**	10
J2. Documentation/Deliverables	0	1	4	7	10	13	1	**1**	13
							CATEGORY L TOTAL	**2**	23
K. PROJECT CONTROL (Maximum Score = 98)									
K1. Right-of-Way & Utilities Cost Estimates	0	2	7	12	16	21	1	**2**	21
K2. Design & Construction Cost Estimate	0	2	7	12	16	21	5	**21**	21
K3. Project Cost Control	0	1	5	9	13	17	5	**17**	17
K4. Project Schedule Control	0	1	5	9	12	16	5	**16**	16
K5. Project Quality Assurance & Control	0	1	3	6	8	10	4	**8**	10
K6. Safety Procedures	0	1	4	7	10	13	4	**10**	13
							CATEGORY L TOTAL	**74**	98
L. PROJECT EXECUTION PLAN (Maximum Score = 83)									
L1. Environmental Commitments & Mitigation	0	1	5	8	12	15	1	**1**	15
L2. Interagency Coordination	0	1	5	8	12	15	1	**1**	15
L3. Local Public Agency Contractual Agreements	0	1	5	8	12	15	1	**1**	15
L4. Interagency Joint-Use Agreements	0	1	4	8	11	14	2	**4**	14
L5. Preliminary Traffic Control Plan	0	1	4	7	10	13	5	**13**	13
L6. Substantial Completion Requirements	0	1	4	6	9	11	4	**9**	11
							CATEGORY L TOTAL	**29**	83
Section III Maximum Score = 341							**SECTION III TOTAL**	**168**	341

Figure 7.6 Section III Score of Example Project

Figure 7.7 presents final score of the example project and those of three sections. The project had a final score of 461 out of 904 total maximum possible score. Figure 7.8 provides a distribution of the elements' definition levels. The project had five non-applicable elements. Of

54 applicable elements, more than half of them (28) had definition levels of one or two and can be considered quite well defined. Nine of the 54 elements had definition level three. Seventeen elements had low definition levels of four or five.

As aforementioned, the APRA assessment would be of little value unless the project team took action based on the results from the assessment. The APRA assessment helped the team generate a list of elements that had low definition (levels 4 and 5) and thus needed extra attention on. There were 17 elements of this type, as listed in Table 7.1 with their corresponding definition level and score.

Overall	**Score**		Max Score
Section 1 - Basis of Project Decision	**126**		217
Section 2 - Basis of Design	**123**		346
Section 3 - Execution Approach	**168**		341
TOTAL	**417**		904
Normalized Score **461**	**APRA TOTAL SCORE** (Maximum Score = 1000)		**0.461**

Figure 7.7 Final Score of Example Project

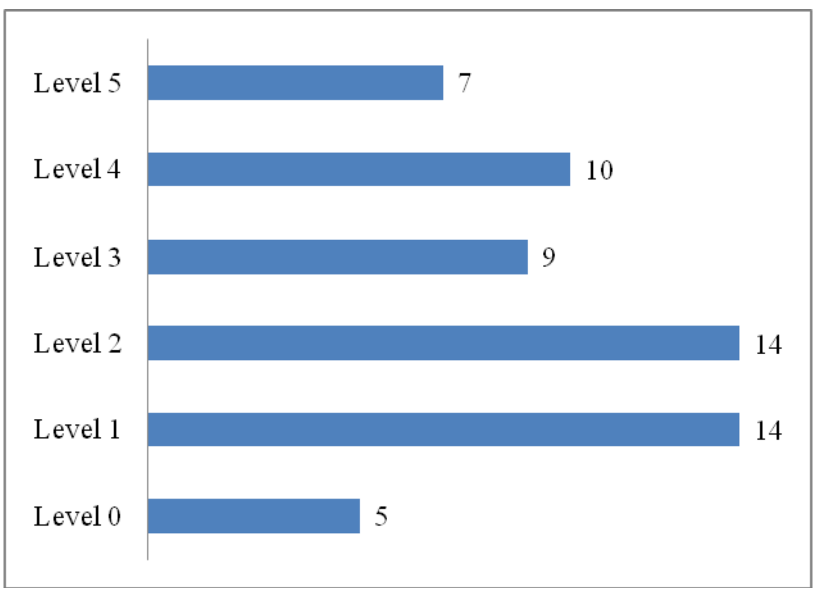


Figure 7.8 Distribution of Elements' Definition Levels for Example Project

Table 7.1: List of Low Definition Elements of Example Project

SECTION	LEVEL	SCORE
A3. Programming & Funding Data	4	23
B3. Maintenance Philosophy	4	12
C4. Determination of Utility Impacts	4	23
C5. Value Engineering	5	12
G1. Provisional Maintenance Requirements	4	9
G2. Constructability	4	14
H2. Equipment Location Drawings	5	8
I1. Long-Lead Parcel & Utility Adjustment Identification	4	19
I6. Design/Construction Plan & Approach	4	11
I7. Procurement Procedures & Plans	5	10
K2. Design & Construction Cost Estimate	5	21
K3. Project Cost Control	5	17
K4. Project Schedule Control	5	16
K5. Project Quality Assurance & Control	4	8
K6. Safety Procedures	4	10
L5. Preliminary Traffic Control Plan	5	13
L6. Substantial Completion Requirements	4	9

7.5 Philosophy of Use

Ideally, the project team conducts an APRA evaluation at various points in the project. Experience has shown that the scoring process works best in a team environment with a neutral facilitator familiar with the process. The facilitator provides objective feedback to the team and controls the pace of team meetings. See Appendix G for details about facilitation. If this arrangement is not possible, an alternate approach is to have key individuals evaluate the project separately, then evaluate it together, ultimately agreeing on a final evaluation. Even using the APRA from an individual standpoint provides a method for project evaluation.

Experience has also shown that the APRA is best used as a tool to help project managers (project coordinators, project planners) organize and monitor the progress of the project development effort. In many cases, a planner may use the APRA prior to the existence of a team in order to understand major risk areas. Using the APRA early in the project's life cycle will usually lead to high APRA scores. This is normal and the completed score sheet gives a road map of areas that are weak in terms of definition.

The APRA provides an excellent tool to use in early project team meetings in that it provides a means for the team to align itself on the project and organize its work. The final APRA score is less important than the process used to arrive at that score. The APRA also can provide an effective means of handing off the project to other entities or helping maintain continuity as new project participants are added to the project.

If the organization (e.g., a TxDOT district) has advance planning procedures and execution standards and deliverables in place, many APRA elements may be partially defined when the project advances to the advance planning phase. An organization may want to standardize many of the APRA elements to improve the cycle time of planning activities.

APRA scores may change on a day-to-day or week-to-week basis as team members realize that some elements are not as well-defined as initially assumed. It is important to assess the elements honestly. The planning process is inherently iterative, and any changes that occur in assumptions or planning parameters need to be resolved with earlier planning decisions. The target score may not be as important as the team's progress over time in resolving issues that harbor risk. To aid the team in understanding the APRA element scores, a guide to the interpretation of these scores was presented in section 5.6 "Interpretation of APRA Elements Scores."

The APRA was developed as a "point in time" tool with elements that are as independent as possible. Most of the elements constitute deliverables in the planning process. However, a close review of the elements shows an imbedded logic. Certain elements must first be defined well in order for others to be defined.

Figure 7.9 outlines the logic at the section level. In general, Section I elements must be well-defined prior to defining Section II and III elements. Note that this is not a critical-path-method-type logic in that certain elements are completed prior to the point when the next elements can start. Many times elements can be pursued concurrently. As information is gained downstream, elements already defined have to be revisited.

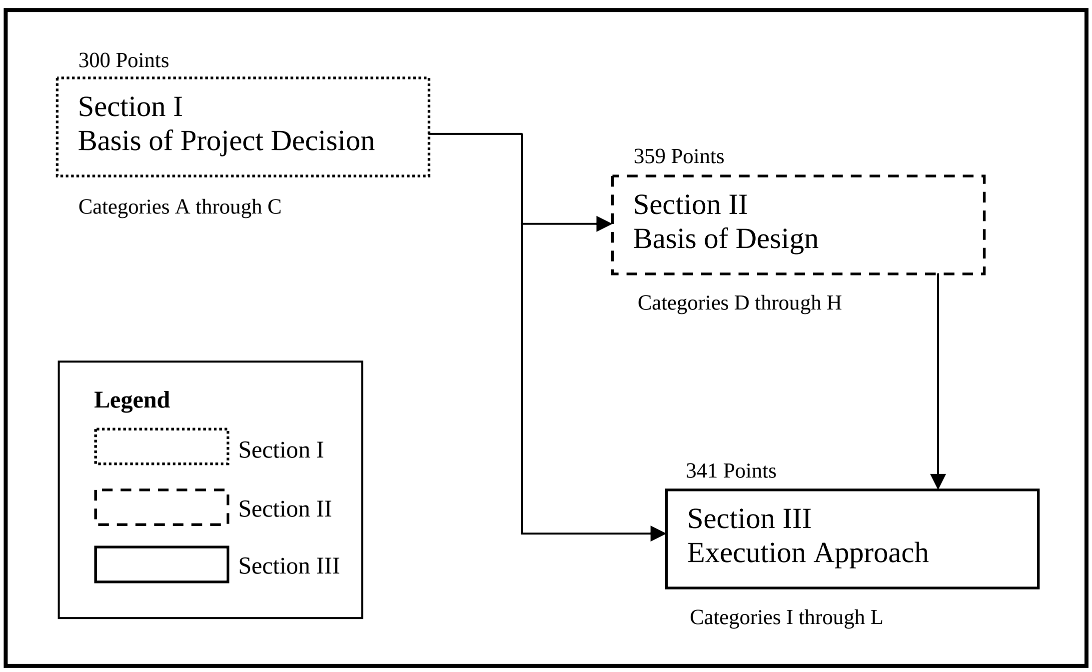


Figure 7.9 APRA Section Logic Flow Diagram

7.6 Use of APRA on Small or Renovation Projects

Small or renovation projects can also benefit from using the APRA, even if these projects are small, short in duration, and frequently performed. Many large organizations such as the Texas Department of Transportation have a number of these projects at any given time. Projects of these types may be driven by environmental regulations or by the need to keep a facility in repair or operation. Projects may also be focused on restoration of a roadway, or to facilitate relocation of a corridor.

On small or renovation projects, the requirements or scope may not encompass many of the elements contained in the entire APRA. In particular, some of the Basis of Project Decision elements found in Section I of the APRA may not be clearly defined. Although business planning is generally performed on an owner's overall program of small projects, it may be difficult to determine if specific business decisions directly apply to one individual project. Customizing the APRA to reflect each individual project can be highly beneficial.

Normalizing the score

If an organization decides to create a scaled-down version of the APRA, it must be aware of the fact that this procedure will alter the maximum possible score from 1000 points to some lower number. Each time an element is deleted from the checklist, the maximum score for the project is reduced by that element's total weight. Further, not only will the maximum score be reduced, but the lowest possible score that can be achieved with complete definition also will drop from 70 points to some lower number.

When using the APRA on smaller projects, the team must also determine a new target score at which they feel comfortable authorizing a project for detailed design and construction. Through experience, each organization should develop an appropriate threshold range of scores for the particular phase of project development. This threshold is dependent upon the size, type, and complexity of the project.

For example, on a small 2-lane rural project, the APRA can be used effectively for this project with some modification. Note that some elements may be assigned a value of zero as not applicable for this type of project (e.g., Bridge Structure Elements (F1), Equipment List (H1), Equipment Location Drawings (H2), and Equipment Utility Requirements (H3)). A "not applicable" element essentially provides no risk, or no potential negative impact to the project. Other elements may become more critical [e.g., Environmental Documentation (D5), Hydraulic Structures (F2)]. After the assessment, if the organization's scaled-down version has a maximum possible score of 800 [after certain elements are given a not applicable (definition level 0) in the score sheet], it may determine that a score of 200 (25 percent of the total applicable points) must be reached before authorizing its small projects for PS&E development.

A word of caution should be given here. Using the APRA for this purpose should be done carefully or else elements that are more important for small projects may be given less emphasis than required. The operative phrase for using the APRA in these situations is common sense. An experienced facilitator can help in this regard.

7.7 Implementation across the Organization

The first requirement for implementation of the APRA across any organization (i.e., using it on all projects) is the unwavering support of upper management. Upper management should create a procedure that lists the utilization of the APRA as a requirement prior to authorizing a project to proceed with R/W release.

There is some danger in too much focus on scoring. Some smaller, maintenance projects may be fully acceptable at a much higher APRA score as long as the project risks have been defined and a mitigation plan is in place to control the project. As stated before, common sense should prevail when reviewing APRA results from a project. Requiring teams to reach a specific score could result in a team artificially adjusting the score so that the project can be executed (to the detriment of the organization, project, and team participants). In most cases, it is more beneficial for the owner to have an APRA assessment along with identified risk issues (gap list) and corresponding mitigation steps. Managers should focus on the high risk elements generated in the assessment session, not just the APRA score. These are the issues that are of most concern as identified by the project team. Focusing too much emphasis on the score can lead to use of the tool as an administrative exercise and not an effective risk management approach.

The second requirement is a local champion. This person is an enthusiastic supporter of the application of this tool. He/she is in contact with other organizations using the APRA to gain knowledge of its use and fosters the widespread application of the tool. This person is an advocate regarding the benefits that this tool and method will bring to the organization.

The third requirement is training. A number of facilitators should be trained by the champion or an outside training resource. The number of facilitators will vary by organization and the number of projects that require approval. The objective is to ensure that every project has access to a trained facilitator in a timely manner. The facilitator should NOT be a member of that project team. In many organizations, Project Managers are trained as facilitators for their peer's projects. In addition to a cadre of facilitators, all key members of the organization should be trained in how to participate in an APRA session and why their participation is important. In most cases, this is accomplished with just-in-time training. The trained facilitator will take the first 15 minutes or so of a session and brief the participants on the meeting's purpose and their role in making the session a success. Then the facilitator will take the opportunity to comment on specific behaviors as they progress through the assessment session. Soon all key members will be well-trained and know what to expect during an APRA assessment session.

If the APRA is implemented across an organization, its use should be monitored. The organization may wish to modify APRA element descriptions to add discussion concerning proprietary concerns, lessons learned, or specific terminology based on its business environment.

7.8 Computer Tool Development and Instructions for Using

This section will provide an overview of the development of a computer tool for using the APRA method and the instructions for using this tool.

7.8.1 Development of the Computer Tool

In order for the use of the APRA method to be easy and effective a computer tool was needed. The computer tool was envisioned to be a tool that must: 1) be user friendly, 2) help utilize the APRA method more effectively, 3) not require much training in use, and 4) not require more investment on software and hardware on top of a normal office personal computer. With these in mind, the research team decided to choose Microsoft Excel program as the basis to develop the computer tool.

The first version of the computer tool was finished in April 2007. It was then presented to the TxDOT PMC members at a PMC meeting in Dallas in April 2007. The tool was well received by the PMC members at the meeting. A considerable amount of time was spent on discussing the tool and its functionality and how to improve it. The tool was then revised based on the comments and feedback from the meeting while at the same time being used for test meetings with districts from May to August 2007. The tool was finalized in August 2007. A screen shot of the APRA welcome screen is presented in Figure 7.10.

Figure 7.10 Welcome Screen of the APRA Computer Tool

7.8.2 Instructions for Using the Computer Tool

A user guide called "User Guide for the Advance Planning Risk Analysis Tool for Transportation Projects"[19] was developed to guide the users on how to use the computer tool. The user guide contains four chapters. Chapter 1 was for giving an overview of the APRA computer tool, including an introduction, system requirements, and the programming structure. Chapter 2 provides guidance on how to start using the computer tool including how to install it in a personal computer, how to start the program and setting up security level. The major part of the user guide is the instructions for how to do a new analysis for a project. This part is Chapter 3. In this part, the user is guided through each step, with intensive use of computer tool screen shots, in assessing a project. There were six steps in doing a new analysis: 1) project information input, 2) assessment meeting input, 3) assessing elements in Section I, 4) assessing elements in Section II, 5) assessing elements in Section III, and 6) generating analysis summary and reports. The final part, Chapter 4, of the user guide was for instructions for reviewing a previous analysis of a project. This user guide is intended to be a companion document of the implementation guide that was discussed on in the beginning of this chapter.

Chapter 8. Conclusions and Recommendations

This chapter will draw conclusions on the initiation, development and testing of the APRA method. Recommendations on the implementation of the method and further research will also be provided.

8.1 Conclusions

Of the five first phases of the project life cycle (Needs Assessment, Feasibility/Scoping, Preliminary Design, Detailed Design, and Construction,) the project development process covers the first four phases. This process is a great area for improvements in project delivery. Effective identification of project requirements during project development would help streamline the process and thus make the project available earlier for public benefits. The interdisciplinary nature of this process however makes this identification effort more challenging. Involvement of all disciplines during project development needs to be ensured if the overall identification effort is to be effective. Therefore, there was a need for a method that can help with accelerating this project requirements identification process across all functions of project development.

The Advance Planning Risk Analysis method was developed to meet this need. It is a method that, if used properly, can help optimize the identification of project requirements during the project development process in all functions, including Planning and Programming, Preliminary Design, Environmental, ROW, Utilities, and Detailed Design. It is a method that can help the project development team control and manage critical project issues during project development. It can provide a platform for project participants to cooperate and coordinate project activities and responsibilities. It can help reconcile participants' difference through discussions. It can also be a means for training new personnel. And the APRA can be used to anticipate project performance after a certain period of using time.

In the development of the APRA a significant amount of literature was reviewed to ensure a comprehensive coverage of issues critical to project development regardless of project type and location. Intensive involvement of experienced TxDOT personnel in meetings, workshops, and interviews also helps improve greatly the practicality of the method. A further step in making the APRA more helpful to the users is the development of a computer tool which is based on the Microsoft Excel program. This tool makes the APRA easier to use and the results easier to be exchanged.

The method and the tool were tested on real projects to gather comments and feedback from potential users. The test results were highly positive when all of the 32 experts participated agreed on the usefulness of the method. Various forms of uses and benefits from the use were also observed and commented.

In short, the APRA method was developed to meet the need of optimizing the identification of project development requirements. Its development took into account a great deal of relevant literature and expert knowledge. The method was tested and well received by potential users and potential benefits were recognized. The following section will provides detail of the recommendations on the implementation of this method and research advancement.

8.2 Recommendations for Implementation

The APRA method as developed and tested could effectively be used to optimize the identification of project requirements during the project development process. It is therefore recommended the APRA be implemented by TxDOT in its districts' development of projects. One approach to the implementation could be starting with several districts to familiarize the users with the method and to further refine the method to better fit practical use. However, it should be emphasized that the APRA alone will not ensure process optimization and successful projects. When combined with sound business planning, alignment, good project execution, and proper actions it can greatly improve the identification process and the probability of meeting or exceeding project objectives. Following are some of recommendations when implementing the APRA:

- **Commit to advance planning**. Effective planning in the early stages of transportation projects can greatly enhance cost, schedule, and operational performance while minimizing the possibility of financial failures and disasters. The commitment should be from the very high level of management.
- **Gain and maintain project team alignment** by using the APRA throughout the advance planning phase and the project development process. Discussions around the scope definition checklists are particularly effective in helping with team alignment.
- **Adjust the APRA as necessary to meet the specific needs of your project**. The APRA was designed so that certain elements considered not applicable on a particular project can be zeroed out, thus eliminating them from the final scoring calculation.
- **Use the APRA to improve advance planning**. Build your own internal database of projects that are scored using the APRA. Compute APRA scores at the various times during scope development and compare versus project success. Based upon the relationship between APRA scores and project success, establish your own basis for the level of scope definition that you feel is acceptable for moving forward from phase to phase.
- **Use caution when beginning detailed design of projects with high APRA scores**. The higher the APRA score, the less defined the project scope, thus there is more likelihood that the project will have poor performance.
- **Properly train APRA assessment facilitators**. Skillful facilitators who are familiar with the APRA and have excellent understanding of team dynamics would help the assessment of projects using the APRA be more effective. One of the obvious advantages is that they could help the participants focus on the discussions of the issues and coordination opportunities instead of delving into the responsibility of those in charge.
- **Be aware of the importance of utilizing the APRA assessment results**. The use of the APRA usually generates scores of projects at different points in time as well as a list of issues of high risk. These results should be utilized to develop

strategies to address the issues and coordinate among project participants instead of blaming anyone for the problems.

8.3 Recommendations for Further Research

As stated earlier in this report, this research was initiated, funded, and fulfilled for Texas Department of Transportation. Data collection when weighting the APRA elements was performed in Texas only and therefore the weighting results are most suitable to projects in Texas. However, the list and descriptions of the APRA elements are greatly generic since: 1) during the identification and synthesis of the elements literature from various sources including other State Departments of Transportation, academic institutions, government agencies and academic journals was used, and 2) the nature of the project development process and its tasks is similar regardless of who performs them and in which state, especially when much of the process needs to conform with federal requirements. Therefore, the list of the elements and their issues can be used for different types of organizations (e.g., owners, developers, designers, and contractors) without losing the accuracy of the APRA's descriptions of the project development process. Following are recommendations for further research:

- Data on project performance and APRA score should be collected. This data collection would be possible when the APRA is used for some time. The availability of the data would enable the analysis of the relationship between project performance and the level of project advance planning, which is in part illustrated by the APRA score.
- The elements could be reweighted when using for other areas such as other State Departments of Transportation to better reflect the circumstantial characteristics and expert opinions of those areas. If the elements are to be reweighted, workshop is the recommended method to tap the expertise of experienced professionals.

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Appendix A: Project 0-5478 Interview Guide

TXDOT RESEARCH PROJECT 0-5478

RESEARCH INTERVIEW QUESTIONNAIRE

Research Introduction & Project Confidentiality

The Center for Transportation Research (CTR – UT) and the Texas Department of Transportation (TxDOT) are currently working on a research endeavor to optimize the identification of right of way requirements throughout the project development process. Research on this project (TxDOT #0-5478) commenced in the fall of 2005 and is scheduled to conclude with the presentation of project deliverables to RTI in fall of 2007. Presently, CTR staff is in the process of obtaining valuable information from various TxDOT districts and divisions through structured interviews. The research team is composed of the following TxDOT and CTR officials:

TxDOT Team Members	
Tommy Jones, *Project Director*	TxDOT – Abilene District
Dale Booth	TxDOT – Tyler District
Kristy Gardner	TxDOT – Abilene District
Travis Henderson	TxDOT – Dallas District
Sylvia Medina	TxDOT – RTI (RMC 3)
Tom Yarbrough	TxDOT – RTI (RMC 3)

CTR Research Staff	
G. Edward Gibson, *Research Supervisor*	CTR – UT
Carlos Caldas, *Co-PI*	CTR – UT
Tiendung Le	CTR – UT
Michael Thole	CTR – UT

Key project objectives are as follows:

- To develop a Best Practice Model for engineers and designers during the project development process.
- To develop an electronic guide of design-related factors to determine the R/W requirements determination.
- To develop a tool to perform a sensitivity analysis of the certainty associated with the R/W requirements determination.
- To synthesize data-driven findings into recommended strategies and tactics for expediting these processes, including, if applicable, recommendations for process changes and/or policy changes.

The results of this questionnaire will help determine the design-related factors that are essential in R/W requirements determination. Moreover, it can provide insight on strategies for recommendation and possible process/policy changes as well.

Personal Professional Information:

1) Could you give us a brief introduction on your current position with TxDOT:
    - Job responsibilities and deliverables produced?
    - Relation to PDP (Project Development Process) & attaining ROW (Right of Way)?
    - What is the nature of projects you work on?

2) How does your position directly interface with ROW issues?

3) Have you had any prior experience working in other districts, divisions, or capacities for TxDOT that resulted in your interfacing with ROW issues?

4) Have you personally participated in any TxDOT training programs related to PDP or ROW?
    - Which programs?
    - To what extent are they beneficial or insufficient?

5) Are most of the projects you work on considered rural, urban, or a combination of the two?

6) In what capacity do you work on several projects simultaneously?

Current Processes, Tools, and Techniques for ROW Development:

1) Do you, or does your office, have specific objective measures set up to efficiently plan projects that are inclusive of ROW?
    - Implementation plans, roadmaps, checklists, etc?
    - Cost and schedule control diagrams?
    - Prioritized list of activities?

2) What TxDOT project development guides, tools, or documentation are you aware of that can assist in performing your job functions in the PDP?
    - How are they integrated into planning process?
    - When are they implemented?
    - Who is involved in carrying out the tool?
    - Who are the key providers of data for input into tool?

(As the interviewer, we should introduce the following information if not mentioned by the interviewee – PDP Manual, PDP Flowchart, PS&E Manual, ROW Manual, ROW Process Map, ROWIS, RUDI)

3) What are your purposes in using the guides mentioned above, and how effective is the information obtained by using these tools in attaining your overall planning objectives?
    - Specific attributes of the current tools?
    - What hinders development or renders tool difficult to use?

Current Processes, Tools, and Techniques for ROW Development:

1) Does your office maintain processes other than the ones we've described above, developed locally for your office's use?
    - How were they created and by whom?
    - Why are they implemented instead of/in addition to the general TxDOT tools?
    - How difficult is it to integrate these into the project development process?
    - Is it possible to obtain a copy of these materials?

2) Do you have current methods for tracking project development in terms of ROW acquisition (schedules, matrices, etc.)?

3) Can you identify deliverables that you produce, as part of your job description, containing ROW information or information gathered from ROW officials?
    - Which deliverables particularly impact ROW development?
    - How often do these deliverables get changed during planning & execution?

Problems Resulting from Current Practices:

1) What do you feel are the biggest constraints to your daily activities regarding the definition of ROW issues during the project development process?

(These do not necessarily need to be specific activities, but can incorporate general concerns, such as social, economic, schedule, and communication requirements.)

2) Do you know of anything that is currently being done to ameliorate these concerns? Do you have any targeted ideas for improving these concerns?

3) Are there any apparent process-related problem areas in project planning and ROW development?
    - What in your opinion are the root causes of these failures in the system?
    - Which seem to have the biggest impact on project objectives?
    - Which seem to require substantial efforts in order to be overcome?

4) Which problems, or potential problems, result from the interfacing of various parties, districts, and divisions within TxDOT or the project community?

Key Stage Factors in the Project Development Process:

Upon completing questions related to the general practices employed by the TxDOT district, we would like to detail the five stages of project development, indicated in the PDP Manual. Interviewees will only respond to the areas of project development in which they are functioning as team members. These stages are as follows:

Planning & Programming

1) Who is involved in this sub-process regarding ROW development?

2) How do you evoke public involvement in this stage of the project and how does your office interact with the public regarding ROW concerns?

3) What meetings or other interactions between project and ROW stakeholders take place during this sub-process?

4) What ROW issues, defined or examined in this stage, are in your opinion, critical to project development?
   - Barriers/difficulties (e.g. personnel, cost, communication, time)?
   - Requirements/pressure (e.g. regulatory, other legal)?

5) What special ROW issues result from jurisdictional issues?

6) What are current performance characteristics for this sub-process and how are they measured?
   - How long does this process last?
   - How much money is authorized for planning & programming?
   - What is the quality of the information gathered in this stage?

7) Are delivery and contracting strategies discussed in terms of impact on ROW prior to design and execution?

Key Stage Factors in the Project Development Process:

Preliminary Design

1) How do you obtain ROW input information for the preliminary design phase? (e.g. from owner, utility companies, public)

2) What ROW issues, defined or examined in this stage, are in your opinion, critical to project development?
   - Specific Information?
   - Coordination?
   - Approval?

3) What interactions take place to organize ROW information during the design phase and who is involved?
   - Public involvement?
   - Division & District meetings?
   - Design deliverables?
   - Legal & Jurisdictional issues?

4) What are current performance characteristics for this sub-process and how are they measured?
    - How long does this process typically last?
    - What is the quality of the deliverables relating ROW and Design? How often are they resubmitted and reissued?

5) What critical problem areas can you point out in regards to ROW development in the design phase?

Key Stage Factors in the Project Development Process:
Environmental

1) What are the environmental regulatory requirements associated with ROW development?

2) What are your current processes/guidelines to meet these requirements?

3) Who is involved in Right of Way Division and Environmental Division interfacing?

4) What ROW issues, defined or examined in this stage, are in your opinion, critical to project development?
    - Information
    - Process
    - Approval
    - Public

5) How do these issues affect ROW in particular and PDP in general?
    - How long is the revision process for ROW development (or schedule impact) if environmental problems are found?

6) What should be done to improve the situation?

Key Stage Factors in the Project Development Process:
ROW & Utilities

1) Who is involved in this sub-process and what additional members can you foresee as beneficial?
    - At what point are local utilities brought in to the planning process?
    - What information do utilities companies provide that TxDOT does not have initial access to?

2) How do project team members and the public interact/communicate/coordinate to produce a detailed list of ROW requirements prior to release?

3) What ROW issues, defined or examined in this stage, are in your opinion, critical to project development?

4) What are the biggest obstacles and difficulties in this sub-process?

(Attention may be paid to land owners and utility companies?)

5) What are current performance characteristics for this sub-process and how are they measured?

6) What needs to be improved in this sub-process and do you have any recommendations?

Key Stage Factors in the Project Development Process:
Post-ROW

1) How do Right of Way Division employees maintain their initial interactions with other project participants, stakeholders, and the public?

2) Are there inter-Division deliverables that still need to exist during this stage regarding the effective execution of ROW acquisition and maintenance?

3) What are the most critical issues after ROW release and prior to construction?
   - What maintenance and operational factors can be defined early in the project development process? Are these issues brought to light early on?

4) What can be done to improve this sub-process in terms of present ROW inefficiencies and definition?

Tool Definition:

1) In summary to our research, we will propose a tool that can be utilized to guide TxDOT personnel to efficient ROW definition in the project development process. Do you have any suggestions for its development?

   - What form of appearance should it take? *(web-based, computer application, document-based)*
   - What should be the main functions and contents of the tool?
   - What should be its inputs and outputs?

2) What stage of the project development process do you feel could best benefit from the implementation of this tool? At which point should it be implemented?

3) How would you like this tool to be used? (*checklist, decision-maker, identifier)*

Please feel free to comment on any additional areas, that you feel could be beneficial to this project, that were not already discussed.

Appendix B: Element Descriptions

The following descriptions have been developed to help generate a clear understanding of the terms used in the Unweighted Project Score Sheet. Some descriptions include checklists to clarify concepts and facilitate ideas when scoring each element. Note that these checklists are not all-inclusive and the user may supplement these lists when necessary. Moreover, for specific information regarding certain processes and tasks during the Project Development Process, a listing of Texas Department of Transportation (TxDOT) requirements is included for many of the element descriptions.

The descriptions are listed in the same order as they appear in the Unweighted Project Score Sheet. They are organized in a hierarchy by section, category, and element. The Unweighted Project Score Sheet consists of three main sections, each of which is a series of categories that have elements. Scoring is performed by evaluating the levels of definition of the elements. The sections, categories, and elements are organized as follows:

SECTION I – BASIS OF PROJECT DECISION

This section consists of information necessary for understanding the project objectives. The completeness of this section determines the degree to which the project team will be able to achieve unification in meeting the project's business objectives.

Categories:

A – Project Strategy

B – Owner Philosophies

C – Project Requirements

SECTION II – BASIS OF DESIGN

This section consists of geotechnical, hydrological, environmental, structural, and other technical design elements that should be evaluated to fully understand impacts on the acquisition of right-of-way. Similarly, this section includes a number of right-of-way requirements prior to acquisition, occurring simultaneously with preliminary design.

Categories:

D – Site Information

E – Location & Geometry

F – Structures

G – Design Parameters

H – Installed Equipment

SECTION III – EXECUTION APPROACH

This section consists of elements that should be evaluated to fully understand the requirements of the owner's execution strategy and approaches for detailed design, R/W acquisition, utility adjustments, and construction.

Categories:

I – Acquisition Strategy

J – Deliverables

K – Project Control

L – Project Execution Plan

The following pages contain detailed descriptions for each element in the APRA.

SECTION I – BASIS OF PROJECT DECISION

A. PROJECT STRATEGY

A.1. Need & Purpose Documentation

The need for a project may be identified in many ways, including suggestions from maintenance supervisors, area engineers, transportation planners, local elected officials, developers, and the public. This process typically includes site visits, seeking input from individuals with relevant knowledge. Documentation should result in assessing the need and purpose of a potential project based on factual evidence of current and future conditions. This documentation must consider how the project will address previously determined problems and inefficiencies, in language that is understandable to the general public. It will eventually serve as the basis for identifying, comparing, and selecting alternatives. Issues may include:

- ❑ Project scope and definition
- ❑ Community concerns and critical issues
- ❑ Consultation with local public officials regarding supportive legislation
- ❑ Multi-modal alternatives and inter-modal relationships
- ❑ Current operational/maintenance inefficiencies and high costs
- ❑ Current and future economic development needs
- ❑ Adjacent properties and transportation facilities
- ❑ Site visits and interviews
- ❑ Capacity improvement needs:
    - ❑ Existing levels of service
    - ❑ Traffic modeling of future travel demands
    - ❑ Trend analysis and forecasted growth
- ❑ Safety improvement needs:
    - ❑ Accident frequency and severity
    - ❑ Conformance with current geometric standards
    - ❑ Pavement and bridge structure conditions
- ❑ Other

TxDOT Requirements:

- ❑ *"Need & Purpose Statement"*

A.2. Investment Studies & Alternatives Assessments

Various studies address possible alternatives when the solution is unknown. In some cases, these studies may show that the project is not economically justifiable – or that it has so many environmental impacts that it is not viable. Early determination of these findings will avoid unnecessary expenditure of funds on preliminary engineering and related costs. These studies may take the form of feasibility/route studies or major investment studies. Issues of concern during study processes include:

- ❑ Stakeholder activity responsibilities
- ❑ Consultant reviews and selection

- Route requirement determinations
- Corridor selection and major alternatives
- Preliminary surveys:
    - Population densities
    - Trends in land use and development
    - Travel patterns
    - Travel trends
    - Directional distribution and volumes
    - Economic, social, and environmental conditions
- Existing traffic data at governmental levels (e.g., city, county, state)
- Alternative profile layouts and preliminary mapping
- Multi-modal alternatives and inter-modal connections
- Toll lane and high occupancy vehicle lane inclusions
- Railroad corridor preservation
- Preliminary public involvement
- Major investment study needs
- Transportation Planning:
    - Short-term
    - Medium-term
    - Long-term
- Other

TxDOT Deliverables and Processes:
- *"Request for Feasibility Study" preparation, execution, and approval*
- *Unified planning work program (UPWP)*
- *Statewide transportation implementation plan (STIP)*
- *Long-range transportation plan (LRTP)*

A.3. Programming & Funding Data

Authorization of projects within local, governing transportation plans is a typical requirement prior to executing funding agreements. As part of the authorization process, relatively accurate cost estimates must be prepared, assessing funding directed towards preliminary engineering, construction, right-of-way acquisition, utility adjustment, maintenance, and other project expenses. As such, strategic measures must be in place for determining the sources, levels, and forms of funding available to the project, as it competes against others for limited funds. Issues to consider include:

- Initial construction cost estimates
- Initial right-of-way cost estimates
- Cost drivers, such as:
    - Utility adjustment costs
    - Environmental/mitigations costs
    - Significant traffic control costs
- Cost-benefit analysis
- Sources and forms of funding:
    - Local government entities

    - State and federal agencies
    - Private entities
- Breakdown of funding participation
- Congruity with local transportation programs
- Economically disadvantageous community funding
- Level of local level community support
- Unusual funding scenarios
- Other

TxDOT Deliverables and Processes:
- *"Programming Assessment Study" preparation and execution*
- *Design and Construction Information System (DCIS) estimate update*
- *Financial Management Information System (FMIS) estimate update*
- *"Long Range Project" status execution under Unified Transportation Plan (UTP)*
- *"Advanced Funding Agreement" preparation and execution*

A.4. Key Team Member Coordination

Establishing a positive alliance among all project team members facilitates the potential for an efficient, successful outcome – particularly if this alliance is achieved early during the planning process. Infrastructure projects typically involve many different team members existing in both the public and private sectors. All key team members must be informed of project decisions and given the opportunity to attend project planning meetings, in order to minimize the impacts on sequential activities. Key team members may include:

- Right-of-way planning
- Traffic planning and programming
- Design engineering
- Environmental planning
- Construction engineering
- Operations and maintenance
- Consultants
- Local governmental authorities:
    - Local/state government officials
    - Local public agencies
    - Environmental resource agencies
    - Budgeting officers
- Federal authorities (e.g., Federal Highway Administration (FHWA) and Federal Transit Administration (FTA))
- Other

TxDOT Meetings:
- *Feasibility Scoping Meeting*
- *Project Concept Conference*
- *Project Design Conference*
- *Utility Coordination Meetings*

A.5. Public Involvement

Public involvement is an integral part of project development. Every project has to afford some level of public involvement to inform the public of project scope issues and to measure public attitudes regarding the development process. The level of public involvement is dependent upon a number of social, economic, and environmental factors, along with the type and complexity of the project. Public involvement efforts may include meetings with key stakeholders, including affected property owners, public meetings, and public hearings. Issues to consider include:

- ❑ Policy determinations regarding public involvement
- ❑ Notification procedures and responsibilities
- ❑ Identification of key stakeholders
- ❑ Identification of utility providers
- ❑ Types of public involvement:
    - ❑ Meetings with affected property owners
    - ❑ Public meetings
    - ❑ Public hearings
- ❑ Local support and/or opposition
- ❑ Public involvement strategies after project approval
- ❑ Press releases and notices
- ❑ Available website content
- ❑ Other

TxDOT Deliverables and Processes:

- ❑ *Incorporate into "Draft Environmental Impact Statement" (DEIS)*
- ❑ *Incorporate into "Final Environmental Impact Statement" (FEIS)*
- ❑ *Written summary of proceedings*
- ❑ *"Opportunity for Public Hearing" notice*
- ❑ *"Public Hearing" notice*

B. OWNER/OPERATOR PHILOSOPHIES

B.1. Design Philosophy

A list of general design principles should be developed to achieve a completed project that fulfills a functional requirement and also assimilates into the existing roadway infrastructure. Issues to consider include:

- ❑ Design life
- ❑ Safety requirements
- ❑ Multimodal Requirements
- ❑ Aesthetics requirements
- ❑ Compatibility with long-range transportation goals
- ❑ Environmental sustainability
- ❑ Access management
- ❑ Geometric/traffic speed
- ❑ Community image

- ❑ Other

B.2. Operating Philosophy

A list of general design principles should be developed to preserve the level of service desired and sufficient transportation capacity over an extended period of time. This particularly focuses on developing strategic operations plans to prevent sub-optimal capacity-related problems. Issues to consider include:

- ❑ Daily level of service requirements
- ❑ Directional volume and lane change requirements
- ❑ Operating timetables
- ❑ Technological needs assessment
- ❑ Future improvement schedule
- ❑ Flexibility to change layout
- ❑ The owner/operator of the facility
- ❑ Traffic control plans and detour availability
- ❑ Utilities location (e.g., in median, under pavement)
- ❑ Other

B.3. Maintenance Philosophy

A list of general design principles should be developed to lay out guidelines to maintain adequate roadway operations and safety over an extended period of time. Furthermore, a specific traffic control plan should be in place for the project corridor, if traffic operations interface simultaneously with maintenance operations. Issues to consider include:

- ❑ Scheduled shut-down frequencies and durations
- ❑ Traffic monitoring requirements
- ❑ Equipment access needs and provisions
- ❑ Traffic control plans and detour availability
- ❑ Environmental conservation programs
- ❑ Selection of materials for design and construction
- ❑ Other

B.4. Future Expansion & Alteration Considerations

The possibility of expansion and/or alteration of this transportation facility and site should be evaluated. These considerations consist of a list of items that will facilitate the potential expansion or evolution of facility use. Issues to consider may include:

- ❑ Regional transportation plans
- ❑ Statewide transportation plans
- ❑ Interface with future urban development sites
- ❑ Expected population densities along corridor
- ❑ Availability for added capacity and widening:
    - ❑ Vertical added capacity
    - ❑ Horizontal added capacity
- ❑ Availability for interchanges, access ramps, and frontages

- ❑ Pending and future traffic regulations
- ❑ Corridor preservation (i.e., sloped to grade, with potential for retaining walls in the future)
- ❑ Other

C. PROJECT REQUIREMENTS

C.1. Functional Classification & Use

An essential step in the design process is to determine the functions that the facility is to serve. The two major functions to consider in classifying a roadway are access and mobility. In added capacity projects, a distinction must be made as to the existing and prescribed classification. Important in this classification is whether the facility is on or off the state system. Classification often determines funding requirements and allocation. Functional types to consider include:

- ❑ Principal arterial roads (freeways):
  - ❑ Urban freeway
  - ❑ Rural freeway
- ❑ Minor arterial roads:
  - ❑ Urban frontage road
  - ❑ Rural frontage road
- ❑ Collector roads:
  - ❑ Urban multi-lane
  - ❑ Rural multi-lane
- ❑ Local roads and streets:
  - ❑ Urban street
  - ❑ Suburban street
  - ❑ Rural one-lane
- ❑ Bike and pedestrian trails
- ❑ Other

C.2. Evaluation of Compliance Requirements

Project planning requires adherence to various local, regional, and statewide plans for efficient and comprehensive tracking. As part of project development, applicable requirements must be determined and complied with. Issues to consider for compliance include:

- ❑ Regional transportation plans
- ❑ Statewide transportation plans
- ❑ Local master plans and documentation
- ❑ Related investment studies and reports
- ❑ Local entity input:
  - ❑ Municipal departments
  - ❑ Chambers of commerce
  - ❑ Public utilities
  - ❑ Public housing

- Railroads
- Ports and harbors
- Transit authorities
- Governmental councils

- Other

TxDOT Transportation Plans:

- *Texas Transportation Plan (TTP)*
- *Metropolitan Transportation Plan (MTP)*
- *Coastal Zone Management Plan (CZMP)*
- *Transportation Improvement Program (TIP)*
- *Statewide Transportation Improvement Program (STIP)*
- *Unified Transportation Program (UTP)*

C.3. Survey of Existing Environmental Conditions

A preliminary survey consists of fieldwork and data acquisition from a variety of sources, including previous surveys, geographic information systems, and resource agency databases. Identifying problematic issues at an early stage in the project development process enables adequate time to address and mitigate these concerns. Issues to consider include:

- Natural resource surveys:
    - Endangered species
    - Wetland status
    - Bodies of water
    - Existing and potential park system land
    - Permit needs
- Cultural resource surveys:
    - Historical preservation
    - Existence of cemeteries
    - Archaeological sites
- Air quality surveys:
    - Mobile source pollutants
    - Air quality analysis
    - Congestion mitigation-air quality
- Noise surveys:
    - Evaluation of need for abatement
- Hazardous materials:
    - Existing land use
    - Superfund and regulatory agency database review
    - Underground storage tanks
    - Site visits
    - Local inhabitant interviews
- Socioeconomic Impacts
- Other

C.4. Determination of Utility Impacts

Infrastructure projects often necessitate the adjustment of utilities to accommodate the design and construction of proposed transportation facilities. Failure to mitigate utility conflicts in the design process or to relocate facilities in a timely manner can result in unwarranted delays and increased project costs. Issues to consider include:

- ❑ Field verification of existing utilities facilities
- ❑ Field verification with proposed alignment
- ❑ Necessary utility facility repair and modernization
- ❑ Action plans for utility adjustments
- ❑ Physical constraints to utility placement
- ❑ Schedule impact of utility relocations and adjustments
- ❑ Determination of utility location in state right-of-way
- ❑ Local ordinances or industry standards
- ❑ Safety clearances requirements
- ❑ Other

TxDOT Requirements:

In Texas, public utilities have been granted the right to occupy State right-of-way. These rights are extended, provided that utility use will not interfere with safety of the traveling public nor the State's ability to construct and maintain highways.

- ❑ *Utility Accommodation Rules (UAR) compliance*
- ❑ *Texas Administrative Code, Environmental, 290.44 (TAC) compliance*

C.5. Value Engineering

Value Engineering (VE) studies may be used to assess a project's overall effectiveness or how well the project meets identified needs. VE is another tool that may be used in alternative selection. Study findings may show that redesign of an alternative is needed, in which case schematics may require revisions. VE is designed to gather expertise and experience of individuals to produce the most effective solution to the transportation need. Issues to consider include:

- ❑ Policy requirements and processes
- ❑ Team member and team leader identification
- ❑ Strategic resource collection and studies:
    - ❑ Redundancy factors
    - ❑ Over capacity factors
    - ❑ Life-cycle and replacement costs
    - ❑ Environmental clearance impacts
    - ❑ Other
- ❑ Report preparation and recommendations
- ❑ Session attendance requirements
- ❑ Approved response submittals
- ❑ Planning document revisions
- ❑ Other

SECTION II – BASIS OF DESIGN

D. SITE INFORMATION

D.1. Geotechnical Characteristics

Geotechnical and soil test evaluations of the project corridor should be developed. Issues to consider include:

- ❑ General site descriptions (e.g., terrain, spoil removals, areas of hazardous waste)
- ❑ Soil composition and strata structure
- ❑ Potential soil expansion considerations
- ❑ Soil densities and compaction requirements
- ❑ Seismic requirements
- ❑ Foundation requirements:
    - ❑ Allowable bearing capacities
    - ❑ Pier/pile capacities
- ❑ Water table
- ❑ Groundwater flow rates and directions
- ❑ Soil percolation rate and conductivity
- ❑ Existing contamination
- ❑ Karst formations
- ❑ Man-made/abandoned facilities
- ❑ Soil treatment and remediation needs
- ❑ Boring tests and test pits
- ❑ Other

D.2. Hydrological Characteristics

Hydraulic information should be reviewed and analyzed at a high level prior to selection of alternatives and detailed design. This information is necessary for determining hydraulic structural requirements and detention facilities, as well as preliminary right-of-way requirements. Issues to consider include:

- ❑ Drainage basin characteristics:
    - ❑ Size, shape, and orientation
    - ❑ Slope of terrain
    - ❑ Watershed development potential
    - ❑ Geology
    - ❑ Surface infiltration
    - ❑ Antecedent moisture condition
    - ❑ Storage potential (e.g., overbank, wetlands, ponds, reservoirs, channels)
- ❑ Flood plain characteristics
- ❑ Soil types and characteristics
- ❑ Ground cover and erosion concerns, including scour susceptibility
- ❑ Meteorological characteristics:
    - ❑ Precipitation types and amounts
    - ❑ Peak flow rates

    - ❑ Hydrographs
    - ❑ Special precipitation concerns
- ❑ Storm water runoff control
- ❑ Potential impacts of future development
- ❑ Other

D.3. Surveys & Planimetrics

Once it has been determined that a corridor needs to be studied, a reconnaissance of the corridor is conducted. This includes a study of the entire area. The study facilitates the development of one or more routes or corridors in sufficient detail to enable appropriate officials to recommend which will provide the optimum location. Issues to consider include:

- ❑ Right-of-entry requirements
- ❑ Surveying consultant requirements
- ❑ Current aerial photographic displays
- ❑ Existing right-of-way maps/inventory
- ❑ Preliminary survey, including recovery of existing monumentation
- ❑ Topography (contours)
- ❑ Existing structure locations
- ❑ Grid ticks and centerlines
- ❑ Geotechnical summaries
- ❑ Utility information
- ❑ Affected area maps
- ❑ Special property owner concerns
- ❑ Other

US Requirements:

- ❑ *Use of Subsurface Utility Engineering (SUE)*

D.4. Permitting Requirements

Permitting usually begins concurrently with surveys and continues throughout project construction. Personnel responsibilities should be specific to each permit and clearly delineated. In many cases, permits must be obtained before further approval of project development activities and site access. Issues to consider include:

- ❑ Waterway permits
- ❑ Wetland permits
- ❑ Flora and fauna permits
- ❑ Resource agency permits
- ❑ Historic and cultural association permits
- ❑ Pollutant and emissions permits
- ❑ Approved points of discharge permits
- ❑ Grading and erosion permits
- ❑ Local jurisdictional permits
- ❑ Other

US Requirements may include:

- ❑ *U.S. Army Corps of Engineers (USACE) and U.S. Coast Guard (USCG) permits*
- ❑ *Clean Water Act Section 404 requirements*
- ❑ *Endangered Species Act requirements*

D.5. Environmental Documentation

Project environmental classification drives the type of environmental documentation that is required. Environmental documentation should provide a brief summary of the results of analysis and coordination, as well as information about of the social, economic, and environmental impacts of a project. This includes a determination of what decision should be made on a project's construction, location, and design. In addition, the document should describe early interagency coordination and preliminary public involvement, including estimates of time required for milestones.

Types of environmental documentation in the U.S. include:

- ❑ *Environmental Assessments (EA)*
- ❑ *Environmental Impact Statements (EIS)*
- ❑ *Categorical Exclusions (CE)*
- ❑ *Potential Outcomes*
  - ❑ *Findings of No Significant Impact (FONSI)*
  - ❑ *Notice of Intent (NOI)*
  - ❑ *Record of Decision (ROD)*
  - ❑ *Categorical Exclusion (CE)*
- ❑ *Section 4F Documentation (e.g., parks and recreation areas, refuges, cultural resources, and other sites)*
- ❑ *Other*

(Note: As defined in the U. S. National Environmental Policy Act (NEPA), three levels of environmental analysis exist. At the first level, an undertaking may be categorically excluded (CE) from a detailed environmental analysis if it meets certain criteria which a federal agency has previously determined as having no significant environmental impact. At the second level of analysis, a federal agency prepares a written Environmental Assessment (EA) to determine whether or not a federal undertaking would significantly affect the environment. If this is not the case, the agency issues a Finding of No Significant Impact (FONSI). An Environmental Impact Statement (EIS) is a more detailed evaluation of the proposed action and alternatives. A Notice of Intent (NOI) announces an agency's decision to prepare an EIS for a particular action and must be published in the Federal Register. The public, other federal agencies and outside parties may provide input into the preparation of an EIS and then comment on the draft EIS when it is completed. Following the Final EIS, the agency will prepare a Record of Decision (ROD).)

D.6. Property Descriptions

In contrast to right-of-way maps being internal documents, property descriptions are prepared as exhibits for the conveyance of property interests that will be affected. The property descriptions reflect a boundary survey and include metes and bounds descriptions, as well as parcel plat determinations. Property descriptions should be summarized from survey information into an appropriate documentation form that can be logged into project information systems. Information needed includes:

- ❑ Type of property or businesses affected
- ❑ Historical data used in preparing the survey
- ❑ Parcel plats
- ❑ Parcel size and area
- ❑ Control reference point data
- ❑ Centerline station ties
- ❑ Control of access lines
- ❑ County lines
- ❑ City limit lines
- ❑ Other

D.7. Ownership Determinations

Right-of-way ownership descriptions and title determinations should be produced and made available to complement draft schematics. Property ownership along the proposed routes can be determined in the following ways:

- ❑ Review of existing right-of-way maps from previous projects
- ❑ On-site canvas of the proposed affected properties
- ❑ Appraisal maps and records
- ❑ Abstractor's indices
- ❑ Real property records
- ❑ Other

D.8. Right-of-Way Mapping

A right-of-way map is a compilation of internal data, property descriptions (which includes field notes and parcel plats), appraisal information, and improvements related to the transportation project. Right-of-way maps are recognized as internal plans and management documents, with significant impact on the project development process. Preparation of these maps normally begins after obtaining schematic design approval. Issues to consider include:

- ❑ Parcel numbers and priority
- ❑ Existing site information:
    - ❑ Improvements within right-of-way
    - ❑ Utility locations
    - ❑ Record ownership data of adjacent properties
    - ❑ Existing boundaries and limits
    - ❑ Existing drainage channels and easements

- ❑ Design information:
  - ❑ Access control lines
  - ❑ Configuration of roadway
  - ❑ Hydraulics
  - ❑ Frontage roads
  - ❑ Connecting Ramps
- ❑ Parcel information:
  - ❑ Property owner name
  - ❑ Parcel title requirements
  - ❑ Parcel number
  - ❑ Parent tract
  - ❑ Type of conveyance, if known (e.g., donation, negotiation, condemnation)
  - ❑ Station to station limits and offset
  - ❑ Area in acres and/or square feet
  - ❑ Area of uneconomic remainders
  - ❑ Property lines
  - ❑ Bearing and distance to control points
  - ❑ Property descriptions
- ❑ Other

D.9. Constraints Mapping

Environmental constraints should be incorporated into preliminary right-of-way maps and schematics. This makes it easier to track the project alternatives across potential hazardous environmental locations. Issues to consider include:

- ❑ Landfill and superfund records
- ❑ Underground storage tank locations
- ❑ Wetlands identification
- ❑ Floodway identification
- ❑ Endangered species locations
- ❑ Public park space
- ❑ Cultural resources
- ❑ Historical landmarks
- ❑ Stockpiles and production sites
- ❑ Outfall locations
- ❑ Oil and gas well piping
- ❑ Poly-chlorinated biphenyls (PCB) transformers
- ❑ Other

D.10. Right-of-Way Site Issues

Certain issues may cause difficulties in right-of-way acquisition. These issues need to be identified for the proposed parcels and a determination should be made as to their impact. Issues to consider include:

- ❑ Hazardous material exposure
- ❑ Railroad interests

- ❑ Special use properties (e.g., government use, alcohol sales, cemeteries, pet cemeteries, etc.)
- ❑ Beautification and signage
- ❑ Land use impacts
- ❑ Socioeconomic impacts
- ❑ Economic development/speculation
- ❑ Legal (lawyer) activity in area
- ❑ Title curative issues
- ❑ Federal properties
- ❑ Number of partial takings
- ❑ Splitting of parcels
- ❑ Cultural issues
- ❑ Other

E. LOCATION & GEOMETRY

E.1. Horizontal & Vertical Alignment

Due to the near permanent nature of roadway alignment once a transportation facility is constructed, it is important that the proper alignment be selected considering design speed, existing and future roadside development, subsurface conditions, topography, etc. Issues to consider include:

- ❑ Curve radius
- ❑ Super-elevation
- ❑ Crossover grades and profiles
- ❑ Sight distances and roadway contours
- ❑ Other

E.2. Control of Access

Maintaining access to specific portions of the highway is developed with the preliminary design. Furthermore, the preliminary design needs to address the concerns of controlled access limits to and from adjacent property. Simultaneously, right-of-way personnel can look into access deeds and restrictions required for the proposed design. Issues to consider include:

- ❑ Entrance/exit locations and length
- ❑ Access deed restrictions
- ❑ Safety access and turnarounds
- ❑ Special required lanes:
    - ❑ Bike and pedestrian lanes
    - ❑ High Occupancy Vehicle (HOV)/High Occupancy Toll (HOT) lanes
    - ❑ Truck-only lanes
    - ❑ Crossover lanes
- ❑ Frontage road requirements
- ❑ Controlled access systems
- ❑ Split-parcel access requirements

- ❑ Driveway access requirements
- ❑ Other

E.3. Schematic Layouts

The submission of schematic layouts should include basic information necessary for the proper review and evaluation of the proposed improvement. The schematic is essential for use in public meetings and coordinating design features. Issues to consider include:

- ❑ General project information (e.g., boundary limits, speed, classification)
- ❑ Location of interchanges, main lanes, frontages, ramps
- ❑ Signing schematic
- ❑ Profiles and alignments
- ❑ Added capacity analysis
- ❑ Tentative right-of-way limits
- ❑ Geometrics
- ❑ Location of retaining and noise abatement walls
- ❑ Projected traffic volumes
- ❑ Control of access lines
- ❑ Interstate access justification
- ❑ Median location and width
- ❑ Auxiliary lanes
- ❑ Existing structures and removal of improvements
- ❑ Other

TxDOT Requirements:

- ❑ *Schematics must be approved by the Federal Highway Administration (FHWA) if involving Federal funding.*

E.4. Cross-Sectional Elements

Typical highway cross-sections are an important design element related to cost and schedule of the proposed project. The width of the right-of-way will be controlled by the proposed design. Examination of the typical cross-section will indicate those elements of design affecting the width of proposed right-of-way and utility adjustments among other factors. Issues to consider include:

- ❑ Pavement cross slopes
- ❑ Number and width of lanes
- ❑ Width of median
- ❑ Width of shoulder
- ❑ Cross drainage structures
- ❑ Horizontal clearances to obstructions
- ❑ Extent of side slopes and ditches
- ❑ Extent of berm area
- ❑ Frontage roads and ramp radii
- ❑ Sidewalks and pedestrian elements
- ❑ Noise abatement walls

- ❑ Other

F. STRUCTURES

F.1. Bridge Structure Elements

Bridge requirements along the extent of right-of-way for a project are often necessary. As a result, right-of-way requirements must take into account the impacts of bridge design on the affected corridor. Foundations and clearance requirements should be addressed along with the following:

- ❑ Bridge structure locations
- ❑ Safety tolerances:
    - ❑ Maximum height clearances
    - ❑ Maximum loads and capacities
    - ❑ Other
- ❑ Clear roadway width
- ❑ Utilities attached to bridge structures
- ❑ Turnarounds
- ❑ Access requirements
- ❑ Maintenance of right-of-way
- ❑ Retaining walls and abutments
- ❑ Vertical and horizontal alignment
- ❑ Other

F.2. Hydraulic Structures

In analyzing or designing drainage facilities, the investment of time, expense, concentration, and completeness should be influenced by the relative importance of the facility. Some of the basic components inherent in the design or analysis of any highway drainage facility include data, surveys of existing characteristics, estimates of future characteristics, engineering design criteria, discharge estimates, structure requirements and constraints, and receiving facilities. Issues to consider include:

- ❑ Open channels and outfall structures:
    - ❑ Right-of-way impact
    - ❑ Environmental impact
- ❑ Storm drain systems
- ❑ Culverts
- ❑ Irrigation controls
- ❑ Street cleaning requirements
- ❑ Special required easements
- ❑ Other

F.3. Miscellaneous Design Elements

In addition to typical roadway design elements, the following features may require design consideration and the acquisition of additional right-of-way. These items should be identified and listed. Items may include:

- ❑ Longitudinal barriers
- ❑ Fencing
- ❑ Noise abatement walls
- ❑ Historical markers
- ❑ Rest areas and stops
- ❑ Extended shoulders for service
- ❑ Truck weigh stations
- ❑ Hazardous material traps
- ❑ Pedestrian separations and ramps
- ❑ Parking
- ❑ Traffic control operations
- ❑ Signage, delineation, roadway markings
- ❑ Emergency median openings and widths
- ❑ Runaway vehicle lanes
- ❑ Truck and bus facilities
- ❑ Other

G. DESIGN PARAMETERS

G.1. Provisional Maintenance Requirements

Everything constructed or placed in the highway right-of-way must be maintained. This would include items such as roadway structures, drainage structures, traffic control devices, vegetation, and other highway related items. The roadway alignment and cross-sections should provide accommodation for maintenance equipment off the paved areas to service these items when necessary. Placement of utilities should be considered in terms of impact on maintenance. To the extent practical, utilization of desirable design criteria recommended regarding maximum roadway side-slope ratios and ditch profile grades will reduce maintenance and make required maintenance operation easier to accomplish. Items to consider include:

- ❑ Extent of berm areas
- ❑ Elevated and subsurface roadways
- ❑ Route accessibility
- ❑ Route detour options
- ❑ Retaining walls
- ❑ Technology support structures
- ❑ Access gates or ramps
- ❑ Surfaces finishes (paint, hot-dip galvanized, etc.)
- ❑ Types of vegetation
- ❑ Other

G.2. Constructability

Constructability is the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives. Maximum benefits occur when people with construction knowledge and experience become involved at the very beginning of a project. A structured approach for constructability analysis should be in place. Provisions should be made to provide this on an ongoing basis. This would include examining design options and details of construction that minimize construction costs while maintaining standards of safety, quality, and schedule. Elements of constructability during advance planning include:

- ❑ Constructability program in existence
- ❑ Construction knowledge/experience used in project planning
- ❑ Early construction involvement in contracting strategy development
- ❑ Developing a construction-sensitive project schedule
- ❑ Developing site layouts for efficient construction
- ❑ Early identification of project team participants for constructability analysis
- ❑ Construction easements for right-of-way planning
- ❑ Usage of advanced information technologies
- ❑ Other

H. INSTALLED EQUIPMENT

H.1. Equipment List

Project-specific installed equipment should be defined and listed. Items may include:

- ❑ Electronic signage
- ❑ Highway traffic signals
- ❑ Temporary traffic control zone devices
- ❑ Traffic control devices:
  - ❑ Low-volume roads
  - ❑ For school areas
  - ❑ Highway-rail or transit grade crossings
  - ❑ Bicycles
  - ❑ Highway-light rail transit grade crossings
- ❑ Intelligent transportation systems devices:
  - ❑ Cameras
  - ❑ Loop detectors
  - ❑ Sensors
  - ❑ Monitors
- ❑ Rest area requirements
- ❑ Toll equipment
- ❑ Other

H.2. Equipment Location Drawings

Equipment location/arrangement preliminary drawings identify the location of each item of installed equipment in a project. Issues to consider include:

- ❑ Location, including coordinates
- ❑ Coordination of location among all equipment
- ❑ Setbacks
- ❑ Traffic interface

- ❑ Elevation views of equipment, if possible
- ❑ Visibility of equipment
- ❑ Structural or foundation requirements for equipment
- ❑ Other

H.3. Equipment Utility Requirements

This evaluation should consist of a tabulated list of utility requirements for all major installed equipment items, including:

- ❑ Power:
  - ❑ Hard line
  - ❑ Solar
- ❑ Water
- ❑ Sewage
- ❑ Communications
- ❑ Fuel
- ❑ Other

SECTION III – EXECUTION APPROACH

I. ACQUISITION STRATEGY

I.1. Long-Lead Parcel & Utility Adjustment Identification

Right-of-way acquisition and utility adjustment are always on the critical path of a highway project if they are one of the tasks required. It is important to identify and focus on all parcels, but especially those that might cause delay (as identified in element D.10.). A strategy must be developed to address these problematic parcels and/or utility adjustments. Issues to consider include:

- ❑ Prioritization of parcels for acquisition and utilities for adjustment
- ❑ Defining responsible party for parcel acquisition and utility adjustment
- ❑ Appraisal performance
- ❑ Title commitment review
- ❑ Relocation of displacees
- ❑ Abatement and removal of improvements
- ❑ Other

I.2. Long-Lead/Critical Equipment & Materials Identification

Installed equipment and material items with long lead times may impact the design and construction schedule. These items should be identified and tracked. A strategy should be developed to expedite these items if possible. Examples may include:

- ❑ Toll equipment
- ❑ Electronic information boards
- ❑ Bridge structural components
- ❑ Pre-cast elements
- ❑ Other

I.3. Local Public Agencies Utilities Contracts & Agreements

Contractual agreements with Local Public Agencies (LPA) participants may be required. The execution of contractual agreements establishes responsibilities for the acquisition of right of way, adjustment of utilities and cost sharing between the LPA(s) and the Department of Transportation (DOT). The type of contract to be used is determined by whether the LPA desires to administer right of way activities and payments or defer those responsibilities to the DOT. Issues to consider include:

- ❑ Cost participation and work responsibilities between the DOT and LPAs
- ❑ Prerequisites to secure right-of-way project release on non-federal-aid projects
- ❑ Request for determination of eligibility
- ❑ Other

TxDOT Requirements:

- ❑ *ROW-RM-37, Contractual Agreement for Right of Way Procurement*

- ❑ *ROW-RM-129, Agreement to Contribute Funds*

I.4. Utility Agreement & Joint-Use Contracts

Prioritizing utility agreements may be essential to insure that the concurrent review and approval processes are coordinated and efficient. The utility agreements and joint-use contracts effectively enable the utility to share space on public right-of-way and complete utility adjustments. Issues to consider include:

- ❑ Utility agreements, plans, and estimates
- ❑ Supporting documentation
- ❑ Transmittal memo from district to division
- ❑ Other

TxDOT Requirements:

- ❑ *Form ROW-U-1A, ROW-U-1B, or ROW-U-1C, appropriate property interest document*
- ❑ *Form ROW-U-48, statement covering contract work*
- ❑ *Form ROW-U-JUAA, Joint-use acknowledgement*
- ❑ *Form ROW-U-40, signature authority*
- ❑ *District and division approval processes*

I.5. Project Delivery Method & Contracting Strategies

The methods of project design and construction delivery, including fee structure should be identified. Types of project delivery methods and contract strategies to consider include:

- ❑ Owner self-performed
- ❑ Comprehensive development agreement (CDA) concession
- ❑ Designer and constructor qualification selection process
- ❑ Selected methods (e.g., design/build, construction management (CM) at risk, competitive sealed proposal, bridging, design-bid-build)
- ❑ Fee arrangement (e.g., lump sum, cost-plus, negotiated)
- ❑ Design/build scope package considerations
- ❑ Other

I.6. Design/Construction Plan & Approach

This is a documented plan identifying the specific approach to be used in designing and constructing the project. It should include items such as:

- ❑ Responsibility matrix
- ❑ Subcontracting strategy
- ❑ Work week plan/schedule
- ❑ Organizational structure
- ❑ Work Breakdown Structure (WBS)
- ❑ Sequencing with parcel acquisition
- ❑ Construction sequencing of events
- ❑ Site logistics plan
- ❑ Safety requirements/program

- ❑ Identification of critical activities that have potential impact on facilities (i.e., existing facilities, traffic flows, utility shut downs and tie-ins)
- ❑ Quality assurance/quality control (QA/QC) plan
- ❑ Design and approvals sequencing of events
- ❑ Integration of design, right-of-way acquisition, utility adjustment, and construction
- ❑ Equipment procurement and staging
- ❑ Contractor meeting/ reporting schedule
- ❑ Partnering or strategic alliances
- ❑ Alternative dispute resolution
- ❑ Furnishings, equipment, and built-ins responsibility
- ❑ Other

I.7. Procurement Procedures & Plans

Procurement procedures and plans include specific guidelines, special requirements, or methodologies for accomplishing the purchasing, expediting, and delivery of equipment and materials required for the project. Issues to consider include:

- ❑ The party performing procurement
- ❑ Listing of approved vendors, if applicable
- ❑ Client or contractor purchase orders
- ❑ Reimbursement terms and conditions
- ❑ Guidelines for supplier alliances, single source, or competitive bids
- ❑ Guidelines for engineering/construction contracts
- ❑ Responsibility for owner-purchased items, including:
    - ❑ Financial
    - ❑ Shop inspection
    - ❑ Expediting
- ❑ Tax strategy, including:
    - ❑ Depreciation capture
    - ❑ Local sales and use tax treatment
    - ❑ Investment tax credits
- ❑ Definition of source inspection requirements and responsibilities
- ❑ Definition of traffic/insurance responsibilities
- ❑ Definition of procurement status reporting requirements
- ❑ Additional/special owner accounting requirements
- ❑ Definition of spare parts requirements
- ❑ Local regulations (e.g., tax restrictions, tax advantages)
- ❑ Incentive/penalty strategy for contracts
- ❑ Storage
- ❑ Operating manual requirements and training
- ❑ Restricted distribution of construction documents for security and anti-terrorism reasons
- ❑ Other

I.8. Appraisal Requirements

Acquisition cannot begin until a formal right-of-way release is obtained. An early step in acquisition is to determine the value of parcels for reimbursement. Ensuring appraisal occurs in a timely manner is essential. Appraisal requirements include:

- ❑ Pre-appraisal contacts
- ❑ Determination of number of appraisers required
- ❑ Determination of appraisal assignments
- ❑ Use of contract appraisers
- ❑ Prioritization of parcel appraisals, if required
- ❑ Other

I.9. Advance Acquisition Requirements

Advance acquisition is defined as right-of-way acquisition that occurs before normal release for acquiring right-of-way is given on a transportation project. Advance acquisition requirements need to be identified and addressed as soon as possible in the project. Although this process bypasses detailed environmental scoping, consideration for environmental effects should be made in determining parcels for advance acquisition. Examples of advance acquisition include the following:

- ❑ Hardship acquisition of a parcel at the property owner's request
- ❑ Protective buying to prevent imminent parcel development that would materially increase right of way costs
- ❑ Donation of land for right-of-way purposes for no consideration
- ❑ Other

J. DELIVERABLES

J.1. CADD/Model Requirements

Computer Aided Drafting and Design (CADD) requirements should be defined. Evaluation criteria should include:

- ❑ Application software preference (e.g., 2D or 3D CADD, application service provider (ASP)), including licensing requirements
- ❑ Geographical Information System (GIS) requirements
- ❑ Configuration and administration of servers and systems documentation defined
- ❑ Compatibility requirements of information systems (e.g. design information system, construction information system)
- ❑ Owner/contractor standard symbols, file formats and details
- ❑ Handling of life cycle facility data including asset information, models, and electronic documents
- ❑ Information technology infrastructure to support electronic modeling systems, including uninterruptible power systems (UPS) and disaster recovery
- ❑ Security and auditing requirements defined
- ❑ Physical model requirements
- ❑ Other

TxDOT Requirements:

- ❑ *Use of Microstation in design*
- ❑ *Use of Statewide TxDOT Computer-Aided Drawing (CAD) Standard Plan Files (e.g, Bridge, Maintenance, Roadway, Traffic Standards)*
- ❑ *TxDOT Geopak Data Files*

J.2. Documentation/Deliverables

The following items should be included in a list of deliverables:

- ❑ Field surveying books
- ❑ Estimates
- ❑ Required submissions and/or approvals
- ❑ Drawings
- ❑ Project correspondence
- ❑ Permits
- ❑ Project data books (quantity, format, contents, and completion date)
- ❑ Equipment folders (quantity, format, contents, and completion date)
- ❑ Design calculations (quantity, format, contents, and completion date)
- ❑ Procuring documents
- ❑ As-built documents
- ❑ Quality assurance documents
- ❑ Updated information systems and databases
- ❑ Other

TxDOT Requirements:

- ❑ *Updated Design and Construction Information System (DCIS)*
- ❑ *Updated Financial Information Management Systems (FIMS)*
- ❑ *Updated Right of Way Information System (ROWIS)*
- ❑ *PS&E Submission:*
  - ❑ *PS&E Submission Data Sheet*
  - ❑ *Supporting Papers Checklists (e.g. ROW and utilities certificates, review plans prints, contract time determination summary)*
  - ❑ *PS&E Checklists (pre-submission checklist and PS&E checklist for either district review projects or division review projects)*

K. PROJECT CONTROL

K.1. Right-of-Way & Utilities Cost Estimates

The cost estimates will be prepared by the utility and submitted in support of the utility agreement and plans required for the proposed work. An agreement assembly should include estimates covering only the work for clearing transportation project construction. Right-of-way costs are defined as those instances where there is an interest in land acquired. Replacement right-of-way may be defined as the land and interests in land acquired outside existing highway right-of-way for or by the utility. Right-of-way costs incurred by a utility before issuance of the right-of-way project release may not be eligible for reimbursement. Right-of-way costs incurred after release may be reimbursed, if otherwise found eligible. Issues to consider include:

- ❑ Cost of right-of-way
- ❑ Cost of utility adjustment
- ❑ Salaries and expenses of utility employees engaged in the valuation and negotiation
- ❑ Amounts paid to independent fee appraisers for appraisal of the right-of-way
- ❑ Recording costs
- ❑ Deed fees
- ❑ Costs normally paid that are incidental to land acquisition
- ❑ Payment of property damages and losses to improvements
- ❑ Other

K.2. Design & Construction Cost Estimates

The project cost estimates should address all costs (excluding right-of-way acquisition and utility adjustment costs that are addressed in element K.1.) necessary for completion of the project. These cost estimates may include the following:

- ❑ Construction contract estimate
- ❑ Professional fees
- ❑ Administrative costs
- ❑ Contingencies
- ❑ Cost escalation for elements outside the project cost estimates
- ❑ Startup costs including installation
- ❑ Capitalized overhead
- ❑ Safety items
- ❑ Site-specific insurance requirements
- ❑ Incentives
- ❑ Miscellaneous expenses including but not limited to:
  - ❑ Specialty consultants
  - ❑ Inspection and testing services
  - ❑ Bidding costs
  - ❑ Site clearance
  - ❑ Environmental impact mitigation measures
  - ❑ Local authority permit fees
  - ❑ Sureties
- ❑ Taxes:
  - ❑ Depreciation schedule
  - ❑ Capitalized/expensed
  - ❑ Tax incentives
  - ❑ Contractors’ sales tax
- ❑ Utility costs during construction (if paid by owner)
- ❑ Interest on borrowed funds (cost of money)
- ❑ Site surveys, soils tests
- ❑ Availability of construction laydown and storage at site or in remote or rented facilities

- ❑ Other

K.3. Project Cost Control

Procedures for controlling project cost need to be outlined and responsibility assigned. These may include cost control requirements such as:

- ❑ Financial (client/regulatory)
- ❑ Phasing or area sub-accounting
- ❑ Capital versus non-capital expenditures
- ❑ Report requirements
- ❑ Payment schedules and procedures
- ❑ Cash flow projections/draw down analysis
- ❑ Cost code scheme/strategy
- ❑ Costs for each project phase
- ❑ Periodic control check estimates
- ❑ Change order management procedure, including scope control and interface with information systems
- ❑ Costs pertaining to right-of-way acquisition and utility adjustment during project execution
- ❑ Other

K.4. Project Schedule Control

The project schedule is created to show progress and ensure that the project is completed on time. The schedule is necessary for design and construction of the facility. A schedule format should be decided on at the beginning of the project. Typical items included in a project schedule are listed below:

- ❑ Milestones
- ❑ Required submissions and/or approvals
- ❑ Required documentation/responsible party
- ❑ Baseline schedule versus progress-to-date schedule
- ❑ Critical path activities, including field surveys
- ❑ Contingency or “float time”
- ❑ Permitting or regulatory approvals
- ❑ Activation and commissioning
- ❑ Liquidated damages/incentives
- ❑ Unusual schedule considerations
- ❑ The owner must also identify how special project issues will be scheduled. These items may include:
  - ❑ Selection, procurement, and installation of equipment
  - ❑ Stages of the project that must be handled differently than the rest of the project
  - ❑ Tie-ins, service interruptions, and road closures
- ❑ Other

K.5. Project Quality Assurance & Control

Quality assurance and quality control procedures need to be established. Responsibility for approvals needs to be developed. Electronic media requirements should be outlined. These issues may include:

- ❑ Administration of contracted professional services
- ❑ Responsibility during design and construction
- ❑ Testing of materials and workmanship
- ❑ Quality management system requirements (e.g. ISO 9000)
- ❑ Environmental quality control
- ❑ Submittals
- ❑ Inspection reporting requirements
- ❑ Progress photos
- ❑ Reviewing changes and modifications
- ❑ Communication documents (e.g., Requests for Information, Requests for Qualifications)
- ❑ Lessons-learned feedback
- ❑ Other

U.S. Requirements:

- ❑ *Environmental quality control as outlined in U. S. National Environmental Policy Act (NEPA)*

TxDOT Requirements:

- ❑ *Administration of contracted Right of Way Acquisition Professional Services (ROWAPS)*

K.6. Safety Procedures

Safety procedures and responsibilities must be identified for design consideration and construction. Safety issues to be addressed may include:

- ❑ Staging area for material handling
- ❑ Environmental safety procedures, including hazardous material handling
- ❑ Right-of-way needs for safe construction
- ❑ Right-of-way requirements for design safety
- ❑ Safety in utility adjustment
- ❑ Interaction with the public
- ❑ Working at elevations/fall hazards
- ❑ Evacuation plans and procedures
- ❑ Drug testing
- ❑ First aid stations
- ❑ Accident reporting and investigation
- ❑ Pre-task planning
- ❑ Safety for motorists
- ❑ Safety orientation and planning
- ❑ Safety incentives
- ❑ Contractor requirements
- ❑ Other special or unusual safety issues

L. PROJECT EXECUTION PLAN

L.1. Environmental Commitments & Mitigation

Environmental commitments determine what a project's involved parties can and cannot do to protect the environment. Environmental commitments begin at the earliest phase of project development, although completion of commitments may not occur until the operation and maintenance phase of a project. Because there is a substantial time gap between the beginning and end of a commitment, it is imperative that commitments are communicated from environmental clearance through detailed design, pre-bid conference, project letting, maintenance, and operation. Issues to consider include:

- ❑ Avoidance commitments
- ❑ Compensation commitments
- ❑ Enhancements commitments
- ❑ Minimization commitments
- ❑ Habitat mitigation
- ❑ Water quality facilities management
- ❑ Wetland mitigation
- ❑ Storm water management plans
- ❑ Cultural resources mitigation
- ❑ Noise abatement remediation
- ❑ Hazardous materials abatement locations
- ❑ Environmental remediation plans
- ❑ Other

L.2. Interagency Coordination

Early coordination with appropriate resource agencies, local governmental entities, and the public plays a vital role in project planning and environmental development of proposed projects. Both the districts and divisions are responsible for interagency coordination during project planning and development. Coordination is initiated at the regional and statewide levels. Coordination agencies to consider may include:

- ❑ State historic preservation offices
- ❑ Natural resource conservation services
- ❑ Environmental protection agencies
- ❑ Fish and wildlife services
- ❑ International boundary and water commissions
- ❑ Federal emergency management agencies
- ❑ Offices of habitat conservation
- ❑ Law enforcement agencies
- ❑ Immigration agencies
- ❑ Parks and wildlife agencies
- ❑ Other

U.S. & TxDOT-Related Agency Coordination:

- ❑ *Metropolitan Planning Organization (MPO)*

- ❑ *Texas Commission on Environmental Quality (TCEQ)*
- ❑ *Coastal Coordination Council (CCC)*
- ❑ *Environmental Protection Agency (EPA)*
- ❑ *Federal Emergency Management Agency (FEMA)*

L.3. Local Public Agency Contractual Agreements

To establish acquisition and funding responsibilities and requirements of the Department of Transportation (DOT) and a Local Public Agency (LPA), an agreement must be entered into before a project is released for right-of-way acquisition. Issues to consider include:

- ❑ Master agreement governing local transportation project advance funding agreements
- ❑ Reimbursement to the LPA for negotiated parcels
- ❑ Local project advance funding agreement
- ❑ Other

TxDOT Requirements:

- ❑ *Master Advance Funding Agreement (MAFA)*
- ❑ *Local Public Agency Funding Agreement (LPAFA)*

L.4. Interagency Joint-Use Agreements

There are various agencies, districts, and commercial interests that the Department of Transportation must execute agreements with in order to jointly use certain right-of-ways or for utility adjustments. Joint-use agreements may include:

- ❑ Railroad agencies
- ❑ Flood control district
- ❑ Utility companies
- ❑ Municipal utility districts (MUDs)
- ❑ Roadway utility districts (RUDs)
- ❑ Other

U.S. joint-use agreements may include:

- ❑ *Corps of Engineers*

L.5. Preliminary Traffic Control Plan

Traffic control plans should clearly show provisions for safe and efficient operation of all modes of transportation during construction and safety of construction workers and inspection personnel. A preliminary traffic control plan that is compliant with the U. S. and state Department of Transportation Manual of Uniform Traffic Control Devices (MUTCD) should be developed. Issues to consider include:

- ❑ A detour plan
- ❑ Appropriate signs, markings, and barricades per the traffic control plan
- ❑ Safety equipment, such as:
    - ❑ Barrels
    - ❑ Signage

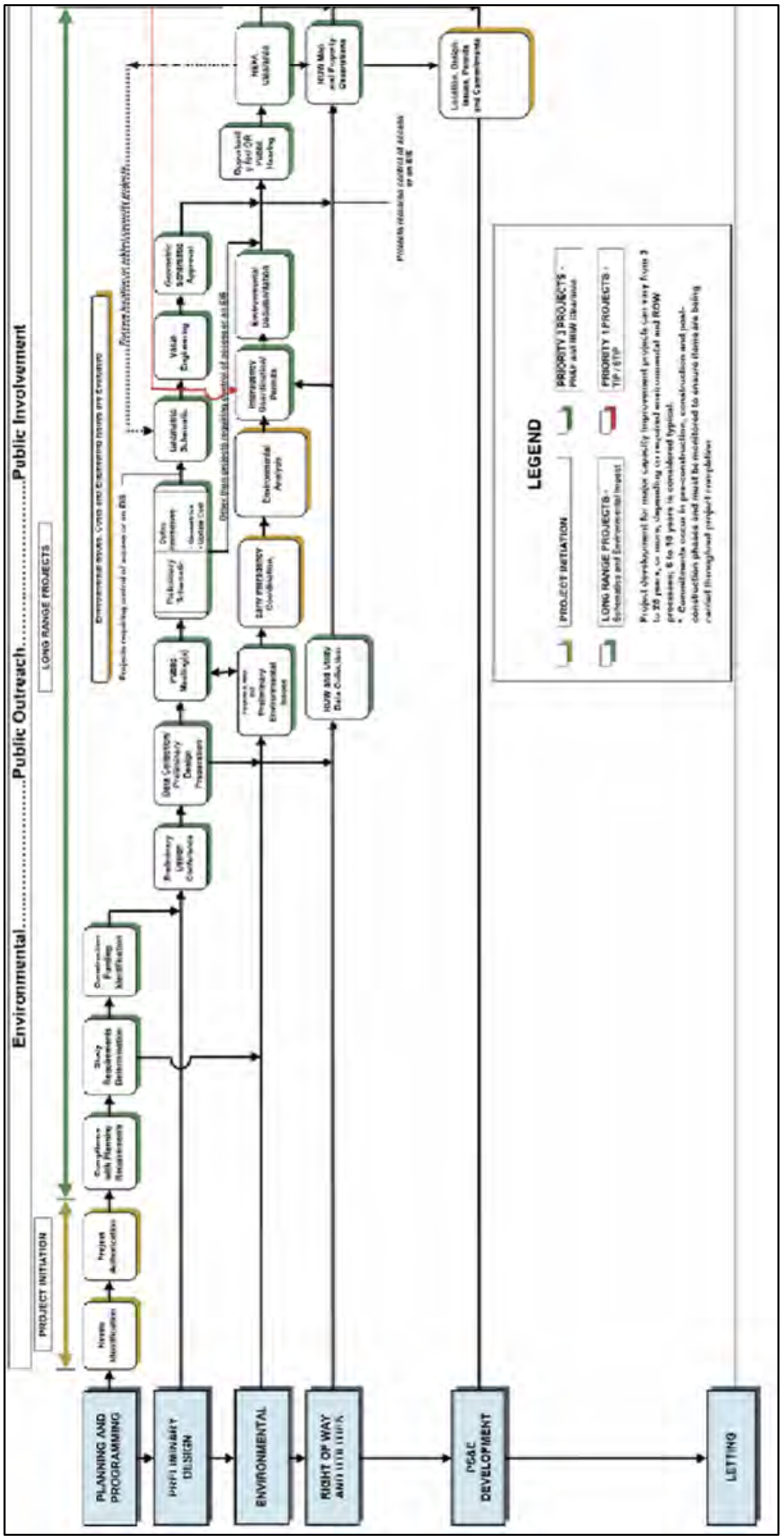
  - Flagmen
  - Positive barriers
  - Vertical panels
- Clear zone protection devices, such as:
  - Concrete traffic barriers
  - Metal beam guard fencing
  - Appropriate end treatments
  - Other appropriate warning devices
- Other

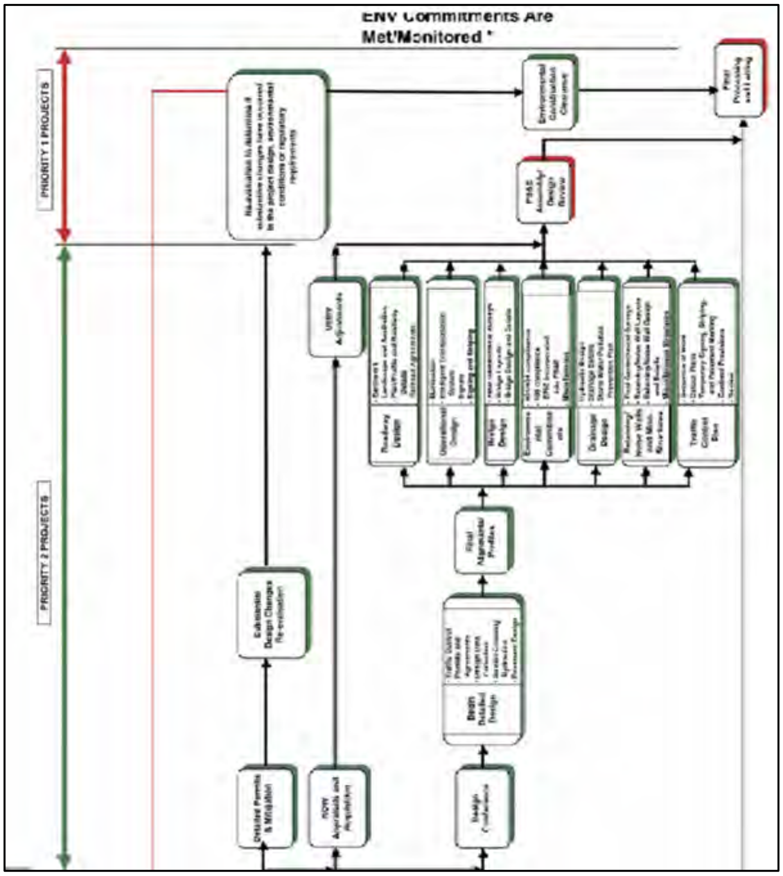
L.6. Substantial Completion Requirements

Substantial Completion (SC) is the point in time when the facilities are ready to be used for their intended purposes. Preliminary requirements for substantial completion need to be determined to assist the planning and design efforts. The following may need to be addressed:

- Specific requirements for SC responsibilities developed and documented
- Warranty, permitting, insurance, and tax implication considerations
- Commissioning
- Technology start-up support on-site, including information technology and systems
- Equipment/systems startup and testing
- Occupancy phasing
- Final code inspection
- Calibration
- Verification
- Documentation
- Training requirements for all systems
- Community acceptance
- Landscape requirements
- Punchlist completion plan and schedule
- Substantial completion certificate
- Other

Appendix C: Environmental Project Development Flowchart





Environmental Project Development Flowchart (cont'd)

Appendix D: Select Weighting Workshop Documents

A WORKSHOP AGENDA EXAMPLE

TXDOT RESEARCH PROJECT 0-5478
APRA Weighting Workshop Meeting Agenda

MEETING DETAILS:

Date:	September 13, 2006
Time:	9:30 AM – 3:00 PM (CST)
Location:	Dallas District Office 4777 US Highway 80 East Mesquite, TX 75149
Re:	Advance Planning Risk Analysis

TOPICS OF DISCUSSION:

I. Introductions & Background Information *(9:30 – 10:00 am)* – GEG

II. Weighting Input to the APRA *(10:00 – 11:30 am)* – GEG

III. Lunch – Provided by CTR *(11:30 – 12:30 pm)*

IV. Weighting Input to the APRA – continued *(12:30 – 2:30 pm)* – CHC

V. Final Discussion on APRA *(2:30 – 3:00 pm)* – GEG, CHC

BRIEF INTRODUCTION TO THE APRA

TxDOT Research Project 0-5478 Team is developing the **Advance Planning Risk Analysis (APRA)** as a best practices tool for improving the effectiveness of the project development process on **transportation projects**. The APRA is envisioned to help the project development team to improve the process through structured yet flexible risk management, which consists of identifying, analyzing, and controlling risk issues. Fifty-nine risk issues have been identified by the research project team. Upon completion, the tool can be used to rate a project and yield a score and generate a list of issues to be addressed. The score and the list can be used to evaluate riskiness of the project, the project's chance for success, and the areas that the project team needs to address.

As stated above, fifty nine risk issues have been identified and grouped into categories and sections. However, we understand that they are not equally important regarding to the impact on the project's success. We are asking that experienced project managers and project development subject experts help us determine the issues' impact on overall project success. For this, we sincerely request your assistance. We believe that your skills and experience will be invaluable in helping us determine **weighting factors** that should be assigned to each issue.

Again, we appreciate any assistance you can provide in developing the APRA. We believe this tool to be a valuable resource for improving advance planning efforts on transportation projects. Once it is complete, we will provide you with a copy for your use. We plan to have a completed version ready fall 2007.

Thank you very much for your time and effort.

INSTRUCTIONS FOR EVALUATING THE APRA ELEMENTS

Who should evaluate the APRA?

The APRA consists of three sections:

- Section I: Basis of Project Decision
- Section II: Basis of Design
- Section III: Execution Approach

As stated in the Brief Introduction to the APRA, those with experience in both *project management* and the *project development process* should complete the APRA Weighting Factor Evaluation form. This approach will provide the research team with the most accurate evaluation of the APRA element weights and allow us to assess the relative importance of each element.

How to evaluate the APRA?

Evaluate each element in the following manner:

> Assume that your team is estimating a typical project that your organization works on and evaluating its probability of success based on the 59 criteria defined in the APRA Descriptions document. (When performing this evaluation, please consider a typical project type and size familiar to you. Please state the type of project as well as its total installed dollar value in the Background Information sheet.) Evaluate the *level of definition* of each element in the APRA Element Descriptions and apply what you feel to be an appropriate **contingency** to that element **(i.e., its individual impact on Total Installed Cost stated as a percentage of the overall estimate at the point where detailed design is about to commence)**. In other words, what contingency would you deem appropriate for an element when evaluating its current level of definition considering that you were about to begin the development of PS&E (plans, specifications, and estimates), i.e. after environmental clearance and ROW release. An element's level of definition has impact on both cost and time aspects of a project. Thus, when determining the level of contingency to apply, take both cost and time (converted into cost) impacts into consideration. The levels of definition that will be used for evaluating each element are 1 and 5 and are defined as follows:
>
> 1 = Complete Definition
> 5 = Incomplete or Poor Definition
>
> As an element becomes more well-defined, assess how this would affect the percentage of contingency that you would allocate for it when planning the project. For example, if you were developing an estimate for a new highway construction project, how would the level of definition of the "Right-of-Way Mapping" in the project definition package affect your estimate? What contingency would you deem appropriate for the "Right-of-Way Mapping" that were well defined and totally undefined.

Our recommended methodology:

Consider each element *individually*. Evaluate the worst case scenario first. If that element is incomplete or poorly defined (i.e., level 5), assess what percent contingency you would deem appropriate for that element and write it on the evaluation form in the corresponding box. As shown in the following example, you may feel that 30 percent is appropriate for this element. Then, evaluate the best case scenario assuming that the element is perfectly defined (i.e., level 1), and apply a contingency in a similar fashion. This contingency should be a low number, perhaps 2 percent.

Example:

CATEGORY Element	**Definition Level**				
	1	**2**	**3**	**4**	**5**
D. SITE INFORMATION					
D8. Right-of-Way Mapping	2%				30%

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

Also enclosed is a Background Information sheet. We ask that you please take a few moments to complete this form. The research team needs to thoroughly document all sources used to create the APRA to ensure its acceptance by the user. Further, we have enclosed a Suggestions for Improvement sheet with which you may evaluate any item in this package. We gladly welcome your opinions and sincerely request any feedback regarding items that may be unclear, redundant, unnecessary, or left out. We will discuss these issues at the close of the workshop.

Thank you very much for your time and effort. If you have any questions, please contact:

Tiendung Le
Graduate Research Assistant
The University of Texas at Austin
1 University Station C1752
Austin TX 78712
Phone: (512) 825-4834
Fax: (512) 471-3191
E-mail: tdle@mail.utexas.edu

Dr. Carlos H. Caldas
Assistant Professor
The University of Texas at Austin
1 University Station C1752
Austin TX 78712
Phone: (512) 471-6014
Fax: (512) 471-3191
E-Mail: caldas@mail.utexas.edu

BACKGROUND INFORMATION

Name:	Date:
Employer:	
Working Position:	
Department/Division:	
Working Address:	Alternate Address:
Phone: ( )	Phone: ( )
Fax: ( )	Fax: ( )
Email address:	

Project Management/Project Development Experience

1) Total years of PM/PD experience:

2) What percentage of your experience was spent on the following types of projects:
- Urban?
- Rural?
- Other (what types)?

3) Average annual dollar value of projects worked on or estimated over the last 3 years?

4) What percentage of your experience was spent on the following types of projects:
- New construction?
- Renovations/Expansion?

5) During your career, what is the approximate total value of your projects involving...
- New construction?
- Renovations/Expansion?

Typical Project for Your Organization and Your Basis for APRA Weighting

1) What type of projects, typical for your company, was used as a basis for weighting the APRA? (*please choose one*)

❑ New, Urban ❑ New, Rural
❑ Renovations/Expansion, Urban ❑ Renovations/Expansion, Rural

2) What was the total installed dollar value of the project considered? (*please choose one*)

❑ Less than $5 million ❑ $5 to $10 million ❑ $10 to $20 million
❑ $20 to $50 million ❑ $50 to $100 million ❑ Over $100 million

3) Write down the name and size of the project. (i.e., ABC Highway, 10 miles)

4) Using a scale of 1 to 5, please rate how successful you feel that this project was (circle only one):

1 2 3 4 5

very unsuccessful =======================> very successful

APRA WEIGHTING FACTOR EVALUATION FORM

ADVANCE PLANNING RISK ANALYSIS (APRA)
FOR TRANSPORTATION PROJECTS

Name: ___________________________________ Date:

SECTION I – BASIS OF PROJECT DECISION						
	Definition Level					**Comments**
CATEGORY Element	**1**	**2**	**3**	**4**	**5**	
A. PROJECT STRATEGY						
A1. Need & Purpose Documentation						
A2. Investment Studies & Alternatives Assessments						
A3. Programming & Funding Data						
A4. Key Team Member Coordination						
A5. Public Involvement						

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

B. OWNER/OPERATOR PHILOSOPHIES						
B1. Design Philosophy						
B2. Operating Philosophy						
B3. Maintenance Philosophy						
B4. Future Expansion & Alteration Considerations						
C. PROJECT REQUIREMENTS						
C1. Functional Classification & Use						
C2. Evaluation of Compliance Requirements						
C3. Survey of Existing Environmental Conditions						
C4. Determination of Utility Impacts						
C5. Value Engineering						

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

SECTION II – BASIS OF DESIGN						
	Definition Level					**Comments**
CATEGORY Element	**1**	**2**	**3**	**4**	**5**	
D. SITE INFORMATION						
D1. Geotechnical Characteristics						
D2. Hydrological Characteristics						
D3. Surveys & Planimetrics						
D4. Permitting Requirements						
D5. Environmental Documentation						
D6. Property Descriptions						
D7. Ownership Determinations						
D8. Right-of-Way Mapping						
D9. Constraints Mapping						
D10. Right-of-Way Site Issues						

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

E. LOCATION & GEOMETRY						
E1. Horizontal & Vertical Alignment						
E2. Control of Access						
E3. Schematic Layouts						
E4. Cross-Sectional Elements						
F. STRUCTURES						
F1. Bridge Structure Elements						
F2. Hydraulic Structures						
F3. Miscellaneous Design Elements						
G. DESIGN PARAMETERS						
G1. Provisional Maintenance Requirements						
G2. Constructability						
H. INSTALLED EQUIPMENT						
H1. Equipment List						
H2. Equipment Location Drawings						
H3. Equipment Utility Requirements						

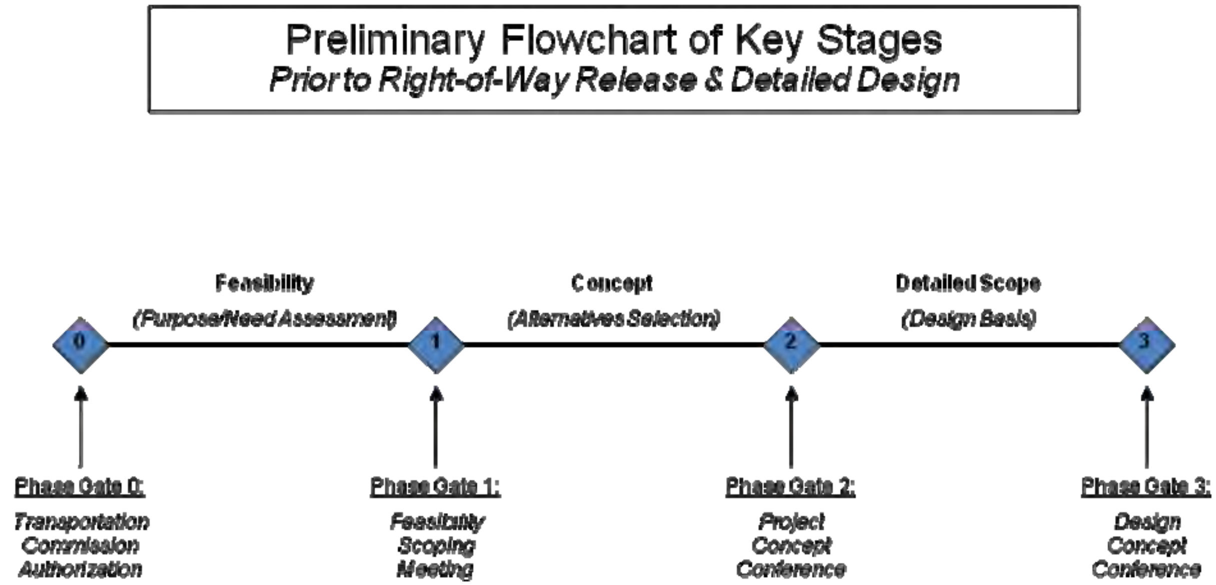
Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

SECTION III – EXECUTION APPROACH						
CATEGORY Element	Definition Level					Comments
	1	2	3	4	5	
I. ACQUISITION STRATEGY						
I1. Long-Lead Parcel & Utility Adjustment Identification						
I2. Long-Lead/Critical Equipment & Materials Identification						
I3. Local Public Agencies Utilities Contracts & Agreements						
I4. Utility Agreement & Joint-Use Contracts						
I5. Project Delivery Method & Contracting Strategies						
I6. Design/Construction Plan & Approach						
I7. Procurement Procedures & Plans						
I8. Appraisal Requirements						
I9. Advance Acquisition Requirements						
J. DELIVERABLES						
J1. CADD/Model Requirements						
J2. Documentation/Deliverables						

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**

K. PROJECT CONTROL						
K1. Right-of-Way & Utilities Cost Estimates						
K2. Design & Construction Cost Estimates						
K3. Project Cost Control						
K4. Project Schedule Control						
K5. Project Quality Assurance & Control						
K6. Safety Procedures						
L. PROJECT EXECUTION PLAN						
L1. Environmental Commitments & Mitigation						
L2. Interagency Coordination						
L3. Local Public Agency Contractual Agreements						
L4. Interagency Joint-Use Agreements						
L5. Preliminary Traffic Control Plan						
L6. Substantial Completion Requirements						

Definition Levels: **1 = Complete Definition** **5 = Incomplete or Poor Definition**


Preliminary Flowchart of Key Stages
Prior to Right-of-Way Release & Detailed Design
Feasibility
(Purpose/Need Assessment)
Concept
(Alternatives Selection)
Detailed Scope
(Design Basis)
0
1
2
3
Phase Gate 0:
Transportation Commission Authorization
Phase Gate 1:
Feasibility Scoping Meeting
Phase Gate 2:
Project Concept Conference
Phase Gate 3:
Design Concept Conference

SUGGESTIONS FOR IMPROVEMENT

Name: __________________________ Date:

Please answer the following questions regarding the APRA.

Is the list of 59 elements complete? If not, please list all others that should be added.

Are any of the elements redundant? If so, please list which ones and any recommended changes.

Are any of the definitions unclear or incomplete? If so, please list which ones and any recommended changes.

Do you have any other suggestions for improving the APRA or the instruction sheet?

Please answer the following questions regarding the Background Information sheet.

Are any of the questions unclear? If so, which ones and how should they be reworded?

Are there any other questions not included in the information sheet that may provide the research team with important information regarding the experience of the project managers and project development subject experts? If so, please list the ones that should be added.

General Comments:

Thank you very much for your time and effort in filling out this questionnaire

Advance Planning Risk Analysis – Transportation Projects
Unweighted Project Score Sheet

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
A. PROJECT STRATEGY							
A1. Need & Purpose Documentation							
A2. Investment Studies & Alternatives Assessments							
A3. Programming & Funding Data							
A4. Key Team Member Coordination							
A5. Public Involvement							
CATEGORY A TOTAL							
B. OWNER/OPERATOR PHILOSOPHIES							
B1. Design Philosophy							
B2. Operating Philosophy							
B3. Maintenance Philosophy							
B4. Future Expansion & Alteration Considerations							
CATEGORY B TOTAL							
C. PROJECT REQUIREMENTS							
C1. Functional Classification & Use							
C2. Evaluation of Compliance Requirements							
C3. Survey of Existing Environmental Conditions							
C4. Determination of Utility Impacts							
C5. Value Engineering							
CATEGORY C TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION II - BASIS OF DESIGN							
CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
D. SITE INFORMATION							
D1. Geotechnical Characteristics							
D2. Hydrological Characteristics							
D3. Surveys & Planimetrics							
D4. Permitting Requirements							
D5. Environmental Documentation							
D6. Property Descriptions							
D7. Ownership Determinations							
D8. Right-of-Way Mapping							
D9. Constraints Mapping							
D10. Right-of-Way Site Issues							
CATEGORY D TOTAL							
E. LOCATION & GEOMETRY							
E1. Horizontal & Vertical Alignment							
E2. Control of Access							
E3. Schematic Layouts							
E4. Cross-Sectional Elements							
CATEGORY E TOTAL							
F. STRUCTURES							
F1. Bridge Structure Elements							
F2. Hydraulic Structures							
F3. Miscellaneous Design Elements							
CATEGORY F TOTAL							
G. DESIGN PARAMETERS							
G1. Provisional Maintenance Requirements							
G2. Constructability							
CATEGORY G TOTAL							
H. INSTALLED EQUIPMENT							
H1. Equipment List							
H2. Equipment Location Drawings							
H3. Equipment Utility Requirements							
CATEGORY H TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION III - EXECUTION APPROACH							
CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
I. ACQUISITION STRATEGY							
I1. Long-Lead Parcel & Utility Adjustment Identification							
I2. Long-Lead/Critical Equipment & Materials Identification							
I3. Local Public Agencies Utilities Contracts & Agreements							
I4. Utility Agreement & Joint-Use Contracts							
I5. Project Delivery Method & Contracting Strategies							
I6. Design/Construction Plan & Approach							
I7. Procurement Procedures & Plans							
I8. Appraisal Requirements							
I9. Advance Acquisition Requirements							
CATEGORY I TOTAL							
J. DELIVERABLES							
J1. CADD/Model Requirements							
J2. Documentation/Deliverables							
CATEGORY J TOTAL							
K. PROJECT CONTROL							
K1. Right-of-Way & Utilities Cost Estimates							
K2. Design & Construction Cost Estimates							
K3. Project Cost Control							
K4. Project Schedule Control							
K5. Project Quality Assurance & Control							
K6. Safety Procedures							
CATEGORY K TOTAL							
L. PROJECT EXECUTION PLAN							
L1. Environmental Commitments & Mitigation							
L2. Interagency Coordination							
L3. Local Public Agency Contractual Agreements							
L4. Interagency Joint-Use Agreements							
L5. Preliminary Traffic Control Plan							
L6. Substantial Completion Requirements							
CATEGORY L TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Appendix E: APRA Weighted Project Score Sheet

SECTION I - BASIS OF PROJECT DECISION							
	Definition Level						Score
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**	
A. PROJECT STRATEGY (Maximum = 122)							
A1. Need & Purpose Documentation	0	1	7	12	18	23	
A2. Investment Studies & Alternatives Assessments	0	2	8	14	19	25	
A3. Programming & Funding Data	0	2	9	16	23	30	
A4. Key Team Member Coordination	0	1	6	11	16	21	
A5. Public Involvement	0	2	7	13	18	23	
CATEGORY A TOTAL							
B. OWNER/OPERATOR PHILOSOPHIES (Maximum = 76)							
B1. Design Philosophy	0	1	7	12	18	23	
B2. Operating Philosophy	0	1	5	10	14	18	
B3. Maintenance Philosophy	0	1	5	9	12	16	
B4. Future Expansion & Alteration Considerations	0	2	6	11	15	19	
CATEGORY B TOTAL							
C. PROJECT REQUIREMENTS (Maximum = 102)							
C1. Functional Classification & Use	0	1	5	8	12	15	
C2. Evaluation of Compliance Requirements	0	1	6	10	15	19	
C3. Survey of Existing Environmental Conditions	0	2	8	14	20	26	
C4. Determination of Utility Impacts	0	2	9	16	23	30	
C5. Value Engineering	0	1	4	7	9	12	
CATEGORY C TOTAL							
Section I Maximum Score = 300 SECTION I TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION II - BASIS OF DESIGN							
	Definition Level						Score
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**	
D. SITE INFORMATION (Maximum = 173)							
D1. Geotechnical Characteristics	0	1	5	9	12	16	
D2. Hydrological Characteristics	0	1	5	10	14	18	
D3. Surveys & Planimetrics	0	1	5	10	14	18	
D4. Permitting Requirements	0	1	5	9	13	17	
D5. Environmental Documentation	0	2	7	12	17	22	
D6. Property Descriptions	0	1	5	8	12	15	
D7. Ownership Determinations	0	1	4	7	10	13	
D8. Right-of-Way Mapping	0	1	5	9	12	16	
D9. Constraints Mapping	0	1	6	10	15	19	
D10. Right-of-Way Site Issues	0	1	6	10	15	19	
CATEGORY D TOTAL							
E. LOCATION & GEOMETRY (Maximum = 79)							
E1. Horizontal & Vertical Alignment	0	1	6	11	15	20	
E2. Control of Access	0	1	5	9	13	17	
E3. Schematic Layouts	0	2	8	13	19	24	
E4. Cross-Sectional Elements	0	1	5	10	14	18	
CATEGORY E TOTAL							
F. STRUCTURES (Maximum = 48)							
F1. Bridge Structure Elements	0	1	5	9	12	16	
F2. Hydraulic Structures	0	1	5	10	14	18	
F3. Miscellaneous Design Elements	0	1	4	8	11	14	
CATEGORY F TOTAL							
G. DESIGN PARAMETERS (Maximum = 29)							
G1. Provisional Maintenance Requirements	0	1	4	6	9	11	
G2. Constructability	0	1	5	10	14	18	
CATEGORY G TOTAL							
H. INSTALLED EQUIPMENT (Maximum = 30)							
H1. Equipment List	0	1	3	5	7	9	
H2. Equipment Location Drawings	0	1	3	5	6	8	
H3. Equipment Utility Requirements	0	1	4	7	10	13	
CATEGORY H TOTAL							
Section II Maximum Score = 359 SECTION II TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

SECTION III - EXECUTION APPROACH							
CATEGORY Element	**Definition Level**						**Score**
	0	**1**	**2**	**3**	**4**	**5**	
I. ACQUISITION STRATEGY (Maximum = 137)							
I1. Long-Lead Parcel & Utility Adjustment Identification	0	2	8	13	19	24	
I2. Long-Lead/Critical Equipment & Materials Identification	0	1	4	7	9	12	
I3. Local Public Agencies Utilities Contracts & Agreements	0	1	6	10	15	19	
I4. Utility Agreement & Joint-Use Contracts	0	1	6	11	15	20	
I5. Project Delivery Method & Contracting Strategies	0	1	4	7	10	13	
I6. Design/Construction Plan & Approach	0	1	4	8	11	14	
I7. Procurement Procedures & Plans	0	1	3	6	8	10	
I8. Appraisal Requirements	0	1	4	8	11	14	
I9. Advance Acquisition Requirements	0	1	4	6	9	11	
CATEGORY I TOTAL							
J. DELIVERABLES (Maximum = 23)							
J1. CADD/Model Requirements	0	1	3	6	8	10	
J2. Documentation/Deliverables	0	1	4	7	10	13	
CATEGORY J TOTAL							
K. PROJECT CONTROL (Maximum = 98)							
K1. Right-of-Way & Utilities Cost Estimates	0	2	7	12	16	21	
K2. Design & Construction Cost Estimates	0	2	7	12	16	21	
K3. Project Cost Control	0	1	5	9	13	17	
K4. Project Schedule Control	0	1	5	9	12	16	
K5. Project Quality Assurance & Control	0	1	3	6	8	10	
K6. Safety Procedures	0	1	4	7	10	13	
CATEGORY K TOTAL							
L. PROJECT EXECUTION PLAN (Maximum = 83)							
L1. Environmental Commitments & Mitigation	0	1	5	8	12	15	
L2. Interagency Coordination	0	1	5	8	12	15	
L3. Local Public Agency Contractual Agreements	0	1	5	8	12	15	
L4. Interagency Joint-Use Agreements	0	1	4	8	11	14	
L5. Preliminary Traffic Control Plan	0	1	4	7	10	13	
L6. Substantial Completion Requirements	0	1	4	6	9	11	
CATEGORY L TOTAL							
Section III Maximum Score = 341 SECTION III TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Appendix F: Select Test Meeting Documents

Example of APRA Test Meeting Agenda

MEETING DETAILS:

Date: June 22, 2007

Time: 9:00AM – 11:30 AM

Location: TxDOT Brownwood District Office
2495 Highway 183 North, Brownwood, Texas 76802

Re: Advance Planning Risk Analysis

TOPICS OF DISCUSSION:

VI. Introduction & Demonstration of the APRA *(9:00 – 9:30 am)*

VII. Testing the APRA on projects *(9:30 – 11:30 am)*

Example of APRA Test Questionnaire for Completed Projects

APRA VALIDATION QUESTIONAIRE FOR COMPLETED PROJECTS

Center for Transportation Research
The University of Texas at Austin

How to Complete this Questionnaire

1. Read the Introduction, Potential Use and Benefits of the APRA, and Research Methodology sections in the two following pages

2. Select a completed project for the purpose of testing the APRA; the preferred characteristics of the project include:
   - Completed within the last 3 years
   - Had a budget of $5 million or more
   - Used Traditional (Design-Bid-Build) project delivery method
   - Be one of the project types listed in question c, section "2.1. General Information"

3. Fill in the background and project information in Sections 1 and 2[2]

4. Form a team to assess the project using the APRA; the team should:
   - Have 2—5 people who were involved in the project
   - Include (but not be limited to) people from design, planning & programming, ROW & Utilities, and environmental.

5. Together with CTR researchers, assess the APRA element by element using the detailed instructions in Section 3.

6. Together with CTR researchers, provide feedback by filling in Section 4.

[2] This step can be done during step 5 if that is more convenient.

ADVANCE PLANNING RISK ANALYSIS (APRA) FOR TRANSPORTATION PROJECTS

Introduction

Research in the building and industrial construction sectors has proven that the more effort put in the early phase of planning, the more the chance of project success. These sectors have tools, such as Project Definition Rating Index, that can help project team identify and manage critical risk elements in an effective manner. Given the different nature of building and industrial projects versus transportation projects, these tools cannot be successfully used in transportation. A similar tool for transportation projects, if developed, would give the similar benefits as the tools in building and industrial construction do.

TxDOT Research Project 0-5478 team is developing the Advance Planning Risk Analysis as a best practices tool for improving the effectiveness of the project development process on transportation projects. The APRA is envisioned to help the project development team to improve the process through structured yet flexible risk management, which consists of identifying, analyzing, and controlling risk issues. Fifty-nine risk issues have been identified by the research project team. These issues were grouped into 12 categories, which are further grouped into 3 sections. Upon completion, the tool can be used to rate a project and yield a score and generate a list of issues to be addressed. The score and the list can be used to evaluate riskiness of the project and its chance for success and identify the areas that the project team needs to address.

Potential Use and Benefits of the APRA

The APRA is expected to help improve the effectiveness of the project development process of the transportation process and maximize the chance of project success. The APRA can be used as:

- A checklist of critical risk elements of concern for project team;
- A means to monitor progress at various stages during the project development process;
- A communication and alignment tool among major project stakeholders such as owner, designer, and contractor;
- A means for reconciling differences among project team members;
- A list of standardized terminology for the project development process;
- A standard for managing project risks in early planning phase of transportation projects;
- A training tool for organizations and individuals;
- A benchmarking tool for evaluating projects within an organization against the performance of projects in the past to help with predicting project success probability.

Research Methodology

The final draft of the APRA has been developed and is currently being validated through testing on real transportation projects. Major steps of the methodology are:

- **Identification and categorization:** the first step of this research project was to identify and categorize the critical risk elements in the early planning phase of transportation projects. Current literature on related topics was reviewed and experienced professionals from TxDOT districts and divisions were interviewed to help identify and categorize the critical elements.
- **Weighting:** the elements were then evaluated with respect to their relative importance to the project with the input from 51 TxDOT professionals participated in 6 workshops throughout Texas.
- **Practical tool development:** the weighted elements constitute the main part of the APRA tool. In order for the users to use it efficiently, an electronic version of the tool is being developed. Feedback from the testing in the next step will be used to finalize this version of the tool.
- **Validation:** the next step is to test the tool on real projects to observe the use of the tool in practice and draw conclusions on the usefulness of the tool. The survey using questionnaire is the essence of this testing process. The survey documents include this introduction to the APRA and its development, a questionnaire to be filled out by the participants (yellow), and the “APRA Elements Descriptions” document. When participating in this survey by filling out the attached questionnaire, you are contributing significantly to the successful development of the APRA tool. This is the current step of the research project.
- **Validation data analysis:** after collecting the test data, analysis will be performed to draw conclusions on the use and usefulness of the tool.
- **Finalizing research products:** the final step in this research project is to finalize the research products, including the electronic version of the tool, research report, and user guide.

1. Background Information

Date: ....

Point of Contact:

a. Name: ....

b. Title: ....

c. Address: ....

....

d. Tel. No.: .... Fax. No.: ....

e. E-mail: ....

2. Project Information

General Information

a. Project Name: ....

b. Location of the Project: ....

c. What type is this project?

[ ] Convert Non-Freeway to Freeway	[ ] Interchange (New or Reconstruct)
[ ] Widen Freeway	[ ] Bridge Widening or Rehabilitation
[ ] Widen Non-Freeway	[ ] Bridge Replacement
[ ] New Location Freeway	[ ] Upgrade to Standards - Freeway
[ ] New Location Non-Freeway	[ ] Upgrade to Standards - Non-Freeway

d. Project size and general descriptions (*i.e., 5 miles expansion*):

....

....

e. Please describe any unique characteristic of this project (*e.g., significant geometric complexity, significant environmental impact*):

....

....

....

f. How many ROW parcels were acquired for the project? ....

g. How many utility adjustments were completed for the project? ....

Schedule Information

a. Please provide the following **schedule** information:

Item	Planned at Start of *PS&E Development* *(Design Conference)* (mm/dd/yy)	Actual (mm/dd/yy)
Right of Way Release Date		
Design Conference Date		
Letting Date		
End Date of Construction		

b. Please list significant causes of schedule changes and their corresponding time extensions/reductions that you know of and indicate whether they were an extension (Ext.) or reduction (Red.). (*Write on the back of this sheet if you need more room.*)

Delay	Months	Ext.	Red.
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]
....	....	[ ]	[ ]

Please give any additional comments regarding any causes or effects of schedule changes?

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Cost Information

a. Please provide the following **cost** information:

Item	Estimated Cost at Start of *PS&E Development* *(Design Conference)*	Actual Cost
PS&E		
ROW		
Utilities		
Construction		

Change Information

a. What was the total number of change orders issued (including during both PS&E development and construction)?

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b. What was the total dollar amount of all change orders: $ ....

Please give any comments on significant changes and what/how they affect the project's objectives (*e.g., time, cost*)

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Owner Satisfaction

a. Based on the original plan/intent of the project set prior to the beginning of PS&E development, rate how the constructed project matches the original plan/intent: (*circle only one*)

1 Very Different	2	3	4	5	6	7	8	9	10 Perfectly Matches

Please give a brief explanation of your choice:

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b. Reflecting on the overall project, rate how successful you feel the project has been: (*circle only one*)

1 Very Unsuccessful	2	3	4	5	6	7	8	9	10 Very Successful

Please give any additional comments regarding owner satisfaction:

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3. Project Rating Information

Please complete the Project Rating Information form in the next few pages. Instructions for completing this form are explained below.

INSTRUCTIONS FOR RATING A PROJECT

The Advance Planning Risk Analysis (APRA) is intended to evaluate the level of scope definition of a project when PS&E (Plans, Specifications, and Estimates) development is about to begin. When evaluating a project, the team involved in the advance planning effort should consider the level of definition of each element in the APRA **at the time the project was ready to begin the development of PS&E**. For the purposes of this research, the project must have been substantially **completed within the last 3 years** and had a budget of at least **$5 million**, ideally greater than $10 million. The project should have used traditional project delivery method (Design-Bid-Build) and been one of the 10 types listed in question c, section "2.1. General Information".

The APRA consists of 3 sections, which are broken into 12 categories that contain 59 elements. Evaluation is performed for each individual element. Elements should be rated numerically from 0 to 5 based on its level of definition at the time when PS&E is about to begin. Think of this as a "zero defects" type of evaluation. Elements that were as well defined as possible should receive a perfect rating of "one". Elements that were completely undefined should receive a rating of "five". All other elements should receive a "two", "three", or "four" depending on their levels of definition. Those elements deemed not applicable for the project under consideration should receive a "zero". The ratings are defined as follows:

0 – Not Applicable:
The element is not part of the project requirements

1 – Complete Definition:
The element is well defined, no more work required before PS&E development

2 – Minor Deficiencies:
Some minor work needed for several items in the element before PS&E development

3 – Some Deficiencies:
Major work needed for some items or some work needed for most of the items in the element before PS&E development

4 – Major Deficiencies:
Major work needed for most of the items in the element before PS&E development

5 – Incomplete or Poor Definition:
The element is poorly defined, major work needed for (almost) all items in the element before PS&E development

Steps to rate an element:

1. Read its definition in the "APRA Elements Descriptions" document. Some elements have a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists. Note, however, that some of these items may not be applicable for your project.
2. Refer to the "Project Rating Information" form and locate the element. Recall back to the **time of beginning of PS&E development** and determine how much about the element was known at that point in time.
3. Choose the appropriate (only one) definition level for the element (0, 1, 2, 3, 4, or 5) and check (√) the corresponding box. It should be reminded again that the time of determining the definition level is **at the beginning of PS&E development**.
4. Repeat the above steps for each of the 59 elements in the APRA. Be sure to rate each element.

Example of rating an APRA element:

Assuming you are about to rate element C3 (Survey of Existing Environmental Conditions) using the instructions above.

1. You read the element's descriptions provided in the "APRA Elements Descriptions" document and find that a number of surveys need to be done and a list of hazardous materials be identified, among others (Figure 1).
2. You **recall back to the time of beginning PS&E development** and find that surveys on natural resources and cultural resources had been done very well; hazardous materials on the site had also been identified. However, air quality and noise surveys had not been completed at that time. You feel that the element had *some deficiencies* that should have been addressed before starting PS&E development.
3. You choose definition level 3 for the element and check (√) the corresponding box (*some deficiencies*) in the "Project Rating Information" sheet of the questionnaire (Figure 2).
4. You then move to the next element, C4 (Determination of Utility Impacts), until all the elements have been rated.

C3. Survey of Existing Environmental Conditions

A preliminary survey consists of fieldwork and data acquisition from a variety of sources, including previous surveys, geographic information systems, and resource agency databases. Identifying problematic issues at an early stage in the project development process enables adequate time to address and mitigate these concerns Issues to consider include:

- ❑ Natural resource surveys:
  - ❑ Endangered species
  - ❑ Wetland status
  - ❑ Bodies of water
  - ❑ Existing and potential park system land
  - ❑ Permit needs
- ❑ Cultural resource surveys:
  - ❑ Historical preservation
  - ❑ Existence of cemeteries
  - ❑ Archaeological sites
- ❑ Air quality surveys:
  - ❑ Mobile source pollutants
  - ❑ Air quality analysis
  - ❑ Congestion mitigation-air quality
- ❑ Noise surveys:
  - ❑ Evaluation of need for abatement
- ❑ Hazardous materials:
  - ❑ Existing land use
  - ❑ Superfund and regulatory agency database review
  - ❑ Underground storage tanks
  - ❑ Site visits
  - ❑ Local inhabitant interviews
- ❑ Socioeconomic Impacts
- ❑ Other

Figure 1. Example of an Element's Description (Element C3)

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element		**Definition Level**					
		0	**1**	**2**	**3**	**4**	**5**
C. PROJECT REQUIREMENTS							
	...						
C3.	Survey of Existing Environmental Conditions				√		
	...						

Figure 2. Example of Selecting an Element's Definition Level

PROJECT RATING INFORMATION

SECTION I - BASIS OF PROJECT DECISION						
	Definition Level					
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**
A. PROJECT STRATEGY						
A1. Need & Purpose Documentation						
A2. Investment Studies & Alternatives Assessments						
A3. Programming & Funding Data						
A4. Key Team Member Coordination						
A5. Public Involvement						
B. OWNER/OPERATOR PHILOSOPHIES						
B1. Design Philosophy						
B2. Operating Philosophy						
B3. Maintenance Philosophy						
B4. Future Expansion & Alteration Considerations						
C. PROJECT REQUIREMENTS						
C1. Functional Classification & Use						
C2. Evaluation of Compliance Requirements						
C3. Survey of Existing Environmental Conditions						
C4. Determination of Utility Impacts						
C5. Value Engineering						

Please check (√) only 1 box for each element. Please do not leave any elements blank

0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

SECTION II - BASIS OF DESIGN						
	Definition Level					
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**
D. SITE INFORMATION						
D1. Geotechnical Characteristics						
D2. Hydrological Characteristics						
D3. Surveys & Planimetrics						
D4. Permitting Requirements						
D5. Environmental Documentation						
D6. Property Descriptions						
D7. Ownership Determinations						
D8. Right-of-Way Mapping						
D9. Constraints Mapping						
D10. Right-of-Way Site Issues						
E. LOCATION & GEOMETRY						
E1. Horizontal & Vertical Alignment						
E2. Control of Access						
E3. Schematic Layouts						
E4. Cross-Sectional Elements						
F. STRUCTURES						
F1. Bridge Structure Elements						
F2. Hydraulic Structures						
F3. Miscellaneous Design Elements						
G. DESIGN PARAMETERS						
G1. Provisional Maintenance Requirements						
G2. Constructability						
H. INSTALLED EQUIPMENT						
H1. Equipment List						
H2. Equipment Location Drawings						
H3. Equipment Utility Requirements						

Please check (√) only 1 box for each element. Please do not leave any elements blank

0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

SECTION III - EXECUTION APPROACH						
	Definition Level					
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**
I. ACQUISITION STRATEGY						
I1. Long-Lead Parcel & Utility Adjustment Identification						
I2. Long-Lead/Critical Equipment & Materials Identification						
I3. Local Public Agencies Utilities Contracts & Agreements						
I4. Utility Agreement & Joint-Use Contracts						
I5. Project Delivery Method & Contracting Strategies						
I6. Design/Construction Plan & Approach						
I7. Procurement Procedures & Plans						
I8. Appraisal Requirements						
I9. Advance Acquisition Requirements						
J. DELIVERABLES						
J1. CADD/Model Requirements						
J2. Documentation/Deliverables						
K. PROJECT CONTROL						
K1. Right-of-Way & Utilities Cost Estimates						
K2. Design & Construction Cost Estimates						
K3. Project Cost Control						
K4. Project Schedule Control						
K5. Project Quality Assurance & Control						
K6. Safety Procedures						
L. PROJECT EXECUTION PLAN						
L1. Environmental Commitments & Mitigation						
L2. Interagency Coordination						
L3. Local Public Agency Contractual Agreements						
L4. Interagency Joint-Use Agreements						
L5. Preliminary Traffic Control Plan						
L6. Substantial Completion Requirements						

Please check (√) only 1 box for each element. Please do not leave any elements blank

0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

4. Follow-up Information

a. How long did it take you (or your team) to fill out the forms? Please specify in total work-hours (*e.g., a team of 3 working for 4 hours equals 12 total work-hours*).

Background and Project Information (parts 1 & 2): .... total work-hours
Project Rating Information (part 3): .... total work-hours

b. Please write down names of all experts participated in filling out this questionnaire:

....

....

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Thank you very much for your participation in this survey!

Please email a scanned copy of this form to Dr. Carlos Caldas (caldas@mail.utexas.edu) or mail it to:

Dr. Carlos H. Caldas
University of Texas at Austin
Dept. of Civil, Arch. & Environmental Engineering
1 University Station C1752
Austin, TX 78712-0273

APRA VALIDATION INFORMATION

Example of APRA Test Questionnaire for Ongoing Projects

0-5478 TxDOT Research Project

ADVANCE PLANNING RISK ANALYSIS (APRA) FOR TRANSPORTATION PROJECTS

APRA VALIDATION QUESTIONAIRE FOR ON-GOING PROJECTS

Center for Transportation Research
The University of Texas at Austin

How to Complete this Questionnaire

7. Read the Introduction, Potential Use and Benefits of the APRA, and Research Methodology sections in the two following pages

8. Select an on-going project for the purpose of testing the APRA; the preferred characteristics of the project include:
    - Currently be prior to the beginning of PS&E development
    - Have an estimated budget of $5 million or more
    - Use Traditional (Design-Bid-Build) project delivery method
    - Be one of the project types listed in question c, section “2.1. General Information”

9. Fill in the background and project information in Sections 1 and 2[3]

10. Form a team to assess the project using the APRA; the team should:
    - Have 2—5 people who were involved in the project
    - Include (but not be limited to) people from design, planning & programming, ROW & Utilities, and environmental.

11. Together with CTR researchers, assess the APRA element by element using the detailed instructions in Section 3.

12. Provide feedback by filling in Section 4.

[3] This step can be done during step 5 if that is more convenient.

ADVANCE PLANNING RISK ANALYSIS (APRA) FOR TRANSPORTATION PROJECTS

Introduction

Research in the building and industrial construction sectors has proven that the more effort put in the early phase of planning, the more the chance of project success. These sectors have tools, such as Project Definition Rating Index, that can help project team identify and manage critical risk elements in an effective manner. Given the different nature of building and industrial projects versus transportation projects, these tools cannot be successfully used in transportation. A similar tool for transportation projects, if developed, would give the similar benefits as the tools in building and industrial construction do.

TxDOT Research Project 0-5478 team is developing the Advance Planning Risk Analysis as a best practices tool for improving the effectiveness of the project development process on transportation projects. The APRA is envisioned to help the project development team to improve the process through structured yet flexible risk management, which consists of identifying, analyzing, and controlling risk issues. Fifty-nine risk issues have been identified by the research project team. These issues were grouped into 12 categories, which are further grouped into 3 sections. Upon completion, the tool can be used to rate a project and yield a score and generate a list of issues to be addressed. The score and the list can be used to evaluate riskiness of the project and its chance for success and identify the areas that the project team needs to address.

Potential Use and Benefits of the APRA

The APRA is expected to help improve the effectiveness of the project development process of the transportation process and maximize the chance of project success. The APRA can be used as:

- A checklist of critical risk elements of concern for project team;
- A means to monitor progress at various stages during the project development process;
- A communication and alignment tool among major project stakeholders such as owner, designer, and contractor;
- A means for reconciling differences among project team members;
- A list of standardized terminology for the project development process;
- A standard for managing project risks in early planning phase of transportation projects;
- A training tool for organizations and individuals;
- A benchmarking tool for evaluating projects within an organization against the performance of projects in the past to help with predicting project success probability.

Research Methodology

The final draft of the APRA has been developed and is currently being validated through testing on real transportation projects. Major steps of the methodology are:

- **Identification and categorization:** the first step of this research project was to identify and categorize the critical risk elements in the early planning phase of transportation projects. Current literature on related topics was reviewed and experienced professionals from TxDOT districts and divisions were interviewed to help identify and categorize the critical elements.
- **Weighting:** the elements were then evaluated with respect to their relative importance to the project with the input from 51 TxDOT professionals participated in 6 workshops throughout Texas.
- **Practical tool development:** the weighted elements constitute the main part of the APRA tool. In order for the users to use it efficiently, an electronic version of the tool is being developed. Feedback from the testing in the next step will be used to finalize this version of the tool.
- **Validation:** the next step is to test the tool on real projects to observe the use of the tool in practice and draw conclusions on the usefulness of the tool. The survey using questionnaire is the essence of this testing process. The survey documents include this introduction to the APRA and its development, a questionnaire to be filled out by the participants (yellow), and the "APRA Elements Descriptions" document. When participating in this survey by filling out the attached questionnaire, you are contributing significantly to the successful development of the APRA tool. This is the current step of the research project.
- **Validation data analysis:** after collecting the test data, analysis will be performed to draw conclusions on the use and usefulness of the tool.
- **Finalizing research products:** the final step in this research project is to finalize the research products, including the electronic version of the tool, research report, and user guide.

1. Background Information

Date: ....

Point of Contact:

1. Name: ....
2. Title: ....
3. Address: ....

   ....
4. Tel. No.: .... Fax. No.: ....
5. E-mail: ....

2. Project Information

General Information

a. Project Name: ....
b. Location of the Project: ....
c. What type is this project?

   [ ] Convert Non-Freeway to Freeway   [ ] Interchange (New or Reconstruct)

   [ ] Widen Freeway   [ ] Bridge Widening or Rehabilitation

   [ ] Widen Non-Freeway   [ ] Bridge Replacement

   [ ] New Location Freeway   [ ] Upgrade to Standards - Freeway

   [ ] New Location Non-Freeway   [ ] Upgrade to Standards - Non-Freeway

d. Project size and general descriptions (*i.e., 5 miles expansion*):

   ....

   ....

e. Please describe any unique thing about this project (*e.g., significant geometric complexity, significant environmental impact*):

   ....

   ....

   ....

f. How many ROW parcels are planned for acquisition for the project?

   ....

g. How many utility adjustments are planned for the project? (*if known*)

....

h. Where is the project at in the following project development sub-processes? (*Project Development Process Chart can be referred to for terminology*)

<u>For example:</u>

Planning & Programming: *completed*

Preliminary Design: *completed "Geometric Schematic Approval"*

Environmental: *completed "Public Hearing"*

ROW & Utilities: *50% "ROW Map and Property Descriptions"*

PS&E Development: *not yet started*

Planning & Programming: ....

Preliminary Design: ....

Environmental: ....

ROW & Utilities: ....

PS&E Development: ....

<u>Schedule Information</u>

Please provide the following **schedule** information:

Item	Planned at time of *Evaluation* (mm/dd/yy)
Right of Way Release Date	
Design Conference Date	
Letting Date	
End Date of Construction	

<u>Cost Information</u>

Please provide the following **cost** information:

Item	Estimated Cost at time of *Evaluation*
PS&E	
ROW	
Utilities	
Construction	

3. Project Rating Information

Please, **as a team**, complete the Project Rating Information form in the next few pages. Instructions for completing this form are explained below.

INSTRUCTIONS FOR RARING A PROJECT

The Advance Planning Risk Analysis (APRA) is intended to help project team with evaluating the level of scope definition of a project during the project development (advance planning) phase. When evaluating a project, the team involved in the advance planning effort should consider the level of definition of each element in the APRA **at the time of the evaluation**. Ideally, the team for this evaluation should include (but not be limited to) people from design, planning, ROW & Utilities, and environmental. For the purposes of this research, the project must be **prior to the beginning of PS&E development** and have a budget of at least $5 million, ideally greater than $10 million. The project should be using traditional project delivery method (Design-Bid-Build) and one of the 10 types listed in question c, section “2.1. General Information”.

The APRA consists of 3 sections, which are broken into 12 categories that contain 59 elements. Evaluation is performed for each individual element. Elements should be rated numerically from 0 to 5 based on its level of definition at the time of the evaluation. Think of this as a “zero defects” type of evaluation. Elements that were as well defined as possible should receive a perfect rating of “one”. Elements that were completely undefined should receive a rating of “five”. All other elements should receive a “two”, “three”, or “four” depending on their levels of definition. Those elements deemed not applicable for the project under consideration should receive a “zero”. The ratings are defined as follows:

0 – Not Applicable:
The element is not part of the project requirements PS&E development

1 – Complete Definition:
The element is well defined, no more work required PS&E development

2 – Minor Deficiencies:
Some minor work needed for several items in the element PS&E development

3 – Some Deficiencies:
Major work needed for some items or some work needed for most of the items in the element PS&E development

4 – Major Deficiencies:
Major work needed for most of the items in the element PS&E development

5 – Incomplete or Poor Definition:
The element is poorly defined, major work needed for (almost) all items in the element PS&E development

Steps to rate an element:

5. Read its definition in the "APRA Elements Descriptions" document. Some elements have a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists. Note, however, that some of these items may not be applicable for your project.
6. Refer to the "Project Rating Information" form and locate the element. As a team, please choose only one definition level (0, 1, 2, 3, 4, or 5) for that element based on your perception of how well it is defined at **this** time of evaluation.
7. With the team's consensus, choose the appropriate definition level for the element and check (√) the corresponding box.
8. Repeat the above steps for each of the 59 elements in the APRA. Be sure to rate each element.

Example of rating an APRA element:

Assuming you are about to rate element C3 (Survey of Existing Environmental Conditions) using the instructions above.

5. You read the element's descriptions provided in the "APRA Elements Descriptions" document and find that a number of surveys need to be done and a list of hazardous materials be identified, among others (Figure 1).
6. You, as a team, find that surveys on natural resources and cultural resources have been done very well; hazardous materials on the site have also been identified. However, air quality and noise surveys have not been completed at this time. You feel that the element has *some deficiencies* that should be addressed before starting PS&E development.
7. You, with the team's consensus, choose definition level 3 for the element and check (√) the corresponding box (*some deficiencies*) in the "Project Rating Information" sheet of the questionnaire (Figure 2).
8. You then move to the next element, C4 (Determination of Utility Impacts), until all the elements have been rated.

C3. Survey of Existing Environmental Conditions

A preliminary survey consists of fieldwork and data acquisition from a variety of sources, including previous surveys, geographic information systems, and resource agency databases. Identifying problematic issues at an early stage in the project development process enables adequate time to address and mitigate these concerns Issues to consider include:

- ❑ Natural resource surveys:
    - ❑ Endangered species
    - ❑ Wetland status
    - ❑ Bodies of water
    - ❑ Existing and potential park system land
    - ❑ Permit needs
- ❑ Cultural resource surveys:
    - ❑ Historical preservation
    - ❑ Existence of cemeteries
    - ❑ Archaeological sites
- ❑ Air quality surveys:
    - ❑ Mobile source pollutants
    - ❑ Air quality analysis
    - ❑ Congestion mitigation-air quality
- ❑ Noise surveys:
    - ❑ Evaluation of need for abatement
- ❑ Hazardous materials:
    - ❑ Existing land use
    - ❑ Superfund and regulatory agency database review
    - ❑ Underground storage tanks
    - ❑ Site visits
    - ❑ Local inhabitant interviews
- ❑ Socioeconomic Impacts
- ❑ Other

Figure 1. Example of an Element's Description (Element C3)

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element		**Definition Level**					
		0	**1**	**2**	**3**	**4**	**5**
C. PROJECT REQUIREMENTS							
	...						
C3.	Survey of Existing Environmental Conditions				√		
	...						

Figure 2. Example of Selecting an Element's Definition Level

PROJECT RATING INFORMATION

SECTION I - BASIS OF PROJECT DECISION						
	Definition Level					
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**
A. PROJECT STRATEGY						
A1. Need & Purpose Documentation						
A2. Investment Studies & Alternatives Assessments						
A3. Programming & Funding Data						
A4. Key Team Member Coordination						
A5. Public Involvement						
B. OWNER/OPERATOR PHILOSOPHIES						
B1. Design Philosophy						
B2. Operating Philosophy						
B3. Maintenance Philosophy						
B4. Future Expansion & Alteration Considerations						
C. PROJECT REQUIREMENTS						
C1. Functional Classification & Use						
C2. Evaluation of Compliance Requirements						
C3. Survey of Existing Environmental Conditions						
C4. Determination of Utility Impacts						
C5. Value Engineering						

Please check (√) only 1 box for each element. Please do not leave any elements blank

0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

SECTION II - BASIS OF DESIGN						
	Definition Level					
CATEGORY Element	**0**	**1**	**2**	**3**	**4**	**5**
D. SITE INFORMATION						
D1. Geotechnical Characteristics						
D2. Hydrological Characteristics						
D3. Surveys & Planimetrics						
D4. Permitting Requirements						
D5. Environmental Documentation						
D6. Property Descriptions						
D7. Ownership Determinations						
D8. Right-of-Way Mapping						
D9. Constraints Mapping						
D10. Right-of-Way Site Issues						
E. LOCATION & GEOMETRY						
E1. Horizontal & Vertical Alignment						
E2. Control of Access						
E3. Schematic Layouts						
E4. Cross-Sectional Elements						
F. STRUCTURES						
F1. Bridge Structure Elements						
F2. Hydraulic Structures						
F3. Miscellaneous Design Elements						
G. DESIGN PARAMETERS						
G1. Provisional Maintenance Requirements						
G2. Constructability						
H. INSTALLED EQUIPMENT						
H1. Equipment List						
H2. Equipment Location Drawings						
H3. Equipment Utility Requirements						

Please check (√) only 1 box for each element. Please do not leave any elements blank

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1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

SECTION III - EXECUTION APPROACH							
CATEGORY Element		**Definition Level**					
		0	**1**	**2**	**3**	**4**	**5**
I. ACQUISITION STRATEGY							
I1.	Long-Lead Parcel & Utility Adjustment Identification						
I2.	Long-Lead/Critical Equipment & Materials Identification						
I3.	Local Public Agencies Utilities Contracts & Agreements						
I4.	Utility Agreement & Joint-Use Contracts						
I5.	Project Delivery Method & Contracting Strategies						
I6.	Design/Construction Plan & Approach						
I7.	Procurement Procedures & Plans						
I8.	Appraisal Requirements						
I9.	Advance Acquisition Requirements						
J. DELIVERABLES							
J1.	CADD/Model Requirements						
J2.	Documentation/Deliverables						
K. PROJECT CONTROL							
K1.	Right-of-Way & Utilities Cost Estimates						
K2.	Design & Construction Cost Estimates						
K3.	Project Cost Control						
K4.	Project Schedule Control						
K5.	Project Quality Assurance & Control						
K6.	Safety Procedures						
L. PROJECT EXECUTION PLAN							
L1.	Environmental Commitments & Mitigation						
L2.	Interagency Coordination						
L3.	Local Public Agency Contractual Agreements						
L4.	Interagency Joint-Use Agreements						
L5.	Preliminary Traffic Control Plan						
L6.	Substantial Completion Requirements						

Please check (√) only 1 box for each element. Please do not leave any elements blank

0 = Not Applicable **2 = Minor Deficiencies** **4 = Major Deficiencies**
1 = Complete Definition **3 = Some Deficiencies** **5 = Incomplete or Poor Definition**

4. Follow-up Information

a. How long did it take you (or your team) to fill out the forms? Please specify in total work-hours (*e.g., a team of 3 working for 4 hours equals 12 total work-hours*).

Background and Project Information (parts 1 & 2): .... total work-hours
Project Rating Information (part 3): .... total work-hours

b. Please write down names of all experts participated in filling out this questionnaire:

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Thank you very much for your participation in this survey!

Please email a scanned copy of this form to Dr. Carlos Caldas (caldas@mail.utexas.edu) or mail it to:

Dr. Carlos H. Caldas
University of Texas at Austin
Dept. of Civil, Arch. & Environmental Engineering
1 University Station C1752
Austin, TX 78712-0273

APRA VALIDATION INFORMATION

Post-Test Questionnaire

APRA ASSESSMENT QUESTIONNAIRE

Name: ....

Email: .... Phone: ....

1. The APRA method helps identify critical risk elements that need to be managed during the project development process.

1 2 3 4 5 6 7
Strongly Disagree Neutral Strongly Agree

2. The APRA method helps improve the advance planning process.

1 2 3 4 5 6 7
Strongly Disagree Neutral Strongly Agree

3. Please give a brief explanation of your choices above and any comments you have regarding the APRA method and its use

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Thank you very much for your participation in this questionnaire!

Appendix G: Instructions for Facilitating an Assessment Meeting Using the APRA

From observation, an external facilitator (a person who is not directly involved with the project), has proven to be an essential ingredient in ensuring that the APRA assessment session is effective. The facilitator can be a person from internal to the organization, or an outside consultant, be he/she should be experienced in advance planning of the type of project under consideration and also should have excellent facilitation skills. The following issues should be addressed by the facilitator for to prepare for and conduct the APRA assessment.

Pre-meeting Activities

The facilitator should establish a meeting with the Project Manager/Engineer to receive a briefing on the nature and purpose of the project to be evaluated. The objective of this meeting is to learn enough about the project to ask intelligent/probing questions of the project team members while conducting the session. Many times, the "open ended" discussions concerning key elements provides the most value when conducting an APRA assessment. Therefore, it is the responsibility of the facilitator to ask the types of questions that will result in an open discussion. Gaining some insight prior to the assessment helps in this regard.

This meeting also serves as a good time to preview the APRA elements to see if some of them do not apply to the project at hand. This is especially true for small and renovation projects. In some cases, it is obvious that some of the elements do not apply and these can be removed in advance to save the team time in the assessment.

The facilitator should inform the Project Manager that this is her/his opportunity to *listen* to the team members to see how well they understand the scope of work. The project manager should work with the facilitator to probe the project team to ensure clear two-way understanding of scope requirements and expectations. If the project manager dominates the discussion, and subsequent scoring, the rest of the design team will quickly "clam up" and fall in line. This will result in an APRA assessment that reflects the understanding of the project manager, not the team members.

The facilitator should remind the project manager that the APRA assessment session is an opportunity to team build and align the team members on the critical requirements for the project. Experience has shown that serving food (perhaps lunch or breakfast) can help to increase participation as well as interaction between team members.

The facilitator and project manager should discuss the key stakeholders who should attend the session. Ensure that all key stakeholders are in attendance. Reducing the number of attendees will make the session go more efficiently, but this may compromise the true value of the APRA assessment. Work with the project manager to send out meeting notices in time for the major stakeholders to be able to attend.

Logistics

The facilitator should ensure that the facilities are large enough to accommodate the key project stakeholders in comfort. One method of assessment is to utilize a computer projector to keep score as assessment progresses. Therefore, a room with a screen, computer, and projector is a plus. The APRA can be conducted manually as well. When conducting manually, each participant will require a copy of the score sheet and Element Definitions so they can follow along.

An assessment session takes approximately 2 to 4 hours per project. An inexperienced team, or a very complex project, may well take the full four hours. As teams within an organization get accustomed to the APRA sessions, the time will drop to around two hours. However, it is the discussion occurring during the assessment session that is perhaps its most important benefit. Do not allow an artificial time limit to restrain the open communications between team members.

The session can be conducted over an extended lunch period. In this situation, it is best to start with a short lunch period as an ice breaker, then conduct the session. The facilitator should ensure that the room is set up in advance.

- Make sure the computer, projector, and programs are functioning.
- Set up the notes and Action Items pages
- Make sure all participants have the proper handouts
- When using the automated APRA Scoring Program, make sure the operator is skilled. Lack of computer skills and preparation can lead to ineffectiveness.
- Ensure the programs are loaded and working prior to the session.
- Identify a scribe to capture actions on a flip chart as the session progresses.

Participants

Suggested attendees of the assessment session may include:

- District engineer
- Transportation planning and development director
- District design engineer
- Area engineer
- Construction engineer
- Maintenance engineer
- Environmental coordinator
- Traffic engineer
- Right-of-way administrator
- Utility coordinator
- Contractors if possible.

It is important that all assessment session participants come prepared to actively engage in the assessment. Typically this can be facilitated by sending the APRA assessment sheets and element descriptions out ahead of time with a pre-reading assignment. Expectations of participants include:

- All should be prepared to discuss their understanding and concerns of the elements that apply to them.
- Design/engineering should be prepared to explain what they are doing in regards to each APRA element.
- The district engineer should voice expectations/requirements, and question the design team to ensure understanding.
- Roles and responsibilities during the assessment session should include:
- The project manager should assist the facilitator to probe the team members for answers and insight.
- The facilitator will ensure that everyone has an opportunity to voice their opinions and concerns.

Conducting the Session

- Facilitator should provide the team members with a short overview of the APRA.
- The facilitator or project manager should define the purpose of the assessment session.
- The project manager should give a quick update of the project and its status, including progress supporting the estimates and plans.
- The facilitator should explain the scoring mechanism (definition levels 0, 1, 2, 3, 4, and 5), and explain that the evaluation is not a democratic exercise; rather it is a consensus activity.
- The facilitator should explain that certain elements may apply more to certain team members or stakeholders. Make sure that these key stakeholders have the greatest say in deciding on level of definition.
- The facilitator should keep the session moving and not allowing the participants to "bog down." Many times the participants want to "solve the problem" during the assessment session. Do not allow this to happen. Remember, the session is to perform a detailed assessment only, and actions can be performed later.
- The facilitator should always challenge assumptions and continue to ask the question, "is the material in writing?"

Assessment Session Objectives

1. Capture the degree of definition for each element.
2. Capture significant comments from open discussions.
3. Capture Action Items, assign responsibility and due dates (either at the end of the session, or shortly thereafter).
4. Ensure that the team understands the notes captured and agrees with the path forward.
5. Create alignment among the session attendees.

Roles and Responsibilities/Expectations

- Post session activities: The facilitator should ensure that the APRA notes, action items, and score card are published within 48 hours of the sessions. The ideal target is 24 hours.
- The facilitator should stay engaged with the team if possible to ensure that all Action Items are completed as required to support the scope definition process.
- The project manager should ensure that the actions are addressed.

Small Project Considerations

- Small or renovation projects may have several elements that do not apply.
- As previously mentioned, the facilitator and project manager can meet ahead of time to identify some of these elements.
- Assigning a zero to a significant number of APRA elements can greatly affect the score. It is best to use the normalized score in this case. In this case, less significant elements can have a more significant impact on the overall score. Be careful in interpretation of this score.