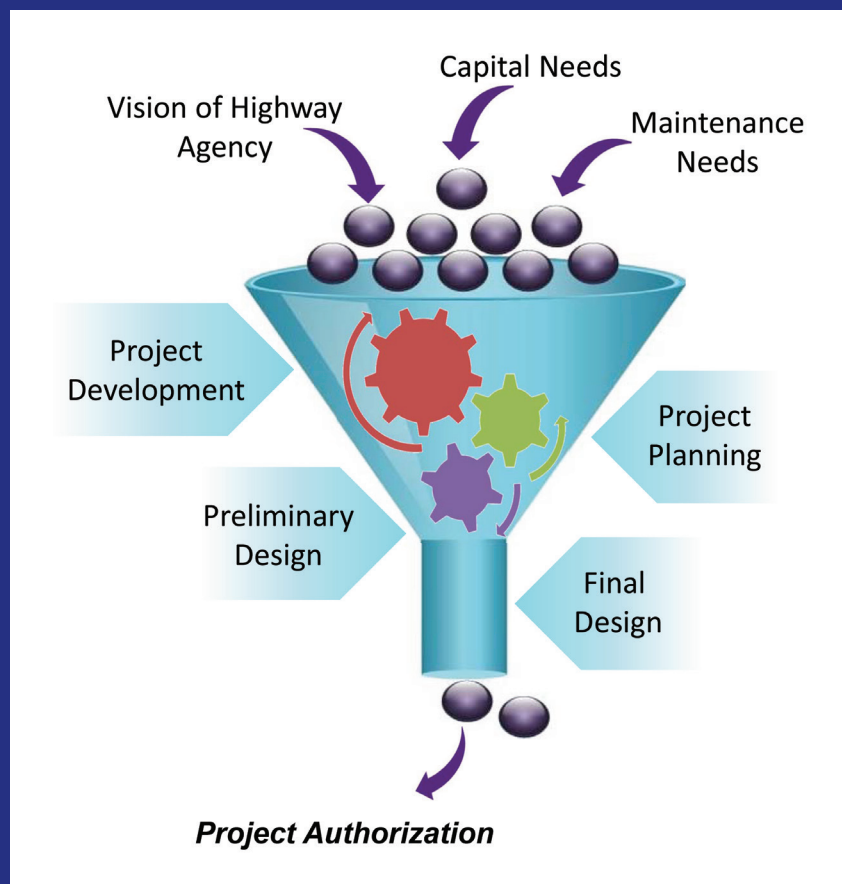


# JOINT TRANSPORTATION RESEARCH PROGRAM

INDIANA DEPARTMENT OF TRANSPORTATION  
AND PURDUE UNIVERSITY



## Pre-Contract Project Scoping Processes: Synthesis of Practices



**Hamed Zamenian, Dulcy M. Abraham**

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## AUTHORS

### **Hamed Zamenian**

Graduate Research Assistant  
Lyles School of Civil Engineering  
Purdue University

### **Dulcy M. Abraham, PhD**

Professor of Civil Engineering  
Lyles School of Civil Engineering  
Purdue University  
(765) 494-2239  
[dulcy@purdue.edu](mailto:dulcy@purdue.edu)  
*Corresponding Author*

## JOINT TRANSPORTATION RESEARCH PROGRAM

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## EXECUTIVE SUMMARY

### PRE-CONTRACT PROJECT SCOPING PROCESSES: SYNTHESIS OF PRACTICES

#### Introduction

Scoping is the process of developing a project's objectives, need, preliminary cost estimate, and preliminary schedule based on a recognized need that the project is intended to address. Scoping includes the preparation of engineering assessments, conducting field inspections, collection and analysis of data to screen a range of alternatives, summaries of the design decisions and preliminary environmental reviews. This study (SPR-3944) was launched by the Indiana Department of Transportation (INDOT)/Joint Transportation Research Program (JTRP) to develop a synthesis of scoping processes in different state highway agencies (SHAs). The study was conducted in parallel with project SPR-3948, *Pre-Contract Scoping Processes Value Stream Mapping*, which focused on the analysis of pre-contract scoping as a business process in order to identify opportunities for process improvements at INDOT and to then help implement these process improvements.

This study was conducted using a qualitative exploratory approach focusing on the review of project scoping practices across different SHAs. Focused interviews with personnel from SHAs, along with the review of documents gathered during the literature search and resources provided by SHAs, were the avenues used for data collection.

#### Findings

This study focused on 11 themes for the assessment of project scoping procedures: (1) primary entity with responsibility for scoping projects, (2) timeline for scoping activities, (3) functional groups within the SHA involved in scoping, (4) cost estimation procedures, (5) application of Context Sensitive Solutions (CSS), (6) addressing maintenance needs, (7) methods of assessing scope creep, (8) tracking the quality and effectiveness of scoping processes, (9) environmental consideration in scoping processes, (10) data collection and data sharing, and (11) scoping practices which have evolved/benefited the SHA.

The key findings are summarized as follows:

- There was no common pattern for scoping practices across SHAs. The entity responsible for scoping maintenance activities and the processes used for scoping maintenance activities are different across SHAs.
- Documents obtained from the Washington State DOT, Minnesota DOT, and California DOT indicate strong links between planning and programming of projects at these SHAs.
- Most SHAs use the American Association of State Highway and Transportation Officials (AASHTO) cost estimation guideline. Right of Way (ROW), utilities, and construction cost estimation are the major elements of the initial cost estimate during scoping phase.
- SHAs recognize that ROW cost estimation has a high degree of risk and contingency.
- The time and degree of stakeholder involvement and public outreach during the early stages of the scoping process varies from agency to agency.
- SHAs follow different practices for assessing scope creep, ranging from the active involvement of project managers

across the project cycle to the use of staged funding approaches and project review boards.

- Although the SHAs stated that the monitoring of cost estimation between scoping phase and construction phase provides a general overview of the scoping performance, most of the SHAs interviewed in this study did not have defined metrics or a formal policy to assess the quality and effectiveness of their scoping procedures.
- Typically, SHAs follow the National Environmental Policy Act (NEPA) processes for environmental analysis during the scoping phase. Environmental assessment during this phase depends on the type of project and varies from agency to agency.
- Most of the SHAs are very proactive in data collection and data sharing during the scoping phase of the project. Different types of data are collected and shared among personnel of each DOT (both at the district level and in the central office). Project Wise is the most popular database software system among SHAs.
- Scoping practices that were beneficial to SHAs included (a) well-developed scoping/project development documents (California DOT, New York State DOT, Utah DOT), (b) early implementation of Practical Design, (c) using a staged approach to reduce scope creep (Maine DOT), and (d) consistent mechanisms/processes used by regions and van tours/field reviews for assessing candidate projects (Michigan DOT).

#### Further Investigation

The following suggestions are presented for further investigation by INDOT:

- Conduct follow-up interviews with Texas DOT, Minnesota DOT, Utah DOT and Washington State DOT to determine (a) when full scopes are determined and (b) when and how budgets are set.
- Conduct a follow-up interview with Kentucky DOT to (a) obtain clarification regarding primary entity responsible for scoping, (b) determine how Planning Liaisons facilitate the scoping process, and (c) determine what scoping is done to select projects for the District Transportation Plan (DTP) and the State Highway Plan.
- Develop a *Scoping Functional Group* (consisting of representatives from INDOT districts) that can further review relevant scoping documents from other SHAs for adoption/adaptation at INDOT.
- Develop and provide training to INDOT personnel involved with scoping, and create collaborative platforms for sharing data and lessons learned during project scoping.
- Develop a consistent definition for scope creep/change and communicate reasons for changes in project estimates (understanding the need to increase confidence in the cost estimate and maintain the trust of stakeholders).
- Develop and evaluate a mechanism for creating early-stage project scopes for different types of projects.
- Evaluate the viability of including risk analysis tools to ensure more effective and transparent cost estimating.
- Review the Final Report and Guidebook of the NCHRP Study 08-88 (Report 821), *Effective Project Scoping Practices to Improve On-Time and On-Budget Delivery of Highway Projects* (<http://dx.doi.org/10.17226/23398>), for more information about scalable scoping templates.

## CONTENTS

1. INTRODUCTION . . . . .	1
1.1 Background . . . . .	1
1.2 Problem Statement and Research Objectives . . . . .	1
2. METHODOLOGY . . . . .	1
3. FINDINGS . . . . .	3
3.1 Primary Entity with Responsibility for Scoping Projects . . . . .	3
3.2 Timeline for Scoping Activities . . . . .	3
3.3 Functional Groups within the SHA Involved in Scoping . . . . .	7
3.4 Cost Estimation Procedures . . . . .	10
3.5 Application of Context Sensitive Solutions (CSS) Including Stakeholder Involvement during Scoping Processes . . . . .	19
3.6 Addressing Maintenance Needs . . . . .	24
3.7 Methods of Assessing Scope Creep . . . . .	24
3.8 Tracking the Quality and Effectiveness of Scoping Processes . . . . .	24
3.9 Environmental Consideration in Scoping Processes . . . . .	28
3.10 Data Collection and Data Sharing . . . . .	30
3.11 Scoping Practices Which Have Evolved/Benefitted DOTs . . . . .	30
4. CONCLUSIONS . . . . .	34
5. SUGGESTIONS FOR FURTHER INVESTIGATION . . . . .	34
REFERENCES . . . . .	35
BIBLIOGRAPHY . . . . .	36
APPENDICES . . . . .	
Appendix A. Study Advisory Committee . . . . .	37
Appendix B. Interview Instrument . . . . .	37
Appendix C. Participants in the Interviews . . . . .	37
Appendix D. Transportation Plan Examples . . . . .	37

## TABLE OF TABLES

Table	Page
<b>Table 3.1</b> Primary entity for scoping	3
<b>Table 3.2</b> Entities involved in scoping maintenance activities	25
<b>Table 3.3</b> Methods of assessing scope creep across SHAs	26
<b>Table 3.4</b> Data collection and data sharing during project scoping	31
<b>Table 3.5</b> Scoping practices which have evolved/benefitted SHAs	33

## LIST OF FIGURES

Figure	Page
<b>Figure 2.1</b> Research methodology	2
<b>Figure 2.2</b> Geographical representation of interviewees	2
<b>Figure 3.1</b> Project development process	4
<b>Figure 3.2</b> Work breakdown structure of project development	5
<b>Figure 3.3</b> PD&E process diagram	5
<b>Figure 3.4</b> Project scoping overview	6
<b>Figure 3.5</b> Phase I (discovery phase) process	6
<b>Figure 3.6</b> Kentucky DOT transportation needs funnel: from a need to a delivered project	6
<b>Figure 3.7</b> Project development process chart	7
<b>Figure 3.8</b> Program development process	7
<b>Figure 3.9</b> Project development process	8
<b>Figure 3.10</b> Project development overview	8
<b>Figure 3.11</b> Project documentation for simple, moderate, and complex projects	9
<b>Figure 3.12</b> Project development and sequences	9
<b>Figure 3.13</b> Project maturity as the project develops	9
<b>Figure 3.14</b> Project development process	10
<b>Figure 3.15</b> Project development meeting	11
<b>Figure 3.16</b> Cost estimation spreadsheet template	12
<b>Figure 3.17</b> Cost estimate process and pay item flowchart	13
<b>Figure 3.18</b> Project cost estimate summary	14
<b>Figure 3.19</b> Project cost and additional information table	14
<b>Figure 3.20</b> WinCPMS software for percentage completion analysis	15
<b>Figure 3.21</b> Preliminary cost estimate form	16
<b>Figure 3.22</b> Preliminary cost estimate format	18
<b>Figure 3.23</b> Flowchart of risk-based cost estimate	18
<b>Figure 3.24</b> Cost estimation procedure	19
<b>Figure 3.25</b> Kentucky DOT public participation in the consultation process	21
<b>Figure 3.26</b> Stakeholder activity format and level matrix	22
<b>Figure 3.27</b> Stakeholder involvement curve	22
<b>Figure 3.28</b> Framework for business engagement through development	23
<b>Figure 3.29</b> Quality assurance involvement	27
<b>Figure 3.30</b> New Mexico DOT – Environmental Processing Plan	29

## 1. INTRODUCTION

### 1.1 Background

Scoping is the process of developing a project's objectives, need, preliminary cost estimate, and preliminary schedule based on a recognized need that the project is intended to address. Project scoping is a critical first step in the overall process of highway project development. Literature is replete with evidence that the outcome of scoping significantly impacts the final project outcomes in terms of the frequency and magnitude of change orders, and the severity of cost overruns or time delays. For example, in the state of Washington, the Joint Legislative Audit and Review Committee (JLARC, 2010) stated that when a transportation agency is given the time to fully understand a project's needs and risks, there is greater chance for more accuracy in a project's cost estimate; and that investing more time and resources into the scoping process may result in more accurate initial project cost estimates.

Scoping includes the preparation of engineering assessments, conduction of field inspections, collection and analysis of data to screen a range of alternatives, and identifying a preferred course of action to resolve a specific identified gap in transportation service. At most agencies, scoping also includes the development of the project cost, making recommendations to assist with the agency's long range planning, evaluating the existing long-term plans, and making recommendations for any revisions to the plan. In many State Highway Agencies including the Indiana Department of Transportation (INDOT), the scoping process includes developing summaries of the design decisions and the preliminary environmental review.

Currently, the scoping activity at INDOT is decentralized with each of INDOT's six districts providing scoping for projects in their districts. Typically, the scoping processes among the six INDOT districts comprise of two phases. During the first phase (preparation for project call), the focus is on developing the portfolio of projects that could be considered for implementation ("put into a hopper for further consideration and evaluation"). At this stage, since there are no designs and a high level of uncertainty, the conceptual estimate is used to merely "set the tone" of the possible project. During the project call process, the Crawfordsville District, for instance, uses statistical models which were developed in-house (Montgomery & Hunter, 2015), using project parameters (for instance, bridge's NBI number, deck area, factors for right of way (ROW)), to develop a conceptual cost estimate. During the second phase, i.e., when the projects are authorized, engineers work with preliminary information, including environmental review, to develop design alternatives and "more realistic" cost estimates. District engineers seek a method to develop estimates based on realistic ranges. Such a method will assist the districts in determining how to appropriately allocate resources at different scoping phases.

### 1.2 Problem Statement and Research Objectives

Current challenges in the pre-contract scoping processes at INDOT include the lack of a consistent definition of project scope across different units with INDOT, the lack of consistency in scoping practices/processes across districts and the lack of resources for coordination and long-term planning. Recognizing these challenges and with the creation of the new position of State-wide Director of Scoping, this six-month study (SPR-3944) was launched to develop a synthesis of scoping processes in different State Highway Agencies (SHAs).

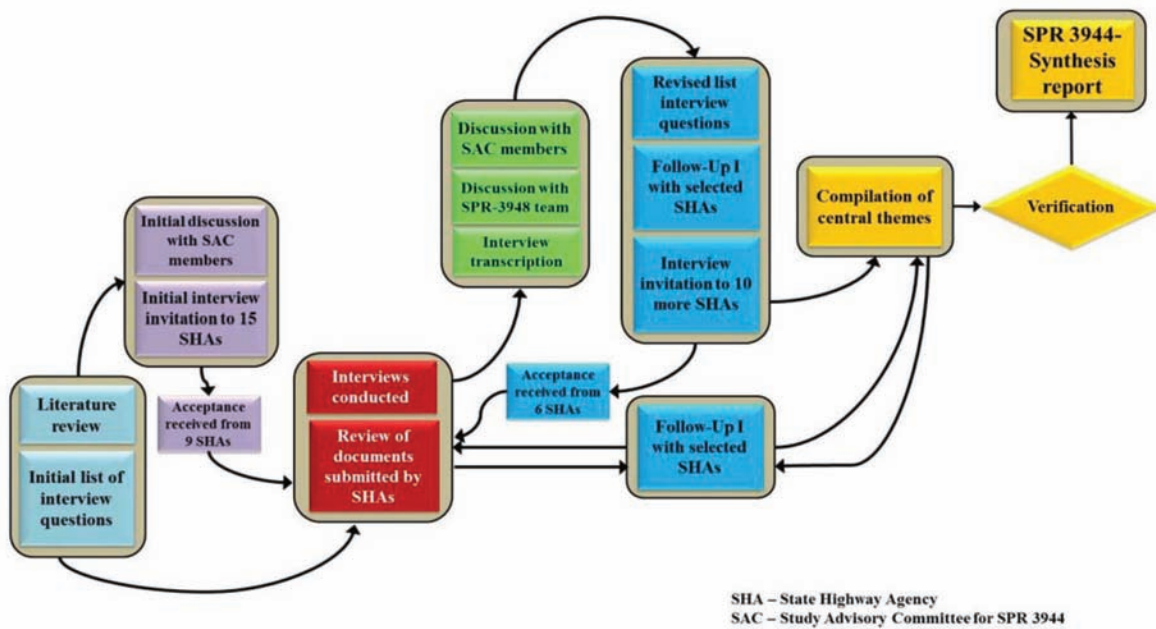
This study focused on 11 themes for the assessment of project scoping procedures: (1) primary entity with responsibility for scoping projects, (2) timeline for scoping activities, (3) functional groups within the State Highway Agency involved in scoping, (4) cost estimation procedures, (5) application of Context Sensitive Solutions (CSS), (6) addressing maintenance needs, (7) methods of assessing scope creep, (8) tracking the quality and effectiveness of scoping processes, (9) environmental consideration in scoping processes, (10) data collection and data sharing, and (11) scoping practices which have evolved/benefited the DOT. The study was conducted in parallel with JTRP SPR-3948, *Pre-Contract Scoping Processes Value Stream Mapping*, which analyzed pre-contract scoping as a business process, and identified opportunities for process improvements.

## 2. METHODOLOGY

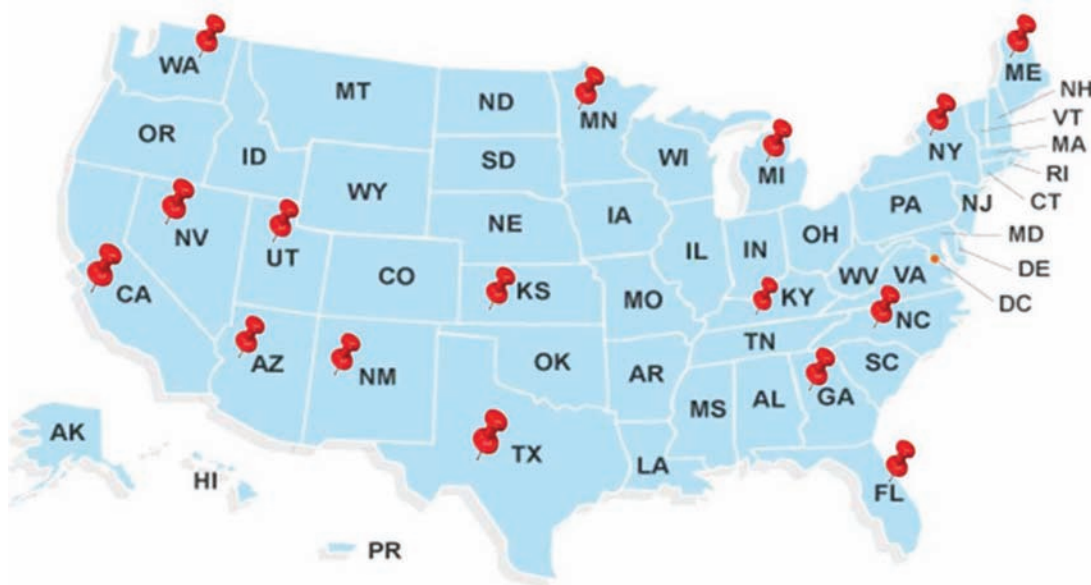
This study was conducted using a qualitative exploratory approach (Creswell, 2009) focusing on the review of project scoping practices across different SHAs. Qualitative research analysis is the preferred research strategy when "how" and "why" questions are being posed and when the focus of the study is on a contemporary problem with some real-life context (Yin, 2009). According to Creswell (2009), "the idea behind qualitative research is to purposefully select participants or sites that will best help the researcher understand the problem and the research question." Two primary methods: (1) focused interviews and (2) review of documents obtained during the literature search and resources provided by SHAs were the avenues used for data collection in this study. Figure 2.1 shows the steps in the project methodology.

A literature search was conducted to identify state-of-art and state-of-practice in pre-contract project scoping. The first round of literature review was performed by using both archival resources as well as on-line sources such as the FHWA, the NCHRP, and the websites of different SHAs. Based on the findings from this review, a preliminary list of themes was generated for further exploration of scoping practices at different SHAs. Recognizing that qualitative research heavily relies on interviews as an important source of information (Marshall & Rossman, 2011), the SPR-3944





**Figure 2.1** Research methodology.



**Figure 2.2** Geographical representation of interviewees.

research team with guidance from the Business Owner, the Project Administrator and the Study Advisory Committee (SAC) (see list of members in Appendix A) initially identified SHAs, to be invited to participate in the interviews. The structured formal interview method using a phone interview (50–75 minutes) with the key respondents at each SHA was used by the research team. With approval from the project's Business Owner, the project's administrator and the SAC, a set of structured interview questions was developed and used for the interviews. The list of interview questions can be found in Appendix B.

Personnel at 25 SHAs were contacted to schedule interview in order to get insight into how SHA

personnel understand and narrate aspects of scoping procedures and practices. Fifteen (15) SHAs agreed to participate in this study: including Arizona DOT (ADOT), California DOT (Caltrans), Florida DOT (FDOT), Georgia DOT (GDOT), Kansas DOT (KDOT), Kentucky DOT, Maine DOT (MEDOT), Michigan DOT (MDOT), Minnesota DOT (MnDOT), North Carolina DOT (NCDOT), New Mexico DOT (NMDOT), New York DOT (NYSDOT), Texas DOT (TXDOT), Utah DOT (UDOT), and Washington State DOT (WSDOT). Figure 2.2 shows the geographical representation of interviewees. The responses of the interviews were informed by their roles with the SHA

and their/agency's experiences with scoping practices. Appendix C lists the participants in each of the interviews.

Synopses of key findings/observations from the interviews were shared with the SAC and with the SPR-3948 team to identify areas which needed further investigation, more nuanced questions and follow-up. Data and interview responses to eleven primary themes (as described in Section 3), were then compiled. These compilations were then shared with each of the SHAs for verification.

### 3. FINDINGS

This study focused on 11 themes for the assessment of project scoping procedures: (1) primary entity with responsibility for scoping projects, (2) timeline for scoping activities, (3) functional groups within the State Highway Agency involved in scoping, (4) cost estimation procedures, (5) application of Context Sensitive Solutions (CSS), (6) addressing maintenance needs, (7) methods of assessing scope creep, (8) tracking the quality and effectiveness of scoping processes, (9) environmental consideration in scoping processes, (10) data collection and data sharing, and (11) scoping practices which have evolved/benefited the SHA. This section provides a summary of the responses.

#### 3.1 Primary Entity with Responsibility for Scoping Projects

Table 3.1 shows whether the SHA has centralized or decentralized approach for managing operations and also lists the primary entity for administering scoping efforts. There was no common pattern for scoping practices across SHAs.

#### 3.2 Timeline for Scoping Activities

##### 3.2.1 Arizona Department of Transportation

"Project scoping is an integral part of the ADOT Project Development Process. The detailed information provided from the Scoping Phase is used in the Priority Programming Process by the Multimodal Planning Division (MPD) for inclusion of projects for construction in the Five-Year Transportation Facilities Construction Program" (ADOT, 2011a). Figure 3.1 shows the project development process that was used for Interstate 10 project in Arizona.

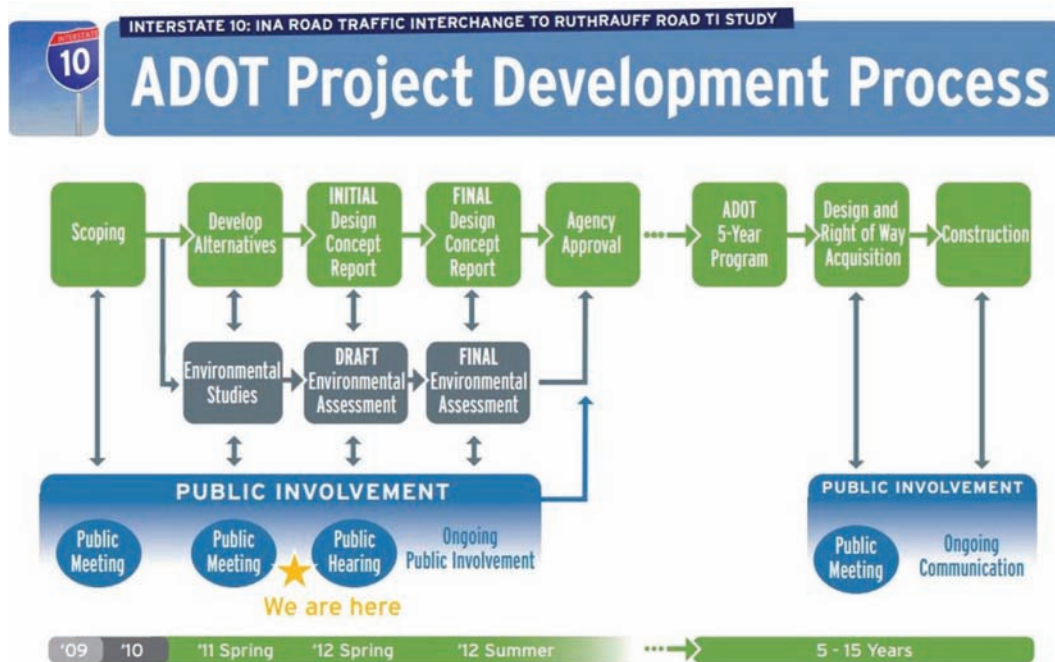
##### 3.2.2 California Department of Transportation

California DOT develops project scopes by assigning a Project Manager to the task and initiating the Project

TABLE 3.1  
Primary entity for scoping

#	DOT	Number of Districts/ Regions	Centralized/ Decentralized*	Primary Entity for Scoping
1	Arizona DOT	10	Decentralized	Central Office (Phoenix)
2	California DOT	12	Decentralized	Districts offices
3	Florida DOT	7	Decentralized	District offices
4	Georgia DOT	7	Centralized	District Offices
5	Kansas DOT	6	Centralized	Headquarters
6	Kentucky DOT	12	Decentralized	District Offices*
7	Maine DOT	5	Centralized	Central Office
8	Michigan DOT	7	Decentralized	Central Office
9	Minnesota DOT	8	Decentralized	District Office
10	North Carolina DOT	14	Centralized	Central Office
11	New Mexico DOT	6	Hybrid (mix of centralized and decentralized)	(Information not provided by DOT)
12	New York DOT	11	Decentralized	Regional Offices
13	Texas DOT	25	Decentralized	District Office
14	Utah DOT	4	Decentralized	District Office
15	Washington DOT	6	Decentralized	District Office

\*Primary planning at Kentucky DOT is done at the Central Office.



**Figure 3.1** Project development process (ADOT, 2011b).

Initiation Document (PID). Figure 3.2 demonstrates the project development process in a Work Breakdown Structure format.

### 3.2.3 Florida Department of Transportation

Florida DOT's (FDOT) Project Development and Environment (PD&E) phase includes scoping, environmental and engineering evaluation, and documentation. "At the end of the Programming Screen, the FDOT project team begins to develop the scope of work for the PD&E phase. The scope of work reflects the activities necessary to complete the PD&E Study and focuses on addressing the issues raised and technical studies identified by the Environmental Technical Advisory Team (ETAT) during the review" (FDOT, 2006). Figure 3.3 shows the PD&E procedure.

### 3.2.4 Georgia Department of Transportation

The scoping process includes all activities through concept approval. GDOT (2015) defines its Project Programming and Scheduling using the seven steps as shown in Figure 3.4.

### 3.2.5 Kansas Department of Transportation

The project scoping occurs at the first stage of project development phase, called the Discovery Phase. The Discovery Phase flowchart is shown in Figure 3.5.

### 3.2.6 Kentucky Department of Transportation

Project scoping is initiated from each district through the preparation of a needs list based on the input from

stakeholders and general public. Figure 3.6 shows the Kentucky DOT transportation needs funnel.

### 3.2.7 Maine Department of Transportation

Before programming, the scoping process takes place to evaluate why this project is needed, and to perform stakeholder assessment, and environment assessment. The Preliminary Alignment Plan, as shown in Figure 3.7, "is a working document that should be reflective as to the context in which the Project is scoped and developed" (MaineDOT, 2015, p. 1-8).

### 3.2.8 Michigan Department of Transportation

"The purpose of the Statewide Scoping Process is to establish a uniform, documented statewide process that improves the internal consistency while reducing the number of changes to projects and the 5 Year Plan during design" (MDOT, 2015). Figure 3.8 shows the project scoping process to the programming phase.

### 3.2.9 Minnesota Department of Transportation

"The MnDOT Scoping Process begins with a Project Planning Phase in which transportation system needs are identified and prioritized" (MnDOT, 2008, p. 2). Figure 3.9 shows the project development procedure, from planning to the programming phase.

### 3.2.10 North Carolina Department of Transportation

Scoping at NCDOT is defined as "a formal process that determines the scope of issues to be addressed for planning a project" (NCDOT, 2006, p. 1).



# Work Breakdown Structure Diagram

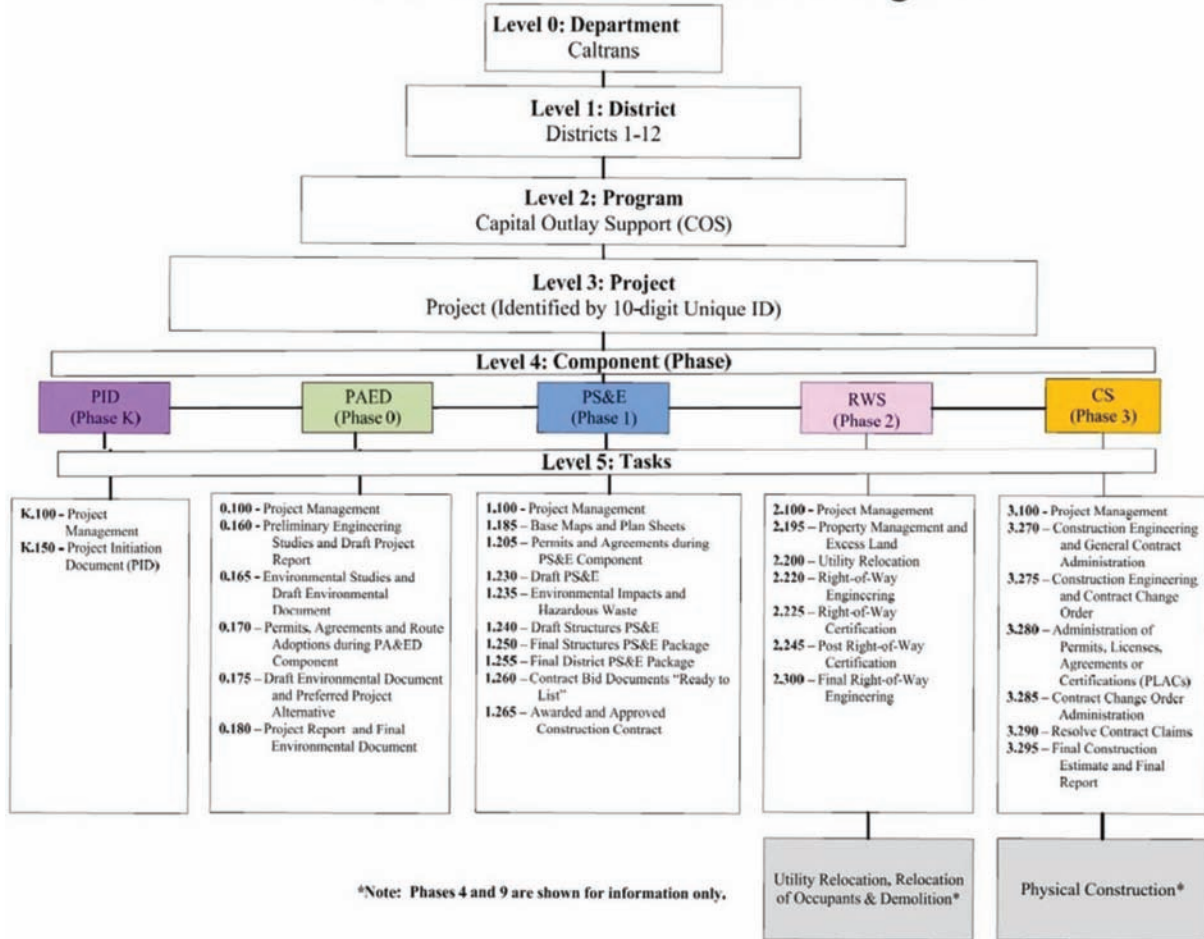


Figure 3.2 Work breakdown structure of project development (Caltrans, 2014c).

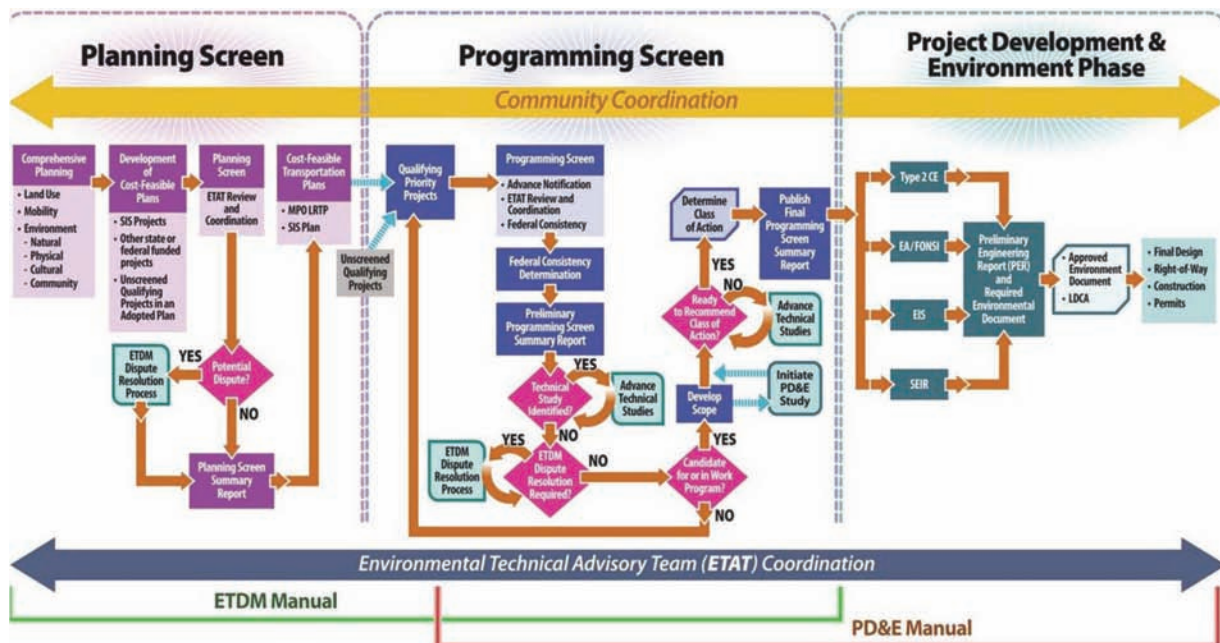


Figure 3.3 PD&E process diagram (FDOT, 2015a, p. 4-1).

### 3.2.11 New Mexico Department of Transportation

“Study Scoping and Conceptual Design is the process whereby the improvement needs identified in the transportation improvement program are defined, the level of effort is determined, and improvement alternatives are developed and evaluated” (NMDOT, 2000, p. 1-3). Figure 3.10 shows the overview and the linkage between each step in the project development process.

### 3.2.12 New York Department of Transportation

Regional asset management teams formulate project scoping/proposals to address needs based on the strategic instructions provided from the Main Office in each region. The project development process builds from these initial project scoping/proposals. Figure 3.11 shows the project development process for different types of projects.

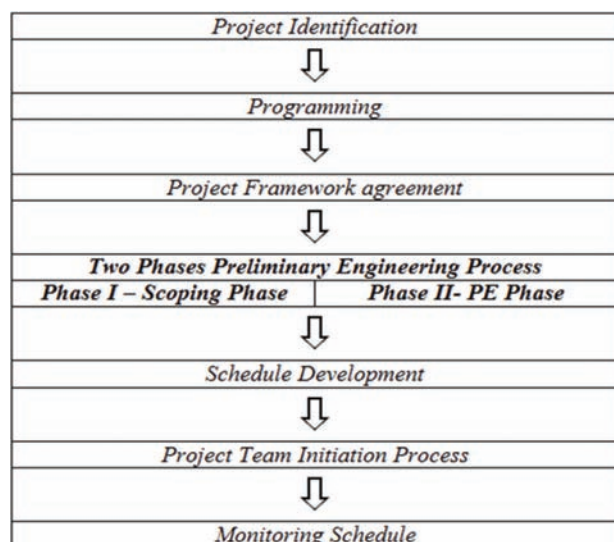


Figure 3.4 Project scoping overview (GDOT, 2015).

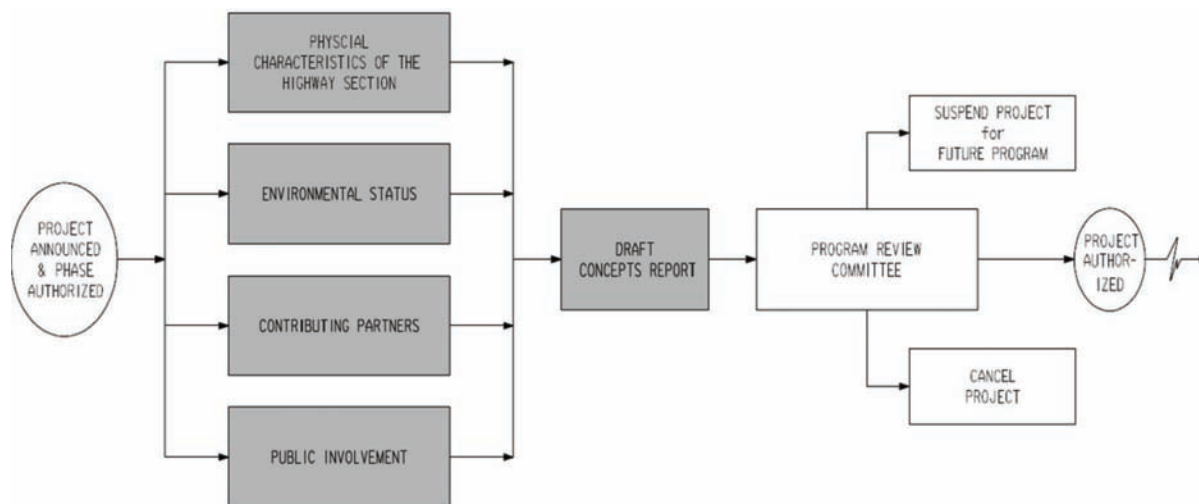


Figure 3.5 Phase I (discovery phase) process (KDOT, 2014).

### 3.2.13 Texas Department of Transportation

Figures 3.12 and 3.13 show the project development and sequences adopted by TxDOT (2015, p. x-3).

### 3.2.14 Utah Department of Transportation

Project scoping occurs early in project development through the Concept Phase. The Concept Phase provides rough estimation for the project, and after allocating the budget, the project manager will be assigned for developing detailed project scopes. UDOT maintains various network charts—some more updated than others. The principal network is the Project Delivery Network which provides different templates outlining the stages, activities and tasks or producing successful projects (UDOT, 2015a).

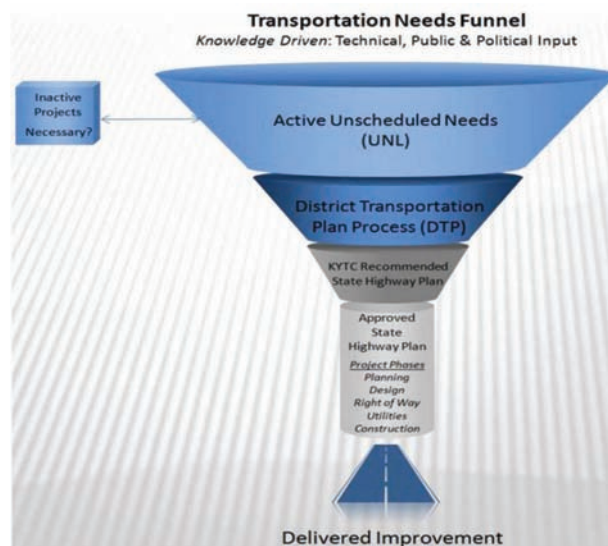


Figure 3.6 Kentucky DOT transportation needs funnel: from a need to a delivered project (KYTC, 2014, pp. 5.1–5.9).

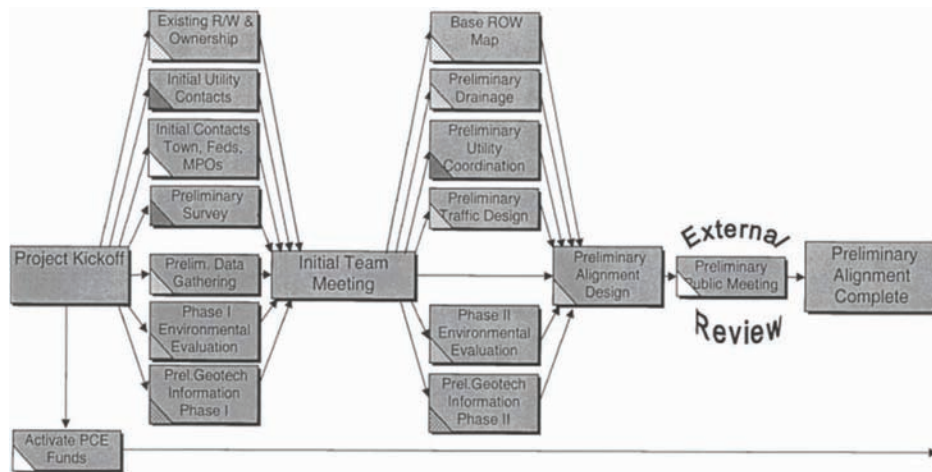


Figure 3.7 Project development process chart (MaineDOT, 2015, p. 1-17).

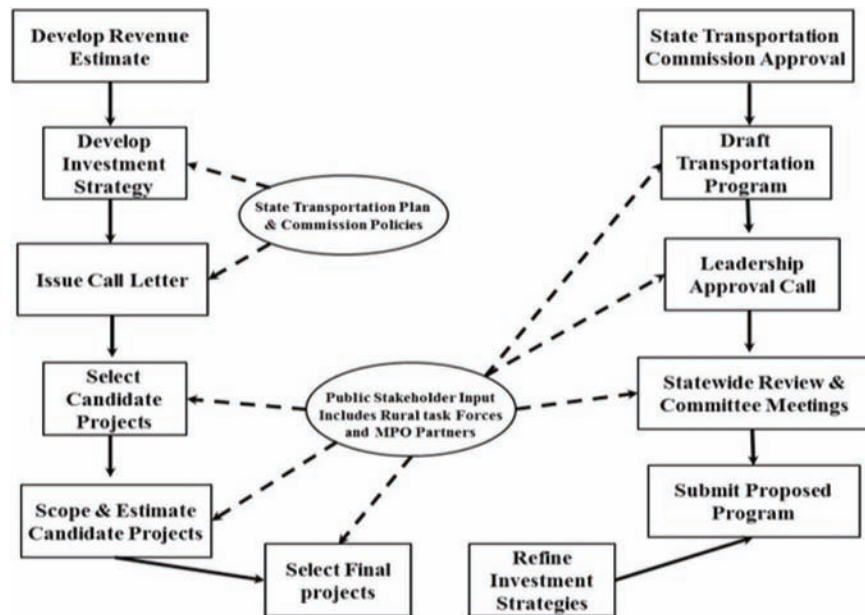


Figure 3.8 Program development process (MDOT, 2015).

### 3.2.15 Washington Department of Transportation

At Washington DOT, the project development process begins with scoping, through programming, and finally to project development approval. Figure 3.14 shows the overview of project development process.

## 3.3 Functional Groups within the SHA Involved in Scoping

The functional groups involved in scoping were similar across the different SHAs.

### 3.3.1 Arizona Department of Transportation

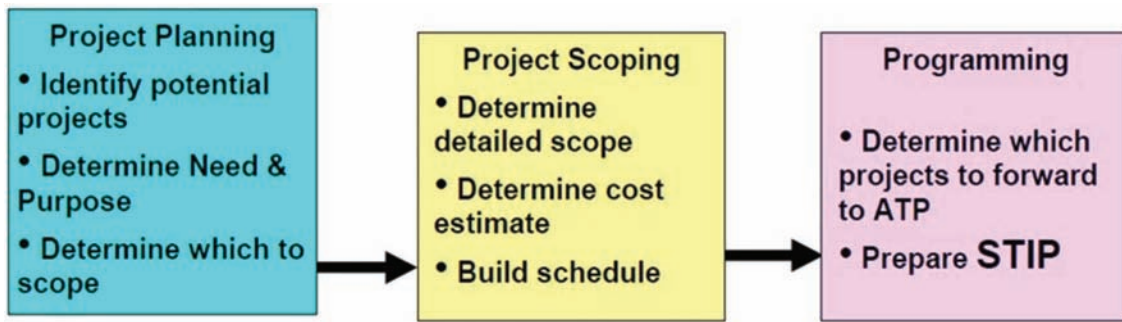
These functional units are involved during the scoping phase: Predesign Section, Valley Project Management,

Planning, Environmental Management, Design (Roadway, Structures, Drainage, Traffic), ROW, Construction and Maintenance, Statewide Project Management, Bridge Group, and Traffic Group. Also, “a Scoping Project Manager from the responsible functional unit leads the project scoping development” (ADOT, 2011a).

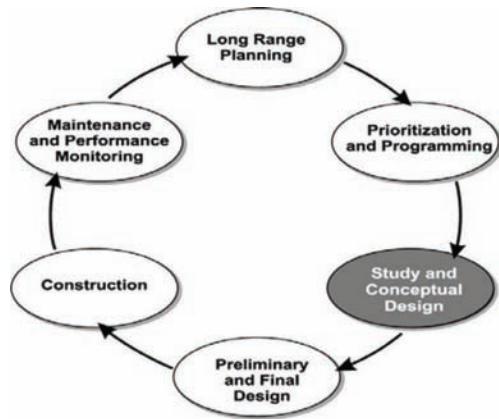
### 3.3.2 California Department of Transportation

The functional units across California DOT that are involved during scoping phase include: Transportation Planning, Environmental, Surveys, ROW, Real Property Asset, Management, Materials, Traffic, Structure Design, Hydraulics, Construction, Maintenance, Landscape Architecture, Utilities, and Districts Office Engineer unit (Caltrans, 2014b).





**Figure 3.9** Project development process (ATP – Area Transportation Partnership; STIP – State Transportation Improvement Program (MnDOT, 2008, p. 2).



**Figure 3.10** Project development overview (NMDOT, 2000).

### 3.3.3 Florida Department of Transportation

The Florida DOT Project Development and Environmental (PD&E) manual lists the following groups as being involved in the project development process: Department District Environmental Management Office (EMO), Design, Planning, and Right of Way Offices plus their Central Office counterparts (FDOT, 2009, p. 1-1). “During the Programming phase each qualifying project is reviewed by appropriate Department personnel (i.e., project manager, environmental specialist, design and drainage staff), Environmental Technical Advisory Team (ETAT) and the Lead Federal Agency” (FDOT, 2014b, p. 2-4).

### 3.3.4 Georgia Department of Transportation

The functional groups during scoping procedure at Georgia DOT include the: (1) Office of Planning, (2) Office of Program Delivery, and (3) Division of Engineering.

### 3.3.5 Kansas Department of Transportation

Two main functional groups are involved during the scoping process: (1) Bureau of Road Design and (2) Bureau of Program and Project Development. In addition, the six construction districts get actively involved during the scoping process.

### 3.3.6 Kentucky Department of Transportation

The KYTC Division of Planning, Design and District Offices are involved in pre-contract scoping.

### 3.3.7 Maine Department of Transportation

The functional groups involved in scoping vary based on the complexity of projects.

### 3.3.8 Michigan Department of Transportation

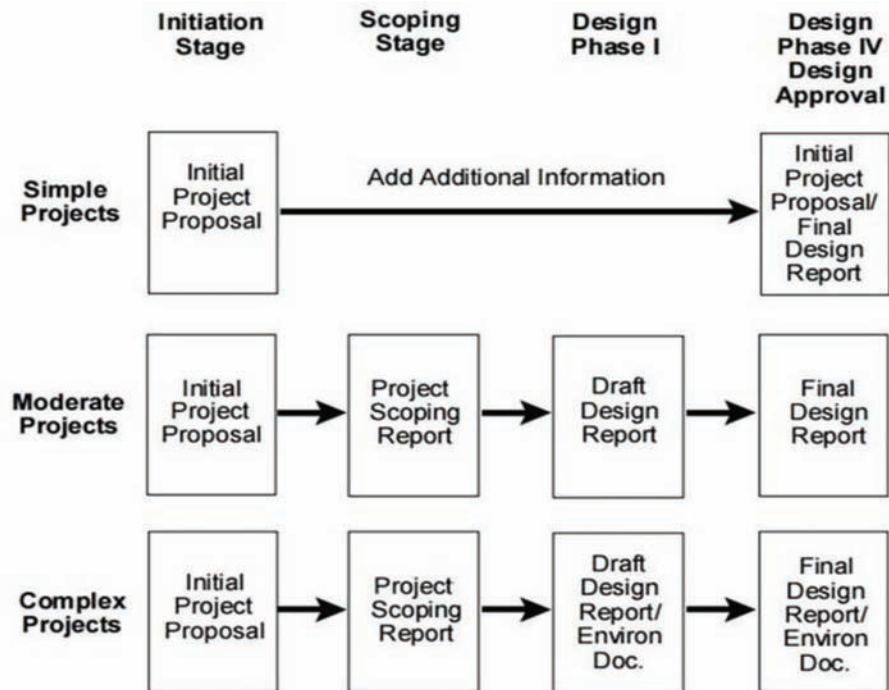
Different groups that are involved during scoping procedure include: the Region Pavement Engineer, the Regional Bridge Engineer, the System Manager, Development or Delivery Staff, Regional Real Estate Staff, Traffic and Safety (T&S) Engineer, Lansing planning Division, Maintenance Staff, Regional Soil Engineer, Transportation Service Center (TSC) Operation Engineer, TSC Construction Engineer, TSC Consultant Coordinator, TSC Traffic and Safety Engineer, TSC Maintenance Coordinator, County Road Commission, Permits or Utility Engineer, and Design Engineer group.

### 3.3.9 Minnesota Department of Transportation

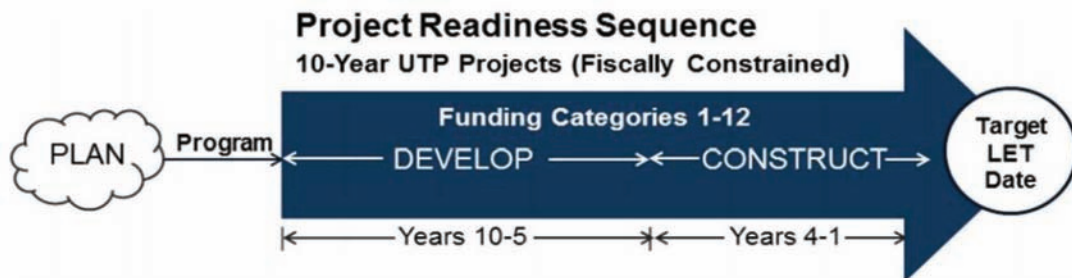
In Minnesota DOT, the divisions of maintenance, traffic, roadway design, hydraulic design, ROW, materials, and environment at the districts level are involved in scoping processes.

### 3.3.10 North Carolina Department of Transportation

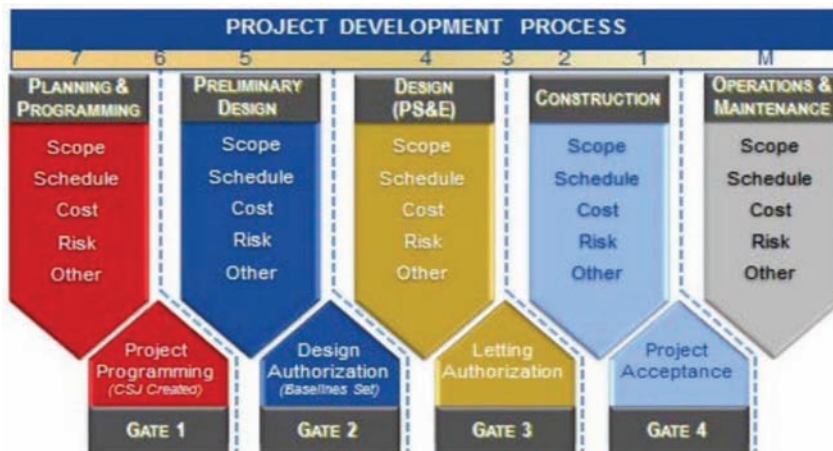
During project scoping process, the Project Development Analysis Unit and any of the pre-construction groups are involved in a large scoping meeting. During the feasibility study scoping meeting, representatives from following units will participate (NCDOT, 2013): Roadway Design Unit, Division(s) Engineer, as well as Assistant Division Engineers and Division Planning Engineers, Transportation Mobility and Safety Branch, Project Development and Environmental Analysis Branch include the Project Development, Human Environment, and Natural Environment Units, Traffic Management Unit, Transportation Planning Branch, and Alternative Delivery Systems Unit.



**Figure 3.11** Project documentation for simple, moderate, and complex projects (NYSDOT, 2004a, p. 2–14).

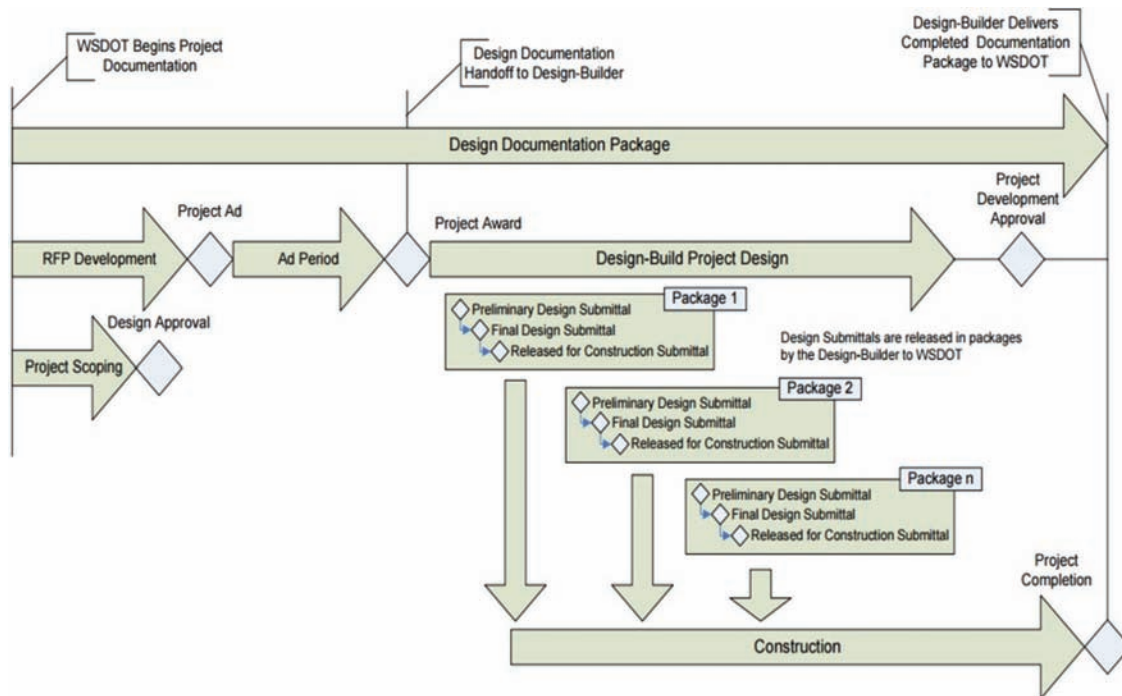


**Figure 3.12** Project development and sequences (TxDOT, 2015).



**Figure 3.13** Project maturity as the project develops (TxDOT, 2013).





**Figure 3.14** Project development process (WSDOT, 2015b, p. 110-4).

### 3.3.11 New Mexico Department of Transportation

The following groups are involved during scoping process: Bridge Bureau, Drainage Bureau, Environmental and Cultural Resources, Environmental Geology, Funding Control, Geotechnical Structures, Pavement Design, Planning Bureau, Infrastructure Design, Design Quality Assurance, ROW Bureau, Traffic Bureau, Railroad and utilities, Survey and Lands Engineering, Value Engineering Unit, and District Engineers group.

### 3.3.12 New York Department of Transportation

Different functional groups are involved during scoping process including Design, Construction, Planning, Traffic and Safety, Operations, Geotech, Materials, and quality control staff. Scoping usually takes place in a meeting, usually with field work done prior to the meeting.

The depth and breadth of the project scoping effort varies widely depending on the project. The level of effort will depend on factors such as the:

- Type of project and context of the project area
- Problems and needs
- Complexity and significance of project related issues
- Scope of alternatives to be evaluated
- Social, economic and environmental considerations

### 3.3.13 Texas Department of Transportation

There are different groups involved during project scoping. Since TxDOT is a decentralized organization, the majority of the road and bridge projects are scoped at the district level with the involvement of the Design, Environmental, and ROW divisions. For projects outside

of the road and bridge program, the Transportation Planning and Project division, the Finance division, and the specific program offices such as Bridge, Rail, Aviation, and Public Transportation are involved in the scope development. At the project progress level, the Planning department, the Finance department, Bridge, Rail, etc. are involved.

### 3.3.14 Utah Department of Transportation

For the project development and project scoping, the following departments are involved: Project Development Director, Statewide Utility Engineer, Director of Construction, State Construction Engineer, Chief Structural Engineer, Engineer for Preconstruction, Deputy Engineer for Preconstruction, Environmental Director, Right-of-Way Director, Engineer for Quality and Materials, State QMS manager, and Statewide Materials Engineer (UDOT, 2015a). The Utah DOT Project Delivery Network has identified other units for project development meeting, as shown in Figure 3.15 (UDOT, 2015c, p. 228).

### 3.3.15 Washington Department of Transportation

No response was provided during the interview.

## 3.4 Cost Estimation Procedures

### 3.4.1 Arizona Department of Transportation

For ADOT, pre-contract scoping is an initial planning level cost estimate based on available project data and a preliminary initial site visit. It is the first estimate for the project based on a system need.

The following <u>must</u> be invited to the Kickoff Meeting:		
<b>Region</b>		
<ul style="list-style-type: none"> <li>Program Manager</li> <li>Maintenance Area Supervisor</li> <li>Region Materials Engineer</li> <li>Region Pavement Management Manager</li> <li>Region Environmental Engineer</li> </ul>	<ul style="list-style-type: none"> <li>Region Utility and Railroad Coordinator</li> <li>Region ROW Engineer</li> <li>Region Traffic Engineer</li> <li>Region Communications Manager</li> </ul>	<ul style="list-style-type: none"> <li>Project Design Engineer</li> <li>Design Engineer</li> <li>Surveyor</li> <li>Region Landscape Architect</li> <li>Region Hydraulics Engineer</li> </ul>
<b>Central Support Personnel</b>		
<ul style="list-style-type: none"> <li>Geotechnical Engineer</li> <li>Structural Engineer</li> <li>Lead Project ROW Agent</li> </ul>	<ul style="list-style-type: none"> <li>Environmental Engineer</li> <li>Hydraulic Engineer</li> </ul>	<ul style="list-style-type: none"> <li>Fiber Business Manager</li> <li>ITS Project Manager</li> </ul>
<b>Consultant Team If Applicable</b>		
Consider inviting the following:		
<b>Outside Agencies</b>		
<ul style="list-style-type: none"> <li>FHWA</li> <li>Utah Transit Authority (UTA)</li> </ul>	<ul style="list-style-type: none"> <li>Local Municipality Representative</li> </ul>	<ul style="list-style-type: none"> <li>Irrigation Company Representative</li> </ul>
<b>Region</b>		
<ul style="list-style-type: none"> <li>Region Director</li> <li>Region Preconstruction Engineer</li> </ul>	<ul style="list-style-type: none"> <li>Region District Engineer</li> <li>Region Archaeologist</li> </ul>	<ul style="list-style-type: none"> <li>Resident Engineer</li> <li>Shed Foreman</li> </ul>
<b>Central Support Personnel</b>		
<ul style="list-style-type: none"> <li>Value Engineer Manager</li> <li>ROW Deputy Director</li> </ul>	<ul style="list-style-type: none"> <li>Traffic Operations</li> <li>Traffic Signal and Lighting Program Manager/Engineer</li> </ul>	<ul style="list-style-type: none"> <li>Traffic and Safety</li> <li>Pedestrian and Bicycle Planner</li> </ul>

**Figure 3.15** Project development meeting (UDOT, 2015c).

All the scoping documents include the cost estimation section. The cost estimating includes (ADOT, 2011a, p. 8):

1. Any special assumptions or basis used for a cost estimate
2. The reference used to obtain the unit costs for an estimate
3. A summary of the itemized cost estimate (Preliminary Engineering, Right-of-Way, utilities and Construction)

In addition, all of the scoping documents have an itemized cost estimation section including (ADOT, 2011a, p. 10):

1. The estimate in the format of a table with five columns (Item, Unit, Quantity, Unit Price, and Amount).
2. Pay items applicable to the project will be listed.
3. The ADOT standard unit of measure for each pay item shall be listed.
4. The estimated quantities for each pay item listed in the "Quantity" Column.
5. The unit price for each pay item listed in the "Unit Price" Column.
6. The product of the "Unit Price" and "Quantity" for each pay item listed in the "Amount" Column.
7. Subtotals calculated and listed at several intervals within the estimate.
8. The total itemized cost listed at the bottom of the estimate.

### 3.4.2 California Department of Transportation

At Caltrans, the initial estimate is the one associated with a locked budget. It is the programmed estimate. The cost estimation practices for scoping process includes all capital outlay costs, including right-of-way, structures and landscaping, but does not normally include capital outlay support costs. There are two categories for cost estimation at scoping phase (Caltrans, 2014a):

- Project planning cost estimates: used for project justification, programming, analysis of alternatives, and approval.

- Project design cost estimates: used to summarize the cost of a project's contract items of work and are used for the bid item list.

Figure 3.16 shows the template for the summary estimation of a roadway project.

Following the initial estimate, the timing of updates is guided by the following factors (Caltrans, 2014a):

- *Annual updates:* All cost estimates must be kept current and updated at least once a year.
- *Programming cycle:* A current cost estimate is needed at the start of each programming cycle so that the next programming document reflects current cost estimates.
- *Approval of project development reports:* Project development reports authorizing a project to proceed further in the project development process require the development and inclusion of a project cost estimate.
- *Significant changes in identified project costs:* Another appropriate time to update the project cost estimate is when a project development workflow task supports the preparation of a more detailed cost estimate.
- *After Plans, Specifications, and Estimate (PS&E):* Final engineer's cost estimates that are more than three months old must be updated for projects that have achieved the Plans, Specifications, and Estimate milestone.

### 3.4.3 Florida Department of Transportation

Florida DOT uses an in-house cost estimating program (Long Range Estimate (LRE) and conducts an annual review of the cost estimates for each project. An estimator can load a project in the LRE system but it is not considered an "initial estimate" until they "take a snapshot" of it. If the project is to be included in the 5-year work program, it must have an initial estimate. Figure 3.17 shows the procedure used for developing the cost estimate and the pay items.

I. ROADWAY ITEMS SUMMARY			
Section		Cost	
1	Earthwork	\$	-
2	Pavement Structural Section	\$	-
3	Drainage	\$	-
4	Specialty Items	\$	-
5	Environmental	\$	-
6	Traffic Items	\$	-
7	Detours	\$	-
8	Minor Items	\$	-
9	Roadway Mobilization	\$	-
10	Supplemental Work	\$	-
11	State Furnished	\$	-
12	Contingencies	\$	-
13	Overhead	\$	-

**Figure 3.16** Cost estimation spreadsheet template (Caltrans, 2014a).

#### 3.4.4 Georgia Department of Transportation

At Georgia DOT, the initial estimate is the project's first estimate. The initial cost estimate is developed prior to the project's addition to GDOT's program. When the Office of Planning identifies and programs a new project:

1. A cost estimate is generated using the Cost Estimating System (CES) and Right of Way and Utility Cost Estimating System (RUCEST). The estimate will be provided to the Office of Financial Management for programming purposes.
2. When initial Preliminary Engineering Phase or Scoping Phase moves into the STIP, the project source office will review and update the cost estimate. (At this stage, the initial PE Cost may be generated as a percentage of the construction cost).

There is a pre-determined list for cost estimates. A project cost estimate will be submitted as a part of the FFPR (Final Field Plan Review) and corrected plans package (plans, special provisions, earthworks, and CES control) to the Office of Engineering Services after corrections from the FFPR have been made, but not less than 18 weeks prior to the scheduled letting. Figures 3.18 and 3.19 show the cost estimation templates used by Georgia DOT.

#### 3.4.5 Kansas Department of Transportation

KDOT considers the first estimate to be the planning estimate based on historical costs. This leads to making programming decisions early based on these numbers knowing that there will be fluctuations.

"The cost estimates that the designer prepares should be based on average unit costs distributed by the Bureau of Construction and Materials. These unit cost values are an average of the contract bid prices for the preceding year in each wage area. The construction cost estimate should be a figure that represents the cost of the project in the year it is expected to be let for construction. Thus, an estimate based on the unit costs discussed above must be increased to allow for inflation. The inflation rate used should be obtained from the Inflation Rate Table published by the Bureau of Program Management" (KDOT, 2014, page 2-27). Initial estimates, originating in the Bureau of Program and Project Management for planning purposes, are comprised of typical project costs per mile based on historical data and inflated from a base year.

"The design leader is responsible for submittal of the completion dates and monthly submittal of the percentage of phase completion for each WinCPMS Activity phase into the WinCPMS" (KDOT, 2014, page 2-27). Figure 3.20 shows the platform of WinCPMS software (Windows Program Management System [WinCPMS]).

#### 3.4.6 Kentucky Department of Transportation

Depending on the amount of detailed information and time available to make the estimate, different methods are used ranging from a per mile estimates to detailed, itemized cost estimates. Early cost estimates are developed for inclusion in the Project Identification Form. Phase costs are also included in the recommended highway plan. Figure 3.21 shows the preliminary cost estimate form.

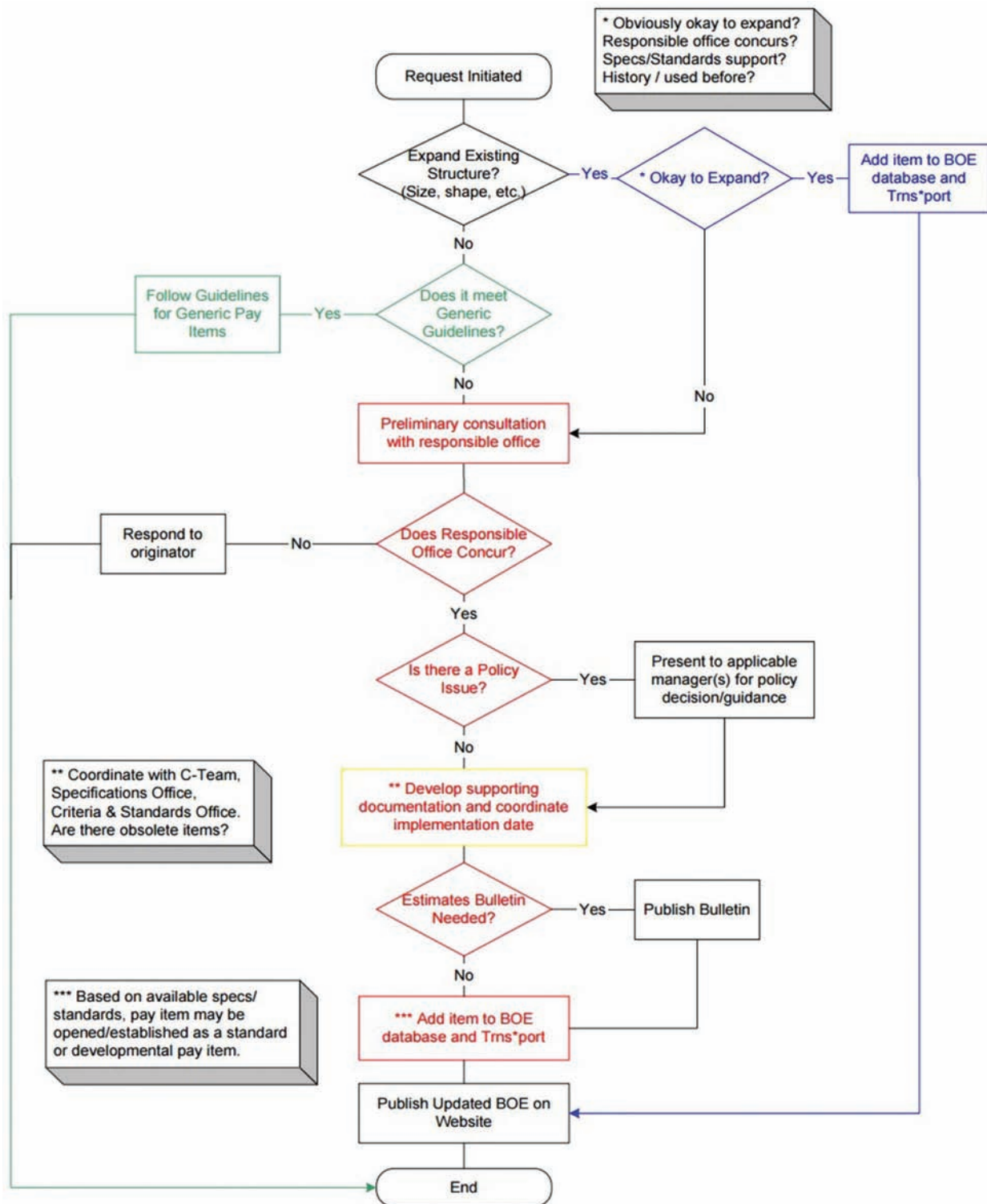


Figure 3.17 Cost estimate process and pay item flowchart (FDOT, 2015c).

### 3.4.7 Maine Department of Transportation

For pavement preservation projects, Maine DOT uses historic data for cost estimation. Maine DOT programs reconstruction and rehabilitation projects for initial engineering and develops cost estimates later.

### 3.4.8 Michigan Department of Transportation

The cost estimating for the scoping process includes determining the costs associated with all phases of a candidate project. The estimated cost during scoping phase is used to program the funding of the design, Right



**Project Cost Estimate Summary and Funding Responsibilities:** Add additional rows as necessary; Attach current cost estimates to report. See Revisions to Programmed Costs Template on ROADS website.

	Breakdown of PE	ROW	Reimbursable Utility	CST*	Environmental Mitigation	Total Cost
Funded By						
\$ Amount						
Date of Estimate						

\*CST Cost includes: Construction, Engineering and Inspection, Contingencies and Liquid AC Cost Adjustment.

**Figure 3.18** Project cost estimate summary (GDOT, 2015, p. 145).

#### PROJECT COST AND ADDITIONAL INFORMATION

Item	Estimated Cost	Date of Estimate	Funded By
Base Construction Cost:			
Engineering and Inspection:			
Contingencies:			
Liquid AC Adjustment:			
<u>Total Construction Cost:</u>			
Right-of-Way:			
Utilities (reimbursable costs):			
Environmental Mitigation:			
<b>TOTAL PROJECT COST:</b>			

**Figure 3.19** Project cost and additional information table (GDOT, 2015, p. 145).

of Way (ROW) and construction for the project. MDOT (2015) uses the following considerations for developing a good project estimate: (1) documentation, (2) always start fresh, (3) list your assumptions, (4) be clear, (5) be neat, (6) quantities and rounding, (7) sketches and typical sections, (8) project identification, (9) QC/QA review of estimate, and (10) project concept statement (if using the estimating spreadsheet only). MDOT uses a pay item book.

#### 3.4.9 Minnesota Department of Transportation

“All project-related costs will be expressed as a Total Project Cost Estimate (TPCE) regardless of project development phase. The Total Project Cost Estimate consists of a Base Estimate and a Contingency. The Base Estimate includes all known project costs at the time the estimate is made. Contingency is the cost that reflects risk and uncertainty associated with the Base Estimate for pre-Letting phases, or risk and uncertainty associated with the Construction Phase (post-Letting). At Letting, when the Base Estimate costs are known, the Contingency cost is zero” (MnDOT, n.d.a).

“To help project managers and estimators as they scope and estimate projects, a list of 19 base estimate

elements has been established” (MnDOT, n.d.b, p. 2). The Base Estimate Elements includes:

1. Pre-Letting Engineering: Internal—Mn/DOT
2. Pre-Letting Engineering: External—Consultants
3. Construction Engineering: Internal—Mn/DOT
4. Construction Engineering: External—Consultants
5. Project Construction Cost
  - Per Scoping Report (e.g., roads, bridges, approaches, and other structures)
  - Contractor Work (e.g., staking, creation of machine control, landscaping and retaining walls)
6. Detours and Haul Roads
7. Pre-Letting Traffic Management: Enforcement and Incident Management
8. Construction Traffic Management: Extraordinary Enforcement and Incident Management
9. Pre-Letting Communications/Public Information
10. Construction Communications/Public Information
11. Right of Way
12. Utilities
13. Railroads
14. Turn-Backs: Before
15. Turn-Backs: After

Plan Activity	Percent Plan Completion	WinCPMS ACTIVITY	WinCPMS Percentage Complete	
Field Survey Received	1%	Begin PRDES	Preliminary Road Design Activity 130	2%
Preliminary Plans Completed	15%			27%
Preliminary Plans Submitted for Geotech, Geology, and Pavement	20%-30%	PRASE & PLNMR		36%-54%
Ready for Field Check	54%			98%
Field Check Completed	55%	PRDES Complete		100%
		Begin FIDES		
Official Right-of-Way Plan Submitted	60%-85%		Final Road Design Activity 184	11%-68%
Office Check	94%			87%
Prints to Bureau of Construction and Maintenance	99%	FIDES Complete		100%
		Begin PS&E		
Plans Ready for Construction Letting	100%	PS&E Complete		100%

**Figure 3.20** WinCPMS software for percentage completion analysis (KDOT, 2014).

16. Turn-Backs: After
17. Landscaping
18. Environmental Clean-Up/Mitigation
19. Incentives (moves to Construction Contingency after Letting)

#### 3.4.10 North Carolina Department of Transportation

The Cost Estimation Tool (CET) generates a cost estimate based on three components:

1. Construction Cost (Roadway, Structure, Intersection/ Interchange)
2. Right-of-Way
3. Utilities Cost

In addition, North Carolina DOT provides itemized cost estimates during initial scoping phase in the NEPA document and the feasibility study. Figure 3.22 shows the Preliminary Cost Estimate Format used by North Carolina DOT.

#### 3.4.11 New Mexico Department of Transportation

The following factors/items are used to develop the preliminary cost estimate:

1. A good scope of the work
2. Itemized list of major items (material) that will be required
3. Quantify the major items as much as possible
4. Account for material availability based on project location
5. Use average unit bid prices or experience to determine prices
6. Account for minor items with a contingency
7. Add additional contingency for any errors and omissions
8. GRT (Gross Receipts Tax)

9. Compare estimated cost estimate to similar past projects.

The development of itemized cost estimate follows these two procedures:

1. An itemized cost estimate is developed when the design phase begins. If the same Engineer developed the estimated cost then they have already started the itemized list. The Project Development Engineer will provide the itemized cost estimate at every plan review (30%, 60%, 90%, Final). This is required as per NMDOT design directives. Through the design process, items are either added or removed from the list.
2. Pay items are determined based on NMDOT specifications. NMDOT has a master list of items that are commonly used or have been used. If there is a unique item, then our Plans, Specifications & Estimates Unit will create a new item. The master itemized list is standard for all NMDOT projects.

#### 3.4.12 New York Department of Transportation

Estimates are produced at the following key milestones during the project development process. Additional intermediate estimates are prepared as the scope of work is refined or significantly changed. The following documents are used for cost estimation purpose:

- Initial Project Proposal (IPP) Approval – Conceptual Estimate
- Scope Approval – Preliminary Estimate
- Design Approval – Updated Preliminary Estimate
- Advance Detail Plan Submission – Detailed Engineer's Estimate
- Plans, Specification and Estimate (PS&E) Approval – Final Detailed Engineer's Estimate

Project Identification Form Preliminary Cost Estimate							
<b>General Information:</b>		County	McMartin	Route	KY 12	MP	6.1-7.9
UNL # or Item #		11-155	Prepared By:	Brad Travis	DATE:	1/31/2013	
Length (Mi)	1.8	mi	Median wid	0	# Lanes	2	Pave Depth (in.)
Ex R/W (Ft)	60		NewR/W(Ft)	100	Total Width (all lanes)	24	Shoulder Width (each side)
Brief Description Summary from Project ID Form		Reconstruct KY 12 and KY 99 from US 66 to US 88 in Billtown					
<b>TOTAL PROJECT ESTIMATE:</b>		<b>\$ 8,711,480</b>					
Planning:		\$ 80,000	Design:		\$ 900,000	Right of Way: \$ 568,000	
Utilities:		\$ 313,480	Construction:		\$ 3,349,500		
<b>Construction Total Construction Cost</b>		<b>\$ 8,840,000</b>					
<input type="checkbox"/> Per Mile Average Cost:		\$3,800,000					
		Total Project Cost = \$ 6,840,000					
<input checked="" type="checkbox"/> Itemized Construction Estimate:		(Use Best Available Information)					
	Quantity	Unit	Unit Price	Total Cost			
Excavation	120000	cy	\$6	\$ 720,000			
Asphalt	15000	Ton	\$80	\$ 1,200,000			
DGA	20000	Ton	\$20	\$ 400,000			
Detour	1	Lump Sum	\$125,000	\$ 125,000			
Bridge	1	Each	\$600,000	\$ 600,000			
Other							
Other							
Other							
Other							
Other							
Other							
Other							
*Miscellaneous		10%	\$3,045,000	\$ 304,500			
		<b>Total Construction Cost = \$ 3,349,500</b>					
* Miscellaneous charges are a Percentage of all other major cost not listed above. This cost might include cost of Clearing and Grubbing, Mobilization, Demobilization, Guardrail, Seeding, Staking, Striping, Culvert Pipes, etc. Any of these individual cost could be added above in the OTHER cell if approximate quantities are known.							
CONSTRUCTION COMMENTS and NOTES:							
<b>Design:</b>		<b>Total Design Cost \$ 900,000</b>					
<input checked="" type="checkbox"/> Per Mile Average Design Estimate:		\$500,000					
		Total Design Estimate (mileage) = \$ 900,000					
<input type="checkbox"/> Percent of Construction, Design Estimate		Percent					
		Total Design Estimate (percent) = \$ -					
DESIGN COMMENTS and NOTES:							
<b>Planning:</b>		<b>Total Planning Cost \$ 90,000</b>					
<input type="checkbox"/> Per Mile Average Planning Estimate:							
		Total Planning Estimate (mileage) = \$ -					
<input checked="" type="checkbox"/> Percent of Design, Planning Estimate		Percent 10					
		Total Planning Estimate (percent) = \$ 90,000					
PLANNING COMMENTS and NOTES:							

**Figure 3.21** Preliminary cost estimate form (provided by Steve Ross from Kentucky DOT on November 17, 2015). (Figure continued on next page.)

New York DOT uses an estimation software, Trns\*port, supported by AASHTO. "There are various modules available within the software to support a project from its inception through preliminary design, final design, construction, and historical archiving of the Engineer's Estimate, bidding, and final cost data" (NYSDOT, 2011, p. 21-86). New York DOT uses three basic approaches for cost estimation purpose:

- Historic data from recently awarded contracts
- Cost-based approach takes into consideration factors related to actual performance of the work (i.e., the current cost of labor, equipment, and materials; sequence

of operations; production rates; and a reasonable value of overhead and profit)

- Combining the use of historical bid data with actual cost development

Revision and changes to the cost estimation are conducted through the Trns\*port software, and requires a new Expedite file to be created and shared with plan holders. Pay items to be deleted, added, or modified (quantity or unit price changes, changes in share distribution) are transmitted via an Excel Worksheet (Pay Item Changes.xls) (NYSDOT, 2011, p. 21-121).



Project Identification Form Preliminary Cost Estimate			
<b>Right of Way: Total Estimated R/W Cost</b> \$      568,000			
<input type="checkbox"/> <b>Per Mile Average Estimated R/W Cost:</b> <div style="text-align: right;">Total R/W Estimated Cost (mileage) = \$      -</div>			
<input checked="" type="checkbox"/> <b>Itemized Right of Way Estimate</b>			
	Quantity	Avg. Value	Total Value
Farm Acres	31	\$8,000	\$ 248,000
Commercial Acres	1	\$100,000	\$ 100,000
Non-Developable Acre	5	\$1,000	\$ 5,000
# of Homes	2	\$100,000	\$ 200,000
# of Buildings	1	\$15,000	\$ 15,000
# Commercial Bldgs			
# of Graves			
Other			
Other			
Other			
Administrative & Legal % of R/W		\$ 568,000	
<b>**Total Right of Way Cost =</b>			<b>\$ 568,000</b>
<input type="checkbox"/> <b>Per Acre Average Estimated R/W Cost:</b> <div style="text-align: right;">Total R/W Estimated Cost (mileage) =</div>			
<b>** Right of Way estimates are based on best assumptions at the time of estimate.</b>			
<div style="display: flex;"> <div style="width: 30%; border: 1px solid black; padding: 2px;">RIGHT-OF-WAY COMMENTS and NOTES:</div> <div style="flex-grow: 1;"></div> </div>			

<b>Utilities: Total Utility Cost</b> \$      313,480																																									
<input type="checkbox"/> <b>Per Mile Average Utility Cost:</b> <div style="text-align: right;">Total Utility Estimated Cost = \$      -</div>																																									
<input checked="" type="checkbox"/> <b>Itemized Utility Estimate</b>																																									
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 10%; text-align: center;">Quantity</th> <th style="width: 10%; text-align: center;">Unit</th> <th style="width: 15%; text-align: center;">Unit Price</th> <th style="width: 35%; text-align: center;">Total Cost</th> </tr> </thead> <tbody> <tr> <td>Gas</td> <td style="text-align: center;">350</td> <td style="text-align: center;">Ft.</td> <td style="text-align: center;">18</td> <td style="text-align: center;">\$ 6,480</td> </tr> <tr> <td>Power</td> <td style="text-align: center;">46</td> <td style="text-align: center;">Ea.</td> <td style="text-align: center;">4,500</td> <td style="text-align: center;">\$ 207,000</td> </tr> <tr> <td>Telephone</td> <td style="text-align: center;">2000</td> <td style="text-align: center;">Ft.</td> <td style="text-align: center;">10</td> <td style="text-align: center;">\$ 20,000</td> </tr> <tr> <td>Sewer</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Water</td> <td style="text-align: center;">3200</td> <td style="text-align: center;">Fl.</td> <td style="text-align: center;">25</td> <td style="text-align: center;">\$ 80,000</td> </tr> <tr> <td>Other</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>**Total Utility Cost =</b></td> <td style="text-align: center;"><b>\$ 313,480</b></td> </tr> </tbody> </table>		Quantity	Unit	Unit Price	Total Cost	Gas	350	Ft.	18	\$ 6,480	Power	46	Ea.	4,500	\$ 207,000	Telephone	2000	Ft.	10	\$ 20,000	Sewer					Water	3200	Fl.	25	\$ 80,000	Other					<b>**Total Utility Cost =</b>				<b>\$ 313,480</b>
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<div style="display: flex;"> <div style="width: 30%; border: 1px solid black; padding: 2px;">UTILITY COMMENTS and NOTES:</div> <div style="flex-grow: 1;"></div> </div>																																									

Figure 3.21 Continued.

### 3.4.13 Texas Department of Transportation

“To obtain adequate funding for a project, prepare construction cost estimate and separate right of way (ROW) cost estimate, and enter the estimates into the Design and Construction Information System (DCIS)” (TxDOT, 2014).

Texas DOT has a framework for Risk-Based Construction Cost Estimation (RBCCE) as shown in Figure 3.23 has recently developed and is presently being rolled out to the agency to provide guidance for RBCCE.

### 3.4.14 Utah Department of Transportation

Utah DOT has developed its own cost estimate spreadsheet, which needs to be filled by a designer (using a preliminary cost estimate and engineering judgment). After the project is funded, the Utah DOT

uses a cost-based estimate (this phase is handled by the group of former contractors). The cost spreadsheet is available on Utah DOT’s website and includes the following items: Inflation, Roadway-Drainage, Traffic-Safety, Structures, Environmental, Utility-ROW, and Assumptions. Utah DOT does not have a list of pay items; however, Utah DOT has the list of every single bid (called measurement payment).

The “initial estimate” for UDOT would be the estimate that was generated during the Concept Phase of the project. This estimate is usually the amount that is requested for the project. If there is a significant scope change between the concept phase and the design phase, additional budget would be requested at that time and it would be noted in the Project Definition Document. The difference between the final cost of the constructed project and the scope and budget agreed to during the



Memo To:	Preliminary Estimate Engineer
From:	Project Planning Engineer or Project Design Engineer
Subject:	TIP Project ____ Construction Cost Estimate Request
Please provide an Updated Construction Cost Estimate for TIP Project ____.	
Type of Estimate and Update Description is indicated below.	
<b>ESTIMATE TYPE</b>	
	<input type="checkbox"/> Update Feasibility Study Estimate (Project to be added to TIP)
	<input type="checkbox"/> Scoping Meeting
CP 1	_____
	<input type="checkbox"/> Functional Design of All Alternatives
CP 2	_____
	<input type="checkbox"/> Functional Design of Alternatives to be Studied in Further Detail
	<input type="checkbox"/> Preliminary Design
CP 2A	_____
	<input type="checkbox"/> Preliminary Design with Approved Structure Types and Locations
CP 3	_____
	<input type="checkbox"/> Preliminary Design on Selected Alternate
CP 4A	_____
	<input type="checkbox"/> Preliminary Design after Impacts are Minimized
CP 4B	_____
	<input type="checkbox"/> Right-of-Way Plans
CP 4C	_____
	<input type="checkbox"/> 13 Month Letting
	<input type="checkbox"/> Final Quantities
	<input type="checkbox"/> Other (Comparison for a Scope Change, or other Revision to Plans)

Figure 3.22 Preliminary cost estimate format (provided by Derrick Lewis from North Carolina DOT on July 6, 2015).

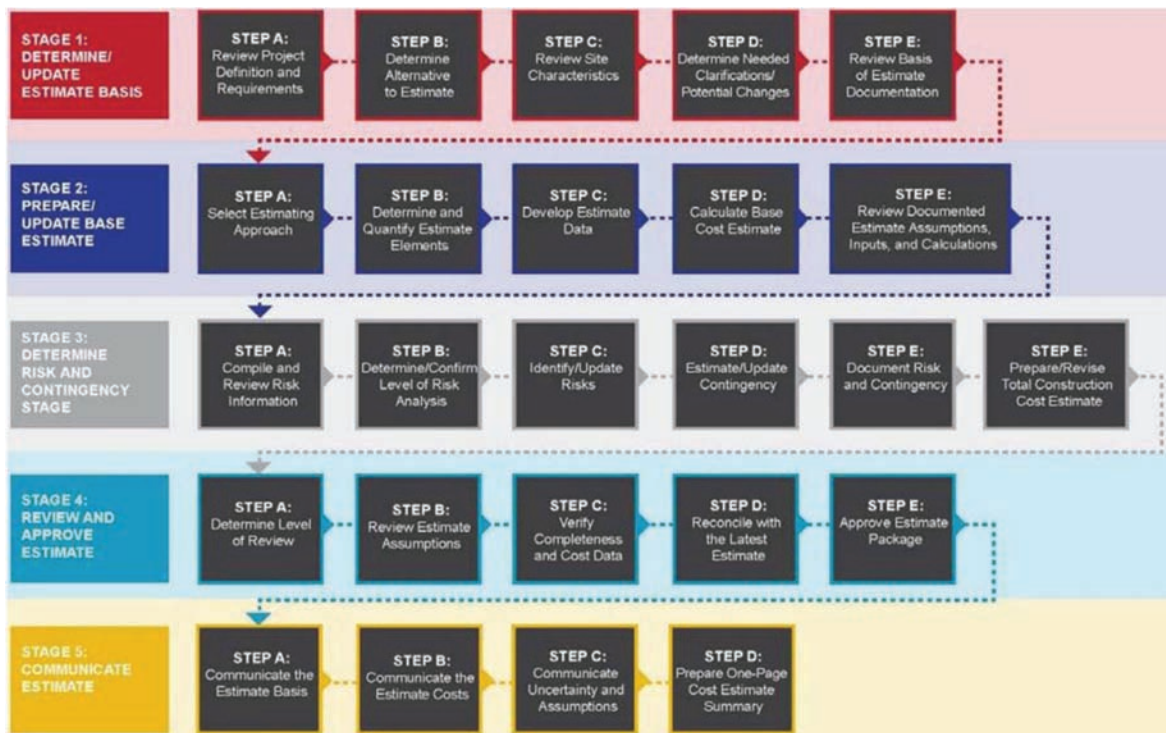
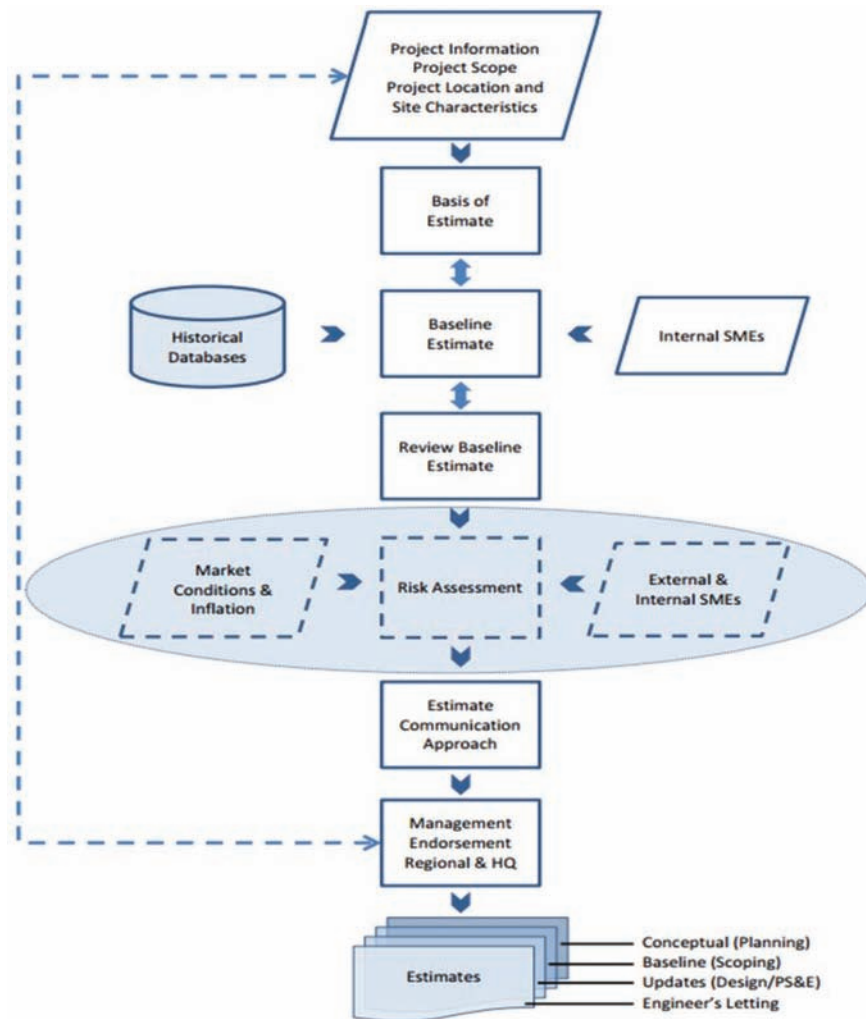


Figure 3.23 Flowchart of risk-based cost estimate (TxDOT, 2013, p. 7).



**Figure 3.24** Cost estimation procedure (WSDOT, 2015a, p. 2-4).

delivery process, is usually in the 5% to 10% range. Scope changes during the concept or design phase are reviewed and approved and are not considered “scope creep,” especially if “the change is the correct thing to do.”

#### 3.4.15 Washington Department of Transportation

Washington DOT’s cost estimation process for the scoping phase covers preliminary engineering (PE), right of way (ROW), and construction (CN). The key inputs for successful cost estimation process include project scope details, historical databases, and other cost databases. “The baseline estimate is also dependent on the estimated project schedule. The estimated schedule should be attached to the Basis of Estimate. An early schedule may only include a few activities, but typically should include estimated durations for the environmental, design, ROW, ad/bid/award, and construction phases” (WSDOT, 2015a, p. 2-2). Figure 3.24 shows the link between cost estimation procedures at Washington DOT.

### 3.5 Application of Context Sensitive Solutions (CSS) Including Stakeholder Involvement during Scoping Processes

#### 3.5.1 Arizona Department of Transportation

“Major Project Scoping solutions are Context Sensitive Solutions (CSS). Multi-disciplinary teams work together to find solutions that meet the transportation needs within the project environment or context. CSS is a process that recognizes the need to consider high-way projects as more than just transportation but as an integration with community values regarding the purpose and need of a project whereby the overall solution balances safety, mobility, and preservation of scenic, aesthetic, historic, and environmental resources” (ADOT, 2011a, p. 2).

Arizona DOT has a Public Outreach and Involvement Plan at the early stage of the project in order to:

- Engaging stakeholders to help ensure the final report incorporates agency and public input

- Providing clear and accurate information that encourages informed public participation and input
- Providing multiple, convenient ways for interested parties to provide comment
- Providing multiple means through which the public can learn about the project

### 3.5.2 California Department of Transportation

At the early stage of the project and before getting into the PID process, California DOT gets the local community involved in the project. The local community gets involved in the Caltrans meetings as well.

### 3.5.3 Florida Department of Transportation

FDOT has an early and continuous public involvement program to fully inform and involve the public, including property owners, tenants, business owners and operators, public officials and agencies, users of the facility, interested individuals, and special interest groups during the development of transportation projects (FDOT, 2015b, p. 5).

### 3.5.4 Georgia Department of Transportation

Georgia DOT's PDP manual defines Context Sensitive Design as "a collaborative approach to design that weaves together design principles, environmental concerns and community quality of life into one complete package." It involves balancing the concerns and desires of the community for their environment and way of life with the sound engineering practices endorsed by AASHTO. It also firmly involves the public in the decision making process to encourage ownership and responsibility for the final product.

### 3.5.5 Kansas Department of Transportation

CSS is a part of Kansas DOT's project development process but it is not specifically called out in the DOT's Road Design Manual. The Local Consult process incorporates the local perspective and regional priorities with statewide priorities as identified through the Enhanced Priority Formula System (EPFS). Every two years, KDOT meets with eight focus groups, one per district plus two metro areas, throughout the state. These groups provide comments regarding projects in various stages of development and assist in determining regional priorities for projects underway and yet to be identified. Modernization and Expansion projects are evaluated and prioritized based on scoring 25% local consult, 25% economic analysis and 50% engineering. Preservation projects are prioritized based on 20% local consult and 80% engineering scoring. The core construction program is developed through iterations of the local consult process and applied funding constraints. Each district in Kansas has a local consult and gets them involved at early stage of the project.

"More complex projects, or those that have a high potential for environmental impact, may require early and extensive public involvement and extensive documentation in accordance with 23 CFR 771" (KDOT, 2011, p. 2-12). The stakeholders provide input, insights and information which is used in the decision making process. Stakeholders are engaged throughout the project and are consulted for handling traffic during construction, attending field check, and on more complex jobs are a member of the technical advisory group which would meet several times during the discovery phase.

### 3.5.6 Kentucky Department of Transportation

KYDOT has a CSS manual and the DOT tries to create balance between environmental, engineering, and economic issues. At the early stage of project identification, the local public gets involved in the process by expressing the needs of the community. The cost estimate is released to the community. Figure 3.25 shows the levels of Kentucky DOT Public Participation in the Consultation Process.

### 3.5.7 Maine Department of Transportation

MEDOT has formalized a partnership with municipalities and has them involved with different types of projects.

### 3.5.8 Michigan Department of Transportation

MDOT has used the CSS concept during project scoping and project development for many years. The principles of CSS are used to provide the tools necessary to consistently apply CSS in the program and project development, as well as provide to better understand the definition of stakeholder engagement. "MDOT's annual Call for Projects process provides an opportunity for stakeholders to have input at the earliest stages of program development (MDOT, 2015)." Figure 3.26 shows the stakeholder activity format and level matrix, and Figure 3.27 shows the value of public involvement at different stages of project development.

#### Level I

- Inform and communicate project information/scope/schedule
- Majority are informal, including email, phone calls, and letters
- Incidental communication at a meeting. Examples: Phone calls, regular meetings with maintaining agencies, scoping meetings, and daily communication

#### Level II

- Informal project meetings to gain input, share information and coordinate activities
- Schedule project meetings with select stakeholders

Public Participation in the Consultation Process

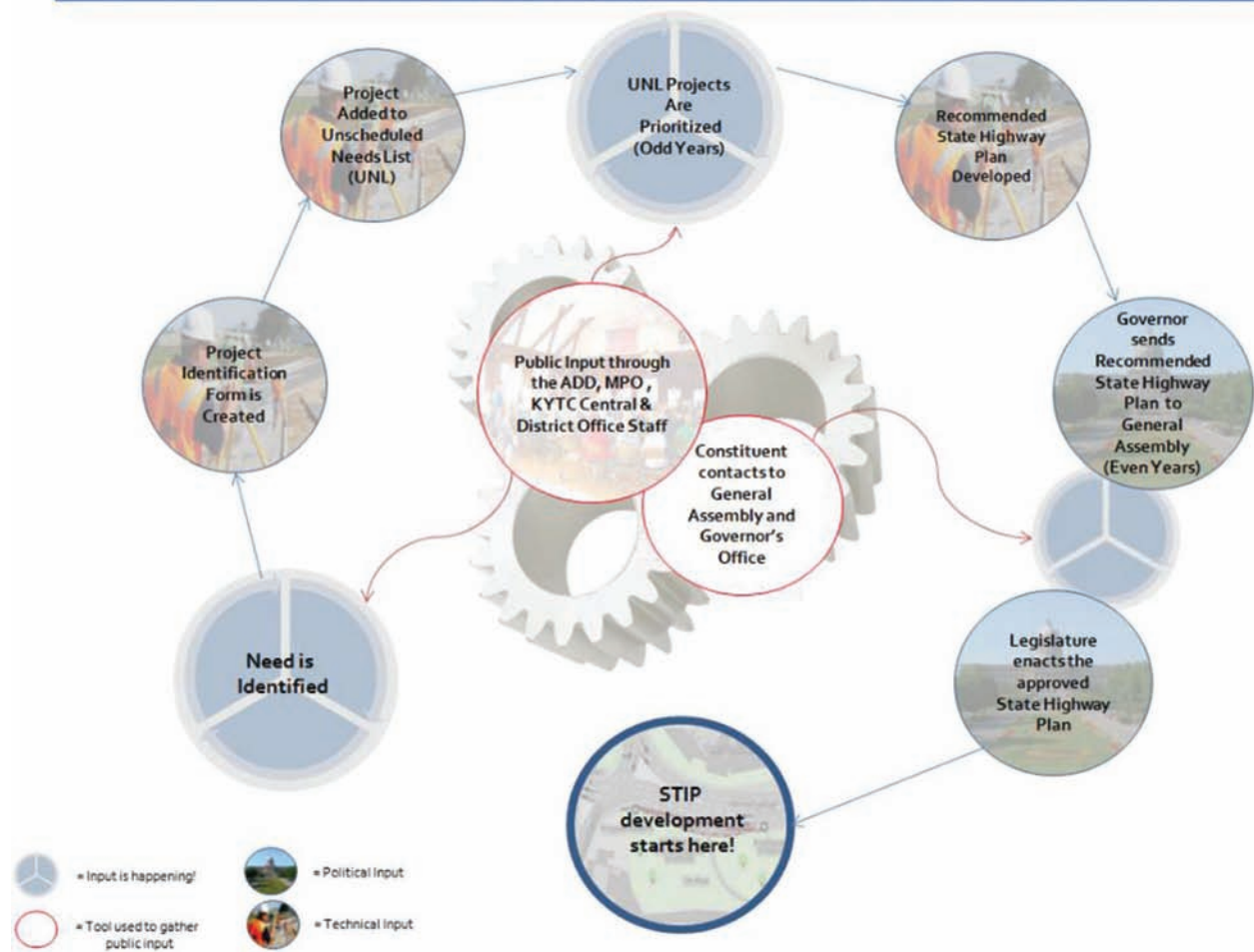


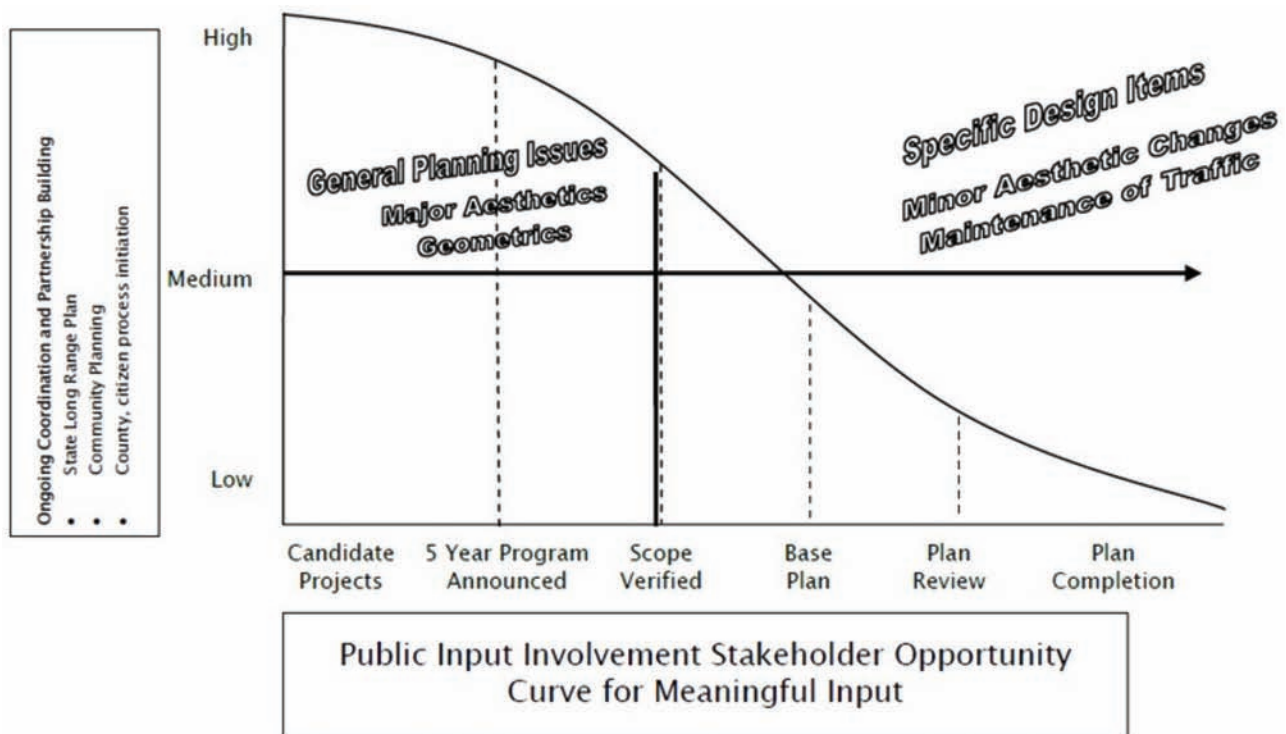
Figure 3.25 Kentucky DOT public participation in the consultation process (Kentucky Transportation Cabinet, 2014, p. 5.1-8).



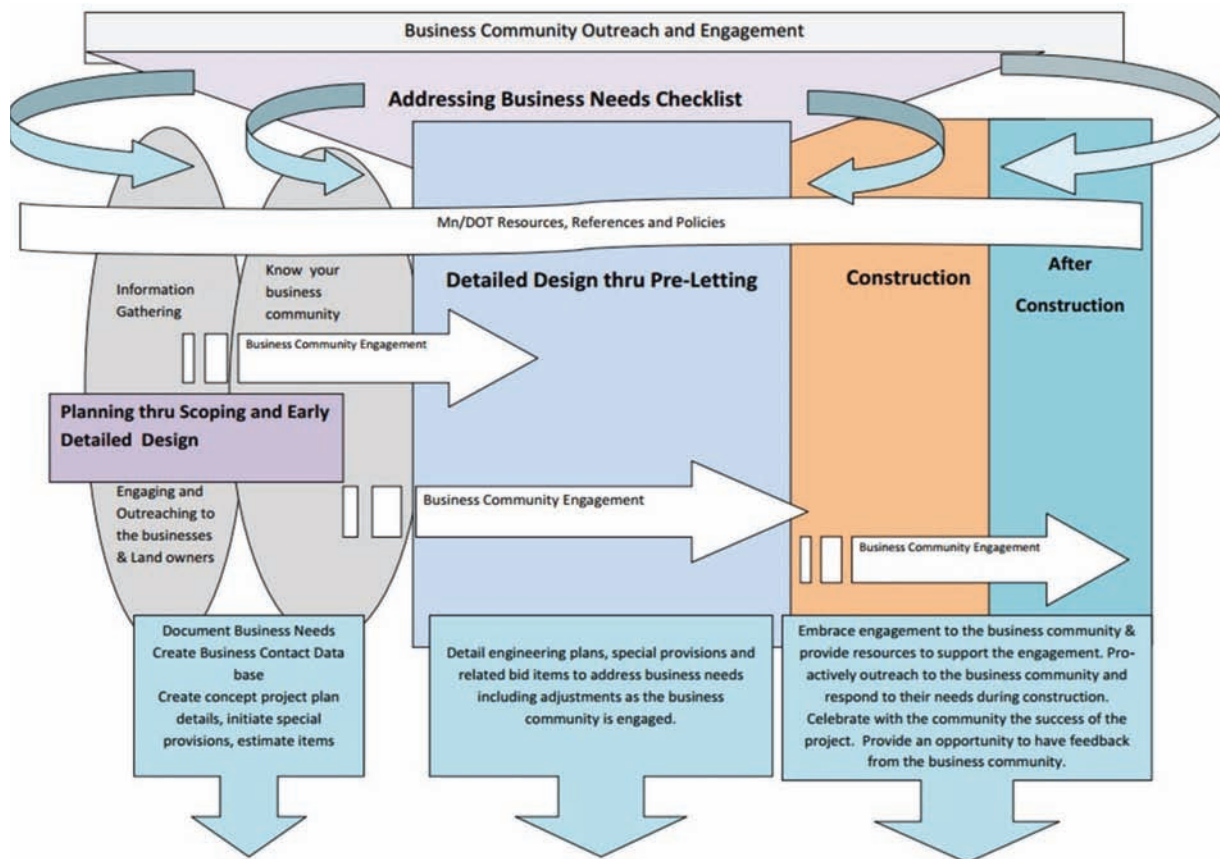
**Stakeholder Engagement Activity Matrix**

Project Type	Activity Level														
	Rural					Small Town					Urban				
Level	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
NR/IC				•	?				•	?				•	?
Road Reconstruct, Bridge Replacement, & Safety		•	?					•	?					•	?
Road & Bridge Rehabilitation/Repair		•	?				•	?				•	?		
Road & Bridge CPM	•	?				•	?				•	?			
Bridge CSM, Road & Bridge Routine Maintenance	•	?				•	?				•	?			
BR CPM		•	?				•	?				•	?		
Enhancement Grants			•	?				•	?				•	?	
<b>Key:</b> • = Minimum Activity Level Necessary      ? = Possible Activity Level Needed <i>Note: Each Engagement Level is cumulative</i>															

**Figure 3.26** Stakeholder activity format and level matrix (MDOT, 2015, p. 6-28).



**Figure 3.27** Stakeholder involvement curve (MDOT, 2015).



**Figure 3.28** Framework for business engagement through development (MnDOT, 2015).

Examples: public meetings (formal and informal), county or local government meetings, metropolitan planning organization (MPO), regional planning agencies (RPA), rural task force (RTF) meetings, and public safety input

### Level III

- Inform/ communicate/ problem solving/ seeking opportunities/ schedule
- MDOT is an invited presenter at scheduled stakeholder meetings (i.e., council, commission, rural task force meeting)
- Special interest group

Examples: summits, studies, corridor interest groups, and quarterly/standing committees

### Level IV

- Maximum stakeholder engagement to inform, communicate, schedule, incorporate, coordinate and respond to stakeholders needs/plan/issue
- Requires multiples activities: media announcements, MDOT hosted open houses and/ or presentations, meetings, workshops

Examples: listening sessions, studies, access management, and annual legislative briefing

### Level V

- Formal public engagement (i.e., public meetings/ hearing with visualization, formal public notice, court reporters, advisory councils and websites pages)

#### 3.5.9 Minnesota Department of Transportation

Minnesota DOT encourages the involvement of the City Engineer during the early stage of planning and also after the project has been defined. The city engineer is the primary link for the identification of stakeholders. Figure 3.28 shows the framework for stakeholder's involvement from the planning phase through the construction phase.

#### 3.5.10 North Carolina Department of Transportation

Principles of CSS are integrated into the feasibility study, scoping process and NEPA. During the NEPA phase, NCDOT reaches out to the local government and also has an early meeting with the public. In the prioritization process, the MPO and RPO, local government, and stakeholders are involved. Public meetings are conducted during the NEPA phase.

For capital projects, the MPO (Metropolitan Planning Organization), the RPO (Rural Planning Organization)

or division engineer submit the project ideas. The Central office cannot submit project ideas.

Capital projects get funded from Highway Trust Funds. Funds for maintenance projects fund comes from Highway Funds (operation and maintenance). These two types of projects are prioritized differently.

#### *3.5.11 New Mexico Department of Transportation*

The CSS is the requirement in NMDOT's scoping and project development practices. Local stakeholders, MPO, and TPO are typically not involved during early stages of project developments. According to the Infrastructure Design Directive guideline (NMDOT 2009), public hearings occur during the last stage of project development, namely, the Pre- Engineering and Environmental Documentation stage.

#### *3.5.12 New York Department of Transportation*

Initial scoping is performed by NYSDOT. Subsequent to this, a call may be made to local public works officials, local representatives, and other groups as appropriate. Also, the project stakeholder list will expand as the project unfolds and public involvement progresses (NYSDOT, 2004b, p. 6). "(The) current policy listed in the Project Development Manual (PDM) is that" (NYSDOT, 2004b, p. 2):

1. Principles of CSS are incorporated throughout the project development process
2. Department projects incorporate Public Involvement (PI) Plans

#### *3.5.13 Texas Department of Transportation*

TXDOT uses the "complete street design procedure" for their projects. At the Planning level, TXDOT has outreach activities such as email and social media to get input from communities. At the Project level, TXDOT has a public meeting and public hearing in the districts.

#### *3.5.14 Utah Department of Transportation*

Concepts of CSS are incorporated in all transportation projects across Utah DOT. In the scoping phase, the Public Information Plan (PIP) explains what types of stakeholders need to be involved as early as possible. Each region has a public involvement coordinator. Depending on the project, the public involvement group may include impacted stakeholders and other UDOT technical personnel.

#### *3.5.15 Washington Department of Transportation*

Context Sensitive Solution is inherent in WSDOTs' approach to keep the public informed about transportation projects and transportation decision making procedure for all transportation facilities. Each region develops a public involvement plan for its use.

"The plan will outline ways to identify and involve the communities affected by the project; provide them with accessible information through reader-friendly documents, graphics, plans, and summaries; and involve them in decision making" (WSDOT, 2009, p. 210-7).

### **3.6 Addressing Maintenance Needs**

As shown in Table 3.2, the entity responsible for scoping maintenance activities and the processes used for scoping maintenance activities are different across SHAs.

### **3.7. Methods of Assessing Scope Creep**

Table 3.3 shows the methods of assessing scope creep across SHAs.

### **3.8 Tracking the Quality and Effectiveness of Scoping Processes**

#### *3.8.1 Arizona Department of Transportation*

Arizona DOT just started to evaluate quality of scoping. Hence, no information was provided about the metrics used in the evaluation.

#### *3.8.2 California Department of Transportation*

Caltrans uses a performance measure that compares the initial estimate and the awarded amount. Typically the cost difference between construction phase and initial estimate is around 20% to 25%.

#### *3.8.3 Florida Department of Transportation*

Florida DOT measures the difference between the initial estimate and the awarded amount.

#### *3.8.4 Georgia Department of Transportation*

The QA process for assessing effectiveness of scoping process is still under review at Georgia DOT.

#### *3.8.5 Kansas Department of Transportation*

Project managers monitor the projects in order to assess the quality of scoping procedures.

#### *3.8.6 Kentucky Department of Transportation*

Typically the cost changes between the initial estimate and "let" project is around 30%.

#### *3.8.7 Maine Department of Transportation*

Maine DOT has just started to assess the effectiveness of the scoping process. Hence, no information was provided about the metrics used in the evaluation.

TABLE 3.2  
Entities involved in scoping maintenance activities

#	DOT	Entity Involved/Type of Decisions
1	Arizona	<ul style="list-style-type: none"> <li>• Same scoping procedure for maintenance activities, as for capital projects</li> <li>• Significant involvement by districts during construction and maintenance phase</li> <li>• Scoping for maintenance activities is done in the central office by the same group involved in scoping capital projects</li> </ul>
2	California	<ul style="list-style-type: none"> <li>• A scoping team field review is required for all Capital Preventive Maintenance (CAPM) projects and provides a forum to identify and make decisions on significant issues</li> <li>• Scoping for maintenance activities is done at district offices by the same group involved in scoping capital projects</li> </ul>
3	Florida	<ul style="list-style-type: none"> <li>• Scoping for maintenance projects is not handled by the same group that handles the capital projects. They are handled primarily by the maintenance office</li> </ul>
4	Georgia	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done at central offices by the same group involved in scoping capital projects</li> <li>• Maintenance activities on interstates and state routes in the Georgia have higher priority</li> </ul>
5	Kansas	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done with a coordinated effort between the Districts and the Bureau of Construction and Materials then advanced to Program and Project Management for programming</li> </ul>
6	Kentucky	<ul style="list-style-type: none"> <li>• States funds are used for maintenance activities at district offices</li> <li>• Scoping for maintenance activities and capital projects activities is done by the different groups</li> </ul>
7	Maine	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done at central offices</li> </ul>
8	Michigan	<ul style="list-style-type: none"> <li>• There is no special requirement for scoping of maintenance projects.</li> <li>• For preventive maintenance projects, the budget for scoping will be lower compared to the budgets available for scoping capacity-related projects.</li> </ul>
9	Minnesota	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done at the central office</li> <li>• MnDOT uses “Complete Streets” approach for pavement preservation projects</li> </ul>
10	North Carolina	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done at district offices.</li> </ul>
11	New Mexico	<b>No information provided during interview</b>
12	New York State	<ul style="list-style-type: none"> <li>• Scoping for maintenance activities is done at district offices by the same group involved in scoping the capital projects</li> <li>• Maintenance activities are defined as simple projects in project development process</li> <li>• For maintenance-type project there may not be a need to assign a separate project manager and project developer</li> <li>• Maintenance projects use an Initial Project Proposal/Final Design Report (IPP/FDR) as a one-step project initiation, scope approval and design approval document</li> </ul>
13	Texas	<ul style="list-style-type: none"> <li>• Scoping of maintenance activities is done at district offices</li> <li>• There is no specific process for scoping of preservation projects; however, there are 25 districts with different requirements for each district</li> </ul>
14	Utah	<ul style="list-style-type: none"> <li>• Each region has a senior team that reviews all projects. Much of the annual maintenance is based on an overall plan/program for maintaining all roadways – year to year. This is typically put together by the Region Materials Engineer and the Pavement Management Engineer</li> </ul>
15	Washington State	<b>No information provided during interview</b>

### 3.8.8 Michigan Department of Transportation

Typically, Michigan DOT’s initial scopes of projects (developed by the regions) is very close to the final constructed project. Michigan DOT follows the QA flow chart (shown in Figure 3.29) to assess the quality of scoping practices.

### 3.8.9 Minnesota Department of Transportation

Minnesota DOT checks the budget at the scoping phase and updates it periodically to assess the scope creep.

### 3.8.10 North Carolina Department of Transportation

NCDOT does not have specific metrics to measure the quality and effectiveness of scoping practices. NCDOT personnel stated that the scope of the final projects are fairly close to the scope defined at the early stage. However, in the past, there have been cases of significant cost increases due to underestimating the cost of ROW acquisition and unit price escalations.

### 3.8.11 New Mexico Department of Transportation

NMDOT’s Project Oversight Division is currently developing a tracking and reporting mechanism to

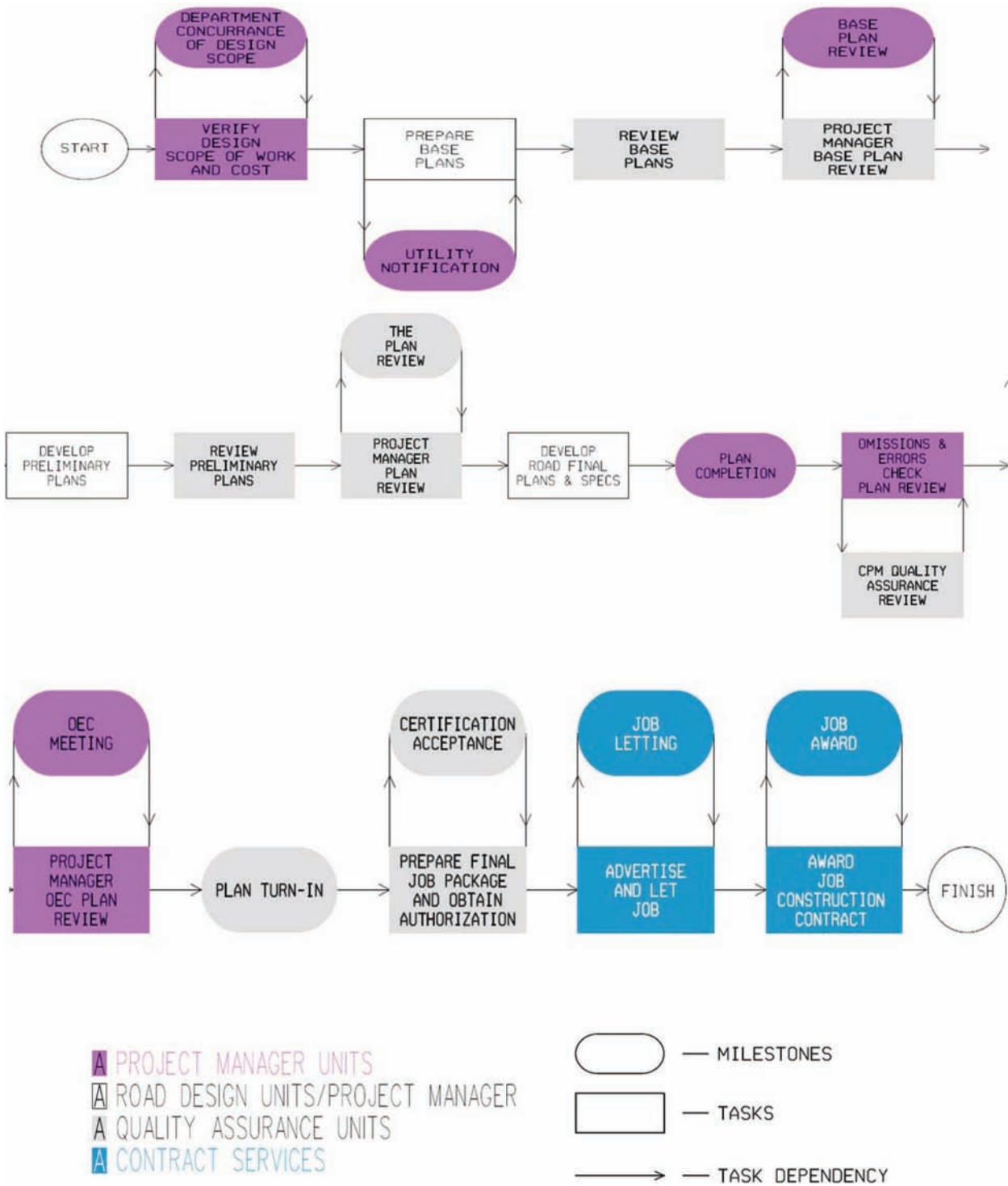


TABLE 3.3  
Methods of assessing scope creep across SHAs

#	DOT	Methods for Assessing Scope Creep
1	Arizona	<ul style="list-style-type: none"> <li>• The Project Review Board (PRB) evaluates projects annually to limit the scope creep</li> <li>• The Financial Division monitors projects</li> </ul>
2	California	<ul style="list-style-type: none"> <li>• Project managers are in charge of monitoring scope creep</li> <li>• Monitoring budgets help to eliminate/reduce scope creep</li> </ul>
3	Florida	<ul style="list-style-type: none"> <li>• Scope creep is assessed by the Project Manager (PM) throughout the life of the project. When issues arise that have the potential to add to the scope (and add to the design or construction costs), the PM can request additional funds if the needs can be justified. The additional work can be added to the scope through a supplemental agreement</li> </ul>
4	Georgia	<ul style="list-style-type: none"> <li>• Project Managers monitor the projects</li> </ul>
5	Kansas	<ul style="list-style-type: none"> <li>• Monitor the projects using production control meetings as a 'gate' for accessing project creep. These meetings are held every month to monitor project progress and issues. Only projects with milestone dates or concerns are brought up. Bi-annual cost estimates are turned in every year. Major scope changes are presented for approval at Program Review Meetings with Executive Staff, but not the Secretary of Transportation</li> <li>• Bi-annual cost estimate review and Production Control Meetings are conducted by the Bureau of Program and Project Management to determine impacts to project coordination and to the construction program as a whole. Major fluctuations in the estimates resulting from plan development, scope changes or scheduling adjustments are presented to the Executive staff by the project managers at Program Review Committee meetings for approval or further direction</li> </ul>
6	Kentucky	<ul style="list-style-type: none"> <li>• Periodically review the purpose and need of the project, updating as necessary and ensure staying within those confines</li> </ul>
7	Maine	<ul style="list-style-type: none"> <li>• Maine DOT uses a staged funding process to reduce scope creep</li> </ul>
8	Michigan	<ul style="list-style-type: none"> <li>• Every region has different procedures and practices to assess the scope</li> <li>• Each region has a QA process and the project manager monitors the process</li> </ul>
9	Minnesota	<ul style="list-style-type: none"> <li>• Minnesota DOT manages budgets very closely to reduce the scope creep</li> <li>• Minnesota DOT has a Major Projects Committee (high level organizationally) and has monthly meetings to monitor and analyze the progress in project development</li> </ul>
10	North Carolina	<ul style="list-style-type: none"> <li>• North Carolina DOT uses cost containment procedures along with the scoping information sheet to eliminate scope creep</li> </ul>
11	New Mexico	<ul style="list-style-type: none"> <li>• The Project Manager is responsible for monitoring scope creep over the life of the project. The primary organization strategy for preventing scope creep from occurring is conducting good project scoping initially, following the Location Study Procedure and completing the Project Scoping Report and Project Evaluation Report</li> </ul>
12	New York State	<ul style="list-style-type: none"> <li>• New York State DOT assesses the cost and schedule information at every milestone so reports can be generated that track the changes between milestones</li> <li>• Changes with program implications are vetted through the Regional Capital Program Committee</li> </ul>
13	Texas	<ul style="list-style-type: none"> <li>• Project Managers monitor projects</li> </ul>
14	Utah	<ul style="list-style-type: none"> <li>• The Project Definition Document (PDD) is a document used to limit the scope creep. The PDD is used to define and manage the scope. The budget recovery process takes place after a project has advertised and the bid is awarded. UDOT maintains a defined % for contingency (5% for Preservation and Rehabilitation projects and 9% for Capacity and Reconstruction projects. At this point – the scope is defined by the plans and we should not have any scope creep at this stage. Once a project is under construction – other factors would have to be considered if additional scope is needed</li> </ul>
15	Washington State	<ul style="list-style-type: none"> <li>• Uses the Continuous Dynamic System (CDS) of following, estimating and explaining changes in project scope throughout the process.</li> <li>• WSDOT assesses the tradeoffs between scope, cost and schedule in order to control scope creep</li> </ul>

determine how well NMDOT delivers on the annual STIP. The spreadsheets track total number of projects and total dollar amount. The initial report indicates about a

79% project delivery rate on the original, benchmark STIP (prior to any amendments.) This is likely to become a threshold metric for improving upon in the future.



**Figure 3.29** Quality assurance involvement. (Provided by Brad Wieferich, Michigan DOT on September 22, 2015.)

### 3.8.12 New York Department of Transportation

No formal policy or formal scoping metrics is in place at present. Planned and expected performance measures will be developed for the scoping phase along with other phases as both data stabilization and historical data is achieved.

### 3.8.13 Texas Department of Transportation

Presently TxDOT measures and reports to the Legislative Budget Board the differences between the engineer's cost estimate at the time of bid to the contractor's actual low bid, however, this measure has been eliminated as a measure of success going into the next biennium.

Rather, a more accurate comparison may be the measurement of the engineer's cost estimate at the time of bid and the final construction cost of the project after completion of the construction phase. TXDOT is looking to measure the difference in cost estimates between the initially scoped phase and the final construction cost.

### *3.8.14 Utah Department of Transportation*

Typically, the difference between the final cost of the constructed project and the scope and budget agreed to during the delivery process, is usually in the 5% to 10% range.

### *3.8.15 Washington Department of Transportation*

No information was provided during the interview.

## **3.9 Environmental Consideration in Scoping Processes**

### *3.9.1 Arizona Department of Transportation*

Arizona DOT has five steps for the environmental assessment during the project scoping phase (ADOT, 2011a, p. 30): (1) Introduction, (2) Affected Environment (Physical and Natural Environment, Socioeconomic Environment, Cultural Resources), (3) Environmental Concern (Physical and Natural Environment, Socioeconomic Environment, Cultural Resources), (4) Conclusion, and (5) Consultation/Coordination.

### *3.9.2 California Department of Transportation*

California DOT uses a Preliminary Environmental Analysis Report (PEAR) for environmental considerations during the scoping phase. The PEAR includes several key sections (Caltrans, 2009): (1) Project Information, (2) Project Description, (3) Anticipated Environmental Approval, (4) Special Environmental Considerations, (5) Environmental Commitments Summary, (6) Permits and Approvals, (7) Risks and Assumptions, (8) Technical Summaries, (9) Summary Statement for PID, (10) Disclaimer, (11) Preparer Review Signatures, and (12) Review and Approval Signatures.

### *3.9.3 Florida Department of Transportation*

The environmental assessment and documentation at FDOT includes four major topics: (1) Social and Economic, (2) Cultural, (3) Natural, and Physical (FDOT, 2014a, p. 6-9).

### *3.9.4 Georgia Department of Transportation*

In the concept report, environmental concerns include the assessment of: History, Potential for archaeology, Neighborhoods, Special interest groups, Context Sensitive Design, Cemeteries, Parks and recreation, Need for a Practical Alternatives Report (PAR), Wetlands and

streams, Open waters, Buffers, Floodplains, Endangered species, Erosion and Sedimentation Control, Air Quality, and Potential for noise impacts (PDP Manual, 2015, page A-2.6).

### *3.9.5 Kansas Department of Transportation*

"The design leader shall send preliminary plans to the Environmental Services Section for review and initiation of environmental clearances" including: (1) Environmental Assessment (EA), (2) Finding of No Significant Impact (FONSI), (3) Draft Environmental Impact Statement (DEIS), (4) Final Environmental Impact Statement (FEIS), and (5) Record of Decision (ROD) (KDOT, 2014, p. 2-35).

### *3.9.6 Kentucky Department of Transportation*

The PIF document lists the environmental considerations for the project. Each district office's environmental coordinator along with division of environmental analysis at central office reviews the environmental documents.

### *3.9.7 Maine Department of Transportation*

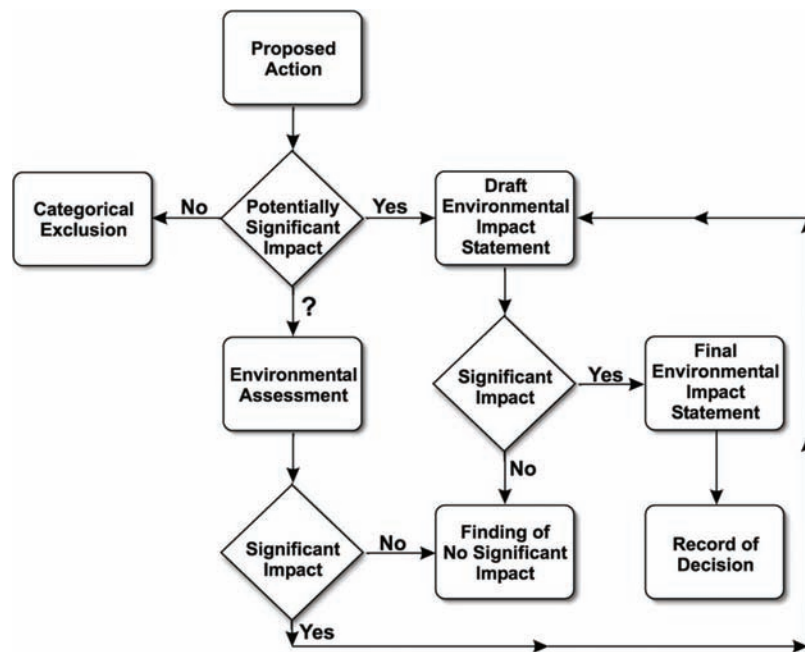
Maine DOT has two phases for environmental evaluation during the project scoping phase. The phase I includes "the Preliminary Wetland Delineation, Preliminary Surface Water Evaluation, Preliminary Hazardous Waste Assessment, Preliminary Landscape Scoping, Preliminary Mitigation Planning, Identification and Preliminary Identification are set. Initial Fisheries comments are sought" (MaineDOT, 2015, p. 1-6). In phase II "initial project information is delivered to the environmental specialty groups for comments. These comments are reviewed and delivered to the Team. At this time, an Interagency Meeting may be required between the DOT, state and Federal Environmental Agencies such as the Department of Environmental Protection, Department of Inland Fisheries, Wildlife and the Department of Marine Resources, Army Corps of Engineers and Environmental Protection Agency" (MaineDOT, 2015, p. 1-7).

### *3.9.8 Michigan Department of Transportation*

Each Michigan DOT project must be analyzed for environmental impacts and environmental clearance obtained through the National Environmental Policy Act (NEPA) process before the funding is released.

There are three basic environmental analysis based on the NEPA classification including environmental impact statement (EIS), (2) categorical exclusion (CE), and (3) environmental assessment (EA).

**Class I** - Environmental Impact Statement (EIS): for projects with significant environmental impacts, typically new roadways or major expansions of existing state trunklines.



**Figure 3.30** New Mexico DOT – Environmental Processing Plan (NMDOT, 2000).

**Class II - Categorical Exclusion (CE):** for the projects without significant environmental impacts such as roads and bridge rehabilitation, reconstruction, and CPM projects.

**Class III - Environmental Assessment (EA):** for the projects with unusual circumstances or in which the significance of environmental impacts is not clearly established such as capacity project within existing state-owned right-of-way

does not pose a serious threat to the environment, and (2) the environmental consequences of the proposed action are insignificant when weighed against the overall benefits provided to the users of the transportation improvement and the surrounding communities” (NMDOT, 2000). Figure 3.30 shows the steps in the Environmental Processing Plan.

### 3.9.12 New York Department of Transportation

Confirmation of the NEPA Class and (State Environmental Review Act) SEQR Type (if a project uses federal funds or requires a federal approval or permit) is required during the Scoping Stage. The NEPA Class and SEQR Type are based on the “significance” (Section 2.3.1.3 in NYSDOT’s Project Development Manual (PDM) provides more information on significance) of the anticipated social, economic, and environmental effects (impacts) of the project. The determination of “significance” also guides the identification of the appropriate level of documentation and public involvement. The necessary data needs to be assembled, the appropriate analysis needs to be completed, and the information documented to support the confirmation.

### 3.9.13 Texas Department of Transportation

Texas DOT has a comprehensive preliminary environmental assessment plan in the project scoping phase. The steps in environmental assessment include: determining public involvement needs; developing and implementing scoping process; conducting meetings with affected property owners; collecting environmental data; and evaluating impacts on waterways and floodplains.

### 3.9.9 Minnesota Department of Transportation

Minnesota DOT includes environmental impact assessment as a part of scoping document, and it concentrates on two main areas: (1) Urban and community impacts, and 2) Natural environmental impacts (MnDOT, 2002, p. 29).

### 3.9.10 North Carolina Department of Transportation

The Environmental Features Map is part of the project scoping process. Environmental information and historic concerns are discussed during the feasibility studies scoping meeting. Environmental Information includes:

- River, Stream and Wetland impacts
- Historic Properties
- Economic Concerns
- Hazardous Waste Sites (NCDOT, 2013)

### 3.9.11 New Mexico Department of Transportation

At New Mexico DOT, environmental documentation is developed so that: (1) “the proposed action

### 3.9.14 Utah Department of Transportation

In Utah DOT, the project manager is responsible for including environmental considerations during the scoping phase. The environmental assessment includes environmental documentation, public and agency involvement, project impact analysis, environmental permits, and mitigation commitments (UDOT, 2015b).

### 3.9.15 Washington Department of Transportation

As a part of scoping document, Washington DOT requires the Environmental Review Summary (ERS) which includes the potential environmental impacts, mitigation options, and necessary permits for the project. “The Region Environmental Manager approves the ERS which enables completion of the Project Summary package” (WSDOT, 2014, p. 300-2). The project classification (listed below) determines the level of environmental assessment and documentation (WSDOT, 2014, p. 300-5):

- NEPA Class I: Actions are likely to have significant impact on the environment because of their effects on land use, planned growth, development patterns, traffic volumes, travel patterns, transportation services, or natural resources.
- These actions are not likely to cause significant adverse environmental impacts.
- When the potential environmental impacts of a proposed project are not clearly understood, an environmental assessment (EA) is prepared.

### 3.10 Data Collection and Data Sharing

Table 3.4 shows data collection and data sharing during project scoping.

### 3.11 Scoping Practices Which Have Evolved/Benefitted DOTs

Table 3.5 shows scoping practices which have evolved and benefitted DOTs.

TABLE 3.4  
Data collection and data sharing during project scoping

#	DOT	Types of Data	Tools	Data Sharing
1	Arizona	Crash data, Environmental information, Cost, Photolog, HPMS etc.	• Transportation Asset Management System (AZ-TAMS)	AZ-TAMS for sharing and dissemination of information
2	California	Survey data, Photolog, as built drawings, field trips, traffic data, accidents data, pavement history records, hydraulics data, culvert conditions assessment, bridge inspection reports, right of way maps	–	Online database for PDF documents
3	Florida	Data includes: Project general and roadway, Drainage, Utilities, Environmental permits and compliances, Structures, Lighting, Landscape, Survey, photogrammetry, mapping, geotechnical, etc.	• Project SOLVE • Project SUITE • Standard Scope of Services and our Staff Hour Negotiation Guidelines • Project Suite Enterprise Edition (PSEE – internal program)	Web-based sharing
4	Georgia	All documents for concept report (survey, design aspect, alignment, etc.)	• TRAQS • Project WISE	Online database
5	Kansas	Program level data: accident rates, roadway geometrics (including functional class, lane/shoulder widths, sight distance, pavement smoothness, pavement structural condition, traffic and truck volumes) and PONTIS for bridge data. Regarding the project level, data including: Roadway geometrics (historic plans), Pavement conditions (inspection reports from the Pavement Section), drainage structure conditions (inspection records), AADT (gathered by our planning section), Safety concerns (Road Safety Audit Reports conducted by the Transportation Safety & Technology section), bid letting information (historic bid tabs from lettings) used to develop planning level project costs by project type	• Enhanced Priority Formula System (EPFS) interfaces with CANSYS	Internal online sharing database
6	Kentucky	Project location, current primary use of land, existing utilizes, economic analysis of the project, accessibility, environmental analysis, etc.	• Project WISE • Highway Information System (HIS) database	HIS is used for sharing roadway data with all of KYTC
7	Maine	Traffic data, project history, field data, drainage survey, existing utilities, preliminary geotech information, environmental assessment, etc.	• PROJEX • MapViewer	Online sharing
8	Michigan	Existing conditions, drainage information, utilities, sidewalks, traffic signals, anticipated design exceptions, permits & agreements, environmental data, real estate, stakeholder information, site visit notes, and traffic safety	• Project WISE	Online database
9	Minnesota	Environmental documents, field observations, hydraulics data, ROW analysis, local/stakeholder interaction, cost estimation, etc.	• Project WISE	Scoping worksheet, and databases

(Continued)

TABLE 3.4  
(Continued)

#	DOT	Types of Data	Tools	Data Sharing
10	North Carolina	Accident data, utilities, railroads, hazardous material sites, sidewalks, signals, deficiencies in existing transportation system, etc.	<ul style="list-style-type: none"> <li>• Sharepoint</li> <li>• STaRS</li> </ul>	Online database
11	New Mexico	Traffic data, safety, drainage, ROW, cost estimate, environmental, social, etc.	<ul style="list-style-type: none"> <li>• PDF documents</li> </ul>	Online database
12	New York	Cost	<ul style="list-style-type: none"> <li>• AASHTOWARE's Tms*port Suit</li> </ul>	<ul style="list-style-type: none"> <li>• Average Bid Price Book</li> <li>• Tms*port "Estimator" Catalog</li> <li>• e-Pay Item Catalog</li> </ul>
		Schedule	<ul style="list-style-type: none"> <li>• Primavera (P6)</li> <li>• PSS</li> </ul>	<ul style="list-style-type: none"> <li>• OBIEE Reports</li> <li>• P6 Dashboards</li> <li>• Projects in Your Neighborhood (WEPI)</li> </ul>
		Engineering	<ul style="list-style-type: none"> <li>• Photolog</li> <li>• Topo maps</li> <li>• Arial photos</li> <li>• Record Plans</li> <li>• Bridge inspection data</li> <li>• Accident data</li> <li>• Road condition data</li> <li>• Safety Information Management System (SIMS)</li> <li>• Sufficiency Manual</li> </ul>	<ul style="list-style-type: none"> <li>• ProjectWise</li> <li>• Project Scoping Reports</li> <li>• BDIS (bridge inspection software)</li> <li>• Safety Information Management System (SIMS)</li> <li>• Sufficiency Manual</li> </ul>
		Environmental	<ul style="list-style-type: none"> <li>• GIS Databases</li> </ul>	Environmental viewer
13	Texas	Includes traffic data, ROW, site visit, traffic crash data, hydraulic studies, topographic survey, etc.	<ul style="list-style-type: none"> <li>• Project WISE</li> </ul>	Online database
14	Utah	Financial data, scheduling information, and design information	<ul style="list-style-type: none"> <li>• EPM (Enterprise Program Management)</li> <li>• Project WISE</li> </ul>	Online database (all documentation for a project it loaded into ProjectWise under the project PIN)
15	Washington	Surveying, ROW, soils and paving, structures, Hydraulics, Traffic, Safety and accident, etc.	<ul style="list-style-type: none"> <li>• Project WISE</li> </ul>	Online database



TABLE 3.5  
Scoping practices which have evolved/benefitted DOTs

#	DOT	Practices/Lessons Learned
1	Arizona	<ul style="list-style-type: none"> <li>• Robust prioritization process for new projects</li> </ul>
2	California	<ul style="list-style-type: none"> <li>• Comprehensive scoping manual (PIF, PID, PSR, etc.)</li> <li>• A scoping team field review that is required for all Capital Preventive Maintenance (CAPM) projects</li> </ul>
3	Florida	<ul style="list-style-type: none"> <li>• Some of the lessons learned with respect to scoping include: <ul style="list-style-type: none"> <li>◦ Identifying design exceptions and design variations early</li> <li>◦ Identifying project risks and response strategies early</li> <li>◦ Involving local municipalities early in scope development to address issues that may arise</li> <li>◦ Involving consultants on the teams that help develop Standard Scope of Services and our Staff Hour Negotiation Guidelines</li> <li>◦ Implementing Practical Design early</li> </ul> </li> </ul>
4	Georgia	<ul style="list-style-type: none"> <li>• At this time, it is premature to measure the benefits of the current scoping processes</li> </ul>
5	Kansas	<ul style="list-style-type: none"> <li>• Tracking of a project's activities, resources used, project schedules, project estimates, and project funding using WinCPMS.</li> <li>• Early and ongoing communication and coordination between Program &amp; Project Management, Design, and the Districts are vital to successfully executing a transportation program, especially when funding levels are a moving target.</li> </ul>
6	Kentucky	<ul style="list-style-type: none"> <li>• Major lessons learned include developing better awareness and reduction/elimination of scope creep</li> </ul>
7	Maine	<ul style="list-style-type: none"> <li>• Using a staged-funding procedure to reduce the scope creep</li> <li>• Uses Van Rides that include personnel from planning, project development, and maintenance (including staff from the central and regional offices) to check scopes of work, verify cost estimates, and finally make recommendation for the work plan</li> </ul>
8	Michigan	<ul style="list-style-type: none"> <li>• Having a mechanism so that all regions follow the same process to come up with a reliable 5-year program</li> <li>• Van tours and field reviews to assess each candidate project as a group to gain a better understanding of the specific issues related to each project</li> </ul>
9	Minnesota	<ul style="list-style-type: none"> <li>• MnDOT provided an example of one district which conducts detailed quantity take-off (they put several hours and man-hours) times for cost estimate and their initial cost estimate is within 10% of final cost</li> </ul>
10	North Carolina	<ul style="list-style-type: none"> <li>• Comprehensive prioritization process (provided an example of a case where consensus from 24 people was required for a projects, accomplished over 16 meetings)</li> </ul>
11	New Mexico	<ul style="list-style-type: none"> <li>• Very detailed planning and environmental procedure</li> </ul>
12	New York	<ul style="list-style-type: none"> <li>• Scoping teams and the Scoping process described in NYSDOT's Project Development Manual works well, by bringing diversity of knowledge and perspective to the transportation problem a project is programmed to address</li> <li>• The Project Development Manual was created combining the Project Scoping Manual and the Design Procedure Manual, streamlining the process by eliminating contradictions and inconsistencies</li> </ul>
13	Texas	<ul style="list-style-type: none"> <li>• TxDOT has adapted a project scoping document from Utah DOT and is underway with customizing and consideration of implementation of this scoping tool</li> <li>• TxDOT has identified a need for a Project and Portfolio Management Tool (MPPM) to manage and prioritize projects and the overall TxDOT portfolio. Presently, procurement is underway to purchase MPPM software with the design phase expecting to kick off in early 2016</li> </ul>
14	Utah	<ul style="list-style-type: none"> <li>• Very good scoping document (PDD), which can limit scope creep. Also, other DOTs (such as Texas) use the UDOT's PDD as a reference. UDOT has a culture of "Do it right the first time," and operates with the understanding the scoping phase of a project (as defined in their Project Delivery Network) is the most critical phase of the project and probably requires the most effort. Hence, if possible, the DOT does not rush through the scoping process and tries to ensure that all options are considered, so that the scope meets the objectives of the project. "We recently had a project that was canceled because we discovered, in the scoping phase, that doing the right thing would cost much more than what we currently had in our budget. We will be seeking to find the additional budget needed and then we'll move forward when that is in place. Some might think of this as "scope creep" but in the long run, this is truly the right course of action. When we finalize our Project Definition Document (PDD), the proper scope and budget would be included. This would be at the end of the scoping phase of our delivery network." (email discussion with discussion with Jim Golden, Utah DOT, November 10, 2015)</li> </ul>
15	Washington	<ul style="list-style-type: none"> <li>• Very detailed cost estimation practices</li> <li>• Inclusion of risk analysis tools (Cost Estimate Validation Process (CEVP), the Cost Risk Assessment (CRA) and the Self-Modeling Quantitative Spreadsheet) to ensure more effective and transparent cost estimating</li> </ul>



## 4. CONCLUSIONS

The purpose of this study was to provide a synthesis of scoping processes used by SHAs in the U.S. A qualitative exploratory approach using literature review and structured interviews was used to develop this synthesis. Fifteen SHAs participated in structured interviews and provided insight on eleven main themes of project scoping. These themes include: primary entity with responsibility for scoping projects, timeline for scoping activities, functional groups and resources involved in scoping, cost estimation procedures, addressing maintenance needs, methods of assessing scope creep, tracking the quality and effectiveness of scoping processes, environmental consideration in scoping processes, data collection, and data sharing during scoping process.

Key conclusions that can be drawn as a result of the analysis of different scoping practices are:

- There was no common pattern for scoping practices across SHAs. The entity responsible for scoping maintenance activities and the processes used for scoping maintenance activities are different across SHAs.
- Documents obtained from the Washington State DOT, MnDOT, UDOT, MDOT and Caltrans indicate strong link between planning and programming of projects (examples provided in Appendix D).
- The cost estimation phase is a significant step for the success of the project development process. Most SHAs use the AASHTO cost estimation guideline. ROW, utilities, and construction cost estimation are the major elements of the initial cost estimate during the scoping phase. Many of the SHAs interviewed stated that the ROW cost estimation has a high degree of risk and contingency. Many SHAs use cost data from recently awarded contracts for itemized cost estimation purposes.
- Stakeholder involvement and public outreach during the early stages of the scoping process is an important factor in project development procedure. However, the timing and degree of public involvement varies from agency to agency. SHAs such as the MDOT and NCDOT, are extensively involved with Metropolitan Planning Organizations (MPO) and Rural Planning Organizations (RPO) during the early stage of the project development. Other SHAs such as KSDOT have a local consult at district level in order to obtain the local communities' input during the early phase of scoping process.
- The entity responsible for scoping maintenance activities and the processes used for scoping maintenance activities are different across SHAs. For instance at Arizona DOT, the scoping procedure for maintenance activities is the same as that for capital projects and scoping is done by the same group in the central office involved with scoping of capital projects. At NYSDOT, scoping for maintenance activities is done at the district office by the same group involved with scoping capital projects. On the other hand, at KSDOT, scoping for maintenance is done as a coordinated effort between the Districts and the Bureau of Construction and Materials, then advanced to Program and Project Management for programming.
- SHAs follow different practices for assessing scope creep. Several agencies including Caltrans, FDOT, GDOT,

TXDOT, and KSDOT have assigned the project managers to monitor the scope creep as the project moves from the scoping phase into the construction phase. Other agencies such as KYDOT, Maine DOT, MnDOT, and NCDOT, strictly monitor the project budget to eliminate the scope creep. For example, NCDOT uses cost containment procedures along with the scoping information sheet to eliminate scope creep. Maine DOT also uses staged funding process to reduce scope creep. NYSDOT and WSDOT assess scope creep by tracking the cost and schedule together in order to control the scope creep.

- Although the SHAs stated that the monitoring of cost estimation between scoping phase and construction phase provides a general overview of the scoping performance, many of the SHAs did not have defined metrics or a formal policy to assess the quality and effectiveness of their scoping procedures.
- Typically, SHAs follow the National Environmental Policy Act (NEPA) processes for environmental analysis during the scoping phase. Environmental assessment during the scoping depends on the types of project, and varies from agency to agency. For example, MDOT uses a comprehensive environmental analysis program during scoping including (I) environmental impact statement (EIS), (II) categorical exclusion (CE), and (III) environmental assessment (EA).
- Most of the SHAs are very proactive in data collection and data sharing during the scoping phase of the project. Different types of data are collected and shared among personnel of each SHA (both in district level and central office) (see section 3.11 for more information). Project Wise is the most popular database software system among SHAs. As a project collaboration and content management platform, ProjectWise is used to store data (i.e., CAD drawing, cost estimate, PDF files) and allow the SHA personnel to do queries for specific information about the project.
- Scoping practices that were beneficial to SHAs included: Well-developed scoping/project development documents (Caltrans, NYSDOT, UDOT), Early implementation of Practical Design, Using a staged approach to reduce scope creep (MEDOT), Consistent mechanism/process used by regions and van tours/field reviews for assessing candidate projects (MDOT).

## 5. SUGGESTIONS FOR FURTHER INVESTIGATION

Based on the analysis of interviews with SHA personnel, the literature review, the analysis of documents provided by the SHAs involved in this study and the review of the draft report of the SPR-3948 study, the following suggestions are presented for further investigation by INDOT.

- Conduct follow-up interviews with Texas DOT, Minnesota DOT, Utah DOT and Washington State DOT to determine: (a) when full scopes are determined, (b) when budgets are set.
- Conduct a follow-up interview with Kentucky DOT to: (a) obtain clarification regarding primary entity responsible for scoping, (b) determine how Planning Liaisons facilitate the scoping process, and (c) determine what

scoping is done to select projects for the District Transportation Plan (DTP) and the State Highway Plan.

- Develop a *Scoping Functional Group* (consisting of representatives from INDOT districts) that can further review relevant scoping documents from other SHAs for adoption/adaptation at INDOT.
- Develop and provide training to INDOT personnel involved with scoping, and create collaborative platforms for sharing data and lessons learned during project scoping.
- Develop a consistent definition for scope creep/change and communicate reasons for changes in project estimates (understanding the need to increase confidence in the cost estimate and maintain trust of stakeholders). For instance, for all projects submitted after December 31, 2009, Washington DOT requires “easy-to-follow” comments in WSDOT’s Capital Project Management System for all changes to base cost estimates’ (JLARC, 2010).
- Develop and evaluate a mechanism for creating early-stage project scopes for different types of projects. Kentucky DOT’s Project Identification Form is a good example. The Project Initiation Document (PID) from Caltrans, the Project Definition Document (PDD) from Utah DOT and Maine DOT’s Highway Preliminary Design Report (shown in Appendix D) also provide good template for early-stage scope development.
- Evaluate the viability of including risk analysis tools to ensure more effective and transparent cost estimating. Further investigation of the Cost Estimate Validation Process (CEVP), the Cost Risk Assessment (CRA) and the Self-Modeling Quantitative Spreadsheet used by the Washington State DOT is recommended.
- Review the Final Report and Guidebook of the NCHRP Study - 08-88 - *Effective Project Scoping Practices to Improve On-Time and On-Budget Delivery of Highway Projects* (expected to be available in late 2015/early 2016), for access to scalable scoping process templates and related tools that can facilitate scoping and cost estimating processes.

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## APPENDICES

The following appendices are available for download at <http://dx.doi.org/10.5703/1288284316192>.

Appendix A. Study Advisory Committee

Appendix B. Interview Instrument

Appendix C. Participants in the Interviews

Appendix D. Transportation Plan Examples

## About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1 — evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,500 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at: <http://docs.lib.purdue.edu/jtrp>

Further information about JTRP and its current research program is available at: <http://www.purdue.edu/jtrp>

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