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Project Scoping Guidebook for Metropolitan Planning Organization Transportation Projects

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Project Scoping Guidebook for Metropolitan Planning Organization Transportation Projects (0-6929-P1)

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CHAPTER 1. INTRODUCTION

To obtain state and federal funding for proposed transportation projects in metropolitan areas, local governments submit project proposals to their Metropolitan Planning Organization (MPO) during the early stages of project planning. The purpose of this guidebook is to help local governments enhance the quality and accuracy of their project proposals. This will in turn facilitate the project review process by MPOs. Improving the accuracy and quality of project proposals will help to ensure a streamlined approval process, and will ultimately assist in providing a better transportation network to the public.

This chapter provides an overview of the guidebook and a basic summary of the recommended process of developing project proposals. More comprehensive recommendations regarding the development of project scopes, cost estimates, and schedules are provided in the following chapters.

1.1. Overview

The success of long-range transportation planning is dependent on the accuracy of projects' scope of work, cost estimates, and schedules. Obtaining this accuracy can be very difficult, since only limited information is available during the initial project-planning stages. The development of preliminary project scope, cost, and schedule involves numerous sources of uncertainty, such as future market prices, users' needs, supply chains, weather conditions, design details, and unexpected site characteristics, among others. For project proposals to be reliable they need to take into account the potential effects of these complex factors.

Additionally, when local agencies submit potential projects to MPOs for consideration in the region's transportation plans, they frequently seek federal or state funding to cover part or all of the costs for the proposed transportation improvements. MPOs may have access to funding programs from multiple federal and state agencies, such as the Federal Highway Administration (FHWA) and state departments of transportation (DOTs). The use of these funding sources can come with additional requirements and regulations that are not mandated for locally funded projects. In many cases the additional project requirements of federal and state funding agencies may be unfamiliar to local governments, and accounting for these funding requirements may increase the time and cost of project development.

For these reasons, local agencies sometimes submit proposals to their MPO with unrealistic cost estimates and/or overly optimistic letting dates. If the agencies and the MPO are not careful when creating and reviewing project proposals, significant negative repercussions can occur. In the worst-case scenario, the local agency may be surprised by snowballing costs and run out of funds to pay for its share of the project, leading to delays and cancellations. Furthermore, if an approved project is not ready for letting during its scheduled timeline, the MPO may be required to revise the area's entire Metropolitan Transportation Plan (MTP) or Transportation Improvement Program (TIP). This can result in the MPO not meeting its transportation agenda or its air-quality goals. Meanwhile, other projects that potentially would have been completed on time and within budget may not have been approved for funding, because they were eclipsed by the over-optimistic project that was unable to meet its proposed cost and schedule.

The research behind this guidebook indicates that MPOs have been vigorously seeking better methods to analyze the scope, scheduling, and cost estimates of proposed projects so as to better serve the public interest. Developing transportation proposals for soliciting state and federal funds is an exhaustive task. Prior to initiating a proposal, local governments need to assess the return on their investment by considering the amount of resources required for preparing a high-quality proposal, compared to the amount of external funding that can potentially be acquired.

Another important initial consideration is the method of delivering the project. Project planners typically assume the project delivery method is Design-Bid-Build. However, depending on the type of project and its specific characteristics, alternative project delivery and financing methods may be more suitable. Some alternative delivery methods that may be considered are Design-Build, Construction-Manager/General-Contractor, and Public-Private-Partnership. The applicability of each alternate method depends upon the type of transportation project, the local agency's enabling legislation, and powers granted to the local agency by the state.

After a local government has decided to go ahead with developing a proposal, and has identified the best project delivery method, the next step is to develop the project's preliminary scope, cost, and timeline. This guidebook lays out a framework for the project scoping, cost, and time estimation process for MPO transportation projects—from the initial concept to a well-prepared solution that is ready for detailed design work. The target audiences of the guidebook are local governments, MPOs, and other metropolitan area project sponsors. Other project stakeholders can also benefit from this guidebook by gaining an increased understanding of how transportation projects are developed.

1.2. Getting Started: Initiating a Project

Once local governments identify a transportation improvement need, they should investigate the possibility of state and federal support to implement their project. There are three important decision-making points for projects to attain this external funding. The first decision-point is when the proposal is reviewed for inclusion in the MPOs' Metropolitan Transportation Plan (MTP). In this guidebook, the process of taking an improvement idea and transforming it into a proposal that is ready for MTP consideration is called Stage A.

After approval for inclusion in the MTP is obtained and sources of funding are identified, a more detailed study can be carried out to investigate specific aspects of the project and to gather extensive information about its implementation and design needs. At this point the initial scope of work, cost estimate, and schedule can be verified and updated. Using the expanded information from the detailed project study a second decision-point is reached, when the MPO again reviews the project for inclusion in its active Transportation Improvement Program (TIP). In this guidebook, the process of preparing a proposal that is ready for TIP consideration is called Stage B.

The last major planning step from the local government's point of view is initiating the design of the project. As preliminary designs become available, the project's scope, cost estimate, and timeline should once again be reviewed and verified to determine if the project is ready to enter the detailed design phase. The decision to enter detailed design can be considered the conclusion of the project scoping process. In this guidebook, the preparation and verification of the final scoping/cost/scheduling report is called Stage C.

Figure 1 illustrates an overview of this entire process, including stages A, B, and C. As can be seen in the figure, the primary tasks carried out during Stage A include the clear identification of a transportation improvement need and an initial characterization of its feasible solutions. Estimates of the project's scope, cost, and scheduling are necessarily tentative at this stage of development. When moving to Stage B, much more detailed analysis can be carried out. Tasks at this stage include the specific evaluation of alternative project solutions, incorporating information about right-of-way, utility requirements, and environmental impacts. During this stage, initial schematics may be produced, and public feedback about the recommended solution is obtained. In Stage C, the scoping report is finalized based on preliminary design work, and all relevant information is reviewed and verified. The final scoping report should be able to serve as a reliable framework for the detailed design phase of the project.

The following chapters present more detailed information about all aspects of the scoping process. Chapter 2 describes the purpose of project scoping and provides a detailed breakdown of scoping tasks throughout Stages A, B, and C. Chapter 3 provides detailed information about development of cost estimates. Chapter 4 presents detailed discussion about development of project timelines. The appendixes of this guidebook provide a number of useful templates that can be used during project preparation, including scoping report templates, review checklists, and a cost-estimation form.

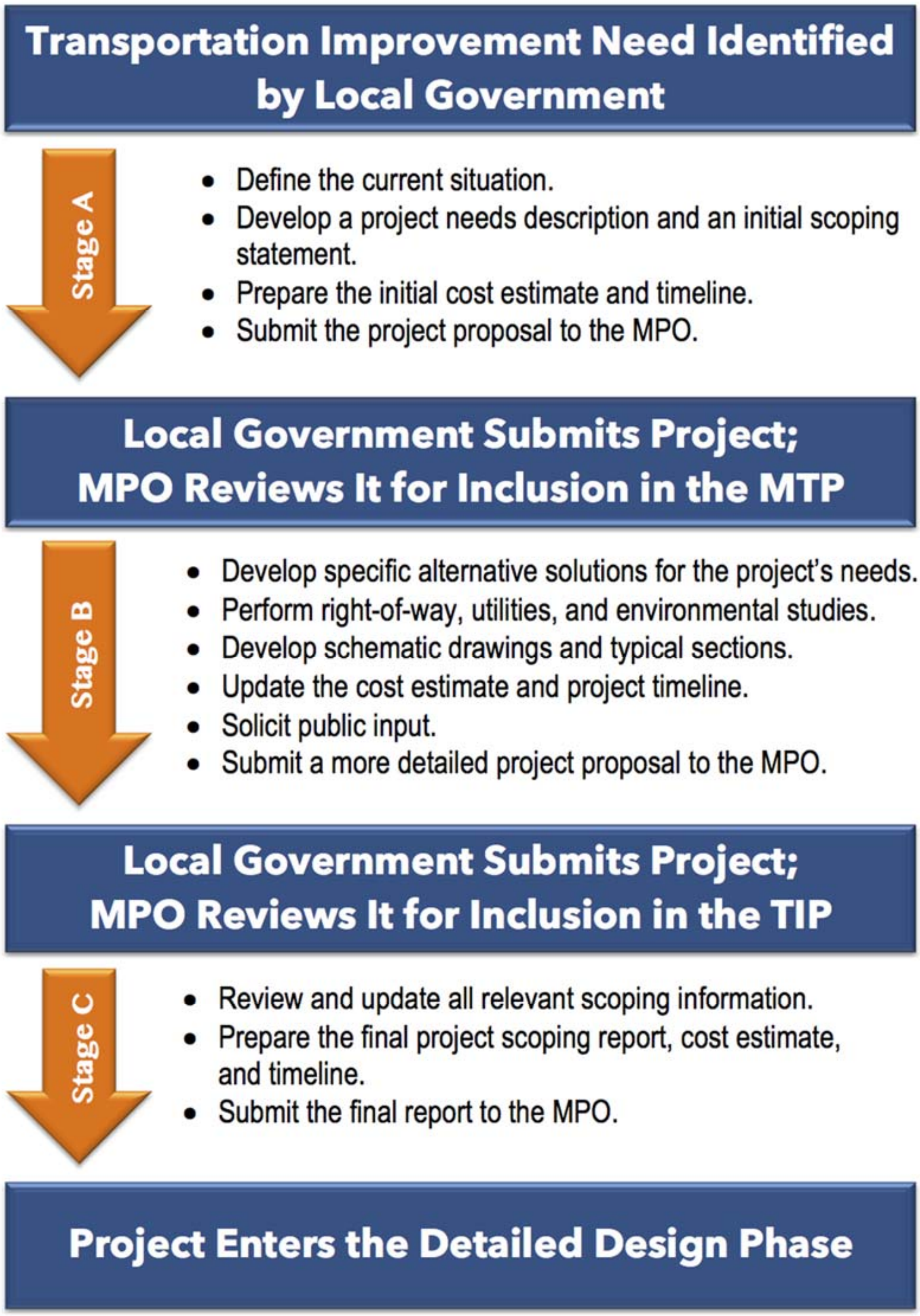

Figure 1. Overview of the project-scoping process for projects submitted to MPOs.

CHAPTER 2. PROJECT SCOPING

Project scoping involves taking a general transportation-improvement idea and transforming it into a well-developed solution that is ready for detailed design work. During project scoping, the boundaries of the project are defined, the components of the project are identified, key design parameters are developed, and the required budget of the project is estimated to an adequate level of detail for planning purposes. A well-defined project scope helps to ensure the development of reasonably accurate estimates of the project timeline and budget.

The scoping process can be understood as having three mutually supporting axes: the scope of the work itself, the budget available for the work, and the time allowed for project completion (Figure 2). All of these factors have to be reasonably accurate and in balance with each other to create a basis for successful project delivery. Accurately defining the scope of the work is the primary focus, and the corresponding cost estimate and schedule are developed based on the scope.

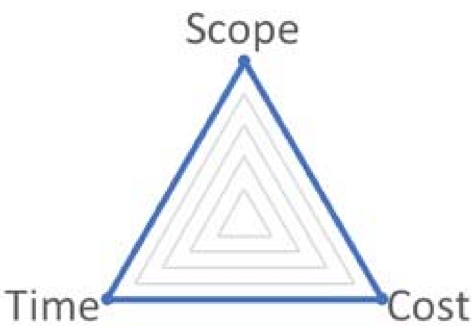

Figure 2. Project scoping dimensions.

At the start of the project scoping process, planners begin with a clearly identified need or goal, a clearly stated purpose for the project, and a solid justification for its implementation. From this point, as scoping proceeds, alternative solutions are studied along with evaluations of what components will be included and excluded from the planned work. All activities necessary to complete the work are enumerated, along with all related impacts (environmental, traffic, legal, etc.) that will need to be taken into account for the successful completion of the project.

Planners seek to evaluate the full impacts of various proposed solutions, along with any issues that might be identified during the subsequent phases of project development (design, construction, and maintenance). Areas where problems might potentially arise are evaluated in order to minimize the risk of underestimating the project's execution activities, costs, and schedule. As project development progresses, the project scope, schedule, and cost estimate are periodically updated and become more refined and accurate. A key concern for MPOs is to determine when these factors have become accurate enough so that they can be reliably used for funding decisions.

2.1. The Importance of Project Scoping

The interrelated factors of project scope, cost estimate, and schedule will serve as a defining framework for the design and implementation phases of the project. If this underlying framework is not well-conceived, thorough, and accurate then there is a significant possibility that unexpected difficulties and complications will arise during later project phases. Inadequate scoping can and often does result in significant cost increases, completion delays, and even poor performance/quality in the constructed project as a result of the development constraints imposed by inaccurate estimates. Furthermore, the changes in budgeting and scheduling that result from inadequate project scoping can spill over to affect other planned projects, requiring adjustments in the organization's entire transportation planning program. The potential "domino effect" caused by budgeting and scheduling inaccuracies makes project scoping a critical component of the overall transportation program's success.

Since the design details of the project have not yet fully coalesced during the scoping phase, accurately estimating the project cost and schedule can be a significant challenge. Nonetheless, planners are called upon to make reasonably accurate predictions and provide contingencies so that a preferred solution can be chosen and project implementation can proceed. The goal of the scoping process is to define the project alternatives accurately enough to make fair comparisons among competing alternatives. Risk analysis is a central component of this process, as planners check carefully to identify potential issues that may arise during project implementation and ensure that adequate contingencies are provided for things that may not yet be identified.

Successful scoping is often "invisible" during the completion of a transportation project, but any flaws in this underlying framework can become very apparent due to the budget overruns and project delays that can result from inadequate attention to scoping. The investment of adequate resources for robust scoping work at appropriate times in the project development process is therefore a proactive approach that will aid tremendously in avoiding unexpected problems that can jeopardize an entire transportation program.

Adequate scoping contributes to project success by:

- Reducing unforeseen project costs for design and construction.
- Eliminating or reducing delays in design and construction time.
- Improving the predictability of project performance, costs, and scheduling.
- Enhancing the project's success in achieving its social and environmental objectives.
- Improving the communication of project plans and outcomes to stakeholders.

2.2. The Timeframe for Project Scoping

Scoping should begin early in the initial planning-phase of project development, and it should continue to be refined through the preliminary design phase. Often the scoping process is divided into multiple stages, with broad evaluations made during initial planning and then further refined as the preliminary design work proceeds. When the project moves into its detailed design phase the scoping framework should be considered definitive and complete (Figure 3).

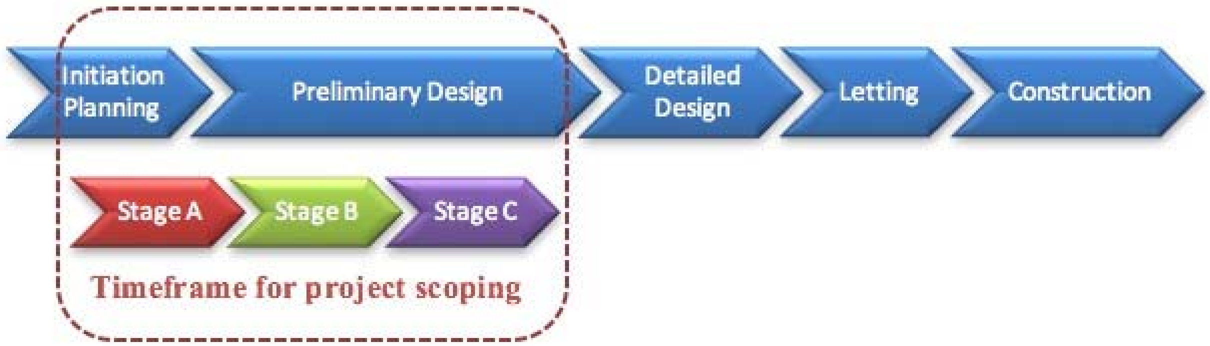

Figure 3. The timeframe of scoping within the project development process.

2.3. Project Scoping Stages

As the details of a project come into focus, more accurate estimates of budget and scheduling become possible. Thus, dividing the scoping process into several stages can help planners to "zero in" on the best project solution and the most accurate definition of project parameters. A typical approach is to divide scoping into three stages (A, B, and C), as will be described in this guidebook.

Metropolitan Planning Organizations typically identify transportation needs and projects for a time horizon of 20–25 years. Each approved project is placed into the organization's Metropolitan Transportation Plan (MTP), and then as the project continues to develop it is moved to the active 4-year Transportation Improvement Program (TIP). The stages of project scoping that are recommended in this guidebook are organized to match this trajectory of MPO projects. Each stage of scoping will end with a "gateway" review, after which the project will advance to the next level. Stage A efforts are required to ready a project to be included in the MTP, Stage B efforts are required to ready a project to be included in the TIP, and Stage C scoping is completed just before the project enters detailed design.

Each subsequent stage is built upon the previous scoping stage, and each gateway review confirms that the project scope, cost, and schedule have been defined sufficiently for the project to advance. In this way, the scope of the project is refined sequentially. Following this approach allows planners to engage in the appropriate types of scoping analysis as the project develops, and ensures that all of the relevant and available information is reviewed at each stage. In the later stages, planners may review and confirm findings from previous stages, while also expanding the analysis to account for newly available information (Figure 4).

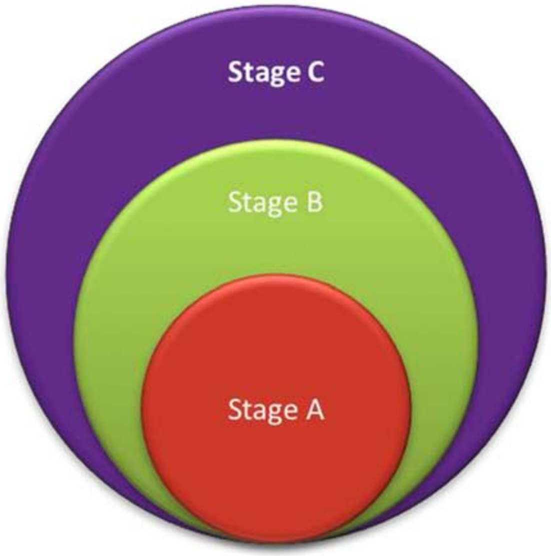

Figure 4. The information defined within the project scope expands and increases in detail as the project advances through the development process.

2.3.1. Stage A: Identification of Project Needs

It can be advantageous to initiate the scoping analysis very early in project development. This is particularly true for metropolitan-area projects, as their parameters tend to be more unique and complex in comparison with projects in more rural settings. Metropolitan-area transportation improvements are more likely to have extensive challenges in regard to utility conflicts, right-of- way acquisition, and similar obstacles. Without adequate attention to the complex needs and challenges of metropolitan-area projects an idea might appear easy to implement at first, and planners may be caught off guard as the true obstacles emerge. Initiating the scoping analysis shortly after the transportation need or idea has been identified will therefore help to ensure that the conceptualized project is feasible and that no unexpected surprises are on the horizon.

A well-developed report on the needs of the project is the defining aspect of Stage A. In this stage of scoping, the proposing agency clarifies the purpose and objectives of the project, gathers initial data about the transportation problem, and identifies project stakeholders. Since the information available at this point is limited, the initial cost estimate is typically prepared using a rough cost-per-mile or similar methods (discussed in Chapter 3). The timeline for the project at this stage is often based on a comparison with other similar projects that have been previously completed.

At a minimum, the needs-identification report includes a purpose statement; proposed project characteristics (e.g., number of lanes involved, types of proposed improvements, and major structures); the current conditions of the relevant infrastructure; traffic projections; relevant utility, right-of-way, environmental, and legal considerations (including nonattainment area status); identified stakeholders for the project; initial cost estimates; initial timelines; and an identification of concerns that will need further investigation. Appendix A provides a template for this initial needs-identification report, and Appendix C provides a checklist for MPOs to review the report. The needs report that is created during Stage A will by necessity have to rely on limited information; it will be updated with more detailed studies as the project develops. At the end of this stage, the project is developed enough to be submitted for the MPO's review for inclusion in the Metropolitan Transportation Plan.

2.3.2. Stage B: Preliminary Project Scoping Study

Stage B of the scoping process is performed to define the project elements in more detail. Preliminary design is underway at this stage of development, and additional data is collected in regard to environmental impacts, drainage issues, right-of-way, and utilities conflicts. This allows for the development of more precise components of the project's scope, cost estimates, and schedules. Environmental clearance may be obtained during this stage, and supporting documents such as right-of-way maps and property descriptions may be developed. However, acquisition is not yet initiated during Stage B. Public involvement is at its peak during this stage and open meetings may be held to solicit feedback from affected stakeholders. In this stage, alternative solutions are evaluated and a primary candidate plan is selected.

At a minimum, the preliminary scoping report that is developed during this stage includes the recommended solution, detailed cost estimates and timelines, right-of-way and restriction maps, utility impact maps and related information, environmental review (activities and permits that have to be addressed), preliminary schematics, and public meeting minutes. Appendix B provides a template for this preliminary scoping report, and Appendix D provides a checklist for MPOs to review the report. Stage B should be completed approximately 4 years before letting and construction. At the end of this stage, the project is ready to be submitted for the MPO's review for inclusion in the 4-year Transportation Improvement Program.

2.3.3. Stage C: Finalized Project Scoping Study

During the last stage of the scoping process the project scope, budget, and schedule are finalized. This step coincides with the completion of the project's preliminary design schematics. At this point in the project development process, there is enough information available to firmly establish the project parameters and initiate detailed design and construction. The final scoping report that is created during Stage C will be passed along to the designers as a guideline for their work.

To prepare for the detailed design stage, the recommended project solution is defined in more depth. The amount of design work that has been completed at the end of the scoping process (i.e., the preliminary design) should be around 10% to 30% of the total project, which is enough to firmly ensure that the parameters defined in the scoping report are feasible. In addition, the project data collected during Stages A and B is reviewed and updated, right-of-way and utility conflicts are fully documented, and the environmental and social impacts are classified and certified. All necessary permits should be identified during this stage. Public hearings are also documented in the final scoping report as part of the project's Public Participation Plan.

At a minimum, the final project scoping report includes cost estimates, project development timelines, environmental classification and certification, right-of-way and utility maps ready for acquisition and relocation, preliminary design schematics at about 30% of completion, and public hearing minutes. On many projects, Stage C is completed approximately 2 years before letting and construction to allow for final design, obtaining plan approval, right of way acquisition, and utility relocation. At the end of this stage, the project moves into the detailed design phase and funding is allocated for the implementation of the project.

2.4. Project Scoping Tasks

An effective three-stage project scoping process is set up in such a way that several activities are repeated during each stage of the procedure, allowing for new information to be added and previous conclusions to be verified or adjusted. A full suggested breakdown of project scoping tasks, throughout stages A, B, and C, is outlined in the following sections.

Stage A-1: Preparation

- *Identify Team Members Based on Project Disciplines*: In this task, the local government agency that is sponsoring the project identifies the nature of the transportation problem and selects qualified personnel for the scoping team. In cases where the project sponsor does not have the specialized staff that is needed in a particular area, outsourcing solutions for that section of the project may be considered. The costs for hiring external consultants during the scoping phase are the responsibility of the project sponsor. If the same consultants are used during preliminary engineering, final design, or construction administration then there may be federal or state funding available; however, appropriate professional procurement procedures will need to be followed according to the regulations of the funding agencies. Information about consultant hiring requirements is available from TxDOT's Local Government Projects Toolkit (http://www.txdot.gov/government/processes-procedures/lgp-toolkit.html).

- *Acquire (or Update) Project Data*: Available data related to the project is collected from local entities, such as traffic planning, pavement management, structures, and engineering divisions. Important data to obtain in this stage includes traffic flow patterns, accident rates, average daily traffic, pavement conditions, bridges-structures condition, right-of-way information, utilities information, the most recent surveys of the area, level-of-service analysis, maps, hydraulic studies, maintenance works, flood history, local agency comments on potential solutions, whether or not the project is located in an air-quality attainment area, and the identification of key stakeholders. In Stage A, the available data is often limited, but spending adequate time at this stage to collect as much information as possible can save significant effort in the future. During subsequent scoping stages this data will likely be updated or expanded.

Stage A-2: Define the Current Situation

- *Conduct a Site Visit:* The scoping team conducts an on-site field inspection of the transportation area to gain a better understanding of the problem. Prior to the site visit, aerial photos and maps can give meaningful insight toward the proposed solutions. However, a direct site visit, aerial photos, and maps cannot be substituted interchangeably. It is best to incorporate all of these information sources into the situational evaluation.

- *Collect On-site Data:* The data collection is based on endpoints, geometric data, bridges (if any), traffic control devices, right-of-way obstacles, and transportation limitations and deficiencies.

- *Develop Projected Traffic Data (if applicable):* Obtaining information about projected traffic loads and travel demand is important for justifying capacity improvement and pavement designs, particularly when making improvements on the State or National Highway System.

- *Elicit Public Input*: As part of the Public Participation Plan, the project manager holds a meeting with federal and local entities first, and then with members of the public, in order to collect concerns that those agencies or members of the general public might have regarding the project. This process can begin in Stage A and will continue in more detail in later stages.

Stage A-3: Define the Project Need and Develop the Initial Scope

- *Create a Purpose and Need Statement*: After the data-collection and stakeholder input, the information gathered is transformed into a "Purpose and Need Statement" where the problems are well-explained and described. This document is intended to justify the spending of public funds. Information on writing a Purpose and Need Statement is available from TxDOT's National Environmental Policy Act (NEPA) and Project Development Toolkit (http://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/nepa.html#pisd).

- *Analyze Potential Project Conflicts*: During the site visit the scoping team identifies potential right-of-way, utilities, and environmental conflicts that may pose a challenge for project implementation. In this task, any major challenges that could affect the project cost and project development time are identified. This is just a preliminary evaluation of issues that will likely need to be investigated in greater detail at later stages.

- *Prepare the Initial Project Scope*: With the information collected up to this point, the scoping team is able to draw a broad conclusion about the project's needs and to consider a proposed best-solution. This allows the team to preliminarily convey a scope of work that will need to be accomplished to solve the transportation problem. It is important to document this analysis in the first section of the Stage A scoping report. Appendix A contains an example scoping report template that can be filled out based on the outcomes of tasks A3 and A4.

Stage A-4: Prepare the Initial Cost Estimate and Project Timeline

- *Prepare the Preliminary Cost Estimate*: Once the initial scope of work is defined, a preliminary cost estimate can be prepared. In the earliest stages of project development there will be a significant amount of uncertainty in the project description, so the cost estimate should contain a large contingency component. This contingency can be reduced in later stages and replaced by a more detailed cost analysis as more project details become available. Detailed information about developing cost estimates, and the appropriate estimation techniques to use at different stages of project development, is given in Chapter 3 of this guidebook.

- *Prepare the Project Timeline*: The initial scope of work also makes it possible to prepare a preliminary project timeline. It is very important to accurately define all activities that have been identified as necessary to deliver the project, and to sequence these activities in their necessary logical order so as to avoid unexpected delays. As is the case with the preliminary cost estimate, the preliminary timeline that is prepared during early planning stages will include a lot of uncertainty, and therefore a significant amount of scheduling contingency should be incorporated into the timeline. The timeline's contingencies will be replaced by more precise analyses as project development proceeds. Detailed information about developing project timelines, and the appropriate scheduling approach to use at different stages of project development, is given in Chapter 4 of this guidebook.

Stage A-5: Submit the Project for Inclusion in the MTP

- *Submit the Project to the MPO*: The Stage A scoping report developed during tasks A3 and A4 (an example report is given in Appendix A) is used as part of a project proposal/application submitted to the Metropolitan Planning Organization. This is typically done in response to a Call for Projects by the MPO. Prior to submitting the proposed project, the local agency may want to meet with the MPO and other entities to identify potential sources of funding for various project development activities. This will allow the proposing agency to clearly identify the potential sources of funding as part of the project proposal. The MPO will review all of the project proposals that are received and then select projects to include in its MTP (an example of an MPO project review checklist is given in Appendix C).

Stage B-1: Update Data Collection and Prepare for Stage B

- *Identify Team Members and Update Project Data*: In this task, the items from Stage A1 are repeated. The composition of the scoping team should be verified or adjusted, and relevant project data should be gathered or updated to provide the basis for a more comprehensive study.

Stage B-2: Develop Alternative Project Solutions

- *Identify Relevant Social and Economic Resources:* The team should collect information about the project area's surroundings such as archaeological or historic sites, community character, aesthetics, agricultural lands, water conservation sites, recreational sites, and hazardous sites. This data can be useful in selecting the best project solution and minimizing adverse environmental impacts.

- *Examine Potential Alternatives*: Formally developing several alternative project solutions and comparing them against one another can help the planners ensure that they identify the best available solution to resolve the identified transportation need. For example, upgrading the current facility along its current alignment or building along a new alignment may be considered as potential alternatives.

Stage B-3: Analyze Right-of-way Concerns

- *Collect Right-of-way Maps*: In this task, the scoping team is encouraged to collect all available right-of-way maps that may be relevant to the project. Sources may include County property tax records, the local agency's own records, and TxDOT property ownership records. These maps can be included as attachments in the scoping report.

- *Identify Restrictions and Interests*: Any known restrictions or interests on real property may be drawn on an overlay map where the areas of potential conflict are highlighted. This analysis should be carried out for each alternative project solution. These conflict maps can be included as attachments in the scoping report.

Stage B-4: Assess Utility Needs

- *Collect Utility Information*: The scoping team is encouraged to contact utility owners (water, sewer, electrical, telecommunications, and others) to identify potential conflicts between the project implementation and utility services.

- *Identify Utility Conflicts*: Possible relocations for utilities affected by each alternative project solution should be identified using alignment maps. The utility relocation maps should be prepared and included as attachments in the scoping report.

Stage B-5: Develop the Environmental Analysis

- *Analyze Environmental Impacts*: The scoping team identifies and documents the environmental and social impacts for each alternative project solution. The team members can benefit from contacting local and federal agencies to coordinate with them about the permits that the project may need. This task initiates the process for meeting National Environmental Policy Act (NEPA) requirements. The scoping team can take advantage of TxDOT's "NEPA and Project Development Toolkit" throughout this process to help ensure that all requirements are met (http://www.txdot.gov/inside-txdot/division/environmental/compliance- toolkits/nepa.html).

- *Document Environmental Study Findings*: Environmental clearance requirements for transportation projects are classified into three categories based on the severity of the project's environmental impacts. Each category has a different documentation requirement. When it is known that the implementation of a project will have a significant effect on the environment, an Environmental Impact Statement (EIS) is prepared. For projects in which the environmental impact is uncertain, an Environmental Assessment (EA) is carried out. When it is known that implementing the project will not have a significant environmental impact, Categorical Exclusions (CE) are issued. Depending on how the project is categorized, it may be necessary to create further documentation, to obtain project certification, or to implement environmental mitigation strategies. An environmental review study should be included as an attachment in the project's scoping report.

Stage B-6: Prepare Preliminary Designs/Drawings

- *Develop Initial Design Plans/Schematics*: During this stage of the project development, the team should begin to define (generally within 10% to 30 % of completion) the type of roadway or other transportation facility, the project's dimensions, the schematic layout, alignment elements, sectional elements, drainage, ADA requirements (sidewalks, ramps), and any other project elements that are significant for cost estimation. Major structures and possible bridge upgrades should be identified if needed. Preliminary design plans/schematics should be included as an attachment in the scoping report.

- *Define Special Considerations during the Construction Phase*: This task involves the identification in advance of special considerations during construction that may affect cost estimates and timelines. Such considerations may include vehicular access limitations, special design or pavement reinforcement requirements, temporary traffic control, or availability of materials and skilled labor in the project location.

Stage B-7: Update the Cost Estimate and the Project Timeline

- *Use the Information Obtained in Stage B to Refine Cost and Scheduling Estimates*: In this task, the items from Stage A4 are repeated, making use of the more detailed information that has been collected during Stage B. The initial cost estimates and timeline can be greatly enhanced at this point, with much of the uncertainty and contingency replaced by more detailed analyses.

Stage B-8: Evaluate Alternative Solutions

- *Prepare an Evaluation Matrix*: It is recommended that the team develop a matrix to compare the data on alternative project solutions. This matrix can be included as an attachment in the scoping report.

- *Recommend a Preferred Alternative*: Based on the scoping team's evaluation of costs and benefits (including social and environmental costs and benefits), a candidate project solution is selected from the available alternatives. The basis for this selection should be fully thought out and documented in the scoping report.

Stage B-9: Conduct Public Meetings or Hearings

- *Meet with Local Entities*: The scoping team should meet with local organizations and officials to present the alternative project solutions that were under consideration and to explain the reasoning behind their recommended solution. Meeting minutes and a summary of feedback from organizations and officials can be included as an attachment in the scoping report.

- *Meet with the General Public*: As part of the project's Public Participation Plan, the scoping team should meet with public stakeholders, present the team's recommendation, and invite public comment. Depending upon the type of environmental clearance required for the project, public hearings that comply with NEPA requirements may be necessary. Meeting minutes and a summary of feedback from the general public can be included as an attachment in the scoping report.

Stage B-10: Submit the Project for Inclusion in the TIP

- *Submit the Project to the MPO for Review*: Appropriate data from the expanded Stage B scoping effort will become part of the project's application for inclusion in the MPO's active Transportation Improvement Program (an example Stage B report is given in Appendix B). The MPO will review all projects submitted and select projects to include in its TIP (an example of a Stage B project review checklist for MPOs is given in Appendix D). If the project is awarded federal or state funding along with its incorporation into the TIP, then the local government will need to enter into a formal funding agreement with the relevant agencies.

Stage C-1: Update All Relevant Scoping Information

- *Verify the Scoping Analysis*: All relevant scoping information should be reviewed and verified in preparation for the final design phase. Some items may need to be changed or expanded in light of new information and as a result of more detailed design studies. The following tasks should be repeated (in this order):

– A1: Confirm the project information in the Purpose and Need Statement, and verify that the project description and limits match the data that is given in the TIP.

– B3: Finalize the right-of-way impact analysis. Include updated right-of-way property interests and restrictions maps in the final scoping report.

– B4: Finalize the utility impact analysis. Include updated utility conflicts maps and relocation maps in the final scoping report.

– B5: Finalize the environmental impact analysis. Include updated environmental review documents in the final scoping report.

– B9: Conduct additional public meetings. Include meeting minutes and a summary of public feedback in the project report and in relevant environmental documents.

– A4: Update the cost estimate and project timeline based on the current project information. Include a detailed breakdown of the cost and time estimates.

Stage C-2: Submit to Relevant Agency and Obtain Approval for the Project to Enter the Detailed Design Phase

- *Demonstrate Compliance*: Submit necessary documentation to demonstrate compliance with all applicable state and federal requirements based on the source of funds and the specific provisions of the project's funding agreements. Prior to commencing final design, the local agency will need to demonstrate to the funding agencies that it has advanced the project to approximately 30% of completion. For large projects, this includes completion of schematic designs, obtaining environmental clearance, and identifying necessary right-of-way acquisitions and utility adjustments. By carrying out a robust scope development, conducting an adequate preliminary design process, and preparing detailed documentation, the local agency will enable the project designers to proceed with their detailed work on a solid foundation. The absence of any drastic, unexpected changes to the project's scope, cost, and schedule during the later implementation phases will be a testimony to the success of the scope development process.

CHAPTER 3. COST ESTIMATION

Cost estimation is an essential factor to the success of transportation projects. Accurate cost estimates enhance transportation plans by better supporting feasibility studies, prioritization, and annual budget allocations for proposed projects. This chapter outlines a process for developing cost estimates and discusses several aspects that planners should consider when creating estimates. In the last section of the chapter, an approach that MPOs can use to review cost estimates is presented.

3.1. The Importance of Cost Estimates

Metropolitan-area projects will benefit from a consistent and systematic approach to generating reliable budget estimates even at the early stages of project development. Inaccurate or unreliable cost estimates can have a "domino effect," resulting not only in delays and overruns for one specific project, but also setbacks and budget revisions for the entire transportation program. Incorrectly estimating project costs may result in planners being misled about the feasibility of implementing a particular project, or prioritizing projects in a less effective fashion. In the worst-case scenario, inaccurate cost estimates can even lead to quality problems in the final delivered result, or an inability to complete a project in the way that it was planned.

3.2. Scoping Cost Estimates vs. Detailed Cost Estimates

There are two basic categories of cost estimates: scoping and detailed. Scoping estimates are made during the early stages of the project development, before any detailed design work has been carried out. Detailed estimates, in contrast, are made later in the project development process and have the benefit of more precise information. While these two types of cost estimates rely on different techniques, they are both equally important. Reliable scoping estimates are critical for planning purposes because they provide the information needed to assess project feasibility and to allow for an effective allocation of limited funds. Detailed estimates are prepared and updated as soon as possible when the design work is initiated, in order to confirm the scoping estimates and make them more precise.

Scoping cost estimates are used by planners to establish the project budget, to compare different alternative solutions for completing a project, and to compare and prioritize among different projects within the overall transportation program. These cost estimates are developed concurrently with efforts to define the scope of the project work (what is to be included and excluded), as described in Chapter 2. Due to the nature of developing projects at this early stage, there is often a significant amount of uncertainty about the extent of the required work that will be needed to complete a project. Various details of the project components and their exact design are not yet fully developed. Therefore, contingency and risk analysis—estimating the breadth of the possible cost-range—is a crucial aspect of creating cost estimates during the scoping stage.

One way to think about scoping estimates and detailed estimates is to consider three components of the cost. The *base estimate* includes costs that are certain and can be readily calculated. The *allowances* are for variable-costs items that are a known part of the project but cannot be calculated precisely until further design work is completed. The *contingency* is an amount reserved for unknown or potential costs that may or may not arise during the project implementation. At the start of the project the allowances and contingency will cover a large range, because there are still many unknowns in regard to the implementation. As the project proceeds from scoping to detailed design the allowances portion of the cost estimate will shrink and then eventually disappear, as the costs of variable items become precisely defined and are incorporated into the base cost. The contingency portion of the cost will also shrink, but will never entirely disappear (Figure 5). The overall result of this process is that the range of error in the cost estimate grows smaller as project development moves from the initial scoping stage toward the detailed design stage.

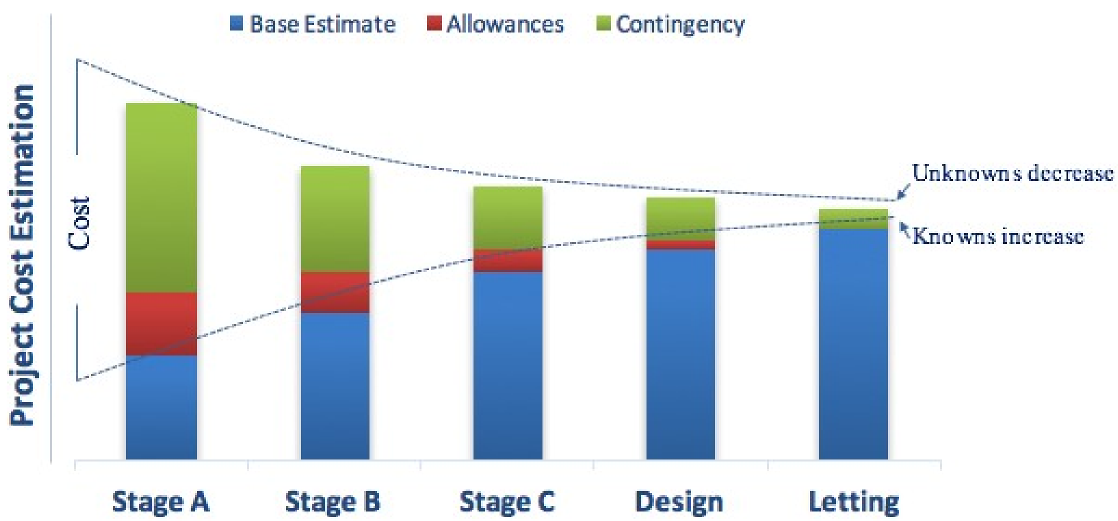

Figure 5. The cost estimate is gradually refined during the course of project development.

3.3. Meeting the Challenges of Cost Estimation during the Scoping Phase

During the scoping phase, the lack of details about how various project components will be implemented creates significant challenges for cost estimation. Nonetheless, it is extremely important that these estimates be reasonably accurate, and consistently performed, so that planners can compare the feasibility of various projects and determine how best to allocate project funding. Using a consistent risk-analysis approach to define adequate contingencies and potential cost ranges can help tremendously in avoiding any unpleasant surprises. Whereas traditional approaches to cost estimation often provide a single ballpark figure, the technique described here of evaluating base estimates, allowances, and contingencies can inform planners about the variability that is present in a cost estimate. This allows for more informed and nuanced decision-making. To identify the range of an estimate, planners can rely on statistical interpretations of the available data, and/or the accumulated experience of transportation professionals. Local governments need to remember that if their project will be partially supported with state or federal funds, the requirements associated with that funding may mean that construction costs will be higher than if only local funds were used.

3.4. Cost Estimate Techniques

A variety of different approaches and sources of data can be used to prepare cost estimates. In the very early scoping stages, the estimate may be based solely on historical data or expert opinion. For example, the cost-per-mile data for previous roadway projects that are similar in nature is often collected and statistically amalgamated. For bridge projects, square-foot cost averages are frequently used. These estimates may sometimes be tailored to a particular proposed project by considering the variable cost of utility work, environmental mitigation work, traffic impact management, and so forth. Regardless of the source of data, there can be great benefit at this stage in calculating the range of variability as well as just a single, approximate figure.

As the project design progresses and more information becomes available, cost estimates can shift to focus on quantities of items and their per-unit costs. These techniques are more suited to detailed cost estimates, but at times they may be incorporated into scoping estimates as well. Regardless of the technique used, it is always important to remember to factor in the effects of inflation and market conditions.

The following list describes some of the most common cost-estimation techniques and their applications:

(a) *Cost-per-parameter using similar projects*. This technique can provide a fairly quick cost assessment at the earliest project stages, using similar projects as a basis for calculating the total cost. Historical data is collected for very similar projects, and then these costs are adjusted according to the new location, current market prices, and any other differences that are noted in relation to the new project. In this approach, the adjustments made to translate the costs of previous projects to the context of the new project are documented and applied consistently to decrease subjectivity of the estimates. In transportation projects, this method is widely known as "cost-per-mile technique." Other parameters may be used, however, such as cost-per-square-foot, cost-per-road-intersection, etc.

(b) *Cost-per-parameter using typical sections*. This technique is similar to the previous one, except that the costs are broken down into different types of roadway sections. For example, sections with sidewalks or with bridges are evaluated separately from other portions of the roadway that lack these features. This allows for a more precise estimate based on the unique characteristics of the current project. Average historical data is gathered for typical sections, and then these costs are applied based on how much of each section type is present in the current project.

(c) *Analogous project with scoping parameters*. Once the project moves into the later stages of the scoping process and its parameters are more clearly defined, it becomes possible to make extrapolations from past projects in a more precise fashion. Planners can identify a past project that has closely similar parameters in terms of scope, complexity, scheduling, and so forth, and use this past project as a basis for estimating the cost of the new one. The accuracy of such estimates is generally greater compared to estimates that rely on historical averages of broadly similar projects. When using this technique, it may still be necessary to make adjustments to fit the current project definitions.

(d) *Component costs*. Increased project definition allows for a component-by-component analysis of materials, equipment, labor, productivity, overhead, and contractor profit margins, again calculated based on historical data. This is a relatively complex estimation method and while it can be used during scoping, it is more often used during the detailed design and letting phase of the project.

(e) *Historical-bids based*. Rather than developing their own estimates of component costs, planners can track the historical trajectory of contractors' previous bids for the major items of the work. Bidding history provides an easily accessible source of data and is more inclusive than simply relying on the final budgets of previous projects. Due to its convenience and effectiveness, this technique is very commonly used. When taking this approach, it is important to have adequate data (i.e., bids drawn from multiple projects) and to obtain a frequently updated sample of bids over time. This technique is also more appropriate for detailed design estimates, but it may sometimes be used during the scoping phase. TxDOT maintains a list of average bid prices that is updated periodically (http://www.txdot.gov/business/letting-bids/average-low-bid- unit-prices.html).

(f) *Historical percentages*. This method can be used for components of the project that are not fully defined at the early stages of project development. It draws on historical data from similar projects that have a different size/scope, and then estimates the cost of a component of the new project as a percentage of the total cost of the previous project. The resulting estimates will need to be adjusted in accordance with current market prices.

(g) *Combined methods*. Sometimes, obtaining the best total estimate for a project means calculating the cost of its different components using different techniques. For example, the cost of labor for a project might be easy to analyze based on available data, but the cost of materials might need to be analyzed based on historical percentages. When different methods are used, it is vital that the planners clearly define and document the procedures and the reasons that they were chosen. A combined approach is more common on complex projects, and it may require the assistance of multiple planners; therefore, clear communication is vital to ensure that commensurate practices are used and that each component's relation to the others is understood when developing the combined/total estimate. The contingency included for such projects may need to be larger than normal to account for the variances in the estimation process.

3.5. Cost Estimation Steps

To streamline the process of making cost estimates, and to help ensure that this process is consistently applied, the following five-step procedure is recommended. This approach is derived from the cost-estimation workflow described in the National Cooperative Highway Research Program (NCHRP) Report 574: *Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction*. It has been modified and tailored to meet the specific needs of metropolitan-area transportation projects. The steps of the process are described in detail in the following paragraphs, and then summarized in Table 1.

3.5.1. *Step 1: Determine the Basis of the Estimate*

To develop an accurate overall cost estimate, the foundation should first be laid by clearly defining the scope and stages of the work, the site characteristics, and any other project determinants that may affect cost. In this step, these project characteristics are carefully elaborated and documented, to whatever extent is possible at the current point in the project development process. All assumptions that were made about the project development should be identified.

As part of this step the planners may identify alternative development paths. The cost estimate of the project may be defined for the main development alternative, with other alternatives evaluated in terms of how their differences would affect the main cost estimate. If at all possible, it is recommended that the planners visit the future construction site or project corridor in person during this step to improve their knowledge of the project's characteristics.

3.5.2. *Step 2: Prepare the Base Estimate and Allowances*

Once all the information about the project is collected, the planners review this material and make their estimate for the known project components, including both the base estimate and the allowances. An important part of this step is to define what estimating technique is most appropriate for the project by considering the current development phase, its complexity, and the level of details available. Various techniques can be used for the calculation of these estimates, as was described in the previous section. Local governments often use historical cost information for similar projects that they have developed or that adjacent local entities have developed. They may also request assistance from a local office of their state DOT. An example of historical unit-cost information from recent TxDOT projects is available on the txdot.gov website (http://www.txdot.gov/business/letting-bids/average-low-bid-prices.html).

The planners may also identify factors that would help to better develop the cost estimate as the project progresses, so that future cost estimates in the later stages can become more precise. As part of this step the planners should carefully document all of the inputs, outputs, tools, and techniques that were used, and any assumptions that were made in creating the estimate. MPOs may have an internal policy regarding whether allowances are categorized as part of the base estimate or (less frequently) as part of the contingency reserve.

3.5.3. *Step 3: Analyze Risk and Set the Contingency*

Risk and contingency analysis is crucial for developing more useful cost estimates. Through this process, project planners gain an understanding not only of the median estimate of cost and timing, but also of the potential impact of undeterminable factors and the range of uncertainty in the estimate. The risk analysis is based on the uncertainty in the estimation process and elements in the project implementation that cannot be clearly defined or predicted in advance (e.g., characteristics and dimensions of work components, market dynamics, supply disruptions, or the weather). The project contingency is an estimate of the potential costs associated with these risks. As the project development and implementation continues through time, the amount of its contingencies will gradually decrease, reflecting the smaller number of remaining uncertainties.

In this step, the planner documents the areas of uncertainty remaining in the project scope, and determines the appropriate risk-analysis method. The cost contingency is then calculated based on these remaining unknowns. Once the contingency is calculated it is added to the base-cost estimate.

3.5.4. Step 4: Review and Approval

The planner's calculations should be carefully reviewed by a second party to detect any possible errors or omissions. This review should be conducted before the cost estimate is used for any decision-making purposes, and before it is released to the public. The intensity of the cost estimate review can vary depending on the project complexity and the project type. In most cases, though, it should include at a minimum a scrutiny of the estimate's assumptions, verification of the cost-data and completeness of the estimate basis, and comparison with previous estimates for similar projects. Local governments may benefit from requesting a review conference with district-level personnel from TxDOT to discuss if the estimate seems reasonable.

3.5.5. Step 5: Communicate the Estimate to All Interested Parties

In this final step, the planners should determine the most clear and effective means for conveying the project estimate and its underlying assumptions to all interested parties. Procedures should be put into place to ensure that there is a common understanding of anticipated project costs throughout the project development process.

Table 1. Cost Estimation Steps

Step	Inputs	Outputs
(1) Determine the basis of the estimate	• Project information	• Project estimate file
(2) Prepare the base estimate and allowances	• Estimate basis • Estimation technique • Specific inputs	• Base estimate
(3) Analyze risk and contingency	• Base estimate • Project complexity evaluation	• Project risks and contingency • Total construction estimate
(4) Review and approval	• Total construction estimate • Project estimate file	• Updated project estimate file
(5) Communicate estimate to interested parties	• Updated project estimate file	• Estimate summary for distribution

3.6. Contents of the Total Cost Estimate

The total cost estimate is considered to be the total amount necessary to deliver the project. These costs cover a wide range of areas, including engineering, right of way, utilities relocation, environmental mitigation, and all aspects of construction. For projects that seek to obtain state or federal funding, an estimated governmental oversight cost should also be included. Unknown costs and costs that might be incurred as a result of potential risks should be included in the contingency amount. Appendix E presents a template for scoping cost estimates and describes the typical components of a cost estimate.

3.7. Review of Cost Estimates by MPOs

Once an MPO receives a project proposal, it evaluates it to determine if the minimum required information is included and to define the quality of the proposal. A review of the project's cost estimates is a vital part of the assessment process as the project is consideration for inclusion in the MPO's Metropolitan Transportation Plan or its Transportation Improvement Program. The MPO reviews the cost estimates to determine if they are accurate and if they reasonably reflect the scope of work.

The most effective manner for MPOs to perform this review is to replicate the planners' cost- estimation steps. The MPO first reviews the basis of the estimate by determining if the project proposal accurately identifies the components and scope of the work. A well-developed and documented scope of work is a solid basis for an estimate. MPOs should also recognize that in the early stages of developing projects, planners make assumptions in preparing their cost estimates. These assumptions should be adequately documented to make the estimate more reliable and to make future changes traceable.

The second step of MPOs' cost estimate review is to assess the base estimate. In this step, the important factor is to determine if the estimation technique is appropriate considering the available level of project detail that is known. The MPOs should replicate the calculation of the base estimate to identify any potential errors. Finally, the MPO should verify that the proposal reasonably identifies potential risks, and that an adequate contingency amount is allocated to cover such risks. All of the relevant assumptions and calculations should be adequately documented in the project proposal.

There are two relatively quick methods that MPOs can use to determine if an estimate is reasonable. The first method is based on the "80-20" or "Pareto" principle. This rule indicates that most effects (80%) are a result of a relatively small number of causes (20%). In reviewing the cost estimates, MPOs can accordingly prioritize major cost drivers; in other words, focus on the small number of factors that account for the majority of the project costs. These factors can be readily identified by arranging the cost estimate breakdown in order of the most expensive items. Those factors that comprise the majority of the costs should receive the most attention in the cost estimate review.

The second, related technique that MPOs can use to quickly assess cost estimates is to compare major cost drivers to similar items in previous projects, considering these cost drivers as a percentage of the total. For example, if utility relocations account for 15% of the total estimated costs in a proposal, but in previous similar projects utility relocations only accounted for 3% of the total costs on average, then this indicates either a unique project requirement or else a likely problem in the current proposal's cost estimate.

A general summary of steps for MPOs to apply when reviewing cost estimates are as follows:

1. Begin with an overview of the proposed scope before reviewing the details of the estimate.

2. Assess the basis of the cost estimate and its underlying assumptions. Verify that all of these assumptions are well documented.

3. Check to see if the estimated items reasonably reflect the scope of work.

4. Determine if the estimation technique is adequate.

5. Review the calculations to identify errors.

6. Review the components of the cost estimate and ensure that it includes all of the standard elements such as construction, design, right-of-way acquisition, utility relocations, environmental studies, and contingency.

7. Determine whether or not the overall cost estimate is reasonable by considering the scope of work and comparing the estimate to similar projects. If the MPO does not have enough internal staffing resources to adequately evaluate all factors, it may consider hiring professional engineers or cost estimators to help review the cost estimates in detail.

CHAPTER 4. PROJECT TIMELINES

Scheduling is an integral part of any construction project. In the field of construction management, a schedule is defined to include the full spectrum of a project's necessary planning, acquisitions, design, and construction activities. Several aspects of a typical project schedule for transportation projects include project initiation, preliminary engineering, environmental assessment, right of way mapping and acquisition, utility engineering and adjustment, final design, letting (advertising and bidding), contract execution, construction, and project close-out. The individual durations for each project activity and the logistical ties between various tasks are used to determine the estimated dates for when specific tasks will occur.

4.1. Definition and Overview of Project Scheduling

The process of scheduling involves the creation of a timetable of project activities. The goal is to fit the final work plan of the project to a specific time-scale, which lays out the duration and order of each item to be carried out. A well thought-out schedule breaks down a project into its detailed activities, categorizes them into different phases, and determines when to begin work on each activity.

A well-crafted, accurate schedule can aid in the lengthy process of bringing a project from idea to completion. After a transportation project need and relevant funding sources are identified, the project enters into a planning process, which includes preliminary design, environmental study, right-of-way acquisition, and utilities analysis. Then, the project continues into detailed design and ultimately into construction, operations, and maintenance. Even without any delays, the completion of this process can take many years. A well-made schedule not only serves to keep the project on a stable course throughout this duration, but also allows planners to get a better understanding of the duration and the requirements of the project before making funding decisions.

4.2. The Importance of Scheduling

One of the main benefits of devoting time and energy to creating a schedule for a project is the increased resources it will yield in the future. By way of analogy, completing a construction project without a schedule is like taking a trip without getting directions; you may arrive at your destination eventually, but not without a lot of wasted time and money. A reasonably accurate scheduling estimate for a project's major items will be highly beneficial for all project stakeholders.

In addition to potential loss of resources, inadequate scheduling in transportation projects can spill over to affect other planned projects, requiring adjustments in the region's entire transportation planning program. Construction projects in metropolitan areas today typically take place under a large flux of traffic, thereby causing physical and time-based disturbances to travelers. Furthermore, the increasing complexity of today's construction projects creates ever-greater opportunities for cascading delays and inconveniences caused by lapses in scheduling. Most importantly, incorrect timeline estimates may also lead to planners misunderstanding the reasonable time required for implementing a project, or lead them to prioritize projects in a less effective manner. Thus, an accurate project schedule is a critical component to the overall success of a transportation program.

4.3. Meeting the Challenges of Scheduling During the Scoping Phase

In the early phases of project development, a lack of detailed information poses distinct challenges to accurate scheduling. Planners will need to rely on historical data and local expertise, while ensuring that an adequate scheduling contingency is included in the timeline estimates. Local governments also need to remember that if they seek to obtain state or federal funding for a project, then the requirements associated with that funding may increase the time required for project development compared to a similar situation in which only local funds were used.

There are a variety of scheduling techniques that can be applied during the scoping phase of project development; several of these techniques will be covered in depth later in this chapter. Due to the importance of the subject, there are also a variety of software programs and sources of data that have been developed to assist with evaluating project timelines. Whatever method is ultimately decided upon, the importance of creating an adequate timeline and mitigating problems stemming from a lack of clarity in the scoping phase cannot be overstated.

4.4. Scheduling Techniques

The wide variety in scheduling techniques tends to boil down to spreadsheets, Gantt charts, or Critical Path Method (CPM) schedules. While three options for scheduling may not seem like a deep selection pool, there are quite a bewildering array of sub-options available, and many transportation organizations opt to employ more than one format to handle the diversity of project types. As an example, for more modest project types, the Texas Department of Transportation (TxDOT) uses spreadsheets that display significant tasks alongside the logistical ties between them. The designer inputs the quantities and production rates into the spreadsheet, and a bar chart is produced. For larger projects, however, TxDOT makes use of a more rigorously prescribed logic and a production-rate database to create a formal CPM schedule. These various approaches to project scheduling are described more fully below.

4.4.1. Spreadsheets

In addition to the state of Texas, the departments of transportation for South Carolina (SCDOT), Nebraska (NDOT), and Kentucky (KDOT) use spreadsheets to estimate their project development timelines. SCDOT and NDOT rely on spreadsheets for significant work activities. They apply an average production rate, and add up the required working days while taking into consideration special project components. KDOT relies on spreadsheet templates for only six project types, while using other approaches for more complex projects.

4.4.2. Gantt Charts

A Gantt chart bears similarity to a common bar chart, with the only notable difference being the addition of start and finish dates for project activities. The usage of Gantt charts is generally reserved for modest enterprises where activities take place in chronological order. Overlapping activities can be considered, but it is more common for Gantt charts to focus only on major work items. The activity durations of each of these items are calculated based on average production rates. The state transportation departments of Idaho and West Virginia frequently use these specialized bar charts to display a construction project's timeline.

4.4.3. CPM Schedules

The CPM schedule is a more advanced approach that includes logistical ties from task to task and creates a date timeline for multiple individual activities. CPM schedules are generally reserved for more sizable projects, but they can be used for smaller projects as well. The primary advantage of CPM schedules is that they can help planners to understand and account for the detailed interrelationships among activities in today's complex transportation projects. Currently, the states of Pennsylvania and Delaware employ CPM schedules for all projects, and many other State DOTs (including TxDOT) employ this type of scheduling for relatively large projects.

In a CPM schedule the critical path of activities is defined, and then subordinate activities are related to this critical path. The critical path is the longest path of interrelated activities. In other words, it is a chain of interdependent activities that determines the maximum project duration. Any critical path activity that is delayed will inevitably delay the project completion. Activities not on the critical path have a certain amount of "float" or "slack"; they can be at least slightly delayed without affecting the overall project schedule.

The Virginia Department of Transportation (VDOT) has used Microsoft project software to develop 46 templates based on CPM methods. These schedule templates are selected according to the information entered by the manager in charge of project scheduling. For the majority of project types, schedule templates are categorized into separate Gantt charts with critical paths to emphasize the importance of activities. As an example, Table 2 summarizes the durations associated with two of these project types as indicated in their appropriate Gantt charts. These durations are categorized into scoping, preliminary design, detail design, final design, right of way acquisition, and advertising. The California Department of Transportation similarly uses a combination of CPM methods, Gantt charts, and spreadsheets in their timeline development, which is organized through the Primavera software platform. Figure 6 displays a sample Gantt Chart, in which critical activities are highlighted in red using the CPM method.

Table 2. Sample VDOT Durations for Pre-construction Activities Extracted from VDOT Templates

Tier	Type	Scoping	PD*	DD*	FD* & RW*	Advertise
Tier 1	Roadwork w/o RW or Bridge (PE only)	178	197	61	-	-
	Roadwork with RW (PE only)	237	221	181	-	-
	Roadwork with RW & Bridge (PE only)	237	221	181	-	-
	Roadwork with RW & Bridge	237	241	180	296	78
	Roadwork with RW	237	221	180	296	89
Tier 2	Road no bridge (PE only)	282	226	206	-	-
	Road with RW and bridge (PE only)	227	271	206	-	-
	Road with bridge, no RW	282	236	173	171	70
	Road with no RW, no bridge	272	226	174	151	100
	Road no bridge	287	258	174	292	91
	Road with RW, bridge	287	258	173	296	90

* PD = preliminary design; DD = detailed design; FD = final design; RW = right-of-way acquisition

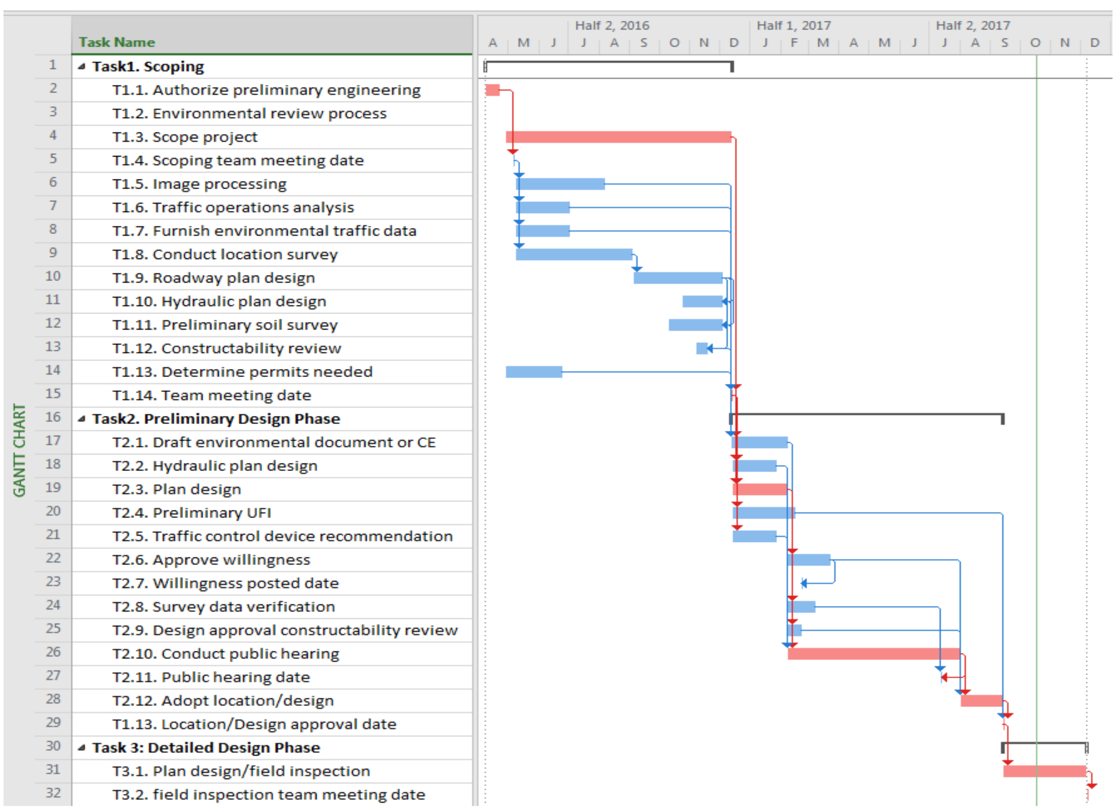

Figure 6. Sample Gantt chart using the CPM method.

4.5. Scheduling Steps: Overview

When creating a schedule there is usually a great deal of flexibility in how the project is analyzed and layered. However, a consistent approach can be useful to streamline the process and assist in comparability among different project proposals. The Virginia Department of Transportation has created a set of eight standard steps that are applicable for creating most project timelines. These steps include (a) defining activities, (b) estimating activity durations, (c) defining activity relationships, (d) calculating the overall project duration, (e) establishing activity time intervals, (f) identifying critical activities, (g) publishing a working schedule, and (h) recording assumptions. This approach may assist local agencies and MPOs in developing and reviewing project timelines during the pre-construction phases of project development.

The following sections will demonstrate how this approach to establish project timelines can be implemented. For the sake of simplicity, this guidebook will focus on creating the timeline for project activities that take place during the scoping stages, including environmental analysis, preliminary design, right-of-way acquisition, utility relocations, and advertising and letting. The analysis of the timeline development will be presented first from the perspective of the transportation agency that is creating the proposal, and then from the perspective of the MPO that is reviewing the proposal.

4.6. Scheduling Steps: Transportation Agency Perspective

In this section the process of creating a project timeline is addressed. The primary intended audience for this section is local government agencies that are preparing project proposals to be submitted to MPOs for state and federal funding consideration. Specific project activities are discussed in detail below, and typical timeline data and scheduling considerations are presented. Most of the timeline data is derived from TxDOT's "Project Tracker" database, which provides historical information for the duration of ongoing transportation project activities. The authors of this guidebook downloaded and amalgamated timeline data for more than 13,000 transportation projects from Project Tracker to provide the basis for this analysis. This information is organized by type of transportation project—farm-to-market roads/highways (FM), state highways (SH), federal highways (US), hike & bike trails, intersection improvements, and county roads. The three highway types are further subdivided into new-road projects vs. resurfacing, restoration, rehabilitation, and reconstruction (4R) projects.

4.6.1. Project Design

The plan-development of a construction project takes place in two phases: preliminary design and detailed design. Preliminary design can be started very early in the project development process. The Project Tracker data for overall design phase duration is presented in Table 3. As can be seen in the table, there is a wide range of design durations depending on the project type. According to VDOT, the preliminary design phase may have a time span of anywhere from 1 to 18 months, depending on the complexity and size of the project. In contrast, detailed design typically lasts only 1 to 12 months. Thus, it is vital to provide adequate time in the project schedule to complete the preliminary design work.

Table 3. Design Phase Durations Based on the Type of Project (According to TxDOT's "Project Tracker")

Design Phase Duration (Calendar Days)					
Project Type		**Mean**	**Median**	**Min**	**Max**
FM	**New**	599	282	64	3503
	4R	259	151	21	3959
SH	**New**	719	510	72	4829
	4R	304	146	36	5529
US	**New**	920	533	55	4001
	4R	289	157	4	4550
Hike and Bike Trail		653	425	96	2105
Intersection Improvement		348	267	1	4937
County Road		521	246	31	3312

4.6.2. Obtaining Environmental Permits

The acquisition of environmental permits is a significant process that can often take years to complete. It is best to start this process as early as possible in the project development process. The project team should consult with relevant government agencies as well as with members of the local community to identify any significant environmental or cultural/historical repercussions of the proposed transportation project. As discussed in Chapter 2 of this guidebook, all projects that receive federal funding must be classified according to their environmental impacts. Depending on the project classification the planners may be obliged to obtain a Categorical Exclusion (CE), create an Environmental Impact Statement (EIS), or create a general Environmental Assessment (EA). More information on these types of environmental project classifications can be found on the National Environmental Policy Act (NEPA) website https://www.epa.gov/nepa/national-environmental-policy-act-review-process). TxDOT has an Environmental Scope Development tool that can also assist in determining which type of environmental document is required for a specific project (http://ftp.dot.state.tx.us/pub/txdot-info/env/toolkit/110-04-frm.pdf).

Predicting the time that is needed to obtain environmental permits can be one of the most complex parts of transportation project scheduling. There is a very wide range of timing possibilities depending on the type of permits required. The Project Tracker data for environmental clearance duration is presented in Table 4. TxDOT's data for projects with FHWA funding (when environmental clearance is the responsibility of local agencies) indicate that Categorical Exclusions usually take 3 to 6 months, Environmental Assessments usually take 3 to 4 years, and Environmental Impact Statements usually take 5 to 7 years. This is consistent with data that has been made available from other states, such as the Virginia Department of Transportation (VDOT) in which the expected time needed to obtain a Categorical Exclusion can range anywhere from 21 to 254 calendar days (1- 9 months). Obtaining an EA or EIS permit requires significantly longer, with the former taking up to 1064 calendar days (3 years) , and the latter taking up to 1979 calendar days (5-1/2 years).

Table 4. Environmental Clearance Phase Durations Guidelines Based on the Type of Project (According to TxDOT's "Project Tracker")

Environmental Clearance Duration (Calendar Days)					
Project Type		**Mean**	**Median**	**Min**	**Max**
FM	**New**	506	274	6	3269
	4R	265	168	28	3656
SH	**New**	585	385	3	4829
	4R	273	150	32	4078
US	**New**	805	437	24	4041
	4R	300	171	4	3734
Hike and Bike Trail		443	259	1	1840
Intersection Improvement		346	213	12	4943
County Road		674	214	57	3312

4.6.3. Right-of-way Acquisition and Utility Relocation

The right-of-way (ROW) for project construction is typically acquired through direct purchase, approval from the land owner, or the use of eminent domain. This task usually takes place when about 30% of the design work has been completed. For projects with FHWA funding, environmental clearance must be completed before the right-of-way acquisition can begin. In addition, all acquisitions and relocations must conform to the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. If these procedures are not followed accurately then FHWA funds cannot be used on any future phase of the project.

At the same time that right-of-way acquisition is carried out, existing utilities in the construction area may need to be relocated. This aspect of transportation projects requires close coordination among state, city, county, and other forms of local government. The Project Tracker data for right-of-way acquisition and utility relocation are presented in Tables 5 and 6 respectively.

Table 5. Right-of-way Acquisition Durations Based on the Type of Project (According to TxDOT's "Project Tracker")

ROW Acquisition Phase Duration (Calendar Days)					
Project Type		**Mean**	**Median**	**Min**	**Max**
FM	**New**	477	305	6	3013
	4R	216	100	1	3066
SH	**New**	449	337	23	1734
	4R	345	85	1	4088
US	**New**	530	359	5	3741
	4R	220	100	2	4315
Hike and Bike Trail		322	254	7	1287
Intersection Improvement		229	122	10	2130
County Road		577	47	20	3066

Table 6. Utility Relocation Phase Durations Based on the Type of Project (According to TxDOT's "Project Tracker")

Utility Relocation Phase Duration (Calendar Days)					
Project Type		**Mean**	**Median**	**Min**	**Max**
FM	**New**	426	233	5	3013
	4R	157	70	1	3066
SH	**New**	511	315	59	4647
	4R	216	87	1	4088
US	**New**	538	369	11	3055
	4R	183	100	5	4315
Hike and Bike Trail		284	186	7	1287
Intersection Improvement		280	122	10	2548
County Road		553	62	21	3066

In 2003, the Center for Transportation Research at the University of Texas amalgamated historical project data to create a software tool called the "Right-of-Way Acquisition and Utility Adjustment Process Duration Information" system, or RUDI. This is an Excel-based program that can take into account specific user inputs regarding current project factors, and offer guidance on the expected duration of the ROW and utility components. Practical applications of RUDI have demonstrated the tool's overall effectiveness and accuracy.

Figure 7 presents a schematic description of how RUDI works. Utility adjustment is shown on the right-hand side of the figure, and ROW acquisition is shown on the left-hand side. The elements labelled R1, R2, and R3, and U1, U2, and U3, correspond to time intervals in the process. For example, R1 shows the duration from the ROW project release to the initial appraisal. R2 shows the duration from the initial appraisal to the possession of the land parcels. R3 represents the sum of R1+R2. The user can apply RUDI to obtain information about each of the durations.

As an example of how output is generated in RUDI, Figure 8 presents the data associated with R1 and R2 for a typical urban roadway project. R1 was expected to take a maximum of 311 calendar days to complete for 50% of the cases (median), while R2 was expected to take a maximum of 301 calendar days to complete for 50% of the cases. Thus, the median value for the total time between ROW project release and land acquisition is less than two weeks. Similarly, Figure 9 shows a comparison of the U3 value for federally funded projects vs. the U3 value for non-federally funded projects. As the figure indicates, 80% of the utility relocations for both types of projects are completed in less than 2000 days (about 5½ years).

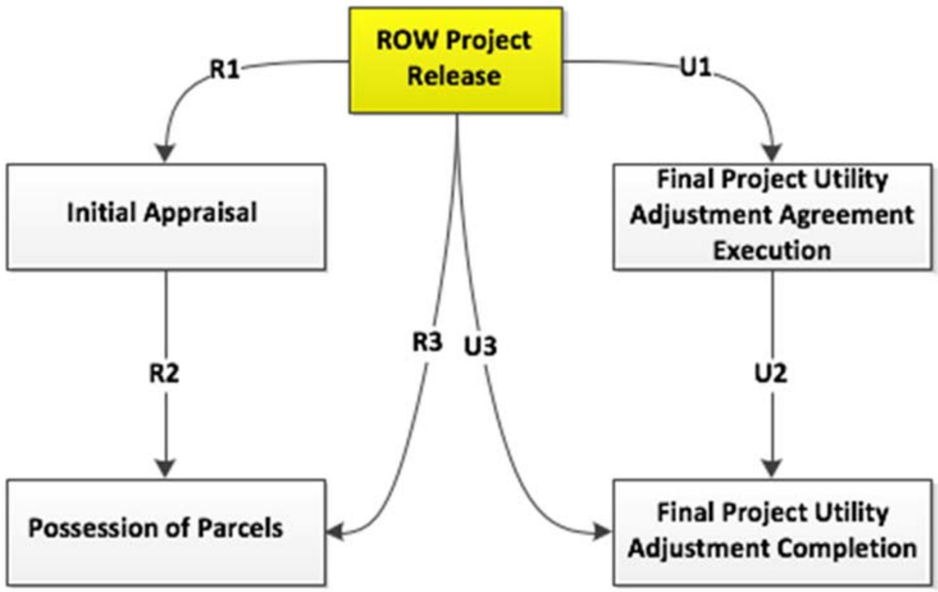

Figure 7. The time frames that can be obtained by using the RUDI tool (source: RUDI TxDOT Library).

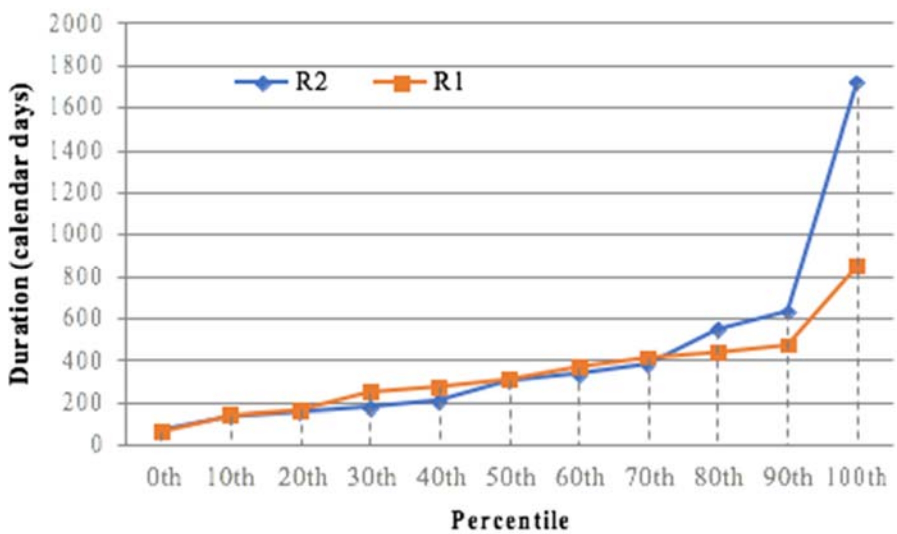

Figure 8. RUDI output for R1 and R2, for a typical metropolitan parcel (source: RUDI TxDOT Library).

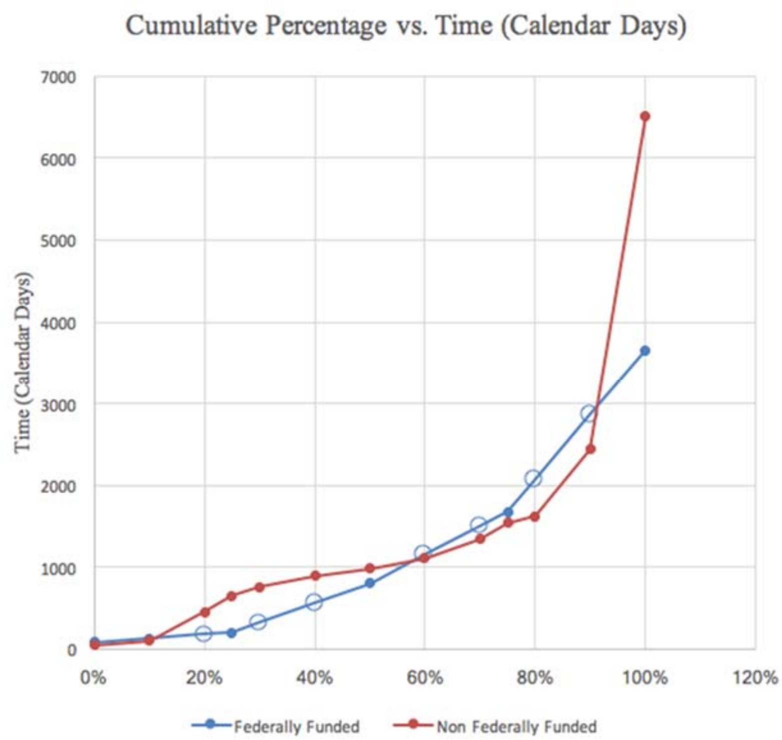

Figure 9. RUDI output from right-of-way project release to final project utility adjustment (U3) (source: RUDI TxDOT Library). The points shown by hollow circles on the Federally Funded graph are interpolated due to a lack of data in the RUDI library.

4.6.4. Advertising and Letting

For projects with TxDOT or FHWA funds, once TxDOT approves the local agency's plans, specifications, and bid documents, TxDOT will authorize the local agency to advertise for construction bids. Federal funding requires a project to be advertised for a minimum of 21 calendar days. Upon receipt of bids, the local agency must award the contract to the responsible contractor with the lowest responsive bid. The local agency must analyze the bids, make a recommendation, and then request and receive concurrence with their recommendation from the state DOT. Usually the length of time from the start of advertising to awarding the contract is about 2 to 3 months. After awarding the contract, it typically takes another 1 to 3 months for the contractor to submit the required documents and for the local agency and the contractor to execute the contract. Total duration for all of these activities is about 3 to 6 months. The Project Tracker data for advertising and letting is presented in Table 7.

Table 7. Bidding and Letting Phase Durations Based on the Type of Project (According to TxDOT's "Project Tracker")

Bidding and Letting Phase Duration (Calendar Days)					
Project Type		**Mean**	**Median**	**Min**	**Max**
FM	**New**	172	134	35	916
	4R	138	136	35	472
SH	**New**	179	161	59	365
	4R	142	133	26	1100
US	**New**	192	137	24	1241
	4R	139	125	47	836
Hike and Bike Trail		149	143	84	244
Intersection Improvement		119	105	26	637
County Road		139	127	70	256

4.6.5. Analyzing Scheduling Dependencies

When preparing the project timeline it is vital to consider scheduling dependencies; that is, which activities must be completed before others can begin. Figure 10 demonstrates how one transportation agency (VDOT) conceptualizes the relationship between the scheduling considerations described above—starting with environmental permits and continuing through advertising and letting. In this schematic, the agency assumes that all environmental permits must be obtained before the start of detailed design, and that preliminary design (30% of the detailed design) must be completed before the start of ROW acquisition and utilities relocation. Other planning agencies may have different approaches or be less rigorous in defining their scheduling dependencies, but careful consideration should always be given to ensure that the critical path of the project is clearly defined. It is also vital to include adequate timing contingencies when developing the project schedule, particularly during the early scoping stages of project development.

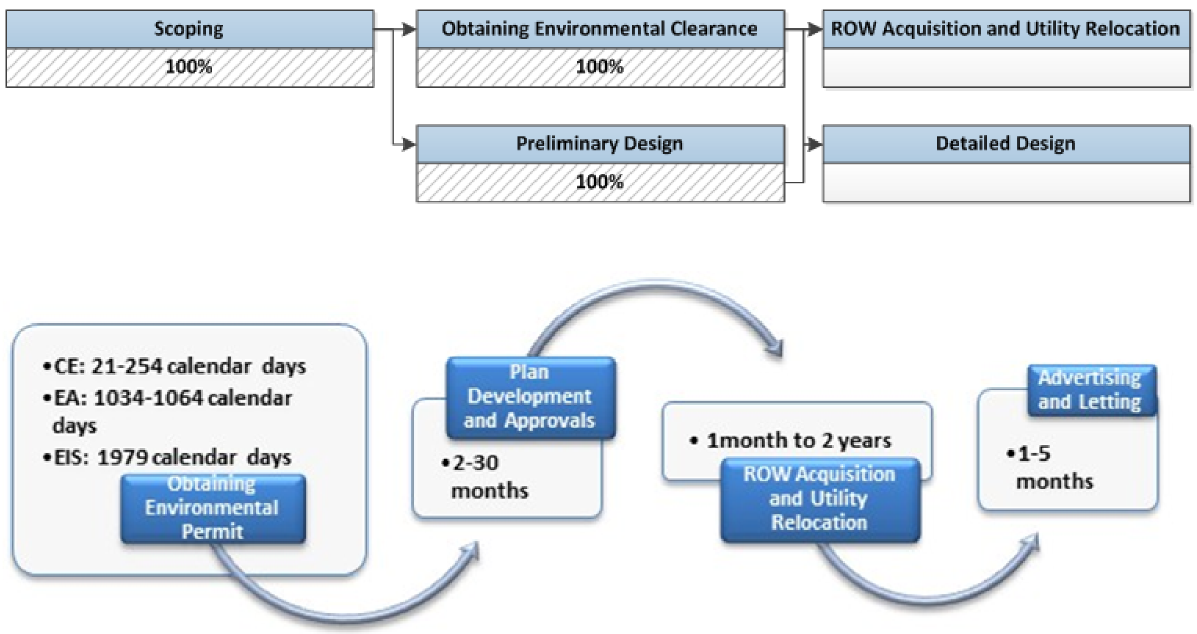

Figure 10. Diagram of timelines associated with pre-construction phases (VDOT).

4.7. Scheduling Steps: MPO Review

The perspectives of different MPOs may vary somewhat in regard to how they evaluate scheduling in project proposals. Two general approaches are common, based on (a) the location and environmental characteristics of the project, or (b) the sources of funding that are being considered. The following sections address each of these outlooks in turn.

4.7.1. Scheduling Expectations Based on Location and Environmental Characteristics

Projects submitted to MPOs may be categorized for scheduling review based on where the project is geographically located, and/or how the project relates the MPO's environmental objectives. Some examples include:

- *Being on-system or off-system*. This is to separate projects that are on the State Highway System from those that are not.

- *Being an STP-MM project versus a CMAQ project*. Under this classification schema, projects are divided into those that fall under Surface Transportation Program – Metropolitan Mobility (STP-MM) programs vs. those that are considered Congestion Mitigation and Air Quality (CMAQ) projects. Examples of STP-MM projects include interchanges, roadway widening, bottleneck removal, and the installation of Intelligent Transportation System infrastructure. Examples of CMAQ projects include park-and-ride lots, high-occupancy vehicle lanes, pedestrian and bicycle facilities, and rideshare programs.

- *Requiring right-of-way*. Another classification system sometimes used by MPOs is to distinguish projects requiring ROW acquisition from those that do not.

Figure 11, which is based on data from the Dallas/Fort Worth MPO (officially titled the North Central Texas Council of Governments), indicates that the major parameters driving project timelines is the Environmental Assessment and ROW acquisition. There was very little difference in expected scheduling times for on-system vs. off-system projects. However, those categorized as STP-MM required significantly longer time periods for environmental review compared to CMAQ projects. Similarly, those that required ROW acquisition required much longer durations.

Schedule Breakdown			Phase Durations (Months)						
			Develop Agreement†	Environmental Assessment	Design PS&E*	ROW Acquisition	Utility Adjustment	Contracting Letting	Total (Years)
On-System Projects	STP-MM Projects	ROW Required	6**	24	3-12	30	6-9	4-6	6-7.5+
		ROW Not Required	6**	24	3-12	NA	6-9	4-6	3.5-4+
	CMAQ Projects	ROW Required	6**	1-12	3-12	30	1-9	4-6	3-6+
		ROW Not Required	6**	1-12	3-12	NA	1-9	4-6	1-3+
Off-System Projects	STP-MM Projects	ROW Required	6**	24	3-12	30	4-6	4-6	6-7
		ROW Not Required	6**	24	3-12	NA	6-9	4-6	3.5-4+
	CMAQ Projects	ROW Required	6**	1-12	3-12	30	1-9	4-6	3.5-6+
		ROW Not Required	6**	1-12	3-12	NA	1-9	4-6	1-3+

*PS&E: Plans, Specifications, and Engineering
**Assuming prompt turn around by all parties
†Including federal project authorization and agreement
Adopted from NCTCOG

Figure 11. Scheduling guidelines based on project location and environmental characteristics (D/FW MPO).

4.7.2. Scheduling Expectations Based on Source of Funding

Other MPOs may categorize project proposals based on the source of funding. The primary division here is between roadway projects vs. mass transit. In this guidebook the emphasis is on projects supported by FHWA funds, so mass-transit projects are not discussed in detail. Figure 12 indicates a typical approval processes for roadway projects that fall under the FHWA banner. As shown in the figure, roadway projects can take anywhere from 8 to more than 17 years from the start of planning to operation, depending on their complexity and other influencing factors. The major portion of this duration is comprised of environmental studies and preliminary design. One final issue that should be noted in this figure is that significant litigation or public opposition to a project can as much as double the time to completion. Project planners would be wise to consider this potentiality, both by including a robust scheduling contingency in the project timeline and by carefully vetting public opinion during the early stages of project development.

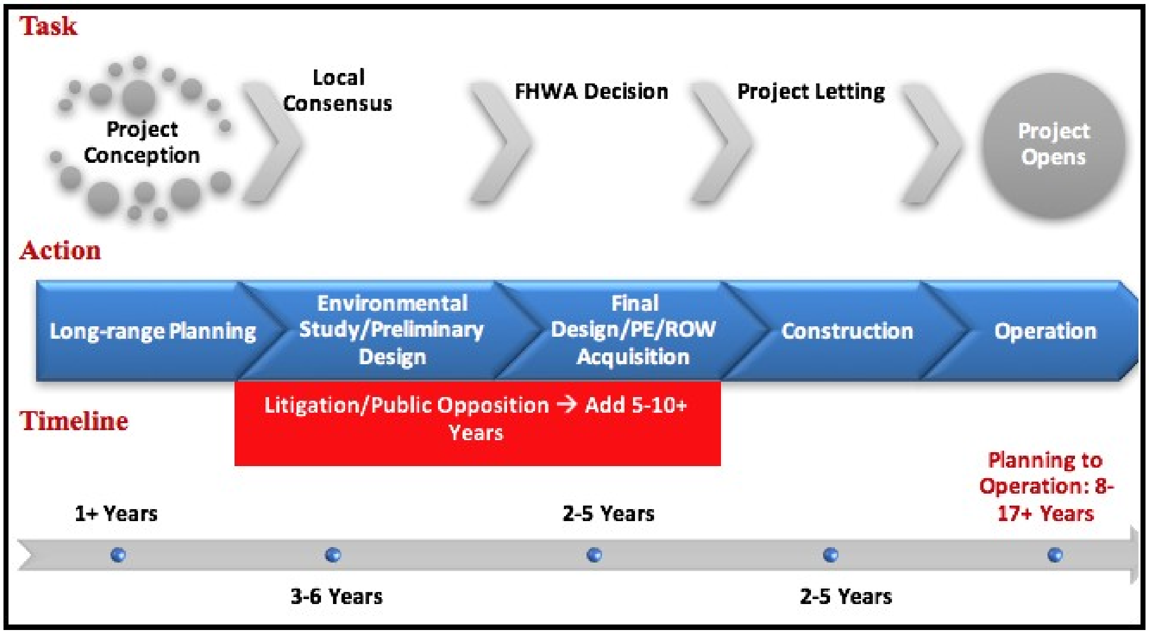

Figure 12. A typical roadway project development process (D/FW MPO).

APPENDIX A: EXAMPLE STAGE A SCOPING DOCUMENT

Date:____________________

Report Prepared By:____

Project Name / Location:____

Project ID:____

Limits (from / to) & Length:____

Project Sponsor:____

Estimated Total Cost:____

Proposed Letting Date:____

Proposed Major Milestones for the Project:_____________________________________

____

____

Desired Funding Sources (federal, state, or local)**:**________________________________

____

____

<u>NEED AND PURPOSE</u>

Project Need (existing conditions / problems to be addressed)**:**______________________

____

____

Project Purpose (goals / outcome to be achieved)**:**__________________________________

____

____

Preliminary Scope of Proposed Improvements:___________________________________

____

____

____

____

Project Name:________________________ Date:______________
Local Government Agency:______________ Prepared By:_________

Existing and Projected Conditions:

Major Land Use:____________________

Accident History:____________________

Current LOS (for year ____):____________________

Current Traffic (ADT or AADT):____________________

Projected LOS (for year ____):____________________

Projected Traffic (ADT or AADT):____________________

Other Projects in the Area (recent or under consideration)**:**____________________

____

Functional Classification:____________________

Major Structural Upgrades Needed:____________________

____

New Major Structures:____________________

____

UTILITY COORDINATION

Potential Utilities Affected (if any)**:**____________________

____

____

____

RIGHT-OF-WAY (ROW)

Existing Width:____________________

Required ROW Anticipated: ☐ None ☐ Yes ☐ Undetermined

Easements Anticipated: ☐ None ☐ Temporary ☐ Permanent ☐ Utility ☐ Other

ENVIRONMENTAL IMPACTS & PERMITS

Anticipated Environmental Document (CE, EIS, EA)**:**____________________

Project Name:________________________ Date:_______________
Local Government Agency:______________ Prepared By:_________

MS4 Compliance (is the project located in the area of a designated Municipal Separate Stormwater Sewer System?)**:**____

Anticipated Environmental Permits, Variances, Commitments, or Coordination Required:

____

____

____

Additional Environmental Comments and Information:_______________________________

____

____

Major Environmental Stakeholders (agencies)**:**_______________________________

____

CONSTRUCTION

Preliminary Construction Schedule:_______________________________________

____

Issues Potentially Affecting Constructability or Construction Scheduling:_______________

____

____

Alternative Financing/Incentives (if any)**:**_______________________________________

____

____

Project Name:__________________________ Date:________________
Local Government Agency:_______________ Prepared By:__________

ATTACHMENTS

YES	NO	
		Aerial Photo with Proposed Project Indicated
		GIS or PDF Map with Proposed Project Indicated
		Preliminary Layout/Sections
		Affected Bridges / Structural Inventory Reports
		Preliminary Total Cost Estimate
		Preliminary Project Development Timeline
		Other:
		Other:

APPENDIX B: EXAMPLE STAGE B SCOPING DOCUMENT

Date:____________________

Report Prepared By:____

Project Name / Location:____

Project ID:____

Limits (from / to) & Length:____

Project Sponsor:____

Estimated Cost Breakdown

Est. Engineering Cost:___________________

Est. Utility Cost:________________________

Est. Right-of-Way Cost:__________________

Est. Environmental Cost:_________________

Est. Construction Cost:__________________

DOT Oversight Cost:_____________

Est. Total Cost:_______________________

Proposed Funding Breakdown

% Federal:______________________

% State:________________________

% Local:________________________

Proposed Letting Date:____

Proposed Construction Completion Date:___________________________________

Proposed Major Milestones for the Project:_______________________________

____

____

<u>NEED AND PURPOSE</u>

Project Need (existing conditions / problems to be addressed)**:_______________________**

____

____

____

Project Name:________________________ Date:______________
Local Government Agency:______________ Prepared By:_________

Project Purpose (goals / outcome to be achieved)**:**____

____

____

____

Scope of Proposed Improvements:____

____

____

____

____

Description of Alternative Solutions that Were Evaluated (indicate preferred solution)**:**

____

____

____

____

____

Existing and Projected Conditions:

Major Land Use:____

Accident History:____

Current LOS (for year ____):___________________________________

Current Traffic (ADT or AADT):_________________________________

Projected LOS (for year ____):_________________________________

Projected Traffic (ADT or AADT):_______________________________

Other Projects in the Area (recent or under consideration)**:**__________________________

____

Functional Classification:____

Major Structural Upgrades Needed:__________________________________

____

New Major Structures:____

____

Project Name:________________________ Date:______________
Local Government Agency:______________ Prepared By:_________

Relevant Studies/Evaluations Performed (if any)**:**______________________________

____

____

UTILITY COORDINATION

Utility Type	Utility Company Name	Crossing or Parallel?	Relocate? (Yes / No)	Party Responsible for Relocation	Has the Utility Been Contacted?

RIGHT-OF-WAY (ROW)

Existing Width:____

Required ROW Anticipated: ☐ None ☐ Yes ☐ Undetermined

Easements Anticipated: ☐ None ☐ Temporary ☐ Permanent ☐ Utility ☐ Other

Estimated Number of ROW Parcels to Acquire:______________________________

Estimated Number of Residential Relocations:______________________________

Estimated Number of Business Relocations:________________________________

Estimated Date for Completion of Property Acquisition:_____________________

ROW Acquisition to Be Performed By (agency or consultant name)**:**_______________

____

Relocations to Be Performed By (agency or consultant name)**:**___________________

____

ROW Acquisition Comments:____

____

____

ENVIRONMENTAL IMPACTS & PERMITS

Anticipated Environmental Document (CE, EIS, EA)**:**_________________________________

Status of Environmental Document Preparation:_____________________________________

____

MS4 Compliance (is the project located in the area of a designated Municipal Separate Stormwater Sewer System?)**:**____

Permits Needed from Army Corps of Engineers, Coast Guard, Railroad Commission, or Other Agencies (list agency name, permit type required, and expected time to obtain)**:**

____

____

____

____

Additional Environmental Comments and Information:______________________________

____

____

Public Environmental Stakeholders and Their Level of Interest:______________________

____

____

PRELIMINARY DESIGN/SCHEMATICS

Current Status of Design: ☐ Less than 10% ☐ Between 10 % and 30 % ☐ More than 30%

Estimated Completion Date for 30% of Design (if not current)**:**________________________

PUBLIC INVOLVEMENT

Description of Public-involvement Activities Related to the Project (previous and upcoming)**:**

____

____

____

Project Name:_________________________ Date:_______________
Local Government Agency:______________ Prepared By:_________

CONSTRUCTION

Preliminary Construction Schedule (letting, start of construction, and completion)**:**

____

____

Potential Issues Affecting Constructability or Construction Scheduling:_________________

____

____

Alternative Financing/Incentives:____

____

Anticipated Special Provisions for Construction Contract:___________________________

____

____

PROJECT QUESTIONS (BENEFITS & CHALLENGES)

YES	NO	
		Does the project improve a metropolitan area, a National Highway System principal arterial, or a designated evacuation route?
		Does the project include pedestrian and/or bicycle accommodations?
		Does the project include a significant Intelligent Transportation Systems (ITS) component to increase facility efficiency?
		Is the project recommended by a regional or local planning study?
		Does the project improve a designated Heavy Cargo Route?
		Does the project reduce current travel times or trip length?
		Does the project avoid negative impacts on air quality?
		Does the project increase the value of transportation assets?
		Does the project have regional significance?
		Does the project meet designated planning goals?

Project Name:_________________________ Date:________________
Local Government Agency:_______________ Prepared By:__________

For All Items Marked Affirmative in the Above List, Please Add a Full Explanation:

____
____
____
____
____
____
____
____
____
____
____

ATTACHMENTS

YES	NO	
		Aerial Photo with Proposed Project Indicated
		GIS or PDF Map with Proposed Project Indicated
		Preliminary Designs/Schematics
		Alternative Solutions Evaluation Matrix
		Utility Relocation Map
		Right-of-way Conflict Maps
		Affected Bridges / Structural Inventory Reports
		Public Involvement Plan and Documentation
		Preliminary Total Cost Estimate
		Preliminary Project Development Timeline
		Other:
		Other:
		Other:

Project Name:_________________________ Date:_______________
Local Government Agency:______________ Prepared By:_________

APPENDIX C: STAGE A SCOPING REVIEW CHECKLIST

The following checklist is provided as minimum suggested criteria for MPOs to review project reports at Stage A. When reviewing projects for inclusion in the MTP, it is at the discretion of the MPO to modify the checklist to meet local needs.

Project Review Questionnaire – Stage A / MTP	YES	NO
General		
Does the project application provide maps describing the site location and visually indicating the area of improvement?		
Does the project application include a scoping cost estimate?		
Does the project application provide an estimate of project timelines, including a work schedule for all phases of the project development process?		
Does the project application define proposed sources and amounts of funding?		
Work Breakdown Structure		
Is there a consistent breakdown of individual project development steps, who will perform each, and proposed allocation of funding for each?		
Need and Purpose		
Do the need and purpose statements adequately describe a transportation problem and the goals to be accomplished with the project?		
Is the scope of work reasonably commensurate with the project complexity and size?		
Does the project application describe the existing conditions of the area of interest, and successfully provide a projection of the design year?		
Are the major structures that would need to be upgraded or constructed in order to implement the project adequately described?		
Utility Coordination		
Does the project application indicate potentially affected utilities and railroads?		
Right-of-way		
Does the project application include an overview of right-of-way requirements?		
Environmental Impacts & Permits		
Does the project application provide information related to permitting requirements and anticipated environmental clearances (CE, EIS, EA)?		
Does the project application provide documentation of any major environmental impact that will need to be addressed in later project development stages?		
Construction		
Does the project application propose and justify any alternative financing methods or use of incentives?		
Does the project identify any potential issues that might significantly affect the construction process or work schedules? Is the risk of these potential issues adequately reflected in the cost estimate and project timeline?		

Project Name:_________________________ Date:_______________
Local Government Agency:______________ Prepared By:_________

APPENDIX D: STAGE B SCOPING REVIEW CHECKLIST

The following items should be regarded as a continuation of the Stage A checklist (Appendix C). MPOs should use both checklists together when reviewing projects for inclusion in the TIP. It is at the discretion of the MPO to modify the checklist as needed to meet local needs.

Project Review Questionnaire – Stage B / TIP	YES	NO
General		
Does the project application meet all requirements indicated in the Stage A checklist?		
Does the project application provide a detailed cost estimate that supports the scope of work and is reasonable for the project type?		
Does the project application include an breakdown of requested funding sources?		
Does the project application specifically identify costs associated with utility impacts, right-of-way acquisition, environmental permits, engineering, and construction?		
Does the project application include a detailed estimate of the proposed project timeline?		
Are several alternatives solutions for the transportation problem evaluated and a preferred alternative identified?		
Work Breakdown Structure		
Is there a consistent breakdown of project development steps, an indication of who will perform each step, and a proposed allocation of funding for each step?		
Utility Coordination		
Does the project application include a description of utility relocations, the entities responsible for carrying them out, and the related financial responsibilities?		
Right-of-way		
Does the project describe the proposed right-of-way acquisition process in detail? Does it discuss railroad coordination and its impact (if applicable)?		
Environmental Impacts & Permits		
Does the project application consider alternative solutions that avoid or minimize harm to the environment or to cultural/historical resources? Is the proposed schedule for obtaining NEPA clearance and permits reasonable?		
Preliminary Design/Schematics		
Has the preliminary design been adequately developed to accurately define the project (typically 20%-35% complete)?		
Public Involvement		
Does the project application describe procedures to properly engage stakeholders?		
Project Benefits and Attachments		
Does the project application describe specific project benefits (such as evacuation route improvements, pedestrian/bicycle accommodations, relevance to long-term planning, etc.)? Does it include the appropriate attachments to support the project description?		

APPENDIX E: SCOPING COST ESTIMATION TEMPLATE

This cost estimation template is tailored to MPOs' needs and reporting requirements. The cost estimation techniques presented here are based on cost-per-parameter methods. Project sponsors can modify this template according to the specific characteristics of their projects. At the time when project proposals are reviewed, all cost estimates have to be adjusted for the year of expenditure. The MPO's internal policies will determine whether this year-of-expenditure adjustment is applied by the project sponsors or by the MPO.

Date:___________________

Report Prepared By:____

I. COST ESTIMATE SUMMARY

Project Name / Location:____

Project ID:____

Limits (from / to) & length:____

Project Sponsor:____

ID	Cost Category	Estimated Cost
1	Earthwork	
2	Structures	
3	Subbase and Base Course	
4	Surfacing	
5	Miscellaneous Items	
6	Mobilization	
7	Engineering	
8	Environmental Studies	
9	Right-of-way	
10	Utility	
11	Contingency	
12	**Total Project Cost**	

Project Name:_________________________ Date:________________

Local Government Agency:_______________ Prepared By:__________

II. COST CATEGORY BREAKDOWN

1. Earthwork

________________________ **X** ______________________ = **$**______________________

(average length in miles) **(cost-per-mile of earthwork)**

To obtain the average cost-per-mile of earthwork, the volume of earthwork in one mile is calculated based on the proposed cross section. This category covers excavation and embankments for roadways, drainage structures, bridges, and retaining walls.

2. Structures

Structure Type:____

________________________ **X** ______________________ = **$**______________________

(area in ft^2) **(cost per ft^2)**

The category of "structures" covers the cost of bridges, culverts, and other non-roadway structures. In the scoping stage, the cost of these structures can be calculated based on average cost per square foot; alternatively it can be given based on the itemized cost of each structure. Average unit costs for bridges of several different types can be obtained from TxDOT at: ftp://ftp.dot.state.tx.us/pub/txdot-info/library/pubs/bus/bridge/unit-costs-12.pdf

3. Subbase and Base-course

________________________ **X** ______________________ = **$**______________________

(average length in miles) **(cost-per-mile of earthwork)**

The thickness of the subbase and base-course are defined according to the preliminary pavement section. In cases where project design reports are not yet available, planners may use the numbers from similar projects. Planners may consider consulting the TxDOT Pavement Manual at: http://onlinemanuals.txdot.gov/txdotmanuals/pdm/pdm.pdf. Table 5-2 of the TxDOT Pavement Manual provides an initial estimate for subbase and base thickness. Once the thicknesses for subbase and base are defined, the volumes of work for one mile can be calculated from the typical cross section. This volume of work can then be used to determine cost-per-mile.

Project Name:________________________ Date:_______________
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4. Surfacing

_______________________ X ____________________ = $___________________

(average length in miles) (cost per mile of surfacing)

Estimating the cost of pavement is similar to estimating the subbase and base. However, this calculation is presented in a separate category because the escalation rate of prices in these two categories follow different patterns. This presentation helps make cost adjustments easier, particularly in cases of a dramatic change in oil prices, which will greatly affect surfacing costs. The first step in calculating pavement costs is to define the type and thickness of pavement layers. This information may be found in the typical cross section. Planners may consider using the TxDOT Pavement Manual at: http://onlinemanuals.txdot.gov/txdotmanuals/pdm/pdm.pdf

5. Miscellaneous Items

Item 1 Description:____
Item 1 Estimated Cost: $_______________________________________

Item 2 Description:____
Item 2 Estimated Cost: $_______________________________________

OR:
List of Items Covered:____
____

_______________________ X ______________%____ = $___________________

(total cost of items 1 through 4) (misc. items percentage)

The category of miscellaneous items includes any construction costs not covered in the previous categories (1 through 4). Pavement markings, signals, striping, and erosion control are some of the items that may be listed here. Each item is described and its estimated cost is reported.

Alternatively, in the early stages of developing a project, the total for miscellaneous items can be calculated as an additional percentage on top of the total construction costs (items 1 through 4). However, the items that are assumed to be covered under this percentage cost must be listed. The percentage should be in the range of 10% to 30% depending on the project's complexity and its current stage of development. Using higher percentages for this category may be appropriate with proper justification.

6. Mobilization

_________________________ X _______________%_____ = $____________________

(total cost of items 1 through 5) (mobilization rate)

Mobilization is added to construction cost to cover the contractor's preconstruction work, such as initial preparation, temporary works, establishing offices, and moving personnel, supplies, or equipment. During the scoping stages mobilization is best calculated as a percentage of the estimated construction cost.

The percentage rate for mobilization is calculated based on the amount of work that is covered under this category. In the early stages of project development, planners may use 10% as an initial estimate, and then adjust this percentage as more information is obtained.

7. Engineering

_________________________ X _______________%_____ = $____________________

(total cost of items 1 through 6) (engineering rate)

This category covers the cost of engineering activities that may occur during scoping, detailed design, or construction. Since some project sponsors outsource environmental studies, the cost associated with these studies is categorized in a separate section below. Engineering costs can range from 5% to 20% depending on the complexity of the project.

8. Environmental Studies

_________________________ X _______________%_____ = $____________________

(total cost of items 1 through 6) (environmental studies rate)

The category of "environmental studies" includes the cost of all activities related to environmental and cultural/historical analysis, compliance reviews, and obtaining necessary permits.

Project Name:________________________ Date:_______________
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9. Right-of-way

__________________________ X ______________________ = $_____________________

(total area in acres) (cost per acre)

Residential Relocations (if applicable)

____________________ X ______________________ = $_______________

(number of relocations) (cost per relocation)

Business Relocations (if applicable)

____________________ X ______________________ = $_______________

(number of relocations) (cost per relocation)

This category covers the costs necessary to acquire the right-of-way, including land costs and acquisition services.

10. Utility Relocations

__________________________ X ______________________ = $_____________________

(length of project in miles) (cost per mile)

The costs incurred for utility adjustments are calculated here. An estimate can be made based on the average cost to relocate utilities for one mile of construction.

11. Contingency

$________________________________

The project's contingency reserve is estimated based on identified risk items.

12. Estimated Total Project Cost

$________________________________

The estimated total project cost is the sum of items 1 through 11.