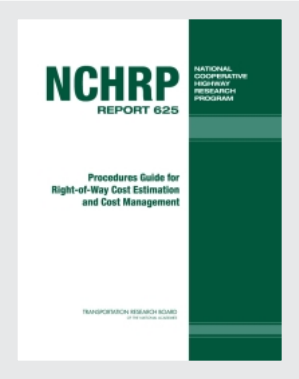

Procedures Guide for Right-of-Way Cost Estimation and Cost Management

DETAILS

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 625

Procedures Guide for Right-of-Way Cost Estimation and Cost Management

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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The needs for highway research are many, and the National Cooperative Highway Research Program can make significant contributions to the solution of highway transportation problems of mutual concern to many responsible groups. The program, however, is intended to complement rather than to substitute for or duplicate other highway research programs.

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FOREWORD

By Lori L. Sundstrom
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This procedures guide presents practical and effective approaches for developing right-of-way (ROW) cost estimates and for then tracking and managing ROW cost during all phases of project development, including planning, programming, and preliminary and final design. It is a resource for managers, practitioners, and decisionmakers interested in developing and managing realistic and accurate estimates of ROW cost from the earliest ROW cost estimate made during planning through to the management of ROW acquisition cost during final design.

Construction project cost escalation, from planning through construction, is a fundamental problem facing state highway agencies (SHAs). As projects progress through the planning, programming, and design stages of development, the accuracy and precision of project cost estimates vary widely, for various reasons. *NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction* presents multiple strategies for controlling cost escalation across the spectrum of planning, programming, and design activities. Building on *NCHRP Report 574,* this project provides an in-depth analysis and a guidebook designed to give SHAs specific guidance on how they can improve the consistency and accuracy of ROW estimates.

External factors that influence ROW include real estate market conditions and the effect of inflation. Rapid increases in the value of properties in areas where commercial and residential growth is occurring has sparked large increases in the cost of acquiring property for highway expansion. Growth areas in smaller communities also experience similar increases in the cost of acquiring property. Court settlements can influence the value of subsequent property acquisitions. Internal factors, such as poor estimating, inconsistent application of contingencies, and the lack of risk assessment procedures related to error and omissions in cost estimates, have all played a role in project cost increases related to ROW, especially in the case of early estimates developed during planning and programming.

The objectives of this research were to (1) further refine ROW-specific cost estimation techniques, management methods, and tools and (2) provide specific guidance to SHAs on how to implement such techniques, methods, and tools. The research team led by the Texas Transportation Institute explored (1) the challenges faced by SHAs, transit agencies, and other transportation organizations in developing realistic cost estimates for ROW and (2) the difficulty of tracking and managing those estimates to produce accurate and reliable information at all stages of project development.

This procedures guide is designed to provide users with processes and practical tools to help manage the cost of ROW and reduce unintended or unanticipated project cost escalation.

CONTENTS

SUMMARY

Procedures Guide for Right-of-Way Cost Estimation and Cost Management

Background

Historically, many transportation projects have been underestimated (U.S. General Accounting Office, 1997; Flyvbjerg et al., 2002). Approximately 50 percent of the recent large transportation projects in the United States have overrun their initial budgets. This cost escalation problem is complex and difficult to address because the time between the initiation of a project and the completion of construction often spans many years. State Highway Agencies (SHAs) have recognized that project cost escalation is a pervasive problem and have sought solutions through research efforts supported by AASHTO and NCHRP. NCHRP Project 8-49 focused on project cost escalation and produced a Guidebook that describes a strategic approach to highway cost estimating and cost estimate management (*NCHRP Report 574*—Anderson et al., 2007a). *NCHRP Report 574* provides SHAs with guidance for structuring their estimating and cost management processes to achieve estimate consistency and accuracy. *NCHRP Report 574* also addresses estimating issues during the planning, programming, preliminary design, and final design phases of project development. The report does not address estimating for change orders or cost management during construction. *NCHRP Report 574* provides appropriate strategies, methods, and tools to develop, track, and document realistic cost estimates during project development.

NCHRP Project 8-49 and other estimating studies identified right-of-way (ROW) cost estimating and management of ROW cost as critical to achieving consistency and accuracy in project cost projections. Although NCHRP Project 8-49 addressed ROW cost estimating to a limited extent, the project's scope did not allow for an in-depth treatment of this specialized area. This report provides a more in-depth analysis of the problems and practices of ROW cost estimating and cost management.

Problem

The NCHRP Project 8-49 findings, based on a critical review of estimating literature, recent estimating research, and current estimating practice, suggest that a component of project cost escalation is related to ROW cost. Specific findings related to ROW from the NCHRP Project 8-49 research are as follows:

- Actual expenditures for project ROW are frequently greater than the cost estimate produced during the initial phase of project development due to factors such as poor estimating methods (difficulty with damages and condemnations), inconsistent application of contingency, and difficulty in accounting for future appreciation and other market conditions.

- Management of these influencing factors and the ROW estimating process can contribute significantly to cost estimate consistency and accuracy throughout project development.
- There is an opportunity to develop ROW-specific cost estimating process steps based on successful SHA practices from around the country.
- There is a need to provide specific guidance on how to minimize controllable influencing factors and implement strategies, methods, and tools such that ROW estimates are improved.

These findings established the initial basis and need for this research project. As part of this project, some SHAs were interviewed about their ROW estimating practices. From those interviews it was clear that

1. Cost escalation is a common occurrence related to ROW (confirming the first statement from the previous list).
2. The ROW cost estimation and cost estimate management processes generally lack structure and definition as compared with the other areas of cost estimation.
3. There is a lack of integration and communication between those responsible for ROW cost estimating and those responsible for the overall project cost estimate.

These three issues are further compounded by uncertainties specific to ROW estimating, which include

- Future highest and best use of the property;
- Damages due to partial takings of properties;
- Subsequent development of the property during the time between the cost estimate and actual acquisition;
- The number of parcels that proceed to Eminent Domain and the associated costs of such takings; and
- Inadequate project scope definition and information on parcels during the planning and programming phases of project development.

Complicating the uncertainties listed above is the human factor related to acquiring property for highway projects. The "human factor" can be defined as the uncertainty and unpredictability related to dealing with property owners when a public agency is attempting to acquire a property. The reaction of individuals affected by the proposed project is difficult to predict. Moreover the effects of all these factors are intensified because of appreciating land values. Therefore, this research developed a structured process approach for ROW estimating that addresses these important issues.

A critical component to achieving accurate cost projections for transportation projects is an agency's approach to ROW cost estimating and the management of ROW estimates. The ability of an SHA to develop accurate ROW cost estimates and to effectively manage ROW cost depends on integrating a structured estimating and estimate management process into the project development process from concept through construction. Following a process approach to estimating and cost management ensures that the financial effects of both design and ROW decisions are always visible to the project development team. Yet, in many agencies, "stove pipe" divisional structures lead to failures to communicate important information affecting project scope, design, and cost. Such agency structures are not specifically the cause of project cost escalation problems; however, they fail to enable staff and management to address adequately the foundational problems that drive project cost escalation.

A Structured Approach

Successful estimating is not so much about "computers and data" per se, as it is about an organizational culture and an environment that supports those charged with producing the estimate. If ROW cost escalation is an agency problem, changes in agency policy that influence how ROW

cost estimating and cost estimating management are performed may be necessary to improve the processes and to support the creation of consistent, accurate ROW estimates throughout project development.

SHA staffs, charged with developing ROW estimates, realize the importance of accurate cost projections for projects and are trying to provide credible cost estimates. However, ROW delivery under the traditional approach suffers from a long chain of command, lack of personal accountability, and inadequate coordination. SHAs will only achieve accurate estimates when senior management fully engages the use of structured ROW cost estimating and cost management processes and ensures that staff have the resources to complete each step in the ROW estimating process. Management is responsible for propagating organizational change that recognizes the importance of (1) a structured approach to ROW estimating, (2) using risk analyses in setting ROW contingency, (3) reviewing and approving all estimates, and (4) communicating the importance and accuracy of each estimate to internal and external stakeholders.

This Procedures Guide describes a structured ROW cost estimation and estimate management process linked to the project development process as shown Figure S-1. The Guide follows the strategic estimating approach described in *NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction.* As shown in Figure S-1 the structured process has five steps:

1. Determine ROW estimate basis;
2. Prepare ROW base estimate;
3. Determine ROW risk and set contingency;
4. Review ROW cost estimate; and
5. Approve and communicate ROW cost estimate.

Accurate ROW cost estimating requires that all five steps be accomplished. The approval and communication step also means that agency management has a definitive indication.

These project development phases serve as benchmarks along a project timeline by which appropriate ROW process steps and tools can be identified. In general, the ROW cost estimation process is complex and differs from SHA to SHA and sometimes may vary between SHA districts/regions. Additionally, the phases typically overlap one another. ROW cost estimation and cost estimate management occur during the first four project development phases: planning, programming, preliminary design, and final design (see Appendix A). Additional ROW needs may be identified during construction as a result of unforeseen project conditions or scope changes. These added requirements should also be estimated using a structured approached as recommended in the Guide. Often these changes represent only a minor portion of a project's overall ROW cost. Consequently, this research concentrated on ROW cost estimates and cost management completed during each of the first four phases of project development.

Four distinct but interrelated ROW cost estimating and cost estimating management processes are described in this Procedures Guidebook. They are

- **Conceptual ROW Cost Estimating,** which occurs during the Planning phase of project development and supports SHA long-range plans; generally this phase is where the first estimate is prepared for a project.
- **Baseline ROW Cost Estimating,** which occurs during the Programming phase of project development and supports intermediate plans (10 years or less). Several cost estimates may be prepared before the final estimate of this phase, based on the preferred project alternative, is used to set a Total Project Baseline Estimate. The Total Project Baseline Estimate is often used to move a project into the State Transportation Improvement Program (STIP). The ROW portion of the Total Project Cost Estimate then becomes the ROW budget amount for the project.

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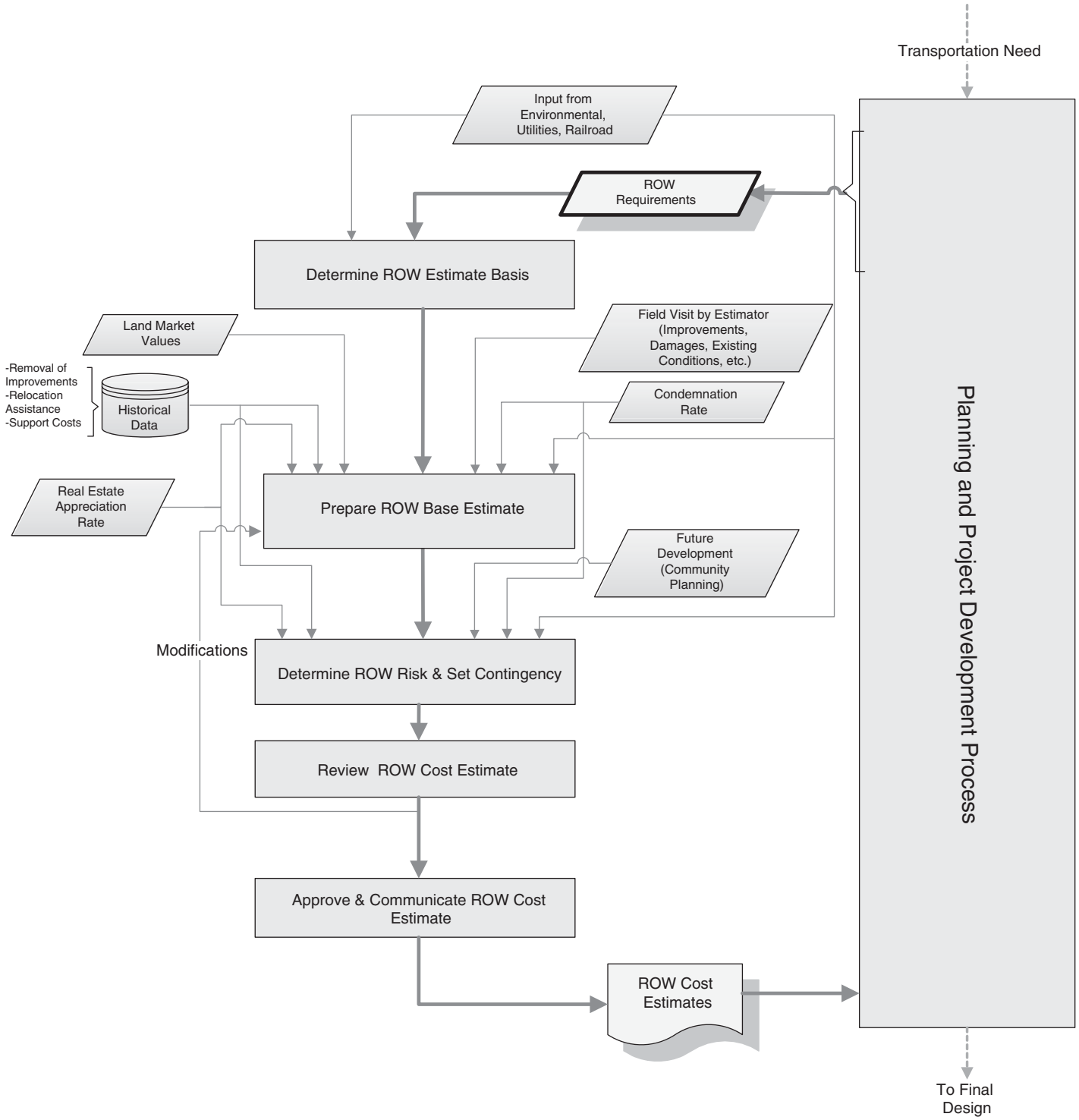

Figure S-1. Baseline right-of-way cost estimating.

Management will use this Baseline ROW Cost Estimate to monitor the cost impact of future ROW estimates prepared in response to development of the project design.

- **Updated ROW Cost Estimates** are prepared during the Preliminary Design phase of project development and involve updating estimated ROW cost as designs are prepared leading to the final ROW plans. Updated estimates are reconciled with the Total Project Cost Estimate to help in managing ROW cost and its contribution to total project cost.

- **ROW Cost Management** occurs when the appraisal and acquisition process begins and continues throughout Final Design activities. Actual ROW expenditures are captured and used to forecast total ROW costs. Management is constantly comparing forecasted ROW cost as compared with the updated ROW budget.

Reviewing, Approving, and Communicating

Even early in project development, agency management is responsible for reviewing, approving, and communicating the ROW estimate. Communication is particularly important for early ROW cost estimates, and management must make all users aware of the estimate precision and the limits of accuracy as related to the uncertainties associated with project scope definition and the real estate market. Management actions can significantly improve proper use of early ROW cost estimates.

Keys to Success

Ideally, SHAs will enhance their project development process to include earlier participation by all preconstruction functions, including right-of-way. The framework for accomplishing this can take various forms, but usually includes the use of project development teams. Such teams affirm that the project manager understands the effect of project design decisions on the professional disciplines of environmental, utility, and right-of-way. Acting together, the team will accomplish the purpose and need of a transportation project. The component functions are only optimally effective if functions act collaboratively and in parallel, rather than independently and sequentially.

A key concept presented in this guide is the setting of a Baseline ROW Cost during the Programming phase of project development. As the ROW scope is detailed during Preliminary Design, Updated ROW Cost Estimates should be prepared and the ROW cost identified in those future estimates should not be accepted as inevitable. Project management should use the established baseline cost for controlling project scope and for coordinating design decisions with ROW cost impacts. Right-of-way is one element in the unified Preconstruction phase of project development. As an agency philosophy, management should (1) encourage collaboration where actions affecting more than one discipline receive full consideration from all affected parties, and (2) insist that ROW activities are performed as much as possible in parallel with other functions, rather than waiting for a "hand-off" from an upstream function.

No estimating technique or tool will ensure development of accurate estimates. Accuracy will only be achieved by consistently following the steps in the structured ROW estimating procedure described in this Guide (see Figure S.1). These steps provide estimate consistency over all phases of project development. Use of this guide by SHAs will enhance and improve their ROW cost estimation and cost management practices. If SHA executive officers support the practices described herein and enable the members of their ROW staffs to participate in training and AASHTO right-of-way professional development activities that enhance their base of knowledge, the completeness and accuracy of project costing is likely to improve.

Limitations

Several limitations are associated with this research. The limitation with the most effect on the content was the issue of the small overall number of SHAs interviewed. The budget and time available for the research project restricted the number of SHAs that could be contacted specifically about ROW estimating. This was addressed by using contacts identified during the initial NCHRP 8-49 Project and with help from the FHWA's Office of Real Estate Services. Experience

from the 18 formal SHA interviews conducted during the earlier phase of the NCHRP 8-49 project also provided the research team with valuable information (Anderson et al., 2007a). Thus, the intent was to focus on a representative sample of SHAs thought to be progressive in the area of ROW cost estimation.

Other limitations are associated with the differences that exist among SHAs, including differences in organizational structure (centralized versus decentralized), terminology, acronyms, and project development phase timing. These differences among SHAs affected data collection and were addressed during interviews by taking detailed and thorough notes that documented the specific attributes of a SHA relative to ROW cost estimation. In addition, the structure of the interview protocol helped reduce the effect of these limitations. The unique environments within which each of the SHAs operates affected the research. The operating environment of each SHA is affected by state laws, politics, and social factors. Subsequently, these issues were addressed by specific questions in the interview protocol.

Recommendations for Future Research

This research focused on developing a framework for the ROW cost estimation and cost estimate management processes that would support the creation of accurate ROW cost estimates. A more in-depth look at specific tools that support ROW cost estimation could be beneficial. This research presented tools discovered through interviews, but did not focus on development of tools, nor did it evaluate the effectiveness of any of the identified tools.

CHAPTER 1

Introduction

The ability of state highway agency (SHA) management to control project cost escalation depends on strategic and structured project development processes. Right-of-way (ROW) costs are among the most difficult to control and, therefore, require disciplined estimating and management procedures. Yet, in many agencies, "stove pipe" divisional structures lead to failure in communicating important project information affecting scope, design, and cost. Although these agency structures may not, in themselves, be the direct cause of project cost escalation problems, such structures hinder management at all levels in addressing adequately the foundational problems that drive program and project cost increases. Agencies realize that project cost escalation is a major challenge and are working to improve their methods of doing business. This Guide seeks to aid agencies in avoiding or controlling cost escalation by providing a strategic approach to estimating project ROW cost.

Background

The challenge of accurately estimating project cost has been confirmed by many studies (U.S. General Accounting Office, 1997; Flyvbjerg et al., 2002). NCHRP Project 8-49 was instituted by SHAs that recognized project cost escalation as a primary challenge to their success in maintaining and developing the national highway system. The initial phase of NCHRP Project 8-49 produced a guidebook (Anderson et al., 2007a) on highway cost estimating and cost estimate management.

Transportation professionals nevertheless continued to stress that ROW cost estimating and management of ROW estimates are critical to achieving consistency and accuracy in project cost projections. FHWA data show that states spent $1,751,167,480 for ROW acquisitions during FY 2005 (FHWA, 2007a). At the TRB workshop, Controlling Project Cost Estimates: Managing the Risks, in March 2004, highway agency professionals made comments such as

- "There was a huge funding shortfall once the DOT started developing more project details. This truly hurt the DOT's reputation and credibility and triggered a very aggressive cost containment program."
- "Detailed cost estimates must be developed for all major areas, including ROW and utilities."
- "Other wildcards are ROW and ITS."

A second phase of Project 8-49 specifically addressing the challenges of ROW cost estimating was, therefore, undertaken to produce this Guide.

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Industry Problem

NCHRP Project 8-49, Phase I, stressed that accurate ROW cost estimating is vital to achieving precision in predicting future project expenditures. The work found that

1. The actual cost of purchasing project ROW is frequently greater than the estimates of such cost produced during early stages of project development;
2. Management of the ROW estimating process can help improve program and project cost estimate consistency and accuracy; and
3. There is a critical need to establish structured ROW estimating processes.

The report from the 2006 Right-of-Way Acquisition and Utility Relocation scan tour (Cambridge Systematics, 2006) highlighted the factors that plague estimators attempting to predict the future value of real estate:

- Rising real estate values,
- Rapid property development in planned program corridors,
- Complications with relocation of utilities, and
- Private property rights.

These factors are often further complicated by the "human factor" related to acquiring property for transportation projects. The human dimension in dealing with property owners adds uncertainty and unpredictability when an agency is attempting to acquire a property. Individual property owner reactions to the proposed project and to the acquiring agency are difficult to predict. Further complicating ROW cost estimating and hindering the accuracy of estimates are state laws and environmental, social, and political factors unique to each state (Kockelman et al., 2004). Although admitting all of these issues, NCHRP Project 8-49, Phase II, revealed that few agencies apply ROW cost estimation methods and tools in a structured manner.

Lack of Structured Processes

NCHRP Report 574 (Anderson et al., 2007a), produced during the initial phase of NCHRP Project 8-49, defined a set of generic project development phases: planning, programming, preliminary design, final design, advertise and bid, and construction. The first four of these phases (see Table 1.1) are relevant to ROW cost estimation and ROW cost estimate management. Typ-

Table 1.1. Development phases and activities (Anderson and Blaschke, 2004).

Development Phases	Typical Activities
Planning	Purpose and need; improvement or requirement studies; environmental considerations; right-of-way considerations; public involvement/participation; interagency conditions.
Programming	Environmental analysis; schematic development; public hearings; right-of-way impact; project economic feasibility and funding authorization.
Preliminary Design	Right-of-way development; environmental clearance; design criteria and parameters; surveys/utility locations/drainage; preliminary plans such as alternative selections; geometric alignments; bridge layouts.
Final Design	Right-of-way acquisitions; PS&E development – final pavement and bridge design, traffic control plans, utility drawings, hydraulics studies/drainage design, final cost estimates.

ically, a ROW cost estimate is produced during each of the first three phases of project development: Planning, Programming, and Preliminary Design. Following preliminary design, appraisals and acquisition commence and no further cost estimates are generated, but cost management should continue as purchases are executed.

To support development of the ROW estimating guidance presented here, current agency ROW cost estimation and management practices were documented in a series of interviews conducted with agencies across the nation (Anderson et al., 2007b). These interviews explored the steps and tools the agencies used to determine project ROW requirements and to estimate the future cost of obtaining real estate. Topical areas of the interviews were

1. Determination of ROW requirements,
2. Cost estimate preparation,
3. Cost estimate reviews,
4. Cost estimate communication,
5. Cost estimate management, and
6. State laws and other factors that affect the ROW process.

Most of the interviews were semi-structured discussions using a prepared interview protocol. The protocol served as a checklist to ensure that all issues were discussed in reference to the four project development phases. These conversations revealed that (1) most agencies lack structured ROW estimating processes and (2) there is very little formal management of the ROW estimating process. Table 1.2 provides a sample of the comments from the interviews.

These comments highlight the unstructured nature of the ROW cost estimating and management processes. Although these comments are not representative of all agencies, the comments indicate fundamental reasons why ROW cost estimates escalate over the course of project development. The researchers found that structured processes are generally not in place and concluded that this lack of structure contributes greatly to the cost escalation manifested during ROW acquisition.

Table 1.2. Sample comments from right-of-way interviews with agencies.

Development Phases	Comments
General	In this study, no program was found that had standardized ROW estimating and cost management across the agency.
Planning	– There is no interaction between planners and ROW. – ROW estimating is completed by the planning group. – Some sort of contingency is usually added using factors. – ROW has little idea where the Planning number comes from (Planning number is not used by ROW).
Programming	– Factors are applied for schedule contingency, administrative/court cost, and market appreciation (predetermined factors are used but the interviewee was unsure where these came from). – Estimates are updated only when there are changes to design and when requested by the design team.
Preliminary Design (detailed cost estimate)	– Estimates are completed for the whole project; estimate is not developed parcel by parcel. – Preliminary cost estimate has no bearing on the detailed cost estimate.
Final Design	– When approximately 60% of acquisitions are completed, the ROW team leader will check to see if the acquisitions are on budget; if not, the team leader will request more money.

Cost Escalation

A transportation agency's program and project cost estimates set expectations both internally and externally. The public demands that agencies be fiscally accountable, and the project cost estimate is normally the benchmark for that accountability. Unfortunately, the estimate made at the earliest stage of project development often serves as the benchmark for the public's expectations, and the uncertainty in these early estimates is not always communicated to internal and external stakeholders.

Project real estate acquisition spending should track within a reasonable range of the ROW cost estimates that were the basis for the establishment of the project budget. However, agencies are substantially underestimating the cost of right-of-way because (1) early estimates of ROW cost are often not made by professionals in the agency's ROW division; (2) early estimates are usually based on limited information; (3) ROW personnel, who prepare later estimates, often have limited time to do so; and (4) typically ROW estimates are prepared years in advance of actual ROW acquisition. The cost of acquiring project real estate is almost always higher than the estimated cost. Published reports of ROW cost escalation are common.

Although the external factors identified during the 2006 Right-of-Way Scan (Cambridge Systematics, 2006) are causes of ROW cost escalation, factors internal to the SHAs also contribute to the cost differences between early estimates and the cost to deliver the ROW real estate. The interviews revealed that, in many agencies, there is a lack of integration and communication between staff responsible for delivering a project and staff in the ROW section of the agency.

Lack of Integration Between ROW Staff and Project Management

ROW cost estimates are based on the ROW requirements; these requirements depend on how exactly the Project Manager and designers can formulate the project scope. Typically, scope definition is clarified as project development proceeds from planning phase to final design and construction. During planning, scope definition is often in flux. In addition to the difficulty of developing a precise cost estimate at this stage of project development given minimal scope definition, in most agencies, planning ROW estimates are completed in the agency's Planning Division without the benefit of active ROW staff participation. Consequently, the ROW cost identified in the planning estimate has minimal bearing on later ROW cost estimates.

When a project moves into the programming phase of development, it should undergo a rigorous scoping process. During programming, the alignment identified should be reasonably close to the project's final alignment. At most SHAs, ROW staff will receive a request at this point from the project manager for a ROW cost estimate. In many agencies, the request has an accompanying aerial map showing the project alignment. Approximate ROW boundaries may be identified on the map. When preparing the programming estimate, a field visit to the project location is usually completed by the estimator. Integration with the project team can be enhanced when there is a formal review process by the ROW estimator and the project team. However, none of the SHAs interviewed had procedures for conducting a formal ROW estimate review. Reviews of completed estimates during any of the project development phases typically were limited to a visual scan by the estimator's supervisor.

Once the project moves into preliminary design, ROW requirements are often described to the ROW Section on an updated aerial map or a preliminary drawing provided by the design engineers. These maps/drawings typically show the ROW boundaries and may even show par-

cel boundaries. With such detailed data, estimates often are prepared based on the estimated value of each parcel. Again, there is no regular practice of formally reviewing the estimates, and regular, formal communication between ROW staff and the Program Manager or the project design team is the exception.

This Guide lays out steps for ROW estimating that integrate with the cost estimation and cost estimate management procedures outlined in *NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction.*

Procedures Guide Development

This Guide was developed under the second phase of NCHRP Project 8-49, "Procedures for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction." Approaches for accurately estimating and managing project ROW cost are proposed based on this research.

The inquiries and analysis to develop this Guide were conducted in two phases. The first phase focused on a state-of-practice examination of ROW cost estimating and cost estimating management practices. The current state of estimating practice was characterized by an extensive review of the literature supported by interviews with various transportation agencies.

Meetings to collect data on ROW cost estimation and cost estimate management practices were conducted throughout the nation by members of the research team. Seven SHAs, the O'Hare Modernization Program Office of the City of Chicago, and the City of Phoenix Street Transportation Department were interviewed. This was in addition to 18 formal SHA interviews (Anderson et al., 2007b) conducted during the earlier phase of NCHRP Project 8-49.

A critical review of practices described in the literature and identified in the interviews formed the basis for developing the structured approach to ROW cost estimating and cost estimating management described herein. This structured ROW estimating process, which integrates with overall project estimating, addresses the major factors causing the under estimation of ROW cost. This approach seeks to address the issue identified in the 2006 Right-of-Way scan report; there needs to be an "Integration of the Right-of-Way and Design processes to decrease right-of-way costs and length of time to purchase right-of-way" (Cambridge Systematics, 2006). The structured process of this Guide links with the strategic estimating approach defined in *NCHRP Report 574.*

The second phase of the research developed this Guide. A draft guide was prepared with a focus on addressing ROW cost escalation through the use of a structured estimating and estimate management process. This draft was critically reviewed by the NCHRP Project 8-49 Panel. Several members of the AASHTO Subcommittee on Right of Way and Utilities commented on portions of drafts of the Guide. The review provided a critique of the Guide's content, structure, layout, and user-friendliness.

Use of the Guidebook

This Guide has been designed to provide transportation agencies with guidance on estimating and managing project ROW cost. The Guide provides the knowledge and information necessary for SHAs to create "how to" approaches that fit within existing agency processes and culture.

The Guide is designed to provide information to various users in several ways. The chapters follow the generic project development phases found in most SHAs. A chapter is dedicated to each project development phase where a ROW estimate should be created; in those chapters, there is a discussion of each cost estimating step:

1. Determine estimate basis,
2. Prepare base estimate,
3. Determine risk and set contingency,
4. Review estimate, and
5. Approve and communicate.

Similarly, in each chapter there is a discussion of each cost management step:

1. Approvals,
2. Communication,
3. Monitoring,
4. Impact of change, and
5. Adjust estimate.

Organizational Level

If ROW cost escalation is a significant problem for an agency, changes in agency policy that influence how ROW cost estimating and cost estimating management is performed may be necessary to produce consistent and accurate estimates throughout project development. If so, the executive managers who will create these policies should review Chapters 1, 2, 3, and 8 of the Guide. These chapters provide a basic structure and approach for developing agencywide policies that will lead to improved ROW cost estimating and cost estimating management processes. Chapter 8 identifies key requirements for successful ROW cost estimating and cost estimating management from an agencywide perspective. These requirements promote a collaborative atmosphere that encourages change to meet the challenges associated with improved ROW cost estimating and cost management practices.

Program and Project Level

Program managers are often charged with implementing policy changes. If policy changes in cost estimating and cost estimating management are necessary, these managers should read Chapters 1, 2, 3, and 7 and the relevant Chapter 4, 5, or 6. For example, planning directors can focus on Chapter 4: Conceptual ROW Cost Estimation, which is directed at processes during the early phases of project development. Project Managers can focus on Chapters 5, 6, and 7, which describe processes for the programming, preliminary design, and final design phases of project development. When using Chapters 4, 5, 6, and 7, Appendix A is referenced frequently to support steps in the cost estimating and estimate management processes.

Discipline leaders who are directly responsible for cost estimating and cost estimating management processes should read Chapters 1, 2, and 3 for a global understanding and relevant Chapters 4, 5, and/or 6 according to their area of responsibility. Appendix A: Tools is referenced frequently with respect to tools that support the processes described in these chapters.

Chapter Summary

Project cost escalation, specifically ROW cost growth over the course of project development, is the major problem that this Guide addresses. As projects evolve from concept to detailed devel-

opment prior to construction, this problem is faced by every SHA, transit agency, and metropolitan planning organization (MPO) in the country. To address project cost escalation, agencies must adopt a structured approach to ROW cost estimating and rigorously complete each estimating step. This Guide was developed as part of NCHRP Project 8-49, "Procedures for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction," and serves as a complement to *NCHRP Report 574*.

CHAPTER 2

Integrated Estimating Process

To successfully plan and execute projects, SHAs must have reliable ROW cost estimates. The foundation for achieving accurate, consistent cost estimates is a structured estimate development process. This Guide focuses on the two major functions necessary to successfully support the development of ROW cost estimates: cost estimating processes and cost estimating management. This chapter frames these two functions within a broadly defined set of project development phases common to SHA practice. The approach is from an agency-level viewpoint. Chapters 4, 5, 6, and 7 present material more specific to ROW cost estimating and ROW cost estimating management for each phase of an agency's project development process.

Transportation Project Development Phases

To support program and project funding decisions, ROW cost estimates are made at various times during the development of solutions to transportation needs. Estimate approaches must conform to the project information available at the time of estimate preparation. When only concept information is available to describe a transportation program or project, the agency has to apply conceptual estimating techniques when preparing a ROW cost estimate. This is the typically the situation for program-level ROW estimates. Similarly, cost estimate management techniques will vary depending on the level of project scope definition, organization of the project team, and cost detail presented in the estimate.

An understanding of project development phases is necessary to discuss the rationale behind a structured ROW cost estimating and cost estimating management approach. The terms used to describe project development phases may vary slightly among agencies; therefore, this Guide presents a generic set of phase designations consistent with *NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction.* To ensure the applicability of terms, SHAs from across the country participated in vetting the development phases described in *NCHRP Report 574.* For purposes of discussing ROW estimating in this Guide, the project development phases of concern are

1. Planning,
2. Programming,
3. Preliminary design, and
4. Final design.

Timeline of Cost Estimating and Cost Management

Agencies prepare cost estimates to support program and project funding decisions. Estimates including probable ROW costs are part of planning documents and program documents and are

continually updated during project development. Agencies perform cost estimation management to support the work of preparing estimates and to ensure that program funding levels are in line with planned funding levels and project budgets. By integrating cost estimation practice and cost estimation management processes, an SHA can manage individual project budgets effectively and, in turn, overall capital programs.

Planning Phase

The planning phase of project development has a significantly longer time horizon than the other phases—usually longer than 20 years. Individual agency approaches to this phase vary significantly. Although some SHAs identify major projects, or even unique minor projects, most long-range plans do not identify specific projects, but rather establish strategic directions for state investment in the transportation system. Statewide plans often identify areas where more detailed planning is required.

The fundamental purpose of planning cost estimates that support long-range plans is to provide a gross estimate of the funds needed over a 20-year planning horizon. Planning phase cost estimates involve the use of conceptual estimating techniques. In some SHAs, planning phase ROW estimates are developed by planning staff without consultation with the agency's ROW staff. In other SHAs, ROW staff prepare a gross real estate estimate based on a line drawing and general location knowledge. During the planning phase, cost estimation management focuses primarily on updating planning dollar amounts and communicating the cost updates through the long-range plan.

Programming Phase

Project cost estimates significantly affect the overall transportation program and, thus, the ability of SHAs and MPOs to meet transportation needs. Producing accurate programming phase cost estimates is critical to successful project development; however, at this early stage, the ROW estimate must be produced based on limited knowledge of real estate requirements and future property values.

Programming phase estimates are predicated on a baseline project scope and, therefore, in many SHAs, they become the baseline cost for managing project development. The baseline cost sets the project budget for inclusion in the priority program. The priority program has a 10-year or less time horizon to the project construction letting. When a project is included in the priority program, authorization is often given for preliminary design to begin. The first 4 years of the priority program form the basis for the Statewide Transportation Improvement Program (STIP). Once preliminary design begins, this baseline cost estimate becomes the basis for cost estimation management, particularly monitoring project scope and the effect of changes. Management must control design changes that affect real estate requirements, particularly those having significant cost impacts.

Preliminary Design Phase

During preliminary design, the agency transforms the project scope from general requirements to detailed physical components. The preparation of costs estimates at various times throughout preliminary design validates project cost against design detail and scope changes. Any later estimate indicating cost growth above the baseline triggers cost management procedures to bring the project cost back in line with programmed amounts (e.g., value engineering studies, creation of a new revised baseline with additional funding, consideration of design alternatives that mitigate ROW cost.). These estimates are important because they support management monitoring and control of the budget.

Cost management using revised or updated estimates is essential during the preliminary design phase when scope is transformed into construction details. Agencies should systematically compare periodic cost estimate updates. If estimates are not preformed regularly during project design, the department will experience "cost blackout periods" (Clark and Lorenzoni, 1997); these can lead to major budget problems when cost increases are identified later in project development. To manage overall project cost effectively, agencies must constantly evaluate changes in scope, design, and project site or market conditions in relation to cost and time impacts. Management uses estimate updates to evaluate scope changes and other issues that affect project cost. Any deviation from budget and schedule must have documented management approval.

Final Design Phase

In the final design phase, plans and specifications typically are nearing completion. Agencies do not typically restate ROW requirements by an estimate update at this point because appraisal and parcel acquisition has begun. During this phase, estimate management typically involves the tracking of appraisals and acquisition costs against the last baseline ROW cost estimate.

Cost Estimating Process

In *NCHRP Report 574,* nine steps are used to describe the fundamental elements of cost estimation and cost estimation management practice. Four basic steps describe cost estimation practice. Table 2.1 presents the four steps, with a brief description of each step. The descriptions are general and, therefore, apply to the estimation process across each development phase. These four steps are sufficient to convey the idea of a structured approach to cost estimation. The operational manner in which the steps are performed will vary depending on the project development phase. The level of completeness in the project scope and refinement of project design will drive these variations. These four steps are combined with two cost estimate management steps (discussed in the next section) so as to correspond to the ROW cost estimating practices discussed in detail in Chapters 3 through 6.

Illustrations of the ROW cost estimation process steps in the introductory sections of the chapters that follow present and discuss more specific items for each project development phase: Chapter 4, "Conceptual ROW Cost Estimation" for the planning phase; Chapter 5, "Baseline ROW Cost Estimate" for the programming phase; and Chapter 6, "Update ROW Cost Estimate" for the preliminary design phase.

Cost Management Process

Five steps describe the cost estimation management process (*NCHRP Report 574*). Table 2.2 describes each of these steps. Again, the descriptions are general and, therefore, apply to the cost estimation management process across project development phases. Implementation of these steps will vary by development phase. Similar to the cost estimation practice steps, the cost estimation management steps and their descriptions could be shown in greater detail, but five steps are sufficient to outline a structured approach to cost estimation management. As with the estimating steps, the project development phase dictates some level of variation in which the steps are performed. The introductory sections of the chapters that follow present illustrations of the cost estimate management process with more specific items for each project development phase. These five steps are customized to fit ROW cost estimating management practices discussed in detail in Chapters 3 through 6 and cost management in Chapter 7.

Table 2.1. Cost estimating process (*NCHRP Report 574*).

Cost Estimating Step	Description
Determine estimate basis	Document project type and scope including • scope documents; • drawings that are available (defining percent engineering and design completion); • project design parameters; • project complexity; • ROW requirements • unique project location characteristics; and • disciplines required to prepare the cost estimate.
Prepare base estimate	Prepare estimate, including • documentation of estimate assumptions, types of cost data, and adjustments to cost data; • document land use and improvements and any assumed damages; • application of appropriate estimating techniques, parameters, and cost data consistent with level of scope definition; • coverage of all known project elements; • coverage of all known project conditions; and • check to ensure that estimate is consistent with past experience.
Determine risk and set contingency	Identify and quantify areas of uncertainty related to • project knowns and unknowns; • possibility of real estate escalation or changes in land use; • potential risks associated with these uncertainties; and • appropriate level of contingency congruent with project risks.
Review total cost estimate	Review estimate basis and assumptions, including • methods used to develop estimate parameters (e.g., quantities) and associated costs; • gross land price assumptions or evaluation of parcels; • completeness of estimate relative to project scope; • application of cost data, including project-specific adjustments; • reconciliation of current estimate with the baseline estimate (explain differences); and • preparation of an estimate file that compiles information and data used to prepare the project estimate.

A Strategic Approach

Numerous research studies document the fundamental causes of project cost escalation (Merrow, 1988; Touran and Bolster, 1994; Ripley, 2004). Each cause is a challenge to every agency seeking to produce accurate project cost estimates. Although every factor will not cause problems on every project, the only way to consistently mitigate the factors is to use a strategic approach to cost estimation and estimate management.

Incorporating an extensive review of estimating literature and discussions with SHAs, *NCHRP Report 574* defined eight strategies to address the principal causes of project cost escalation:

1. **Management strategy**—Manage the estimation process and costs through all stages of project development.
2. **Scope and schedule strategy**—Formulate definitive processes for controlling project scope and schedule changes.
3. **Off-prism strategy**—Use proactive methods for engaging external participants and assessing the macro-environmental conditions that can influence project costs.
4. **Risk strategy**—Identify risks, quantify their effect on cost, and take actions to mitigate the effect of risks as the project scope is developed.

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5. **Delivery and procurement strategy**—Apply appropriate delivery methods to better manage cost because project delivery influences both project risk and cost.
6. **Document quality strategy**—Promote cost estimate accuracy and consistency through improved project documents.
7. **Estimate quality strategy**—Use qualified personnel and uniform approaches to improve estimate consistency and accuracy.
8. **Integrity strategy**—Ensure that checks and balances exist to maintain estimate accuracy and to minimize the effect of outside pressures that can cause optimistic biases in estimates.

The most important strategies, in respect to ROW estimating, are those that address management, scope and schedule, off-prism, risk, estimate quality, and integrity issues.

Management Strategy

Manage the estimation process and costs through all stages of project development. SHA leadership must advance an estimation management strategy that fosters and supports estimate accuracy and consistency through all phases of project development. The highest levels of SHA leadership are responsible for publicly explaining how the project development process works and, most

Table 2.2. Cost estimate management process (*NCHRP Report 574*).

Cost Estimate Management Step	Description
Obtain appropriate approvals	Obtain management authorization to proceed by • review of current project scope and estimate basis; • securing of approvals from appropriate management levels; • approval of current estimate, including any changes from previous estimate; • approval of ROW estimate; and • release of estimate for its intended purpose and use.
Determine estimate communication approach	Communication approach is dependent upon the stakeholder who is receiving the information, but should consider • establishment of continual communication between design and ROW staff responsible for cost estimating; • mechanism for communicating the cost estimate for its intended purpose; • level of uncertainty to be communicated in the estimate given the information upon which it is based; and • mechanism to communicate estimate to external parties.
Monitor project scope and project conditions	Identify any potential deviation from the existing estimate basis, including • changes to scope; • changes due to design development including different ROW requirements; • changes due to external conditions; • the nature and description of the potential deviation; and • whether the deviation impacts the project budget and/or schedule (potential increase or decrease).
Evaluate potential impact of change	Assess potential impact of change, including • cost and time impact of the deviation; • can design change mitigate impact to ROW requirements; and • recommendations as to whether to modify the project scope, budget, and/or schedule due to change.
Adjust cost estimate	Document changes to the baseline estimate, including • appropriate approval of the deviation; • the new project scope, new budget, and/or new schedule; and • notifiy project personnel of the change.

important, ensuring that cost estimation practice and cost estimation management processes are transparent. To produce accurate estimates, SHAs must train their personnel properly, use established estimation processes, and ensure critical reviews of all estimates. Senior management must be active in advancing strategies to increase estimator knowledge and estimate consistency.

Scope and Schedule Strategy

Formulate definitive processes for controlling project scope and schedule changes. Scope control ensures that project changes are identified, evaluated, coordinated, controlled, reviewed, approved, and documented. Scope control requires that the proposed scope of a project be continually evaluated against the essential functions necessary to accomplish its intended purpose. Projects often take years to move through the development process. As the time frame is extended, there are more opportunities for external and internal parties to suggest changes in scope. Additionally, if the schedule is extended, cost impacts will result from increases in land values and other inflation effects. The cost effect of a change depends on when it is introduced. Early in project development, before definitive baseline estimates are prepared, a change in scope does not cause significant problems. Scope changes during the later stages of engineering/design have ripple effects and can increase project cost exponentially.

Off-Prism Strategy

Use proactive methods for engaging external participants and assessing the macroenvironmental conditions that can influence project costs. In projects with significant cost escalation, engineers have often focused on technical solutions with little attention to community interest or concerns. These cost drivers are termed "off-prism" in the literature because they are not within the roadway prism. Engineers frequently discuss technical alternatives at early stages of project development before embarking on community outreach efforts and do not address concerns relating to the external effects until later in the development cycle. Additionally, how environmental compliance and the acquisition of ROW affects individual parcels must be considered when addressing off-prism issues.

Risk Strategy

Identify risks, quantify their effect on cost, and act to mitigate the effect of risks as the project scope is developed. Rather than a single deterministic forecast of project cost, many variables contribute to a range of probable cost. In the case of SHA project estimates, any one cost number represents only one result based on multiple assumptions. Variables that influence project costs are not all directly controllable or absolutely quantifiable. Therefore, cost estimation must consider uncertainties and related risks. Management should use these identified risks and uncertainties to structure management procedures that mitigate, eliminate, or account for the possible variation in the outcomes.

Estimate Quality Strategy

Use qualified personnel and uniform approaches to achieve improved estimate consistency and accuracy. Apparently, SHAs base their estimation practices solely on the experience of the personnel in charge of preparing estimates, usually the section head. Agencies must approach estimate development in the same manner as design and construction—with documented processes to guide cost estimation practice and cost estimation management throughout project development. Structured approaches to quality control (e.g., internal estimate reviews) and quality assurance (e.g., external estimate reviews), together with approvals and documentation, are essential to achieving accurate cost projections.

Integrity Strategy

Ensure that checks and balances exist to maintain estimate accuracy and minimize the effect of outside pressures that can cause optimistic biases in estimates. The potential for estimate error can result from pressure by project sponsors who seek the approval of their projects. In a conceptual estimate, judgment replaces straightforward material takeoffs and costing; therefore, it is difficult to justify estimates quantitatively. Agencies should protect estimators from internal and external pressures to produce estimates that are less than some pre-established budget amount.

Inflation Adjustments

Each project cost estimate is a "snapshot" of projected cost based on information available at a specific point in time and is a forecast of what things will cost at a future time. It is common to make economic comparisons between options in present value amounts during planning and preliminary design. However, for budget purposes and when communicating with stakeholders, cost should be "expressed in year-of-expenditure dollars" (FHWA, 2007b) because that is the actual dollar expense number stakeholders will use to measure success. Agencies, therefore, adjust project construction estimates by an inflation factor to the most likely midpoint of construction. This inflation factor represents the anticipation of cost growth for construction labor and materials. However, a general construction inflation factor is not an appropriate factor for adjusting ROW estimates because it does not reflect real estate appreciation or changes in land use.

The ROW estimate represents the future cost to purchase real estate; therefore, the inflation factor use to adjust a ROW estimate should correlate with value appreciation due to market conditions over time. The time durations over which agencies apply the construction inflation factor and the real estate inflation factors will also differ because real estate is normally purchased before construction commences. Three agencies that use a separate inflation factor to adjust their estimated real estate cost are the Florida DOT (FDOT), the Washington State DOT, and the City of Phoenix. In Phoenix, the City's Budget and Research Department provides estimators with inflations factors specific to the land, construction, and equipment components of a project.

One SHA has procedures specifically directing estimators to communicate ROW estimates in present-day cost amounts, exclusive of inflation/appreciation. The estimator is allowed to include a contingency to cover unknowns in the estimate, but the manual explicitly states that these amounts are to be exclusive of inflation. The agency's computer estimating program, which tracks ROW information, has an internal table for inflation rates. That table is maintained by the agency's ROW division in the central office. These default inflation rates are, for the most part, based on a 10-year rolling average taken from county property appraiser records as reported to the State's Department of Revenue. These inflation rates are automatically applied to the net estimated value. Nevertheless, the agency's ROW estimating guidance allows the estimator to enter inflation/appreciation rates for a particular estimate when local conditions are significantly different than the county experience.

When the estimator prints an estimate document for a requestor in the agency, the program printout will provide the present-day costs, along with annual compounding for 10 years. Therefore, the requestor receiving the estimate, usually the project manager, must decide when in the future the ROW purchase will take place and use the appropriate inflated cost. The project manager is assumed to have better insight concerning the project time line and is consequently the appropriate individual for selecting the ROW cost to be used in the total project estimate.

ROW Cost Management

Cost estimation management should occur continuously throughout the project development process. Some efforts are exclusive to a particular stage of development; others go on throughout the process. The phases of planning, programming, preliminary design, and final design require different cost management methods because of the level of project information available and how the estimate must be communicated internally and externally.

Even early in project development, agency management is responsible for reviewing, approving, and communicating the ROW estimate. Communication is very important in the case of early estimates, and management must make all users aware of an estimate's precision and its limits of accuracy. These management actions, the use of conceptual estimating techniques, and proper communication of estimate uncertainty can significantly improve proper use of early ROW cost estimates.

During this NCHRP project and the two previous NCHRP estimating projects (NCHRP Projects 20-07/Task 152 and 8-49), the research team found individual ROW cost estimate management steps being used in individual SHAs, but no agency had a structured management process.

Supportive Institutional Environment

The 2006 *Best Practices in Right-of-Way Acquisition and Utility Relocation* scan-tour report stated that a common trait of those agencies that "experienced considerable success in improving their right-of-way acquisition and utility relocation processes" (Cambridge Systematics, 2006) was a supportive institutional environment. A critically important characteristic of a supportive institutional environment is executive management support. The scan-tour revealed that, in successful states, "upper management provided the authority along with the responsibility and financial resources to accomplish assigned tasks."

The execution side of cost estimation—cost estimation practice—depends heavily on how an agency manages project development and the support management provides to engineers executing project development, including estimate and schedule preparation. Senior SHA managers should view themselves as investors, developers, and strategists. Management is responsible for investing in and developing project staff and providing staff with the resources to perform effectively, including funding for training and attendance at ROW conferences such as those conducted by the AASHTO Subcommittee on Right of Way and Utilities. Senior management can create an environment for success. An initial investment in project development resources pays dividends in improved project scoping, which translates into delivery of projects that are consistently within budget and on schedule.

To achieve accurate estimates consistently, agencies must do more than institute changes in estimating practices. Senior management must view project cost estimate management and estimate practice as interdependent systems that span the entire planning and project development process. Project managers must be given the authority to manage their projects, particularly in terms of controlling scope, and, with that authority, project managers must accept responsibility for results.

Management Support for ROW Estimating

Many estimating problems can be fostered by management's attitude toward the importance of accurate cost estimates. "Need to focus on getting work done and not let estimating dominate the process" was a comment made in one SHA district office. There is an attitude that acquisition

is the only important function of a ROW office. In many SHAs across the country, ROW estimating is considered a secondary function, and the institutional processes lack structure.

The focus in many other agencies is primarily on creating tools to improve cost estimates with no recognition of the importance of the cost estimation management function. Successful estimating is not so much about "computers and data" per se as it is about an organizational culture and an environment that supports those in charge of producing the estimate. During the interviews with SHAs, many in management positions seemed not to appreciate the need for accurate ROW cost estimates. Conversely, the staff members responsible for developing the estimates realize the importance and were sincerely trying to provide credible cost estimates. It is management's responsibility to assume the lead in propagating organizational change that recognizes the importance of (1) a structured strategic approach, (2) the use of risk analyses in setting contingency, (3) reviewing and approving all estimates, and (4) communicating the importance and accuracy of each estimate with internal and external stakeholders.

This Guide presents a strategic approach to implementing ROW cost estimating and estimate management that will help agency management understand the importance of its role in producing accurate ROW cost estimates. All estimates should be subjected to management approval before being accepted—this enable management to control project cost by using the baseline estimate to measure performance.

Chapter Summary

Because SHAs operate in a fiscally constrained environment, it is inevitable that difficult project decisions have to be made. This chapter argued that SHAs should adopt a structured, strategic process for ROW cost estimating and cost estimate management. A structured ROW estimating and estimate management process is more important to estimate accuracy than any individual estimating tool. Management policies need to be propagated that will demonstrate support and commitment to improving the agency approach to ROW cost estimating.

CHAPTER 3

Agency-Level Process Overview

A structured approach is critical to achieving an accurate ROW cost estimate and to ROW cost management (CE/CM). A structured approach is, therefore, presented in this Guide. Such an approach provides the structure needed for improving the accuracy of ROW cost estimates and managing ROW cost during project development. This approach provides a systematic methodology for describing the CE/CM process during all phases of project development.

Introduction

Using a structured approach ensures that the financial effects of both design and ROW decisions are always visible to the project team. To ensure this visibility, the cost estimating and cost management processes must be integrated. Often, these processes are performed separately and at distinctly different times during project development. This separation contributes to project cost growth. In many agencies, the importance of cost management in managing ROW costs is not recognized. Another issue is the lack of integration between cost estimating and cost management during the project development process (PDP). SHA professionals who perform ROW planning and estimating must be closely aligned with those responsible for the project design functions. Estimate accuracy is compromised if the interface between the CE/CM processes and the PDP is not properly aligned. Finally, the process approach followed in this Guide permits the description of several critical steps in ROW CE/CM that are not usually given proper attention, such as **risk analysis** to support cost contingencies and detailed **estimate reviews and approvals.**

This chapter provides an overview of an agency-level approach to ROW CE/CM. The approach discussed in this Guide is necessarily generic so that it can be adapted by SHAs while they retain their unique PDP procedures. The Guide's approach reflects concepts presented in *NCHRP Report 574,* which describes a broader set of CE/CM strategies, methods, and tools. Detailed process flow diagrams and corresponding discussions are included in Chapters 4, 5, 6, and 7. Specific tools for ROW CE/CM are described in Appendix A and are referenced in the detailed discussions throughout the Guide.

Agency-Level Process Flowchart

Figure 3.1 shows an agency-level flowchart of the main ROW CE/CM processes. The planning and project development phases were discussed in Chapter 1. The key concepts in this flowchart are (1) setting a baseline ROW cost during the programming phase to support a priority

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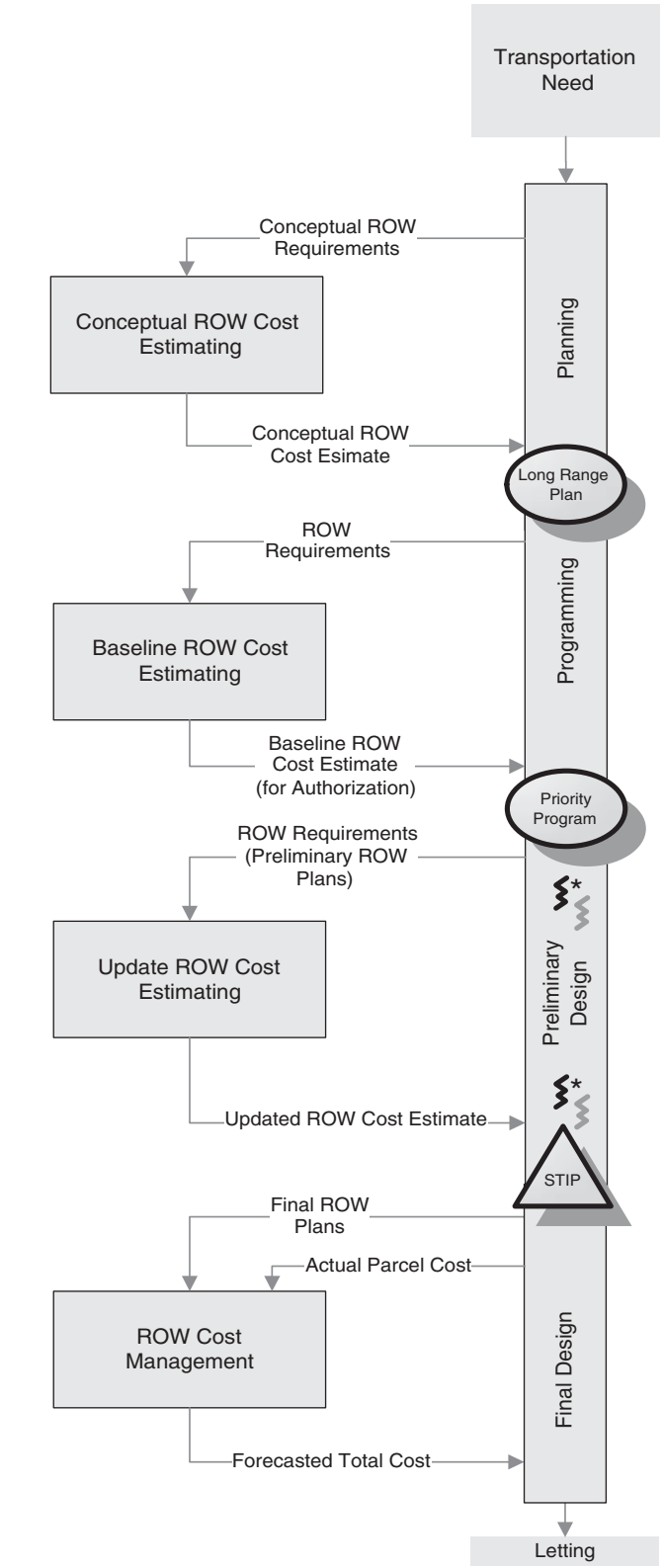

* Represents the dynamic nature of the milestone dependent on the practices of the State highway agency.

Figure 3.1. Agency-level flowchart for right-of-way cost estimating and cost management.

program; and (2) updating and managing the ROW cost estimate in relation to this baseline as the ROW scope is detailed during preliminary design. Estimating is cyclic—it must be performed repeatedly as project design proceeds so that there will be no periods of cost blackout. ROW appraisal and acquisition occurs during the final design phase of project development. The appraisal and acquisition processes are considered part of project development. All costs related to acquiring properties are input data supporting the ROW cost management step. The actual costs are compared with the ROW budget included in the STIP. Final ROW cost performance can then be measured against the baseline cost established during programming and the budget included in the STIP.

Figure 3.1 presents the overall ROW CE/CM process from the identification of transportation need at the planning phase through the acquisition of right-of-way during the final design phase. Each of the major ROW cost estimates, corresponding to a project development phase, is shown in Figure 3.1.

Developing the generic agency-level flowchart was complicated because there is not a clear distinction across SHAs relative to when a given project development phase starts, when it ends, and how ROW cost estimates are integrated with these phases. The most important event in terms of estimate preparation is the record of decision (ROD), which summarizes any mitigation measures required; such measures can significantly affect land requirements. Final design activities and property acquisition [with the exception of hardship and protective buying, as defined in §771.117(d)], cannot proceed until the ROD is signed. Based on conversations with SHAs, this usually occurs toward the end of the programming phase of project development when the preferred alternative is known.

Further, the number of years that compose a priority program varies across SHAs. Some SHAs have priority programs that include projects 10 years from the projected letting date. Alternatively, the priority program in other SHAs is composed of projects only 5 years from the projected letting date. The number of years that a project included in the priority program precedes its letting date affects the timing when the baseline estimate is prepared, as well as the number of estimate updates required before including a project in the STIP (usually at year four).

Additionally, the signing of the ROD affects the project development activities. If major activities to advance the project (i.e., final design, acquisition of right-of-way, approval of PS&E) have not occurred within 3 years after approval of the final environmental impact statement (EIS) or last Administration approval, a written reevaluation is required of a final EIS, per 23 CFR 771.129(b), before further approvals may be granted (Ms. Caryn Brookman, Environmental Specialist, FHWA).

Project time line variations are represented on the flowcharts with an asterisked wavy line to denote that the timing of when projects are included in plans and programs is dynamic and varies among SHAs. As shown in Figure 3.1, when an SHA's priority program begins and when the estimate is input into the STIP may vary. The point at which the baseline ROW estimate is developed will also vary. These milestones and differences in project phase definition and timing can also vary from project to project, depending on the project characteristics (e.g., project size and the complexity and amount of ROW required).

The intent of displaying the ROW cost estimating and cost estimate management activities linked to project development phases is to communicate the critical relationship between ROW activities and the project development process. Moreover, this illustration stresses the relationship that should exist between personnel who estimate and procure right-of-way and personnel who plan and design the project. ROW requirements, defined by the project scope, are the major input into ROW cost estimation and cost estimate management. Design personnel, for example, refine the project scope, and hence the ROW requirements, as project development progresses.

Following the completion of a ROW cost estimate and its review and approval, a total ROW cost is communicated to the project manager and the project development team.

The ROW cost estimates completed during planning, programming, and preliminary design have been defined as the **Conceptual ROW Cost Estimate,** the **Baseline ROW Cost Estimate,** and the **Updated ROW Cost Estimate,** respectively. These estimates are outputs of the first three estimating processes shown on the agency-level flowchart. The fourth process in the flowchart, ROW Cost Management, occurs primarily during final design. Further, cost estimates are not usually completed during final design because the emphasis is on ROW appraisals and acquisition with ROW Cost Management tracking expenditures and then forecasting funds needed to complete ROW acquisition based on trends from actual purchases and other effects (e.g., damages).

ROW Cost Estimating and Cost Estimation Management

As SHAs prepare project cost estimates to support financial decisions, these estimates should include all cost elements. The major project cost elements are preliminary engineering, construction, and right-of-way. The construction component can include environmental mitigation costs, utility relocation costs, and costs related to railroad areas. These three areas are often identified as unique cost components separate from construction costs. Right-of-way may also include costs related to utility relocation and railroad adjustments when property is affected. This Guide specifically focuses on ROW cost elements.

The ROW cost estimate is the first step in building a credible budget for securing the necessary real estate for a project. The estimate allows ROW management to forecast capital outlay support personnel requirements, capital outlay expenditures, and future programming needs. This estimate also provides the ROW cost amount a project manager must include in the total project cost estimate. Direct communication between the ROW and project development staffs is essential during all phases of project development. This communication starts with the initiation of planning studies and carries through to completion of the final design.

Process Steps

Three cost estimating processes are shown in Figure 3.1 and are further described in terms of process steps. Four cost estimating steps from Table 2.1 are tailored to fit ROW cost estimating specifically and, at the same time, follow the basic concepts under the description of each step in Table 2.1. Similarly, cost estimate management is required for the first three cost estimate processes in the form of estimate approvals and communication of estimate results. These two steps are adapted from Table 2.2 and modified to reflect their use in ROW cost estimating. Thus, five steps are used to describe the ROW cost estimate process that occurs during planning, programming, and preliminary design.

The cost estimate management process shown in Figure 3.1 is also described in terms of process steps. The last three steps in Table 2.2 are considered but tailored to fit ROW cost management based on where ROW appraisal and acquisition is occurring in the project development process.

General ROW Cost Estimating Concepts

Unlike the estimates for the construction and engineering/design components of a project, the ROW estimate typically has few elements. The basic ROW estimate elements are

- Land only. Value based on **highest** and **best** use of land (e.g., residential, agricultural, industrial, etc).
- Land and structures. Value based on **highest** and **best** use of property as improved or as vacant, which ever produces the highest value based on types of structures (e.g., house or business building), and the effect of take on land and structures (whole or partial take).

- Other property improvements. Assessment of the cost or contributing value of an improvement when taken (e.g., partial removal of a fence).
- Damages. Assessment of the reduction in value of the remaining property by virtue of the property acquired or the cost to cure a physical effect to a property in the case of a partial take (e.g., replace fence at a different location on the property).
- Utility relocation. Reimbursement for relocation of existing utility.
- Relocation assistance program (RAP) costs. Relocation payments for residential occupants, businesses, farms, and non-profit organizations [as specified in Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally Assisted Programs (49 CFR 24)].
- Administrative settlements. Cost differential to avoid condemnation [as specified in 49 CFR 24.102(c)(2)(ii) and 49 CFR 24.102(i)].
- Settlements or trials. Cost differential for properties that proceed to condemnation.
- Other costs. Demolition of existing facilities and property management when necessary.
- Support cost. Cost of labor for title, appraisal, appraisal review, negotiations, and so on.
- Inflation. Cost element that reflects the difference between the current dollar estimate and the estimated cost when the property is acquired (appreciation).

Although there are fewer ROW elements to estimate than for construction items, these elements are frequently estimated repetitively, depending on the specific ROW project requirements (number of parcels affected). Additionally, there are differences between parcels. For example, land may not have any structures (e.g., buildings) or other improvements, so a ROW estimate for that parcel would only include the land element and relevant administration costs. The type of land use is a key determinant in the difficulty of preparing the estimate.

Key inputs used to prepare ROW estimates include

- Requirements. Total acreage with no parcels identified to specific parcels to be acquired with complete description of what is on the parcel and will be affected by the take.
- Land market values. Tax assessor data, comparable sales through real estate agents, detailed market surveys, and verified market data.
- Historical data. Percentages or cost data on relocation assistance program, factors to cover costs due to improvements or account for costs due to damages.
- Real estate inflation rate. Reflects the appreciation rate from the current day estimate to the time when the right-of-way is acquired.
- Condemnation rate. Percentages of parcels that will go to Eminent Domain.
- Future development. Projection of **highest and best use** of property at the time when the property is likely to be acquired.

A major estimating challenge is determining values for these inputs, especially when preparing planning and programming estimates, because the actual purchase of the right-of-way will occur in the future. ROW requirements evolve as design concepts are developed.

Conceptual ROW Cost Estimate

Conceptual ROW Cost Estimates are program study estimates used for comparing project alternatives. The estimator usually has good-quality aerials or map sheets with an overlay of proposed ROW alternatives. There may be one overlay with all alternatives or separate overlays for each alternative. In many SHAs, these ROW estimates are prepared in the planning division, rather than by ROW staff. Because it is so early in project development, there is usually only limited scope information:

- Hypothetical project length and width;
- Line drawings on aerials;
- Statistical costs factors; and
- Length, width, and percent residential, commercial, agricultural, and industrial information for the project.

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Table 3.1. Conceptual ROW cost estimating.

Cost Estimating Step	Actions
Determine conceptual ROW estimate basis	• Review ROW requirement as documented per project type and scope • Create ROW project estimate file
Prepare conceptual ROW base estimate	• Review estimate basis • Document observations from field visit • Calculate total area by land type • Develop cost basis for each ROW element • Convert cost basis to estimate for each element • Document estimate assumptions including uncertain items • Summarize all estimate elements for total ROW cost
Determine conceptual ROW risk and set contingency	• Identify, document, and evaluate major risks • Assign a percentage contingency to account for risks • Compile total cost estimate (base plus contingency)
Review conceptual ROW cost estimate	• Review estimate basis and assumptions • Verify completeness and cost data • Review contingency amount based on identified risks
Approve and communicate conceptual ROW cost estimate	• Obtain management approval • Authorize communication of the estimate

FDOT considers that these estimates are for internal use only in developing the long-range plan. Caltrans guidance directs the estimator to mark the face of the ROW Data Sheet for this type of estimate: "NOT VALID FOR BUDGETING OR PROGRAMMING PURPOSES" and the reasons for this notation are to be indicated in the estimate's transmittal memorandum. Table 3.1 shows specific steps associated with Conceptual ROW Cost Estimating (adapted from Tables 2.2 and 2.3).

Baseline ROW Cost Estimate

The estimate completed at the end of the programming phase establishes the Baseline ROW Cost Estimate that management should use to evaluate future ROW cost estimates and alignment changes during preliminary design and during ROW acquisition. During programming, several alternative solutions may be evaluated based on project complexity; each requires a ROW cost estimate. The Baseline ROW Cost Estimate is prepared at a point in project development that is typically within 10 years or less from the projected construction letting and the ROW cost is included in the priority program.

Some SHAs include ROW cost in their priority program funding for each project that has a ROW requirement. Other SHAs use a ROW "set aside" fund or "pot of money" approach to provide funds for ROW cost. Regardless, there is still a need for establishing a baseline ROW cost for management to use in controlling project cost and managing overall program performance. The baseline cost is used to measure the effect of ROW/design tradeoffs throughout preliminary design. ROW design tradeoffs can reduce project cost. Table 3.2 summarizes the steps in preparing a Baseline ROW Cost Estimate (adapted from Tables 2.2 and 2.3).

Update ROW Cost Estimate

Estimates must be updated whenever project scope, scheduling, or cost change substantially. Updating a ROW estimate may involve little more than substituting an amended page to an

Table 3.2. Baseline ROW cost estimating.

Cost Estimating Step	Actions
Determine baseline ROW estimate basis	• Review ROW required as documented per project type and scope • Request clarification of uncertain ROW requirements • Document requirements in project estimate file
Prepare baseline ROW base estimate	• Review estimate basis • Document observations from field visit • Calculate total area by land type based on potential parcel area • Develop cost basis for each ROW element • Convert cost basis to estimate for each element • Document estimate assumptions including uncertain items • Summarize all estimate elements for total ROW cost
Determine baseline ROW risk and set contingency	• Identify risks • Assess and analyze risks • Assign contingency • Document risk analysis and basis for contingency • Compile total ROW cost estimate (base plus contingency)
Review baseline ROW cost estimate	• Determine level of review • Review estimate basis and assumptions • Verify completeness and cost data • Review contingency amount based on identified risks • Prepare estimate package for approval
Approve and communicate baseline ROW cost estimate	• Obtain management approval • Authorize communication internally and externally

otherwise current estimate or could involve preparing a completely new estimate based on better information concerning real estate requirements or costs. Once a project is part of the STIP, updating the baseline estimate may occur periodically (typically annually) or whenever it is determined that the latest estimate is no longer valid. Table 3.3 depicts the steps for creating the Updated ROW Cost Estimate (adapted from Tables 2.1 and 2.2).

Project Complexity and Effect on Cost Estimation

The level of effort for planning and developing projects depends on project complexity. Tables 3.4, 3.5, and 3.6 describe three different project complexity scenarios. These tables are based on the Recognition of Project Complexity Tool (*NCHRP Report 574,* Tool Appendix R1.1). The ROW complexity scenario that describes a project will affect the need for and degree of the ROW CE/CM effort. For instance, projects in the most complex category (major projects) will require several estimates because of the need to evaluate several alternatives for a major project, including consideration of significant environmental impacts. In this category, ROW requirements may indicate that numerous people will have to be relocated from their residences or that commercial and/or industrial properties will be displaced. With a potential for several alternative solutions and significant environmental analysis, several ROW estimates probably will be required before a preferred alternative and alignment are selected.

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Table 3.3. Update ROW cost estimating.

Cost Estimating Step	Actions
Update ROW estimate basis	• Review current ROW plans and compare with previous requirements • Identify changes and potential magnitude of changes • Request clarification of uncertain ROW requirements • Update estimate basis in project estimate file
Update ROW base estimate	• Review updated estimate basis to understand changes • Document observations from field visit to confirm modifications • Review changes to existing estimate assumptions/limitations • Calculate total area for by land type for each parcel • Revise cost basis for each ROW element • Convert cost basis to update estimate for each element • Update estimate documentation include uncertain items • Summarize all estimate elements for total ROW cost
Update ROW risk and set contingency	• Review risks • Update risks as necessary • Update contingency value • Document updates to risk and contingency • Update total cost estimate (base plus contingency)
Review update ROW cost estimate	• Review estimate changes (basis and assumptions) • Verify completeness and cost data for changes • Review effect of changes on contingency amount
Approve and communicate updated ROW cost estimate	• Review impact of changes • Obtain management approval • Authorize communication internally and externally

Moderately complex projects will typically require fewer relocations and displacements, so fewer ROW estimates will be needed. Less complex projects may require only a few ROW acquisitions and therefore a minimal effort will probably be required to estimate ROW costs. Finally, some projects do not require right-of-way. Thus, complexity is a consideration when preparing ROW cost estimates and when managing ROW estimates. Complexity levels, with respect to projects with right-of-way, are considered in the specific guidance described in Chapters 4 through 6.

ROW Cost Management

Cost management during the final design phase of project development keeps the project development team current on how actual ROW acquisition costs compare with estimated cost. During this phase, the completed ROW plans are used as a basis for the appraisal and acquisition process given that all parcels are known, including whether there will be a whole take or partial take and the effect of the take on existing conditions. Cost management consists of three steps as shown in Table 3.7 (adapted from Table 2.2). The first step focuses on a final budget check based on completed ROW plans. The second and third steps in Table 3.7 occur after the appraisal and acquisition process commences. These two steps focus on the resulting effect to the budget caused by considering actual acquisition costs of the right-of-way.

Table 3.4. Most complex (Major) project attributes (*NCHRP Report 574* and PennDOT).

	Most Complex (MAJOR) Projects
Roadway	• New highways; major relocations • New interchanges • Capacity adding/major widening • Major reconstruction (4R; 3R with multi-phase traffic control) • Congestion Management Studies are required
Traffic Control	• Multi-phased traffic control for highway or bridge construction that would mandate CPM during construction • Major ITS (Electronic surveillance, linkages) corridor project
Structures	• Replacement, new or rehabilitation of: - Unusual (non conventional like segmental, cable stayed, major arches or trusses, steel box girders, movable bridges, etc.) - Complex (sharp skewed (less than 70 degree) superstructure, non-conventional piers or abutments, horizontally curved girders, three dimensional structural analysis, non-conventional piles or caisson foundations, complex seismic analysis, etc.) - Major (bridge cost of $5 million or more—Federal definition) - Unusual formations (caissons, uncommon piles, mines, Karst situation)
Right-of-Way	• ROW plans are needed and numerous relocations of residences or displacement of commercial and/or industrial properties are required. A few to over 20 property owners are involved. Major involvement of environmental clean-up. Before and after analysis
Utilities	• Major utility (transmission lines, substations) relocations or heavy multi-utility coordination is involved
Environmental	• Environmental Impact Studies are required or complex Environmental Assessment without mitigated finding of no significant impact • Studies of multiple alternatives • Continued public and elected officials involvement in analyzing and selecting alternates • Other agencies (such as FHWA, COE, PHMC, Game Commission, Fish & Boat Commission, DEP, DCNR, EPA, Agricultural Board, etc.) are heavily involved to protect air; water; games; fish, threatened and endangered species; cultural resources (historical, archaeological, parks, wetlands, etc), etc.
Stakeholders	• Controversial (lack of consensus) and high-profile projects. (Fast track design/construction, high public impact, high interaction of elected officials, etc.) • Major coordination among numerous stakeholders is required.

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Table 3.5. Moderately complex project attributes (*NCHRP Report 574* and PennDOT).

	Moderately Complex Projects
Roadway	• 3R and 4R projects which do not add capacity. • Minor roadway relocations. • Certain complex (non-trail enhancements) projects. • Slides, subsidence.
Traffic Control	• Non-ITS but major safety improvements. • Interconnected traffic control/management projects.
Structures	• Non-complex (straight geometry with minimal skew; designs using AASHTO description factors; minimal seismic analysis; footings on rock or conventional piles and abutments) bridge replacements with minor (<610m [2,000 ft]) roadway approach work. • Bridge rehabilitation which requires re-analysis of bridge capacity. • Bridge mounted signs. • Tie back walls. • Noise walls. • Proprietary/non-proprietary walls.
Right-of-Way	• ROW plans needed with less than 20 moderate to significant claims and very few relocations or displacements.
Utilities	• Some utility relocations, most of it prior to construction, but no major utility relocations.
Environmental	• Categorical Exclusion Level 2 or mitigated Environmental Assessment projects. • Cultural resources (historical, archeological, etc.). Coordination with Museum Commission, FHWA, and/or Advisory Council • Wetland mitigation • Parkland involvement • Water and air pollution mitigation • Major coordination with Game or Fish and Boat commissions • Endangered species
Stakeholders	• Involvement of public and public officials is moderate due to non-controversial project type • General communication about project progress is required

Table 3.6. Non-complex (Minor) project attributes (*NCHRP Report 574* and PennDOT).

Non-Complex (MINOR) Projects	
Roadway	• Maintenance betterment projects • Overlay projects, simple widening without right-of-way (or very minimum ROW take) little or no utility coordination • Non-complex enhancement projects without new bridges (e.g. bike trails)
Traffic Control	• Single traffic control/management projects • Non-ITS but minor safety improvements
Structures	• Bridge resurfacing or repairs which do not require re-analysis of bridge capacity • Pipes, box culverts or minor culvert replacements where design can be picked directly from design manual or standards or using simple software where detailed interpretation is not necessary • Sign structures for which the design can be picked up directly from either the standards or using design computer software • Noise walls or retaining walls for which the design can be picked up directly from either the standards or using design computer software
Right-of-Way	• Involve minor ROW acquisitions with no displacements, maintain existing access control
Utilities	• Minimal, if any
Environmental	• Categorical Exclusion (Level 1A or 1B) • Minimum interaction with environmental and permitting agencies • Minor environmental impacts as appropriate have a Statewide Wetland Finding • Do not involve cultural resources, hazardous waste, Section 4(f) evaluations or substantial flood plain encroachments
Stakeholders	• No public controversy

Table 3.7. Cost management steps.

Cost Estimating Step	Description
Assess right-of way scope, conditions, and cost	• Compare final right-of way plan requirements with previous requirements • Identify specific changes in right-of way requirements by parcel • Estimate cost impact on each affected parcel • Compare with current budget for impacted parcel
Evaluate potential cost impact	• Compare actual right-of way cost against current STIP budget by parcel • Determine cost impact on total right-of-way
Adjust right-of way budget	• Document changes including changes to estimate basis and assumptions • Notify project development team of modified budget

Chapter Summary

This chapter provided an agency overview of a process approach to cost estimating and cost estimate management covering project right-of-way. Four distinct processes were briefly described, including steps and actions to implement these processes. General estimating concepts were presented, including ten common ROW estimate elements and key inputs required to prepare estimated costs for the ten elements. Project complexity scenarios were presented because project complexity affects ROW cost estimating and cost management requirements. Chapters 4 through 6 provide specific guidance on ROW cost estimating and cost estimating management during planning, programming, and preliminary design. Chapter 7 focuses on ROW cost management during final design.

CHAPTER 4

Conceptual ROW Cost Estimation

States are required to develop long-range transportation plans. Federal law requires that SHAs develop a statewide transportation plan and that MPOs develop a regional transportation plan [23 U.S.C. 134(g) (2); 49 U.S.C. 5303(f)(2); and regulations 23 CFR 450.322(a)]. The planning horizon for these long-range plans is usually 20 years or more in the future. FHWA advises that it is "prudent" for MPOs to adopt plans with 23- to 25-year horizons so that (during the life of the plan) the plan would not fall below the 20-year threshold at any time (Shepherd, 2005). Approaches by SHAs to statewide transportation planning, or at least terminology, vary across the country. Although some SHAs identify major or even unique minor projects, most statewide transportation plans do not identify specific projects, but rather establish strategic direction for state investment in the transportation system. The MPO regional transportation plan is very different. The MPO regional transportation plan identifies specific projects to be implemented over a 20- to 25-year planning horizon. Federal law requires that the statewide and MPO plans be consistent and that development of the plans include participation by both groups, along with other stakeholders such as local government agencies.

Introduction

Planning level cost estimates can significantly affect the overall transportation program and thus the ability of SHAs and MPOs to meet transportation needs. The term "conceptual estimating" is used here to describe the general method of cost estimating during the planning phase.

When real estate acquisition is required to support project scope development, ROW requirements are determined such that a conceptual estimate of ROW cost can be prepared. This conceptual ROW cost estimate provides an "order-of-magnitude" cost for planning purposes. The extent of this estimating effort varies depending on project complexity and the anticipated letting date for the projects. For example, non-complex or minor projects with minimal ROW requirements can possibly be estimated strictly as a percentage of construction costs. Moderately complex and major projects need at least a limited definition of scope to identify real estate requirements before a conceptual estimate can be prepared. The benefit of performing such estimates, in addition to meeting Federal requirements, is that these estimates can support the queue of projects that enter the programming phase of project development.

Conceptual ROW Cost Estimation Flowchart

Figure 4.1 is a generic flowchart for creating a Conceptual ROW Cost Estimate. As shown in Figure 4.1, this conceptual cost estimate for right-of-way is prepared during the planning phase of project development. Conceptual ROW cost estimates support SHA/MPO long-range plans.

Figure 4.1 shows the CE/CM steps from Table 3.1 for preparing the Conceptual ROW Cost Estimate and then approving and communicating that estimate for incorporation in a long-range plan. The estimating process is initiated by program planners with assistance from functional disciplines and especially ROW staff. The input from program planners is referenced as ROW requirements in Figure 4.1. In many instances, the planner is also the estimator responsible for the ROW component of conceptual estimates. Even if the planner has primary responsibility for preparing the estimate, contact should be made with knowledgeable staff in the ROW section [Tool R2.6 (see Appendix A for all tools)]. ROW staff may not be comfortable with conceptual estimating techniques, because staff are more attuned to parcel specifics, but staff can provide valuable historical data for preparing this early estimate.

As the process steps are performed, the planning estimator uses various inputs to complete the steps necessary to achieve a good conceptual estimate. Projected land market values are the key input for a Conceptual ROW Cost Estimate. Other inputs include historical data to develop typical cost percentages for improvements, condemnations, damages, relocation costs, settlements, and labor costs. An inflation or appreciation rate is another important input. Some of the expected cost elements that are not yet definitely defined may be handled as allowances. Finally, the planning estimator should have knowledge of the project's location-specific conditions. Such knowledge can be gained through area maps or by using free web access to aerial views of the project location. For more complex projects (moderate and major), a site visit is advisable to gain appropriate knowledge of site conditions.

Once all of the estimate development steps are performed, the process output is a Conceptual ROW Cost Estimate. This cost estimate will be incorporated in a long-range plan or it may be used to determine planning feasibility (e.g., exclude a project from the long-range plan). These ROW cost estimates may be updated periodically, but typically no less than every 5 years. More detailed discussion of Figure 4.1 is provided next.

Determine Conceptual ROW Estimate Basis Step

The foundation for every estimate is the source information that affects the estimator's decisions and judgments. This source information is termed the **basis of the estimate.** Therefore, in Figure 4.1, the first step is Determine Conceptual ROW Estimate Basis. The ROW estimator should document the ROW requirement assumptions—both those provided by the planning team and others made in support of estimate development.

Project Complexity

Project complexity can be described by attributes such as those shown in Tables 3.4 through 3.6. If the project is classified as complex or major, the required inputs that describe the estimate basis should be sufficiently broad to encompass different alternative solutions without the necessity of creating individual estimates. Establishing the study area boundaries for real estate land values, expected inflation/appreciation rates, and other ROW cost items should be broadly defined to cover all the alternative project limits. Moderately complex projects may not require alternative analysis; however, there may still be potential improvements and displacements to consider. The study area can possibly be reduced for these types of projects. As a result, the type of infor-

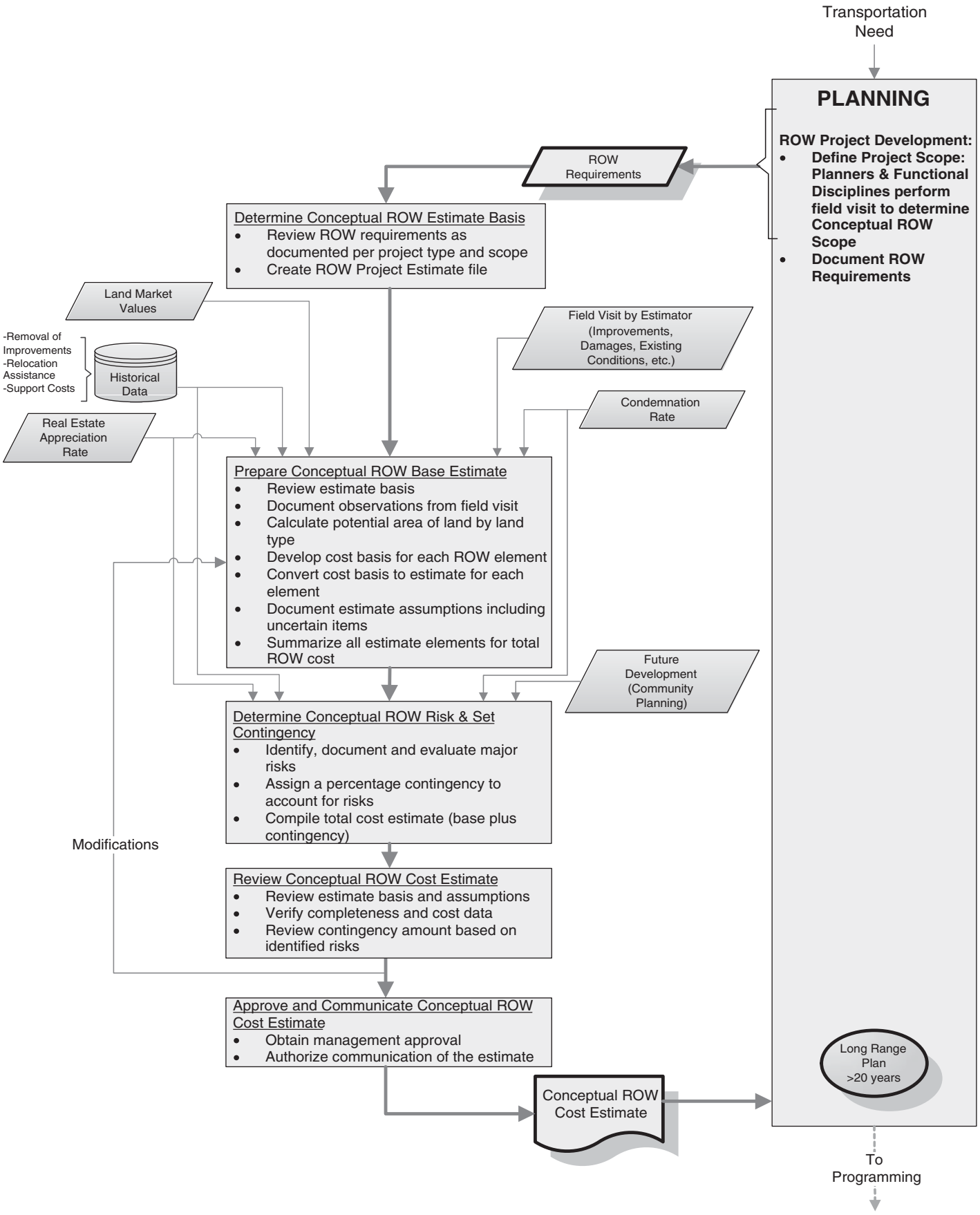

Figure 4.1. Conceptual right-of-way cost estimating process flowchart for planning.

mation documented in the Determine ROW Estimate Basis step for a moderately complex project as compared with a complex project would be less descriptive of the project's specific ROW requirements and more descriptive of the selected historical data used to create the estimate. The discussion that follows is based on knowing only the project location with a broad perspective on the study area and the assumption that no specific designs have yet been developed.

Planning Phase Inputs

Typically, the planning inputs for right-of-way consist of broad concepts such as length and a basic project type (e.g., lane expansion) from which a width can be assumed. All that may be known is the location of the project and general project limits, that is, from Point A to Point B with an approximate width. Conceptual ROW requirements are most often determined by program planners. The intent is to provide sufficient scope definition such that an order-of-magnitude conceptual estimate can be prepared. Although project plans do not yet exist, typically the planner will describe ROW requirements using

- Schematic plans or aerial photographs with the project study area marked. The study area is influenced by requirements such as the limits of the project, number of lanes added, and other key project elements.
- Information on unique site characteristics that may affect different ROW elements (e.g., expected project structures that affect ROW width requirements).

Process Step Description

The ROW estimator should

1. Review ROW requirements for the project. Study the area schematic plans and/or aerial photographs to gain an appreciation for the general area of the project. Specific site conditions identified as potential effects on ROW costs should be noted.
2. Document the requirements in a ROW Cost Estimate File. Documentation is extremely important (all assumptions should be documented) to ensure initial ROW requirements are identified and can be easily retrieved later when the project enters the programming phase and a baseline estimate is prepared.

Tools

A plan view of the study area for the project is one document that the ROW estimator can use (see Figure 4.2). This plan view inscribed on an aerial photo or topographic map of the study area can provide additional insights into structures and the geography of the study area that may affect ROW costs such as improvements (e.g., structures, utilities, and potential access points). Another tool is early scope definition where the planner collaborates with other functional disciplines, including ROW staff, to visit the site location and mark on an aerial photograph the expected project limits as based on the physical constraints found on the ground.

Tips

Planning and other functional disciplines including ROW staff (even when ROW staff are not responsible for preparing the estimate) should interact frequently when developing the early ROW requirements for a project. This is especially important for projects (or corridors) in the complex and major categories. Other practices that support early ROW estimating are use of the following:

- Early scope definition to document physical features in the general area where real estate is required;

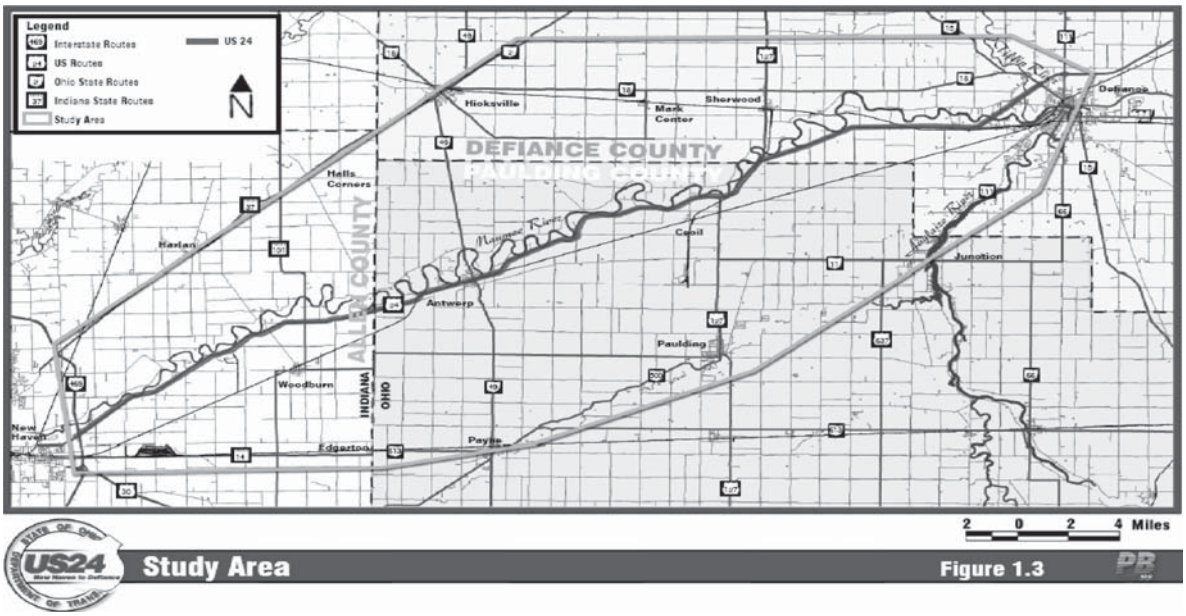

Figure 4.2. Aerial photo with the gross boundaries for a proposed project identified.

- Aerial photographs or web aerial views to provide insights into structures or other site characteristics that will affect ROW costs; and
- Existing SHA mapping, county profiles, or web aerial views to study the surrounding area.

Outputs

An output of this step is a list of ROW requirements; these requirements form the basis for the planning level conceptual cost estimate. This list should be documented in a project ROW Cost Estimate File (Tool D4.1). Thus, the main output of this step is a project ROW Cost Estimate File. This file will be populated with additional information as subsequent steps in the cost estimating process are performed.

Prepare Conceptual ROW Base Estimate

Once the estimate basis is documented, the planning ROW estimator can prepare the conceptual ROW base estimate. This estimate is an order-of-magnitude estimate of anticipated costs, given normal project conditions. It is important that all elements of ROW costs be covered. This should not, however, include a contingency to cover risks due to unknown events or unknowns related to the information used to prepare the estimate. The key output of this step is a conceptual ROW base cost estimate **without contingency.** This is typically the first ROW estimate prepared for a proposed project.

Project Complexity

Two types of complexity must be considered by ROW estimators. First there is "project complexity," and Tables 3.4 and 3.5 provide guidance for such a determination. Complexity in terms of the total project would lead an estimator to develop the cost basis data sufficiently broadly to encompass the different alternative solutions while not having to create separate base cost data for evaluating each solution.

Second, there is complexity of the expected ROW activities. This type of complexity will influence estimator actions when preparing the Baseline and any Updated ROW estimates. Answers to the following questions can indicate a complex ROW situation may exist:

- Will estimating the value of parcels be difficult because market data (e.g., comparable sales) are insufficient or non-existent?
- Is the anticipated value of the proposed acquisition over some minimum amount based on SHA averages for similar types of property?
- Are buildings, wells, signs, and so forth affected?
- Is the anticipated value of the proposed acquisition severing any buildings from the remainder?
- Are trees, shrubs, or any other landscaping efforts involved?
- Does moving the proposed ROW line require analysis of possible proximity damages?
- Is access to the property changed or limited?
- Is the current highest and best use of the property going to be changed as a result of the proposed acquisition?
- Does a significant amount of the total compensation involve items other than land value?
- Is there reason to believe this parcel will proceed to condemnation?
- Is more land than actually needed being acquired?
- Does the proposed acquisition affect the sewage disposal system or property drainage?
- Are there any other considerations that complicate the valuing of this parcel?

If the answer to any of these questions is yes (or even maybe), the parcels may have sufficient complexity to classify the project as complex in terms of ROW activities. "Yes" answers should alert estimators to carefully consider assigned cost and that more questions need to be asked. In preparing conceptual estimates, the estimator is still dealing with a general area containing all alternative alignments, and it would be difficult to answer these specific parcel questions. However, once an alignment is determined, the estimator must start considering a definition of complex in terms of parcels.

Moderately complex projects, under the Table 3.4 definition, may not require alternative analyses; however, a few potential improvements and/or displacements within the study area may need to be considered. The study area for moderately complex projects can probably be reduced compared with that of a complex or major project. The Prepare Conceptual ROW Base Estimate step may be repeated, depending on the planning horizon in which the project falls (i.e., years out from letting time period) and the complexity of the project.

Whenever scope changes are made, it is necessary to cycle through the estimate preparation steps again so that there are no cost blackout periods during project development. The types of cost information needed to create a revised conceptual estimate will be the same; however, the actual data to support an estimate usually change with time. For example, total acreage may be the same, but the approximations of percentages of land that is residential, commercial, industrial, and agricultural could differ.

Inputs

The first and most important input is the estimate basis as documented in the ROW Cost Estimate File (Tools D4.1 and R2.8). The file should include schematic drawings or aerial photographs showing the study area and all supporting field notes. The information contained in the file is used by the ROW planning estimator to develop data for the various elements of the ROW cost estimate.

As shown in Figure 4.1, other critical inputs are needed in order to develop the ROW cost estimate. The three main elements are

1. **Land Market Values.** Cost ($) per acre by type: residential, commercial, industrial, and agricultural. These values are frequently based on historical data, using tax assessor data or county records on sales activity to reflect approximate real estate values close to the project location. This cost could also include land with structures. Ranges are frequently available to the planning estimator.
2. **Historical Data.** Percentages can support the determination of appropriate costs for
   – Removing improvements from purchased real estate;
   – Reduction in value due to damages;
   – Potential for settlements due to condemnation;
   – RAPs, based on percentages of land costs (e.g., residential, commercial, and agricultural); and
   – Labor costs, including external labor for titles, appraisals, appraisal reviews, negotiation and so on considered on a percentage basis of land costs.
3. **Real Estate Appreciation Rate.** ROW cost index to capture expected real estate appreciation occurring between the time when the base cost estimate is prepared and when acquisition will occur. These data are often provided by an SHA financial division.

A critical input that Figure 4.1 calls attention to is the need for a field visit by the ROW planning estimator. Although aerial photographs provide insights, a field visit will crystallize these insights and help to identify potential effects of ROW acquisition on existing facilities such as structures and access points. The site visit can identify any changes to the site that occurred after the aerial photograph was taken. Insights of other disciplines may be required, depending on the complexity of the project. For example, a quick assessment of any potential environmental impacts may necessitate an increase in the estimated acres for environmental mitigation. Similarly, inputs may be necessary from utilities and railroads functional groups. The need for such input may result from observations obtained via the planning estimator's site visit.

Process Step Description

The ROW estimator should

1. Review the estimate basis to understand the location-specific characteristics that affect real estate cost, including existing conditions and physical site limitations that might affect right-of-way.
2. Document observations from a field site visit. Listed items should include potential improvements and damages due to ROW acquisition and confirmation of the assumed conditions. This information can influence the appropriate estimating data used for assigning land values and percentages to cover other ROW cost elements.
3. Calculate potential area of land by land type. Estimate total acreage of land in the area of the project based on gross boundaries. The land area should be estimated by land usage type, based on a combination of information from aerial photographs and county profiles. This evaluation provides an estimate of the land as follows: % agriculture, % residential, % commercial, and % industrial.
4. Develop a cost basis for elements such as land values, percentage adjustments to account for improvements, relocation assistance, support costs, and other related costs. Land values could come from historical data. Such data could include just the land value or could incorporate other costs such as improvements and damages. If they are not already available, develop percentages to account for other cost elements such as percentage of the total land cost that would require administrative settlements at a set percent higher than the estimated costs.
5. Convert cost basis to estimate of costs for each element (agricultural acres times $ per acre) based on current-day dollars.

6. Document estimate assumptions (i.e., write down any assumptions made when developing the cost basis from historical data or other sources). Document the logic behind initial assumptions and log the source of all supporting data.
7. Apply the appropriate inflation/appreciation rate to estimate cost at time of purchase and summarize estimate elements for the total base cost estimate of right-of-way for the project.

Tools

A basic tool used to prepare ROW cost estimates in many SHAs is a Cost Estimate System (Tool R2.8). This system should be able to produce estimates based on different levels of available information. Typically, worksheets or a series of spreadsheet tabs are used to create such systems. The Cost Estimate System could have tabs to cover historical percentages for some of the estimate elements. The Cost Estimate System at the planning level could be very simple, but should provide sufficient information so that the basis, assumptions, and limitations that support the development of the cost estimate are documented and easy to review. Some ROW estimators and planners have developed their own computer spreadsheets for generating these early estimates.

Tips

Although the conceptual estimate is prepared based on very limited information, the planning estimator should consider

- Keeping the estimate approach simple because time to prepare these early estimates is usually limited.
- Using the expertise of functional disciplines to help provide data and supporting information.
- Documenting every component of the estimate, even when limited information is available.
- Making a site visit for complex (or major) projects.
- Remembering that the conceptual cost estimate prepared during planning is the initial ROW cost estimate. It is often revised during planning, but eventually it becomes the starting point for future ROW estimates when a project enters the programming phase.
- Using tax assessor data, which has low data gathering costs and may be collected by in-house staff familiar with computers or court houses (not Appraisers). Note: such data have disadvantages—potentially data may be dated, estimated property values may be understated or overstated by auditors, and data may not reflect current local development activity that may drive a road improvement projects.
- Using market data from county records. This can be accomplished quickly, with less experienced staff and, hence, is less costly; however, the accuracy of such data can be suspect in many instances.

Outputs

Two main outputs are related to this step. The first, a Conceptual ROW Base Estimate, would be generated by the ROW Cost Estimate System tool. The second is the ROW Cost Estimate File. This file will be populated with information related to the cost basis for each estimate element and assumption and limitation statements regarding the cost values derived from historical databases or other sources.

Determine Conceptual ROW Risk and Set Contingency

The acquisition of even a few real estate parcels can be extremely complex and fraught with uncertainty. Planners must consider a multitude of technical, organizational, and human factors when estimating ROW costs. Often, the engineering and construction complexities are

overshadowed by economic, societal, and political challenges to the acquisition. The outcome of meeting these challenges has too often resulted in significant cost escalation. An analysis of the risks and uncertainties involved in a project, even at the conceptual level, and a thoughtful assignment of a contingency to address these risks can help to avoid cost escalation later in the project.

Inputs

The primary input for identifying risks is a review of the ROW requirements and base estimate assumptions contained in the ROW Cost Estimate File. Anytime a planning estimator makes an assumption, risk is introduced into the estimate. The level of risk will depend on the assumption. The second input is the Conceptual ROW Base Cost Estimate itself. The estimator should review the estimate for risks. Additionally, the estimator must remove any contingency from estimate line items and state the estimate's contingency as a separate amount. All of these items will be found in the ROW Cost Estimate File.

Process Step Description

At the conceptual estimate stage, the risk and contingency process will necessarily be succinct because of the limited information available. The two primary steps for this risk analysis process involve (1) identifying, documenting, and evaluating major risks; and (2) assigning a percentage contingency to account for those risks. To avoid any "double counting" of contingency, the ROW estimator must ensure that no contingency is included the conceptual ROW base estimate and that the overall project estimate does not include a separate contingency value for ROW risk or uncertainty. The outcome of this step is to determine the risk associated with the conceptual ROW estimate and to fix a contingency that can be added to the conceptual ROW base estimate to create a total Conceptual ROW Cost Estimate (base estimate plus contingency). Explicitly communicating the risks and associated contingency to all internal and external stakeholders will eliminate double-counting and misunderstanding about the estimate's validity.

Identifying, documenting, and evaluating project risks associated with a conceptual estimate is the first step and begins by asking all planning team members involved in the ROW planning to make a list of ROW acquisition "issues and concerns." This can be accomplished as the scope and estimate basis are developed or through a brainstorming session when the estimate is prepared. The Ohio DOT (ODOT) calls these risks and uncertainties "red flag items" (see Ohio DOT, Appendix H—Red Flag Summary, http://www.dot.state.oh.us/pdp/PDPmanual/pdfs/H_Red_Flag_0107.pdf). This agency identifies these red flag items primarily to focus the engineering efforts on the problematic items. These problematic engineering items are generally the issues that cause cost escalation and should be accounted for with a contingency amount in the estimate. Additionally, risk checklists can be referenced at the end of the risk identification process so that commonly encountered risks are identified. The FHWA-identified objectives of a formal risk management process are (Molenaar, Diekmann, and Ashley, 2006) as follows:

1. Identify and categorize risks that could affect the project and
2. Document the risks.

The outcome of risk identification is a log or list of possible risks.

The second step is to set a percentage contingency to account for the cost consequences of the identified risks and uncertainties. At the conceptual estimate stage, the percentage contingency is most often set from a standard chart of percentages with the selected values dictated by agency policy. These percentages will vary by SHA and with estimator experience. The final step is to compile the total cost estimate (base estimate plus contingency).

301.6 Red Flags

***Red Flags**, including environmental and engineering issues, are locations of concern within the study area. Red Flags do not necessarily identify locations that must be avoided, but rather, identify locations that will entail additional study, coordination, design, right-of-way, or construction cost. Locations that must be avoided are referred to as "fatal flaws." The project manager should ensure consultation with the appropriate specialists to determine the level of concern for each Red Flag item. Both environmental and design Red Flags are identified on the Red Flag Summary.*

Figure 4.3. Ohio DOT red flag example.

Tools

The primary tools for risk identification and setting of contingency at the conceptual estimate stage are

- Red Flag Items (I2.1);
- Risk Checklists (I2.3); and
- Contingency–Percentage (R3.3).

Red Flag Items (Tool I2.1) are a listing of assumptions, issues, and concerns. This list is created at the earliest stages of project development and maintained as a reference as the project progresses through development. This list, perhaps the simplest form of risk identification and risk management, helps planning estimators understand the purpose of the contingency amount and helps managers to control scope growth effectively. ODOT includes identifying Red Flag Items in their comprehensive approach to ROW cost estimating. Figure 4.3 is an excerpt from their Project Development Process (PDP) manual concerning Red Flag Item identification on ROW estimates for minor projects:

Risk Checklists (Tool I2.3) are another tool for risk identification. Checklists should be used only after the project team has, on its own, identified the risks (e.g., through the creation of a Red Flag List). Risk Checklists are developed from analysis of risks identified or realized on past projects. A detailed Risk Checklist is provided in Chapter 5, Determine ROW Risk and Contingency, and in the Tool Appendix.

Table 4.1 and Figure 4.4 provide percent contingencies at various project development phases as defined by the Maryland and Ohio DOTs, respectively. These percentages provide a starting point, but each SHA should (1) develop its own policy for an appropriate range of contingencies for ROW estimates and (2) ensure that the contingency is included only in the ROW estimate or the overall project estimate, but is not applied twice.

Tips

Each project is unique and reflects a specific situation and geographical location. Therefore, each project should be looked at as a distinctive undertaking. The planning estimator should

Table 4.1. Maryland DOT graduated-scale contingency.

Project Phase	Contingency
Planning	35-40%
Programming and Preliminary Design	25-35%
Final Design	0-25%

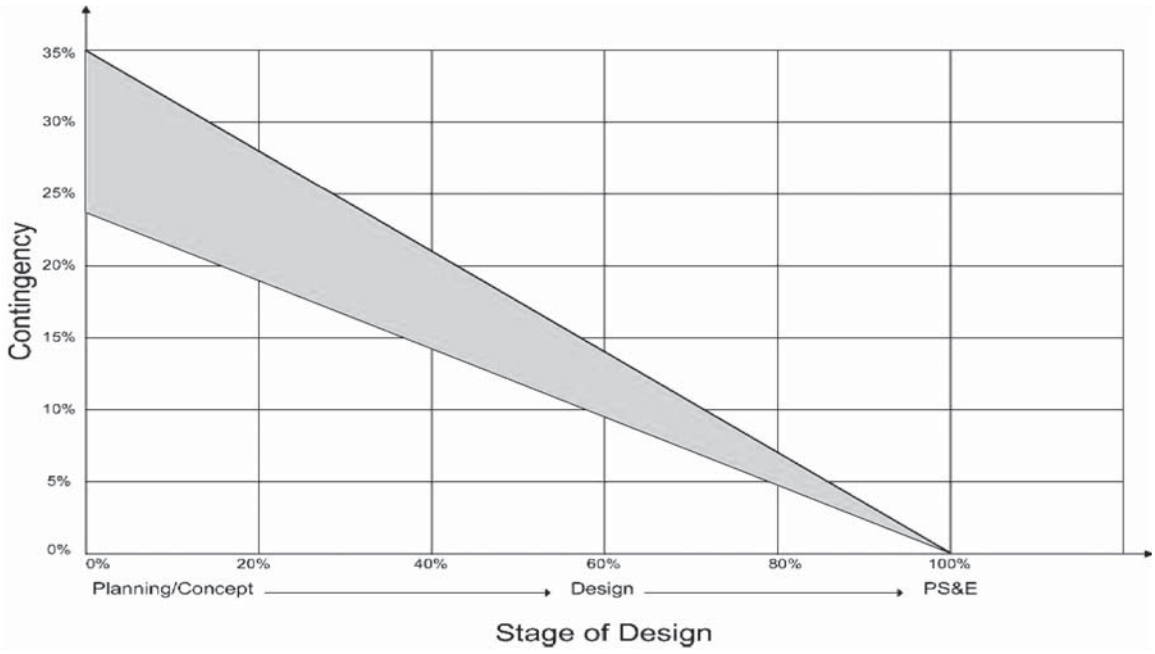

Figure 4.4. Ohio DOT design completion contingency guidelines for cost estimating of major projects.

- Gather issues and concerns (or risks) from all parties involved in the project.
- Include all risks, no matter how small the effect may seem at this early stage of project development.
- Use a risk checklist at the end of the process to avoid missing commonly experienced risks.
- Develop policy regarding percentage ranges of contingencies to ensure consistency and as guidance, but allow planning estimators with project knowledge to choose an appropriate project-specific contingency.
- Ensure that the all contingencies have been removed from the base estimate.
- Ensure that the contingency is included in only the ROW estimate or the total project cost estimate, but not in both.

Outputs

The outputs of this process step are (1) a list of risks, issues, and concerns and (2) a percent contingency to apply to the base estimate to arrive at the total conceptual ROW cost estimate. The list of risks will provide an early indication of where the planning and engineering teams should expend their efforts and the potential costs effects that estimators should be aware of as they develop future estimates. The use of a transparent contingency amount with an associated list of risks will help to avoid future cost escalation and will help management contain project costs. The use of a transparent contingency will also help to communicate estimate uncertainty to internal and external stakeholders. The Cost Estimate System should incorporate the contingency value to provide the total Conceptual ROW Cost Estimate.

Review Conceptual ROW Cost Estimate

Because Conceptual ROW Cost Estimates, prepared during the planning phase of project development, are based primarily on assumptions by the planning estimator based on experience, these estimates should only be developed by experienced estimators. Except for very routine

projects, there is limited definitive information about scope and ROW requirements at this stage in project development; therefore, the right-of-way estimated reflects gross extrapolations from historical data.

Inputs

Besides the estimate proper, the reviewer will require the ROW Cost Estimate File. The review will closely examine the assumptions stated as the basis of the estimate and will consider the appropriateness of the contingency factor based on the documentation risk analysis.

Process Step Description

Conceptual estimates have a substantial range, in terms of precision, in predicting the actual final cost of acquiring the necessary project real estate. This lack of precision results because only preliminary information is known about the project and because estimators must make assumptions about the dynamics of future real estate market changes. These ROW estimates should, therefore, be reviewed for the validity of their basis (i.e., the underlying assumptions); however, the formality and depth of the review will vary depending on the complexity of the real estate issues.

By defining and recognizing project complexity, a proper review can be conducted. Additionally, over time, critical issues can be identified based on different levels of project complexity. This list of issues is useful in conducting future reviews. This "institutional memory" should eliminate some of the relearning that often occurs during the development of projects.

Although this review is depicted as a single activity, it would normally be repetitive, taking place to some extent whenever a conceptual estimate is revised. The review of a conceptual ROW estimate is particularly important during planning because there are often issues relating to land value market condition projections that are beyond the expertise of project planners. If the estimate was prepared by planning staff, which is common in many SHAs, it should be reviewed by ROW staff. The review will verify that peripheral costs (e.g., damages, improvements, relocation assistance, and court and administrative costs) are accounted for in the estimate.

Tools

This is an estimate based almost solely on historical cost averages and data representing similar conditions and location characteristics. An internal review by experienced peers can identify inappropriate use of data and omissions (Tool E3.3).

Tips

Knowledgeable and experienced individuals who are independent of the project team must conduct this review. The agency should provide training for ROW estimators and those responsible for reviews of ROW estimates (Tool R2.5). The need for training has been argued in many forums—Dennis Stork, Exec. V.P. International Right of Way Association stated:

> When it comes to investing in human capital, it appears that some decision makers focus on the cost, not the value, for their organization or business. One modern way of addressing this issue has been the trend toward "return on investment" for calculating the economic value of educational expenditures (*Right of Way Magazine* March/April 2006).

For a project with complicated ROW issues, a field check by the reviewer may be justified. One SHA recommended field reviews that specifically consider the following:

- What is affected,
- Types of real estate,
- Relocation requirements, and
- Demolition requirements.

The field check should critique the effect that the project will have on the property to be acquired. The FHWA warns that "A very small change in the location of the ROW line, or a change in access control or drainage retention placement, particularly in commercial areas, can affect the ROW cost estimate by many millions of dollars because of required damage payments such as severance or business damages."

Outputs

If the review finds no issues, the estimate and summary documentation moves to the Approval step. Some times the review will recommend modifications to the estimate before it is moved forward for approval. In that case, there is a cycle back through the prepare estimate and risk steps before the estimate is advanced for approval.

Approve and Communicate Conceptual ROW Cost Estimate

Agencies should establish formal estimate approval processes. Approvals obligate agency management and external parties to recognize and acknowledge project scope, schedule, and cost.

Inputs

The reviewed conceptual ROW cost estimate package, the cost estimate and its documentation are the input for obtaining an estimate approval.

Process Step Description

To control project cost and achieve accurate project estimates, agencies must have management structures that screen and control project scope, schedule, and cost. As project complexity increases, such management structures become critical. Approval processes promote estimate quality by establishing an organizational structure that shields lower-level staff and estimators from influences that can cause project cost growth. Approval processes place the authority and responsibility for project scope and schedule changes where there is a much broader knowledge base of how the project fits into the agency's total transportation program. Another important function of approvals is to ensure that management is kept informed of a project's current scope, schedule, and cost so that surprises are eliminated.

The approving authority, by signing off on the estimate, indicates agreement with the estimated cost amount and that the estimate can be communicated to other staff in the agency and to external parties. The approval must be given in writing and a copy of the approval document should be kept in the estimate file.

How project estimates and estimate precision are communicated is important in controlling expectations. This is particularly true during the earliest stages of project development. Internally, senior management must convey the importance of a project estimate and that the projected cost

is based on the stated project scope. If cost is to be managed successfully, scope must be controlled during all phases of project development. Communication of cost uncertainty is important internally and externally. Identification and communication of the project's early stage uncertainty and the fact that unknowns can affect scope and costs will help in managing project expectations.

Tools

Tools that establish a set of standards and procedures within an SHA to guide ROW estimate practice through the various stages of project development alleviate cost escalation by consistently providing timely feedback to management on the potential effect of changes to project budgets. Procedures provide a basis for managing costs and match responsibility with authority to make decisions regarding changes to current budgets (Tool B1.3, Standardized Estimation and Cost Management Procedures).

Tips

To support the approval process, estimators must communicate the level of uncertainty and assumptions associated with an estimate so that management and others using the estimate do not make inappropriate decisions (Tool C1.2, Communication of Uncertainty).

Externally, communication of estimate uncertainty is possibly more critical to project success than the transmission of an approved estimate to program planners. To maintain credibility with stakeholders, it is important to "tell the public the truth" about project cost and to explicitly identify the precision of an estimate. Transparency in estimate communication is sometimes difficult because external stakeholders often want "one number" before an accurate estimate can be made by even the best estimators and planners, but transparency of costs will be best over the duration of a project.

Outputs

The approved Conceptual ROW Cost Estimate is transmitted to the program planners for inclusion in the total estimated project budget and eventually in long-range plans.

Chapter Summary

Conceptual ROW cost estimation during planning was the focus of this chapter. The general process for preparing, reviewing and approving this estimate was presented. The conceptual estimate is based on broad assumptions regarding the project requirements for right-of-way. Historical data are mainly used to develop costs for each estimate element. Even at the planning level, the planner should consider risks before assigning a contingency value to cover estimate uncertainties. Various tools are available to support the development of a conceptual estimate.

CHAPTER 5

Baseline ROW Cost Estimate

At some point in project development, a project is incorporated in the State's priority program. The priority program includes projects that are typically within 10 years or less from their anticipated letting date. The first 4 years of the priority program typically constitute the State Transportation Improvement Program (STIP). The priority program is the output from the programming phase of project development. Once projects are included in a priority program, the SHA must manage both the project scope and cost as development continues in the next phase, Preliminary Design.

Introduction

When real estate is required as a component of a project's scope, those requirements must be stated such that an estimate of ROW cost can be developed. Multiple cost estimates may be prepared during this phase, depending on project complexity and the requirement to evaluate alternative solutions that satisfy the transportation need and purpose as previously documented in the planning phase. The cost estimate at the culmination of the programming phase often becomes the Baseline ROW Cost Estimate used to manage ROW costs as design proceeds. Project ROW costs cannot be controlled effectively if there is no baseline scope, cost, and schedule for the ROW component of a project. The benefit of preparing a baseline cost estimate, tied to a baseline ROW scope and schedule, is that such an estimate provides project management a basis from which to control project cost as design proceeds and ROW requirements are further refined. It is also possible that modifications can be made to the project design that aid in maintaining the ROW budget.

Baseline ROW Cost Estimation Flowchart

Figure 5.1 illustrates a generic flowchart for creating a Baseline ROW Cost Estimate. As shown in Figure 5.1, this Baseline ROW Cost Estimate is prepared during the programming phase of project development. The final output of this cost estimating effort is a Baseline ROW Cost Estimate that is part of the Total Project Baseline Cost Estimate for the project included in the priority program.

Figure 5.1 shows the cost estimating and cost estimate management steps for preparing and then approving and communicating the Baseline ROW Cost Estimate for the project's incorporation in the priority program.

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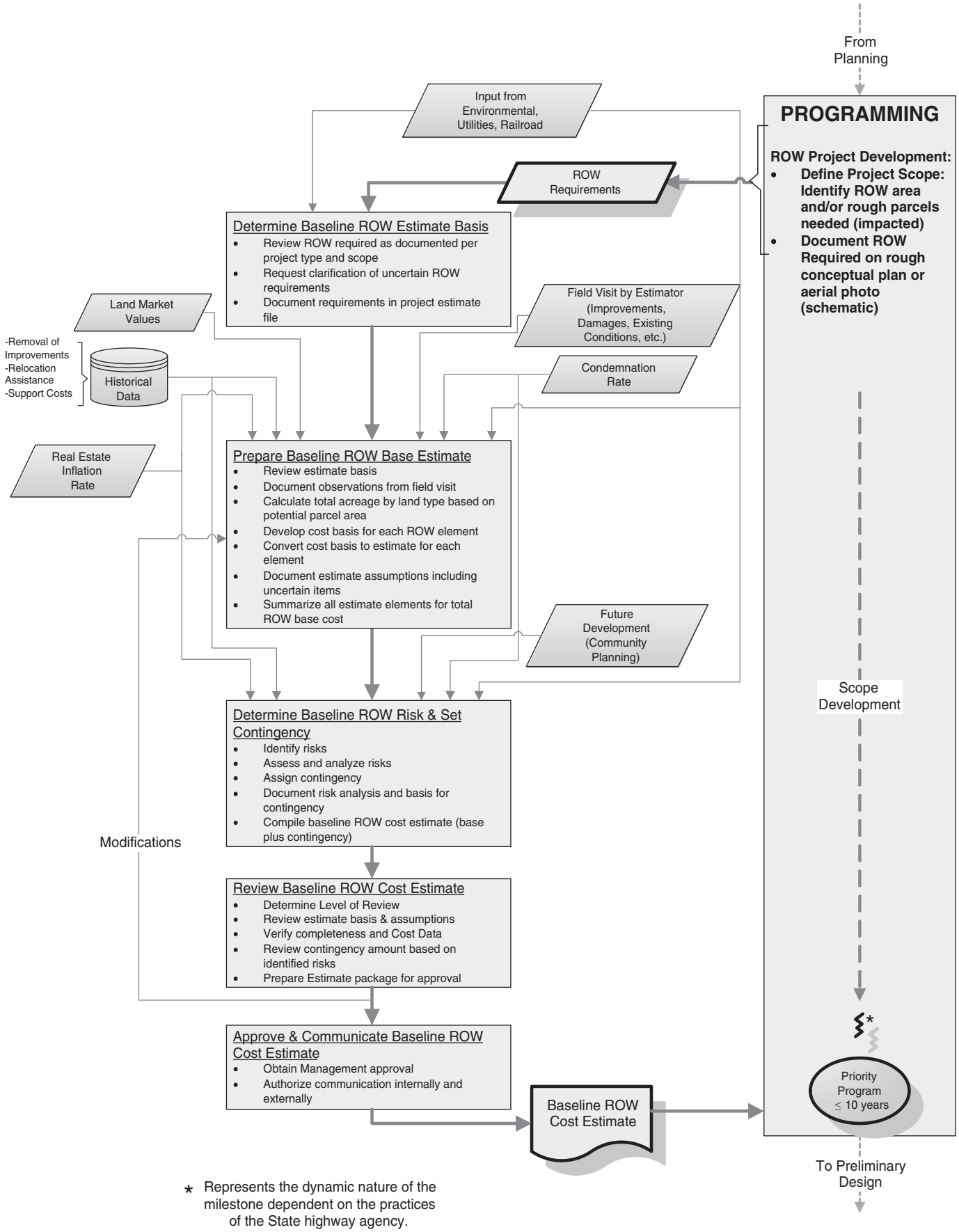

Figure 5.1. Baseline right-of-way cost estimate.

The baseline ROW estimating process is initiated with input from the programming phase through the project manager and other project development team disciplines. This input is in the form of ROW requirements to support the basic design features of the project, the required environmental features (especially those to support environmental mitigation), and any utility and railroad needs. As the process steps are performed by the ROW estimator, various inputs are needed. These inputs include ROW-specific information such as land values, historical condemnation rates, appreciation rates, and historical data related to damages, relocation costs, support costs, and so forth. Input must also be provided by the staff of key disciplines such as environmental, utility, and railroad. Finally, the ROW estimator should visit the site to understand the site-specific conditions and to assess the possibility of future land development effects.

Once each step is performed, the final output is the Baseline ROW Cost Estimate. This estimate is incorporated in the Total Project Baseline Cost Estimate. The project baseline estimate becomes the project cost identified in the priority program. Because even a small change in the location of a ROW line, or a change in access control or drainage retention placement, particularly in commercial areas, can affect the ROW cost estimate by millions of dollars, this ROW cost estimate may reflect several iterations through the illustrated estimating process before the baseline cost is established. These iterations may be necessary to support the selection of a preferred alternative or as the scope of a complex project is refined during the programming phase.

The asterisked wavy line in the right side rectangle of Figure 5.1 indicates the dynamic nature of the priority program milestone. Some SHAs program projects 9 or 10 years before their expected construction letting date. Other SHAs only program a project when the project is ready to be included in the STIP. In the latter case, the STIP becomes the priority program. This milestone would then be the latest time in which a baseline ROW estimate should be established for a project.

Determine Baseline ROW Estimate Basis

The ROW estimator needs definitive information for preparing an accurate cost estimate. The first step in Figure 5.1, Determine ROW Cost Estimate Basis, is critical because the ROW estimator must document all known ROW requirements based on input from the project development team—project manager and lead design staff.

Project Complexity

Overall, project complexity can be described by attributes as shown in Tables 3.4 through 3.6. If the project is classified as complex or major, the necessary input requirements typically increase and are transformed during the programming phase with enhanced project definition. Normally, several alternative solutions are explored when scoping major projects in the programming phase. Each possible solution must be evaluated. At the time of these evaluations, definitive information on ROW requirements is still limited. This will change once a preferred alternative is selected. As a result, the type of information documented in the Determine ROW Cost Estimate Basis step might have limited descriptive detail of ROW requirements. The discussion that follows is based on having a known preferred alternative for a complex project. Thus, for moderately complex projects, the inputs from programming would change somewhat, but the process step, tools, and outputs of the step would remain the same. It is also assumed that the ROW estimators are only beginning to identify parcels and that the parcel criteria questions defining complex ROW actions still cannot be answered.

Programming Phase Inputs

Although the absence of preliminary plans regarding ROW limits at this stage in project development is not uncommon, the project team should be able to provide sufficient information concerning anticipated ROW requirements so that a credible baseline estimate can be prepared. Project ROW requirements may be stated by one or more the following methods:

- Location plotted on aerial photographs or USGS maps to include tax map information (i.e., rough parcel descriptions).
- Location of the centerline on aerial photographs or USGS maps.
- Provision of existing road ROW limits with approximate locations of parcels.
- Provision of preferred alignment with construction limits stated.
- Utilities shown on aerial photos or USGS maps.
- Identification of possible railroad acquisition issues.
- Identification of topographical features.

Input from environmental, utilities, and railroad sections will address

- Environmental. Is mitigation required for the project? What type of mitigation is required? What resource agencies will be involved in mitigation? What is the method of mitigation?
- Utilities. What is name of the company having utilities requiring verification? What is the name of the company having utilities requiring relocation? What additional information is needed concerning utility company involvement in the project? What is the State's utility relocation obligation? (Utility relocation work is eligible for Federal-aid participation as a construction cost item to the extent the state is obligated to pay for such work.)
- Railroad. What is the description of affected railroad facilities or right-of-way? Are branch lines or spurs affected and, if so, what is the cost effect? What types of agreements or rights are required from the railroad?

Process Step Description

The ROW estimator should

1. Review ROW requirements for the project. Study aerial photographs, maps, or web aerials to (1) understand the extent of required project right-of-way in terms of a rough number of parcels affected; (2) note unusual features or complexities in terms of potential whole takes or partial takes; and (3) identify the potential number of condemnations, the potential for damages due to partial takes, the probability of future improvements and possible access issues, and the potential for needing temporary easements during construction. The ROW estimator should list any critical issues and concerns (e.g., red flag items) that contain an element of uncertainty or those which could increase the cost of right-of-way.
2. Request clarification, from the project manager and/or design team leader, about uncertain ROW requirements. This may require discussions with development team members representing environmental, if mitigation is required; utilities, to understand whether utility placement or access issues exist on existing or future right-of-way; and railroads, to identify issues in acquiring property related to this area. The ROW estimator should list any uncertain ROW requirements not adequately resolved or still being evaluated.
3. Document the requirements in the ROW Cost Estimate File (D4.1). Documentation is extremely important to ensure that changes in ROW requirements from the baseline scope can be identified when the preliminary design phase commences.

Tools

Several tools can be used to perform this step. The most important tool is R2.5, ROW Estimator Training. Estimators need to be trained to recognize the factors that affect ROW cost. Another tool is the use of specialized ROW estimators, Tool R2.6.

A more specific tool is the use of a Cost Estimate Map (Tool R2.7). These maps document ROW requirement inputs. A key component of such a map is the identification of the approximate location of parcels in the context of the project's preferred alignment. Tool R2.1 presents a method for handling the question of real estate requirements for interchanges at this early stage of project development.

The ROW Cost Estimate File is an important tool. At this time in project development, the file will primarily include information related to the project requirements. This file will expand to include more material as the estimating steps are accomplished. It will contain documentation concerning estimate assumptions, the cost data used, the cost estimate proper, and other related information generated through the preparation of the baseline ROW base estimate and the determination of the baseline ROW risk and contingency. The file is a critical input to the review baseline ROW cost estimate step and will eventually form the basis for tracking and assessing potential changes to the baseline ROW cost estimate. The ROW Cost Estimate file first prepared in the planning phase is also a good starting point.

Tips

The estimate basis must be documented in detail and the file should include all schematic drawings and clear statements about assumptions, including such approaches as the use of Advance Purchase (Tool R2.2), Condemnation Costs (Tool R2.3), and Relocation Costs (Tool R2.4). The documentation additionally must identify limitations that affect estimate accuracy. Other considerations include

- Preliminary parcel identification, which helps in assessing potential effect on structures, possible future improvements, potential damages, and other costs.
- Effect on access point changes for local businesses, residents, and other properties.
- Temporary construction easements (these may be treated as a risk and covered in contingency if unidentified when the estimate is prepared).

Outputs

The output of this step is a list of ROW requirements that form the basis from which the base estimate is be prepared. This list should be documented in the project ROW Cost Estimate File. Thus, the main output of this step is data in the project ROW Cost Estimate File. This file will be populated with additional information as subsequent steps in the process are performed during the programming phase.

Prepare Baseline ROW Base Estimate

Once the estimate basis is documented, the ROW estimator can prepare a Baseline ROW Base Estimate. This estimate is considered the most likely or best estimate of costs given normal project conditions. The base estimate **does not include contingency** amounts to cover risks and other uncertainties. All elements of ROW costs should have cost amounts calculated based on existing information and the amounts should be exclusive of contingency. ROW estimate contingency is considered in the next step.

Project Complexity

If the project is classified as complex or major, the required inputs to develop the cost basis may improve as the project definition matures during the programming phase. Major projects normally have several possible alternative solutions. Each of these solutions may require independent ROW estimates. Early in evaluating alternatives, data on the cost basis for ROW elements are not as

detailed as later when the preferred alternative is determined. To support alternative selection, multiple ROW cost estimates are necessary. Therefore, the prepare ROW base estimate step is often repeated and the estimate basis evolves during the selection of a preferred alternative. Although the types of cost elements remain the same, the data to support an element might be different as the alignment is refined. For example, parcels may not be known when comparing alternative solutions. In that case, only total acreage may be used to calculate real estate cost with the percentage of land that is residential, commercial, industrial, and agricultural approximated.

Inputs

The first and most important input is the estimate basis description documented on the ROW Cost Estimate Map (Tool R2.7). This file and the information contained in it are used by the ROW estimator to develop data for the various elements of the estimate.

As shown in Figure 5.1, several critical inputs are needed to support the development of a cost basis for each element that is part of the ROW cost estimate. The four main elements are

- **Land Market Values.** Cost ($) per acre by type (land only or with structures): residential, commercial, industrial, and agricultural. Tax assessor data relevant to the project location, discussions with local real estate agents, and experienced ROW professionals are good data sources. The tax assessor data should be adjusted to reflect market value.
- **Historical Data.** Such data can support the determination of representative cost for
  - Removing improvements from purchased real estate;
  - Damages due to residue properties;
  - Relocation assistance programs, based on percentages of land costs for residential, commercial, agriculture and so on (see Tool R2.4 Relocation Costs); and
  - Support costs, including external labor for titles, appraisals, appraisal reviews, negotiation, and so on considered on a percentage basis of land costs.
- **Real Estate Appreciation Rate.** ROW cost index to capture expected real estate appreciation in value between the time when the base cost estimate is prepared and when acquisition will occur.
- **Condemnation Rate.** When right-of-way must be secured by condemnation through eminent domain procedures, it typically involves the transition of control of the settlement from the agency's ROW section to its legal department. The estimator may be able to draw information concerning the percentage of parcel expected to go to condemnation from past experience or from the agency's legal department (see Tool R2.3 Condemnation) if there is an indication of parcel impact.

A critical input shown in Figure 5.1 is the field visit by the ROW estimator. Although aerial photographs provide certain insights, a field visit will clarify these insights and help in identifying the potential effect of whole or partial takes on existing facilities such as structures and access points.

Process Step Description

The ROW estimator should

1. **Review the estimate basis to understand the location-specific characteristics,** including existing conditions and limitations, that might affect project right-of-way. The ROW estimator has substantial specific and definitive information to consider and evaluate in developing the baseline ROW cost estimate. Although parcels are roughly identified, specific cost elements, such as improvements and/or damages, may still require the use of historical data to arrive at an estimated costs.

2. **Document observations from the field visit to include potential improvements and damages** resulting from partial takes and whole takes with structures and confirm the estimate basis prepared in the first step. This information will help refine estimating data used for land values, with and without structures, and percentages or other historical data use to estimate ROW cost elements.
3. **Calculate land areas by use.** Use parcel information when parcels are specifically identified to help determine total area by land use. The Cost Estimate Map tool can provide preliminary parcel information for calculating areas and distributing areas by land use or type.
4. **Develop a cost basis for various cost elements** such as land values, relocation assistance, support costs, improvements, damages, and condemnations. Land values should be based on current market activity in the project area. Land with structures can be based on assessed value per auditor's tax data adjusted to current market value. Both land and land and structures cost estimate values should reflect highest and best use. The number of relocations should be quantified. Typical relocation costs are based on occupancy: residence, business, or farm. Damages to the remainder in partial takes should be based on the experience of a qualified acquisition expert. These costs should be related to past projects from the general geographical area. Estimate data for potential settlements—either to avoid condemnation or for properties that go to condemnation—often are based on historical data (e.g., 10 percent of the properties will settle for 50 percent more than the estimate of the value of the property). Cost data should be developed to cover staff or consultant labor for title searches, appraisals, appraisal reviews, negotiations, relocation assistance, closing, and project management of ROW efforts. The data should be based on historical data for the individual property.
5. **Convert cost basis to estimate of costs for each element.** The quantity of land and other quantities and the cost data are input to the Cost Estimating System. These systems should be able to make the appropriate calculations and identify possible input errors.
6. **Document estimate assumptions,** including items such as a list of issues, concerns, and uncertain base estimate elements for later analysis in the risk and contingency step. The estimate documentation should describe the source of cost data (e.g., tax assessor), the basis for any adjustments made to reflect current market conditions, and historical data used to derive other ROW cost elements.
7. **Apply the appropriate inflation/appreciation rate to estimate the cost at the time of acquisition** and summarize all elements of the estimate for inclusion in the total baseline ROW base estimate. The Cost Estimate System will provide totals for all estimate elements and the total base ROW costs (without contingency).

Tools

A basic tool used to prepare ROW cost estimates is a Cost Estimate System (Tool R2.8). This system should be structured so that it can be tailored to fit the level of information available for the different estimates prepared as project development progresses. Typically, electronic spreadsheets are used for creating such systems. Some SHAs have very sophisticated electronic spreadsheets that are comprehensive in covering most or all of the cost elements related to acquisition of right-of-way. An example spreadsheet from Caltrans is shown in Figure 5.2. The tabs of the spreadsheet show some of the components required for preparing a cost estimate and include Instructions, Basic Input, Worksheet 1 and 2 (which cover estimate inputs and calculate estimated costs), Mitigation Parcels, and information on railroads, and utility impacts.

The ROW Cost Estimate File (Tool D4.1) should be populated with additional information beyond what is included in the ROW Cost Estimating System shown in Figure 5.2.

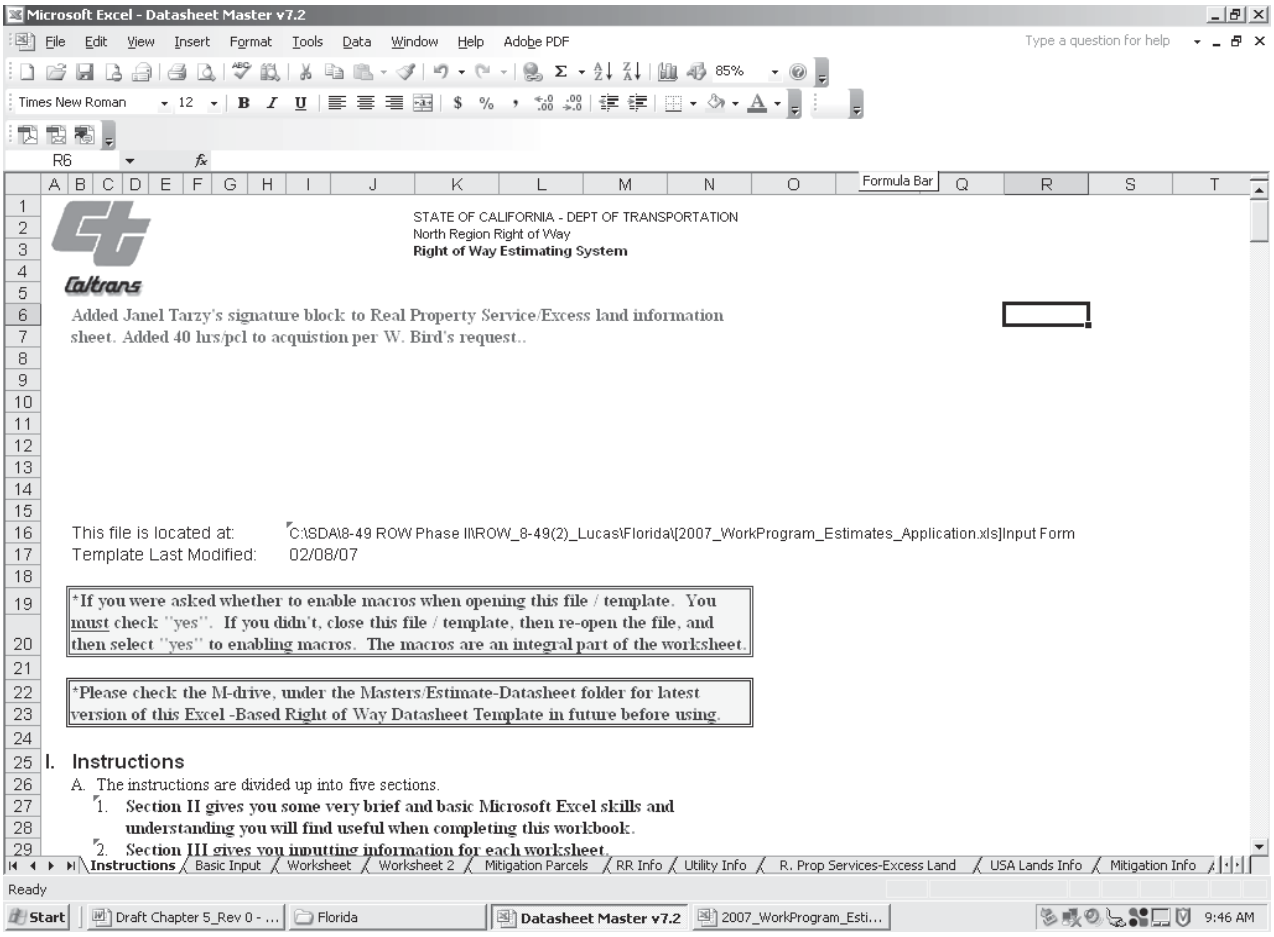

Figure 5.2. Caltrans right-of-way cost estimating spread sheet.

Tips

Tax assessor data relevant to the project location, discussions with local real estate agents, and experienced ROW professionals are good data sources. However, all three sources have disadvantages. The pros and cons of using tax assessor data were discussed previously under the Prepare ROW Base Estimate step in the planning phase (see Chapter 4). Local realtors are familiar with local market activity, local development plans, and local zoning and health department requirements, but these individuals may lack understanding of basic eminent domain valuation concepts and "damages to the residue." ROW professionals are trained in valuation issues (e.g., damages); familiar with local zoning, health department, and building department procedures; and adept at identifying items that affect scope, cost, and schedule; but such professionals introduce higher labor costs and their scarcity often creates timeliness issues. In urban areas, where road widening or a new alignment is required, particular attention should be paid to structures. However, if a total take is assumed, a false estimate may be the result.

SHAs need to recognize the need to provide ROW estimator training, Tool R2.5, or to use separate ROW estimators, Tool R2.6. Trained estimators know how to document correctly and clearly disclose all estimate basis assumptions in the ROW Cost Estimate File. Trained estimators carefully consider the effect of environmental issues, potential utility relocations, and nec-

essary interfaces with railroads. Finally, they know about the best data available for calculating the cost of all base estimate elements.

Outputs

There are two main outputs related to this step. The first output is the baseline ROW base estimate. This output would be generated by the Cost Estimate System tool. The second output would be the expanded ROW Cost Estimate File. The cost estimate file would now be populated with additional information related to the estimate basis for each estimate element and with assumptions and limitations regarding the basis cost values supporting the estimate. The estimate will delineate the costs of each cost element and a total cost for all project-required real estate acquisitions and ROW actions (without contingency).

Determine Baseline ROW Risk and Contingency

At the time a Baseline ROW Cost Estimate is established, there are still uncertainties about project scope and future events. The next step in the estimate preparation process is to determine ROW risk and set the contingency amount that should be added to the base estimate. An understanding of risk and uncertainty and the establishment of an appropriate contingency are fundamental to creating a realistic Baseline ROW Cost Estimate. The development of a baseline estimate permits the use of cost-based performance measures in managing project cost. If a contingency is overestimated, the baseline estimate will not be a useful cost control mechanism. If the contingency is underestimated, the baseline estimate will inhibit the design team from achieving a proper project scope because of overly burdensome cost constraints.

Project Complexity

Project complexity is the key indicator as to the tools that should be used in analyzing risk and setting the contingency amount. Major or complex projects (see Tables 3.4 and 3.5) may require sophisticated risk analysis processes and stochastic estimating techniques (e.g., Monte Carlo modeling). Stochastic estimating techniques can be beneficial when reviewing multiple alternatives on complex projects because such techniques help to enlighten decisionmakers about the uncertainty of the estimates relating to the alternatives. These cost uncertainties are expressed through ranges of possible costs in a stochastic estimating process. For example, a decisionmaker may prefer an alternative that is slightly more expensive if it will yield less cost uncertainty when compared with a slightly less expensive alternative with greater uncertainty. Setting of contingencies on minor or non-complex projects (see Table 3.6) should require little more than the use of red flag lists, standard contingency ranges, and estimator judgment.

Inputs

The experienced judgment of the ROW estimator and the development team members are the primary input to determine baseline ROW risk and set the contingency amount. Anytime an estimator needs to make an assumption, risk or uncertainty is present in the estimate. The estimator and project team should keep a list of (1) assumptions, (2) estimate basis uncertainties, and (3) project issues and concerns in the ROW Cost Estimate File. These assumptions, uncertainties, issues, and concerns form the basis for the risk analysis that is considered when setting the contingency amount. The following sections present process sub-steps and tools that assist in

creating these lists of risks, but the key input is the experienced judgment of the estimator and development team members.

Process Step Description

The ROW estimator, with input from other development team members, should

1. **Identify risks.** Review the lists of assumptions, uncertainties, issues, and concerns generated during the preparation of both the Conceptual ROW Cost Estimate and the prepare baseline ROW base estimate step. In more complex projects, risk identification workshops or discipline-specific interviews can be conducted in addition to reviewing the issue lists. The final step should be to review historical risk checklists or similar completed projects, but these lists should only be reviewed at the end of the analysis, so that the estimators do not miss any project-specific risks not contained on the lists.
2. **Assess/Analyze risks.** Assess risks through a qualitative review of the probability of the risks occurring and the cost and time effects of the risk occurring. If the project is complex, conduct a quantitative risk analysis to more accurately estimate the cost and time effects of the risks and their probability of occurrence.
3. **Assign contingency.** Assign an appropriate contingency amount based on the identified risks and any historical information concerning cost growth from unidentified risks. On non-complex projects, this contingency can be assigned using a simple percentage based on historical data and estimator's judgment. On more complex projects, contingency can be assigned through a stochastic modeling of the identified risks.
4. **Document risk analysis and the basis for the contingency amount.** At a minimum, keep a transparent list of risks and uncertainties. This list should be kept in the ROW Cost Estimate File. It should be summarized and included any time the cost estimate is communicated. On more complex projects, maintain a risk register that provides, at a minimum, a detailed description of the risks, their probability of occurrence, their effect if they occur, strategies to mitigate/manage the risks, an assignment of ownership for the risks, and a schedule to resolve each risk. Proactive corridor preservation strategies can be used to manage ROW cost risk [See Tool R2.2 Advanced Purchase (ROW Preservation)].
5. **Compile the total ROW cost estimate** (base estimate plus contingency). The contingency value is entered into the Cost Estimate System.

Tools

Tools exist for each of the four sub-steps in risk identification and setting of contingency. These tools, however, are not necessarily ROW specific. They are the same tools used for risk identification and setting contingency in the Total Project Cost Estimate. The primary issue in choosing an appropriate tool concerns the level of project complexity.

Risk Identification Tools

Four tools to assist in identifying risk are

1. Red Flag Items (Tool I2.1),
2. Risk Workshops (Tool R3.5),
3. Risk Charters (Tool I2.2), and
4. Risk Checklists (Tool I2.3).

Red Flag Items (Tool I2.1) are a list of assumptions, issues, and concerns that is created at the earliest stages of project development and maintained as a checklist while the project progresses through development (see also Chapter 4, Conceptual ROW Risk and Set Contingency Process Description). It is perhaps the simplest form of risk identification and risk management. The list

helps estimators to better understand the required contingency and helps managers to more effectively control scope growth.

Risk Workshops (see Tool R3.5) are used to identify risks that can influence project cost, scope, or schedule. They are typically used only for major or complex projects and are almost always part of a more comprehensive approach to identifying, analyzing, and managing risks. The Washington State DOT conducts rigorous risk identification workshops as part of the Cost Risk Analysis (CRA) process. Workshop agenda and other information are provided on the WSDOT CRA website (www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment/).

A Risk Charter (Tool I2.2) is the third tool used for risk identification. In addition to risk identification, the Risk Charter is used to communicate, monitor, and control risks. It is appropriate for large or complex projects that have significant uncertainty. The charter organizes risks that can affect cost estimates. A Risk Charter typically is based on either a qualitative or quantitative assessment of risk, rather than simple engineering judgment. The identified risks are listed with relevant information for quantifying, controlling, and monitoring. As part of a comprehensive risk management plan, the Risk Charter will help to control project cost escalation. The risk charter may include relevant information such as

- Risk description,
- Status,
- Date identified,
- Project phase,
- Functional assignment,
- Risk trigger,
- Probability of occurrence (%),
- Impact ($ or days),
- Response actions, and
- Responsibility (task manager).

Risk Checklists (Tool I2.3) are the fourth risk identification tool. Risk Checklists are developed from historical analysis of risks identified or realized on past projects. A summary of ROW risks from various projects conducted by Caltrans and WSDOT are

- Accelerating pace of development in the project corridor;
- Changes in land use/demographics in the project corridor;
- Difficult or additional condemnation;
- Excessive relocation or demolition (including unanticipated remediation) (either globally or for particular parcels);
- ROW staffing shortages;
- Process delays (e.g., ROW plan development by team, plan approval process);
- Railroad coordination/acquisition problems;
- Utility coordination/relocation delays;
- Objections to ROW appraisal taking more time and/or money;
- Variations in estimate quantities (e.g., acres by land use); and
- Variations in cost basis used for estimate elements (e.g., tax assessor data versus current market value).

Risk Assessment/Analysis Tools

The goal of risk assessment and analysis is to quantify risks for the purpose of developing an appropriate estimate contingency and to support cost management. SHAs are beginning to integrate risk assessment and analysis into their project management plans. Caltrans and WSDOT provide good examples of the application of comprehensive risk management for major projects.

Figure 5.3 is a flowchart of the Caltrans Risk Management Process. (Caltrans Project Risk Management Handbook, 2007).

Both Caltrans and WSDOT approach risk management on a total project basis, and ROW estimates and risks are one part of the comprehensive process. Specific tools for assessing and analyzing risks are Analysis of Risk and Uncertainty (Tool R3.1) and Programmatic Cost Risk Analysis (Tool R3.5).

Assign Contingency

Two general tools exist for assigning contingency: (1) assignment of contingency through a percentage and (2) assignment of contingency through a stochastic estimating process. Assignment of contingency through a percentage was discussed in Chapter 4, Conceptual ROW Risk and Set Contingency process description. The process applies to the Baseline ROW Cost Estimate as well, but the percentages change with the increased specificity of scope definition.

The use of stochastic estimates to set contingencies is currently used by SHAs only on the most complex projects. It is generally part of a comprehensive risk management process facilitated by experts from outside the SHAs who are experienced in this type of analysis. Although the stochastic estimating processes can be complex to conduct, the results are fairly intuitive and helpful to apply. Figure 5.4 illustrates an output from a stochastic estimate.

As seen in Figure 5.4, stochastic estimating methods produce a range of possible cost outcomes. In Figure 5.4, there is a 10-percent chance that the project will cost less than $651 million, a 50-percent chance that the project will cost less than $668 million, and a 90-percent chance that the project will cost less than $693 million. Owners will typically choose to budget the project at the 80- or 90-percent certainty level. If the project in Figure 5.4 is budgeted at the 90-percent certainty level, the contingency can be expressed as the 90-percent cost minus the mean, or $25 million in this case ($693 – $668 = $25 million). Again, in this comprehensive estimating approach, ROW estimation is treated one of many components of the Total Project Cost Estimate. However, these risk tools can be used specifically for the ROW cost component of a project. Specific tools for assigning contingencies are Contingency-Percentages (Tool R3.3) and Programmatic Cost Risk Analysis (Tool R3.5).

Document Risk Analysis and Basis for Contingency

The primary tool for documenting risk analysis and basis for contingency is the ROW Cost Estimate File, which should contain the information from, or reference to, the tools used to identify risks, assess/analyze risks, and assign contingency. These will be important communication tools as the Baseline ROW Cost Estimate is approved and released.

Tips

Reliance on experienced judgment is essential for determining ROW risk and setting contingency. Even the most sophisticated tools rely heavily on estimator judgment as input. Although agency policy should specify the upper and lower bounds for contingency percentages based on historical data, the final assignment of contingency should be left to the estimator's overall understanding of the project's scope and completeness of the base estimate.

A comprehensive approach to identifying, assessing, and documenting risks identified by all members of the project team is essential. Red Flag Lists and Risk Charters are excellent tools to capture risks, but a comprehensive approach involving all team members throughout the project development process is needed to ensure that all risks are identified.

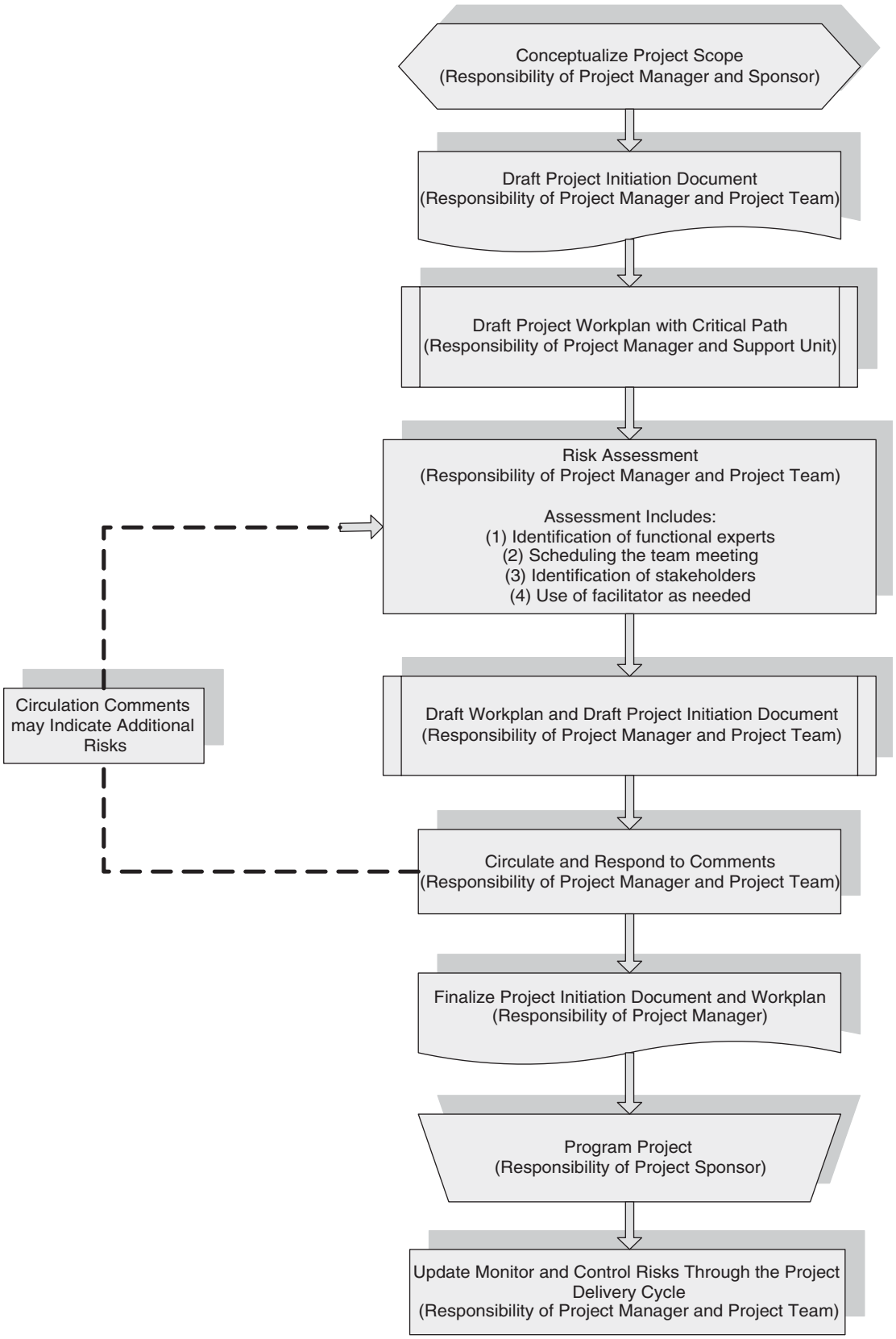

Figure 5.3. Caltrans risk management process flowchart.

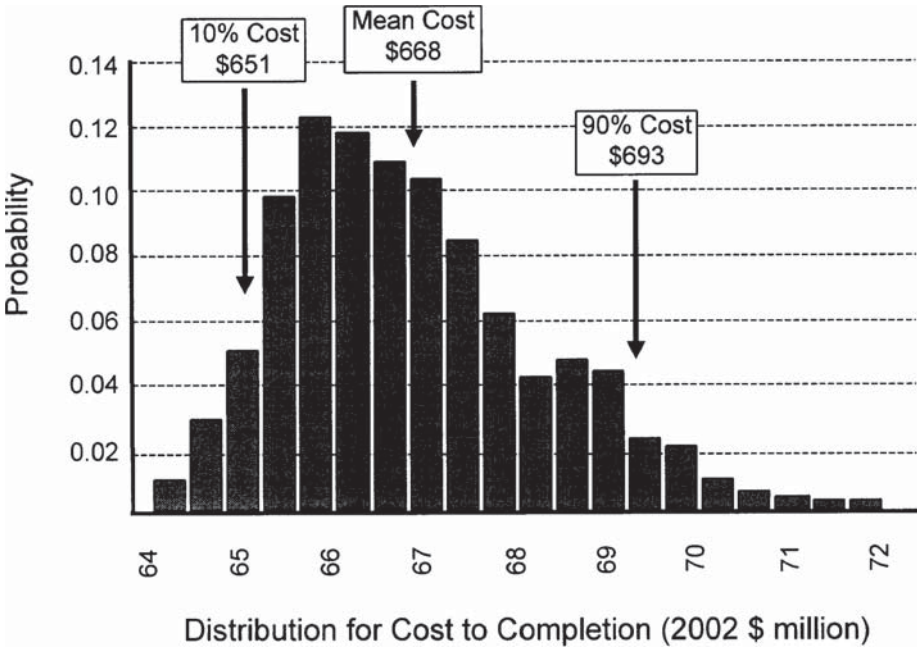

Figure 5.4. Example of a stochastic estimate output.

Given that the same methods and tools are used to estimate contingency for both ROW and total project estimates, consistency is provided between the estimates. However, double-counting of risks and contingencies must be avoided. The ROW estimate must be coordinated with the Total Project Cost Estimate to ensure that there are no overlaps or gaps as contingencies are applied to the base estimates.

Risk Checklists can be helpful, but they should only be used as a check at the end of the risk identification process to ensure that no significant risks have been overlooked. Avoid starting the risk identification process with checklists because unique project risks that do not appear on the checklists can easily be overlooked.

Outputs

The outputs of this process step are (1) a list of risks and uncertainties and (2) a contingency amount to apply to the base estimate to arrive at a total Baseline ROW Cost Estimate. The format for the output will vary depending on project complexity and the tools used for risk identification and management. At a minimum, the output should be a list of Red Flag Items tied to a percentage contingency. For complex projects, a Risk Charter containing ROW-specific items will help to generate a range of total project costs to be managed throughout the remainder of the project development process. The use of a transparent contingency amount with an associated list of risks will help to avoid future cost escalation and will help project management contain costs as the project development progresses. The use of a transparent contingency will help to communicate estimate uncertainty to internal and external stakeholders. The Baseline Right of Way Cost Estimate is included in the Cost Estimate System once a contingency value is input.

Review Baseline ROW Cost Estimate

It is always necessary to verify independently that an estimate is complete, matches the project scope, and is consistent with known site conditions. Because the outcome of this process is

the approved Baseline ROW Cost Estimate that will be used as a cost performance measure throughout the project, the review step at this time is even more critical. A second autonomous review of the estimate will provide managers and decisionmakers with a different perspective or at least a second opinion.

Project managers sometimes push for a reduced ROW estimate so a project can go into the program. The review process and the approval process serve to protect estimators from such pressures. In Figure 5.1, an estimate review step is positioned after the project risk has been quantified and an appropriate contingency amount included in the estimate. Although this review is depicted as a one-time activity, it is commonly a repetitive step, taking place to some extent whenever an estimate is revised and particularly when the final Baseline ROW Cost Estimate is produced.

Inputs

The reviewer needs a copy of the Baseline ROW Cost Estimate and the ROW Cost Estimate File with the supporting documentation. If the Baseline ROW Cost Estimate and the ROW Cost Estimate are not contained in the estimated file, the reviewer also needs a copy of the latest scope document for the project.

Process Step Description

The extent of the estimate review at this stage will vary, depending on the complexity of the real estate issues expected. High-profile projects affecting valuable real estate or those affecting an unusually large number of parcels must be reviewed very carefully, and there must be greater depth to the probing. Recognition of ROW issue complexity will aid in ensuring appropriate review criteria and establishment of an appropriate approval authority.

The review should look at (1) the baseline ROW base estimate without contingency or appreciation, (2) the selected real estate appreciation factor, (3) the risk analysis and assigned contingency value, and (4) the supporting documentation in the ROW Cost Estimate File. To produce these early estimates, estimators make numerous assumptions and the logic behind these assumptions must be documented in the ROW Cost Estimate File. It would be expected that, in the documentation, the estimator identifies any deviation from standard agency practice. Caltrans specifically directs estimators to input data on all reasonable alternatives using a "worst case" forecast (highest cost) and to assume a full take if project design is not far enough along to specify the real estate requirement in detail. If that practice has not been followed in preparing an estimate, the deviation must be documented in the ROW Cost Estimate File. The Caltrans guidance states that an individual estimate file shall contain

- The cost estimate map(s) used in preparing the estimate, with the date of original map(s) and dates of subsequent revisions. If, due to size or number, the maps cannot be maintained in the file, a reference should be placed in the file indicating where the maps are located. Regardless of whether the maps are maintained in the file or in another location, they are part of the file and are to be retained in accordance with file retention requirements.
- Copies of all memoranda of request and responses.
- Copies of all ROW Data Sheets (including attachments) and Estimate Worksheets prepared for the project, along with accompanying ROW Data Sheet Transmittal Memoranda (see Cost Estimate System, Tool R2.8).
- Comparable sales and all other data used to prepare the estimate.
- A diary, annotated by date and person making the entry, of each action taken regarding estimates on the project. The diary shall contain all actions the estimator takes throughout the life of the project.

In summary, the actions required for an estimate review are to

1. **Determine the Level of Review.** The depth of an estimate review is a function of project size and complexity. In this step, the Chief of the ROW Section or the project manager must determine the type of review and who should perform the review.
2. **Review Estimate Basis and Assumptions.** The first component of the review focuses on understanding how the estimate was developed and then on the process and data used to determine cost.
3. **Verify Completeness and Use of Estimating Information and Data.** This step focuses on ensuring that the estimate reflects the scope of the project as currently described. Further, the review should assess whether prices and market assumption correctly reflect the situation.
4. **Review Contingency Amount Based on Identified Risks.** This step evaluates whether or not the contingency amount is realistic in relation to the potential risks and level of uncertainty in the estimate inputs and cost basis for preparing the base estimate.
5. **Prepare Estimate Package for Approval.** This step focuses on compiling all estimate documents and organizing them into a single package to include cost summaries, detailed estimates, estimate basis and assumptions, and quantity calculations.

Tools

The formality of a baseline ROW cost estimate review and the depth of that review at each stage in project development will vary depending on the type of project and ROW situation complexity. For routine projects that have no complex ROW issues, an internal review should be satisfactory.

Internal Review. Consulting peers and subject matter experts can identify possible errors, omissions, and clarifications in estimate basis and assumptions (Tools E3.1, E3.2, and E3.3). Estimates are based on many assumptions, which need to be justified as the estimate is reviewed. Issues that sometimes are overlooked include contractual obligations with property owners to relocate fencing, reconstruct gates, or to reconstruct road approaches. The reviewer should ensure that these items are included in either the ROW estimate or the construction estimate, but not double-counted.

Reviews provide feedback to ROW estimators about the completeness and accuracy of their work. In many SHAs, internal reviews are not formal but involve either the ROW manager or a senior ROW agent reviewing all estimates and having responsibility for recommending approval of the estimate. Projects with complex ROW issues require reviews in greater depth and proactive efforts to identify off-prism issues that can affect ROW cost. Projects with more complex ROW issues may require external review.

External Review. At the programming phase, only cost estimates for large projects or corridors in urban areas that have extremely complex ROW requirements will be subjected to an external review by qualified professionals (Tool E2.1). There may be certain critical elements of these estimates that require a unique expertise to verify estimated costs. This external review should include the results of a risk analysis that identifies the risks associated with these critical elements, the high and low cost limits for each critical element, and the assigned probability that the risk will occur.

It was found that agencies, which use the bond market to fund their projects, subject even early estimates to a systematic review by an external third party. Such agencies may even perform early estimates looking at the effect of specific parcels on pricing and subjecting this pricing to scrutiny during the review. This is very important because bond rating agencies use the reviews as part of their rating evaluation.

Tips

To be successful, the review must closely examine the assumptions that form the basis of the estimation, and knowledgeable and experienced individuals from within the agency must conduct the review. When software is used to generate the estimate, the information fed into the computer program must be examined during the review. Conducting reviews at appropriate times during the development of programming estimates provides assurance that the estimates are reasonably accurate for the existing knowledge of project scope and site conditions.

Output

If the review finds no issues with the estimate, the estimate moves to the Approval and Communicate Baseline ROW Cost Estimate step. Sometimes modifications to the estimate will be necessary before it can be passed forward, so it might cycle back through the Prepare Estimate and Risk steps before advancing.

Approve and Communicate Baseline ROW Cost Estimate

As the project design develops and more is known about project conditions, budget control is critical to managing project costs. During programming, an approved Baseline ROW Cost Estimate would be used to set the ROW budget for the project. The risk analysis has identified possible cost escalation factors and the approval step makes management aware of the possible effect of such factors. Different levels of approvals will be required as a project proceeds through development.

Inputs

A summary of the reviewed and acceptable Baseline ROW Cost Estimate package goes forward to management for approval before the cost amount is communicated to the project manager and the design team.

Process Step Description

Completing all the cost estimation steps, which are initiated during programming, leads to an approved Baseline ROW Cost Estimate, as shown in Figure 5.1. The review and approval steps support baseline cost estimates for priority programming and ensure that the planned facility meets project requirements so that a project can be entered in the STIP.

Scope changes are the primary contributors to cost escalation, and these changes have to be monitored closely as design detail evolves. The ROW estimate has been developed based on an assumed alignment and layout. The requirement that management approve an estimate ensures that agency and project management are aware (1) of the expected ROW cost based on specified assumptions of how project design will proceed; (2) that the total estimated cost is a deterministic number that will be affected by the identified risk factors as they are realized or resolved; (3) that the contingency amount stated in the estimate is appropriate to counteract the occurrence of the specific risks events and not an add-on amount to be used for scope changes; and (4) that a specific percentage has been applied to account for real estate appreciation only to a specified date in the future.

Tools

Budgeting is a balancing act of meeting the agency's objectives—responding to transportation needs—to the fullest extent possible within the limits of its financial capacity. To optimize the

agency's programs, it is better to establish budget constraints early in the project development process and to demand that estimate reviews and approvals be a critical component of all project decisions. Tools B1.1 through B1.5 will assist SHAs in establishing a disciplined budget process.

Properly communicating the uncertainty involved in an estimate will help to ensure that appropriate decisions are made from the estimate (Tool C1.2). Estimate uncertainty can be communicated by providing a range estimate rather than a point estimate. Communication of estimate uncertainty can also be conveyed by simply listing the assumptions, allowances, unknowns, and contingencies included in an estimate.

Tips

Management must be informed of project changes and external impacts that affect the project baselines of cost, scope, and schedule and should have procedures in place that restrict changes unless approved by senior management.

As project development proceeds, the agency may be required to alleviate perceived negative effects on the local societal environment as well as the natural environment. Measures may include, but are not limited to, introducing alignment changes. These steps are often taken to respond to issues raised by the local residents, business owners, and environmental groups. All alignment changes must be approved by management with a full understanding of their cost impacts and the Baseline ROW Cost Estimate provides management with a tool to evaluate the effect of changes.

Outputs

The output of the approval step is a Baseline ROW Cost Estimate. This estimate is used to manage project scope and cost as the design team proceeds to translate the transportation solution into contract documents. How the estimate uncertainty and contingency are communicated both internally and externally is important.

Chapter Summary

Baseline ROW cost estimation during programming was the focus of this chapter. The general process for preparing, reviewing, and approving this estimate was presented. The baseline estimate is generally determined for a preferred alternative so ROW requirements are better known. Historical data are not the primary source of land value information because this estimate element is based on tax assessor data updated to reflect current market values. Historical data are used to develop the cost basis for the other ROW elements. The effect of structures and other improvements on property values is better known. ROW estimating staff should consider risks to help set a contingency value to cover these risks and other uncertainties related to both the estimate basis and cost basis (scope requirements) used in preparing the estimate. Quantitative techniques are recommended for complex projects. Various tools are available to support the development of the baseline cost estimate. Finally, this estimate is critical because the output is used to manage and control costs for right-of-way throughout design.

CHAPTER 6

Update ROW Cost Estimate

The preliminary design phase often is considered the start of the design process. The starting point for this phase depends on the level of project definition achieved during the programming phase. On major or complex projects where a significant design effort is required to identify the preferred alternative and ensure that environmental regulations are met, design completion may reach 25- to 30-percent by the end of the programming phase. On moderately complex projects, design is probably less than 25-percent complete when programming is complete. Preliminary design moves the project forward to approximately 60- to 80-percent design completion.

Introduction

When acquisition of right-of-way is necessary to support the project scope, the completion of final ROW plans is a key milestone that transitions ROW activity from cost estimating to appraisal and acquisition. This milestone generally initiates the appraisal and purchase of real estate. If the SHA's policy is to have right-of-way purchased before the start of construction, which is common, this milestone must often occur several years before the project letting date if acquisition of a significant number of parcels is necessary. In the case of a moderately complex project or a project of limited extent, the time duration, between when ROW acquisition must begin and the letting date, would probably be much shorter than that required for a complex project because fewer parcels are required.

Before the start of appraisal and acquisition, the Updated ROW Cost Estimates are prepared periodically as project design progresses. These updated estimates are critical to controlling project cost because they ensure that the project does not experience a cost blackout period where the cost effect of design decisions is unknown. The driving focus of these updates is to compare an updated cost estimate to the baseline cost estimate. The purpose of this comparison is to aid in managing the ROW budget by identifying potential design decisions that affect cost. This is especially important when real estate costs are increased by design changes or because of changed market conditions. Identifying cost increases early allows the design team to consider changes in design details that can reduce the amount of ROW required or reduce the cost effect on existing structures if a partial take is required. If ROW estimates indicate a potential reduction in the ROW budget, then project management will have the option of using such reductions to support changes in project design features or can apply the funds to other projects. This requirement of updating estimates is a cost estimate management method that aids in managing program budgets related to right-of-way.

Update ROW Cost Estimation Flowchart

Figure 6.1 is a generic flowchart for the Update ROW Cost Estimating process. As shown in Figure 6.1, these cost estimate updates for right-of-way are prepared repeatedly during the preliminary design phase of project development and follow the same structured process used to create the baseline and conceptual estimates. This cyclic estimate effort occurs periodically as project design evolves. The output of each update is a confirmation or an indication of the necessity for a potential revision to the baseline estimate set in the programming phase.

Figure 6.1 shows the cost estimating and cost estimate management steps for updating the ROW cost estimate and then comparing the Updated ROW Cost Estimate with the Baseline ROW Cost Estimate. A decision point is shown on Figure 6.1 after the review estimate step because the comparison of the updated estimate versus the baseline cost may require action, especially when there is a significant increase in estimated cost over the baseline estimate or budget. This comparison might initiate a cost management loop in which the project design team analyzes different design details to determine if ROW costs can be reduced by design changes. The cost estimate management loop also serves as an approach to studying changes in right-of-way that might affect design in a positive way. ROW/design tradeoff analysis can be used to determine what types of changes should be made and what value the changes bring to the project.

Value engineering or some similar method is used to evaluate proposed changes. An example would be the choice between the cost of a retaining wall against that of increased ROW cost resulting from the slope requiring more land area. The decision can be considered from both points of view. A retaining wall may be the right choice if the slope creates a high cost of damages to an existing business. A slope typically requires acquiring a larger portion of an affected piece of property. This issue can be considered in reverse if the wall is extremely expensive compared with the piece of property that would be necessary for the slope. ROW personnel can provide valuable insight to project design that can combat the cost escalation problem and may reduce the overall cost of the project. Once a change decision is made, the updated cost estimate is approved and communicated to the project development team. Changes in the cost estimate may initiate changes in the priority program budget and/or the STIP budget.

The estimate updating process is initiated with input from the preliminary design phase through the project manager or other design disciplines. This input is in the form of ROW requirements, and, as shown in Figure 6.1, it is typically reflected in preliminary ROW plans and other design documents. As these process steps are performed by the ROW estimator, various additional inputs are needed. Although the categories of inputs are the same as discussed in the programming phase, the types of data used for each category can be different. For example, the preliminary plans will have parcels identified so that land values can be estimated on the basis of comparable sales and/or market surveys specific to the compatible property.

The asterisked wavy line in the right side rectangle of Figure 6.1 indicates the dynamic nature of this STIP milestone. As discussed in the programming phase, some SHAs only program a project when it is ready to be included in the STIP. In this case, the STIP becomes the priority program. In such a case, preliminary design commences in the outyear of the STIP such as in year four. Whether or not right-of-way is already included in the STIP depends on SHA policy and approach. Further discussion of the Figure 6.1 information is provided in the following sections.

Update ROW Estimate Basis Step

Once preliminary design begins on the preferred project alternative and a baseline cost estimate has set a project budget for right-of-way, the ROW cost estimate must be updated periodically as design progresses. As shown in Figure 6.1, the first step is to update the ROW estimate basis. The

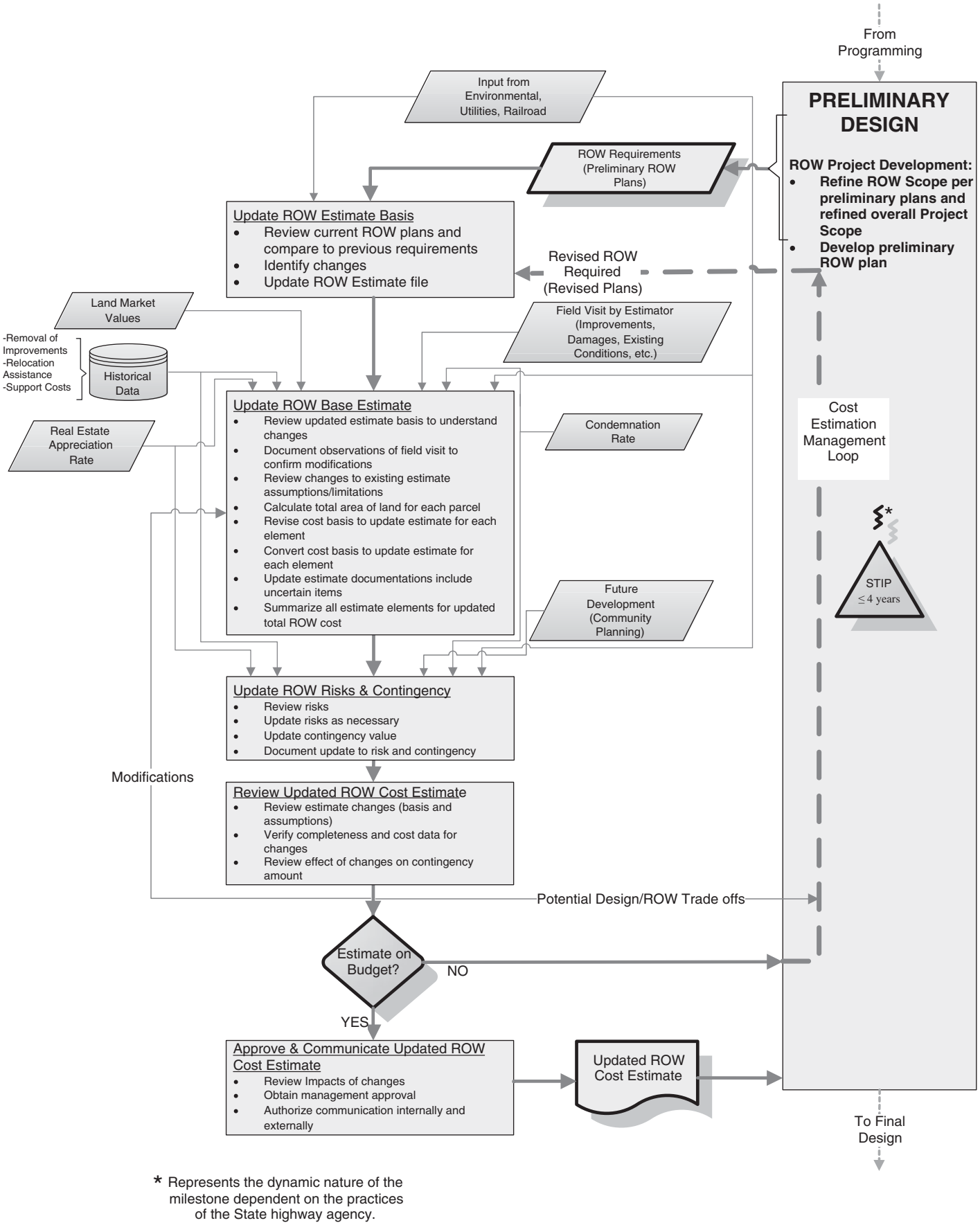

Figure 6.1. Update right-of-way cost estimate.

objective of this step is to update the estimate basis section of the ROW Cost Estimate File to reflect changes in the ROW requirements and to include new information received from the environmental, utilities, and railroad sections of the agency.

Project Complexity

During preliminary design, project complexity was defined in terms of the design requirements. The items are listed in Tables 3.4 and 3.5. At this point in project development, complexity should be defined in terms of the required ROW actions. The estimator now thinks in terms of individual parcels. The parcel impacts–criticality/complex–influences the level of effort required to maintain the data that document the ROW estimate basis. For example, with complex parcel actions, more time is needed to assess differences in ROW requirements compared to those requirements identified during programming. This increased effort is defined by the number of parcels affected and effects such as partial takes, damages that require compensation, and relocations.

Preliminary Design Inputs

At this stage in design, preliminary plans are developed and continued to be developed through preliminary design. These plans will evolve as design details are characterized. The preliminary plans will begin to depict sufficient detail so that parcel can be identified with confidence. Environmental commitments should be summarized and included as plan notes. Needed utility adjustments will be identified and their effect on ROW requirements can be established. Other documents that might be used to update the cost of right-of-way include property map sheets and project profiles.

Process Step Description

The ROW estimator should

1. Review the preliminary ROW plans and compare these with previous ROW requirements from the programming phase. The main focus of this comparison should be on the parcels now identified and whether or not a parcel is a partial take or a whole take and if structures are involved. This review should characterize each parcel needed for the project.
2. Identify changes and the potential magnitude of the change (e.g., more area is required for a parcel then previously determined, potential damages are higher than previously indicated, or temporary easement is now needed).
3. Request clarification from the project manager and/or design team leader regarding uncertain ROW requirements that may require discussions with other project development team members such as environmental, utilities, and railroad.
4. Update the estimate basis component of the ROW Cost Estimate File by documenting known changes in ROW requirements.

Tools

Project ROW Cost Estimate File, Tool D4.1, will support this process step. This file should be created in the planning phase and then modified during programming to support the Baseline ROW Cost Estimate.

Tips

The scope and cost baseline of every project should be the reference to which all changes are compared. Throughout project development and construction, the baseline is used to evaluate

performance. Most agencies that practice baseline development for their projects report doing so usually at the point when an identified need becomes a "real" project and is budgeted.

By identifying the effect of changes early, the cost estimate file can be updated with the new information in those areas, thus focusing the estimate updating work and reducing the time requirement for updating the base estimate.

Outputs

The output of this step is an updated and more detailed summary of ROW requirements. This summary forms the basis for updating the base estimate. This summary is included in the ROW Cost Estimate File for the project. This file will be modified with additional information as subsequent steps in the process are performed.

Update ROW Base Estimate

Once the estimate basis is updated, the ROW estimator can update the ROW base estimate. This estimate is considered the most likely or best estimate of costs, given normal project conditions. This updated estimate **does not include contingency** to cover identified risks due to unknown events or information unknowns. The focus should be only on actual ROW cost elements included in this base estimate update.

Project Complexity

During preliminary design, project complexity influences the level of effort to update the ROW base estimate. For example, in the case of complex projects, more time is needed to modify the estimate when changes in the estimate basis are required. This increased effort is due to the larger number of parcels affected and, in many cases, the multiple types of effects (e.g., partial takes where improvements are taken and damages that require compensation).

Inputs

The first and most important input for updating the estimate is the estimate basis description documented in the ROW Cost Estimate File (Tool D4.2 or R2.8). This would include the latest version of the ROW plans. The information contained in the file is used by the ROW estimator to modify the cost projections for the various elements of the base estimate.

As shown in Figure 6.1, several critical inputs are needed to support the development of a cost basis for each element that composes the updated ROW cost estimate. The four main elements are

- **Land Market Values.** Cost ($) per acre by parcel (land only or with structures) and influenced by type of use—residential, commercial, industrial, or agricultural. Values should be based on detailed market surveys with verified market data. Experts in the field should provide these data. These values can be verified through an agency ROW tracking system.
- **Historical Data.** Such data can support the determination of representative cost for the following:
  - Removing improvements from purchased real estate;
  - Damages to residue property;
  - Relocation assistance program costs. Use pre-acquisition survey data to help determine these cost data as well as time necessary for relocation services;
  - Support costs to include external labor for titles, appraisals, appraisal reviews, negotiation, and so on. Use current cost data for these items based on known values.

- **Real Estate Appreciation Rate.** ROW cost index to capture expected real estate appreciation in value between the time when the updated cost estimate is prepared and when acquisition will occur.
- **Condemnation Rate.** When right-of-way must be secured by condemnation through eminent domain procedures, this typically involves the transition of control of the settlement from the agency's ROW section to its legal department. The estimator should be able to draw information concerning those parcels likely to go to condemnation from the agency's legal department and knowledge of the owners of the property.

As shown in Figure 6.1, a field visit by the ROW staff may be helpful to clarify specific characteristics of individual parcels. This type of field visit may be particularly beneficial in providing insight about the potential effects of whole or partial takes of existing structures.

Process Step Description

The ROW estimator should complete the following eight steps:

1. Review the updated estimate basis to understand changes in the ROW requirements based on parcels and knowledge of whether the parcel requires a whole take or a partial take.
2. Document observations from a field visit to confirm modifications to the ROW requirements based on individual parcels.
3. Review changes in existing assumptions and limitations and review new assumptions and limitations. The effect of any changed assumptions should be covered when developing the area for each parcel and the cost basis for each ROW cost element.
4. Calculate total area of land for each parcel. This calculation should consider whether or not the parcel is a whole take or a partial take. It should also note effects to existing structures.
5. Revised cost basis for various cost elements of each affected parcel such as land values, relocation assistance, support costs, improvements, and damages including condemnation rates and related costs. Land values should be based on verified market data for **highest and best use.** Cost data for the other ROW estimate elements should be reviewed and updated by professional ROW staff (in-house or outsourced such as appraisers).
6. Convert the cost basis to updated estimate of costs for all pertinent ROW cost elements by each parcel and adjust for the appropriate inflation/appreciation rate to obtain the estimated cost at time of purchase. The parcel number, amount of land, cost data for all elements, and other information is input in the Cost Estimating System. This system will make the appropriate calculations.
7. Update estimate documentation including uncertain items. All previous documentation should be updated to reflect estimates by parcels. If certain risks have been mitigated or covered in the updated base estimate, this should be noted.
8. Summarize all estimate elements for a total updated base cost estimate of project right-of-way. The Cost Estimate System will provide totals for all estimate elements and a revised total base cost estimate for right-of-way.

Tools

A basic tool used to prepare ROW cost estimates is a Cost Estimate System (Tool R2.8). This system should be structured so that it can be tailored to fit the level of information available. The system should allow easy input of updated information on parcel acreage and cost data for various estimate elements. The system should automatically mark changes for easy estimate review. The ROW Cost Estimate File should be populated with changes noted and additional information beyond what is included in the Cost Estimating System.

Another tool is a Formal Database (Tool R2.9) that captures relevant historical data on actual costs of the acquisition of properties [e.g., the Minnesota DOT's (MnDOT's) Right of Way Electronic Acquisition Land Management System (REALMS) or the Virginia DOT's (VDOT's) Right of Way and Utilities Management System (RUMS) systems]. REALMS and RUMS provide ROW managers with a single, comprehensive view of project and land parcel status. These are database systems for tracking parcel information. Similarly the Utah DOT (UDOT), ROW Division has Electric Project Management (ePM) for tracking ROW purchases. An issue that some SHAs have when developing databases is the question of public access to the information. This will depend on state law, but should be considered.

A second type of database is the Purchase Values Database (Tool R2.10), which identifies purchase values for the proposed location of the project where right-of-way will be acquired (e.g., Ohio Sales Data Book). There are also commercial real estate databases available. Such tools can be used to revise the cost data basis for estimating purposes (Sub-step 5 above).

Tips

The ROW estimator should consider the following

- Other information when preparing the updated estimate such as data on local health department regulations for sanitary/sewer and water/well, as well as maps depicting locations of any sanitary or water lines in the area, zoning regulations, and local building codes relating to setbacks from property lines/right-of-way lines.
- Using skilled eminent domain staff for estimating the value to improvements taken and damages to residue as well as skilled staff when estimating relocation costs.
- Time needed for relocation process and acquisition of parcels given that a schedule impact can affect the start of construction.

The ROW estimator must carefully document changes made to the updated cost estimate basis in the ROW Cost Estimate File.

- Create parcel impact notes.
- Compare updated estimate to baseline cost estimate and note changes in cost and relate these changes to changes in ROW requirements and/or cost basis.
- Continue to consider the effect of environmental issues, potential utility relocations, and interface with railroads.

Outputs

There are two main outputs related to this step. The first output is the updated ROW base estimate. This output is generated by the Cost Estimate System tool. The second output is the updated ROW Cost Estimate File. The updated ROW Cost Estimate File is populated with details of noted changes and additional information related to the cost basis for each estimate element and any changes to or new assumptions and limitations regarding the cost values derived from the revised cost basis. Updated detailed costs of each element and a total cost for all required project right-of-way would be included in the file.

Update ROW Risks and Contingency

After updating the ROW base estimate, the ROW risks and contingency element must also be updated to obtain an accurate total Updated ROW Cost Estimate. As the project progresses through preliminary design, risks will be either resolved or remain; therefore, the contingency

must be adjusted accordingly. The contingency should generally be reduced as the preliminary design progresses. There will be cases where new risks are recognized and the project contingency cannot cover the changes, but the norm should be a reduction in contingency as the design progresses and better design and scope information becomes available.

Inputs

The ROW Cost Estimate File, along with the experience and judgment of the ROW estimator and that of the project team, are the key inputs for the risk and contingency analysis. Depending on project complexity, the ROW Cost Estimate File should contain a list of red flag items or a formal risk register from when the Baseline ROW Cost Estimate was prepared. However, the ROW estimator cannot rely solely on the red flag list or the risk register. The estimator must actively seek to identify new risks that may be apparent since the creation of the Baseline ROW Cost Estimate. These new risks can be found through (1) review of estimator or project team assumptions, (2) study of the estimate basis uncertainties, and (3) analysis of project issues and concerns as explained in Chapter 5, Baseline ROW Risk and Set Contingency. Lastly, the analysis should carefully note any risks in real estate appreciation, condemnation rates, or possible future development that could affect **highest and best use** and, therefore, the contingency dollars. As was explained in Chapter 5, these are common risks in ROW estimating that should not be overlooked.

Process Step Description

The ROW estimator should complete the following five steps:

1. Review identified risks from the previous estimate with the goal of identifying (1) the risks that have changed, been resolved, or have materialized; and (2) any new risks that have been discovered.
2. Update the list of risks as necessary to reflect the current state of estimate uncertainty.
3. Update the contingency amount based on the new risks and how the previously identified risks have changed, been resolved, or materialized.
4. Document the updates to the risks and contingency in the ROW Cost Estimating File.
5. Update the total cost estimate (base plus contingency) using the Cost Estimating System.

Tools

The tools applied to update ROW risks and contingency will be a function of risk and project complexity. The tools should be consistent with those used in the baseline ROW risk and contingency analysis, unless a new level of project complexity has been realized. As explained in Chapter 5, risk identification can be accomplished using Red Flag Lists (I2.1), Risk Workshops (see R3.5—Table R3.5.3), Risk Registers (I2.2), and Risk Checklists (I2.3). Two risk assessment/analysis tools are (1) Analysis of Risk and Uncertainty (R3.1) and (2) Programmatic Cost Risk Analysis (R3.5). For assigning contingency, the tools of Contingency Percentages and Programmatic Cost Risk Analysis apply for updating as they did in setting the baseline estimate as described in Chapter 5. Finally, the ROW Cost Estimate File tool should be used in all cases, no matter the level of project complexity.

The primary difference, in tool use, from developing a baseline estimate to creating an updated estimate involves active risk management. The project team should shift from simply identifying risk and setting contingency to actively managing and seeking to mitigate risks. The project team should seek ways to avoid project risks or to mitigate the effect of a risk on project cost. The ROW cost estimator is a vital team member in the risk management approach. The Risk Charter tool provides a guide for risk management. In addition to maintaining a list of risks with risk

assessments, the Risk Charter can be used to actively manage risks. Risk management items typically found on the Risk Charter include

- Response actions,
- Responsibility (Task Manager), and
- Risk resolution schedule.

Tips

Although there will be a list of risks identified from the previous estimate, be sure to "invite" the project development team to a discussion of the possibility of new risks. Do not rely solely on the current list of risks as the project evolves—new risks may arise or, in the previous reviews, an existing risk may have been overlooked.

When updating the list of identified risks, consult with the project development team members who can mitigate the risk. A formal risk management process will assign an "owner" to each risk for purposes of risk planning and risk reduction. Obtain updated information from the development team members most closely associated with the risks.

As risks are realized or mitigated, risk costs should be removed from the contingency and known costs should be included in the base estimate. Be sure to verify that risk costs removed from contingency are included in the base estimate. Be sure to carefully document changes in risks and contingency in the ROW Cost Estimate File.

Output

The two key outputs to the updated ROW risks and contingency are (1) a revised list of red flag items or a revised risk charter and (2) a revised ROW contingency amount. The revised red flag items or risk charter should be documented in the ROW Cost Estimate File. The revised contingency should be combined with the base estimate to complete the Updated ROW Cost Estimate.

The ROW contingency should generally be reduced or resolved as the preliminary design progresses. The contingency resolution can take three general forms:

1. **Identified risks are realized = baseline is intact.** When an identified risk is realized, the contingency is reduced but the base estimate is increased at the cost of the risk that is realized.
2. **Identified risks are avoided = reduction in current baseline.** When identified risks are avoided through good engineering analysis (cost estimate management loop in Figure 6.1) or fortunate circumstances, there is a reduction in the contingency and a corresponding reduction in the project baseline because no resolved contingency is added to the base estimate.
3. **New risks are identified or realized = increase in current baseline or decrease in scope.** If risks were missed in earlier estimates and subsequently realized during an estimate update, the project management process will need to allow for an increase to the current baseline or appropriate scope adjustment will need to be made to keep the project within the baseline (cost estimate management loop in Figure 6.1).

Review Updated ROW Cost Estimate

A cost estimate is a project cost control tool and the updated cost estimate is an important management resource for controlling project cost. Therefore, all estimates should undergo a rigorous review process to ensure their accuracy and completeness. An estimate should be evaluated to ensure that it (1) is valid, (2) contains all required information, and (3) is presented in a

manner understandable to all project development team members. In Figure 6.1, an estimate review step is positioned after the Update ROW Risk and Contingency step. The review is a presented as a one-time activity, but an estimate review is completed on the changed portions of each updated estimate. The accepted updated estimate is compared with the current baseline estimate. If the updated estimate is greater then the baseline estimate, management must consider the causes of the cost increase and if the requirement for increased funds is acceptable or whether changes should be made to reduce project cost.

Inputs

Reviewers need a copy of the Updated ROW Cost Estimate and the ROW Cost Estimate File with the supporting documentation. Any changes to project scope or design and the effect of these changes on ROW requirements and cost should be specifically noted in a documentation summary. If a copy of the latest scope document for the project is not contained in the estimated file, the reviewer also needs this document.

Process Step Description

All updated ROW estimates should be subjected to a structured review of all the changed portions of the estimate and a check of total estimate compatibility with the current project scope and design and environmental commitments. The first review of the estimate should be conducted by the estimating team that prepared the estimate. This review would be a screening to check (1) the mathematics; (2) that extensions of pricing are correct; (3) that the documentation correlates with the assumptions; and (4) that the estimate adheres to agency guidelines. The documentation of the estimate basis should be carefully reviewed to ensure it is complete and reflects the current project scope. The overall scope should be summarized and the ROW requirements detailed. All assumptions regarding the effect of scope on ROW requirements must be documented. All preliminary plan drawings that show ROW requirements should be documented to include the latest revision date and sheet number. On the Caltrans "RIGHT OF WAY DATA SHEET" the final block is for the District Division Chief/Regional Manager Right of Way to sign after performing a personal review.

> I have personally reviewed this Right of Way Sheet and all supporting information. I certify that the probable Highest and Best Use, estimated values, escalation rates, and assumptions are reasonable and proper subject to the limiting conditions set forth, and I find this Data Sheet complete and current.

By this point in project development, the ROW section has begun to identify individual parcels, and the complexity of ROW issues will be clearly understood. Major portions of the updated estimate will be developed based on the expected cost of these parcels, instead of average evaluations for general land type methods. The estimator should document the type of appraisal information used to price each parcel (e.g., comparable properties or market survey with verified market data).

As with the earlier reviews, ROW complexity should determine the appropriate level of estimate probing. Complex projects can require considerable time to move through development and, therefore, demand greater attention to escalation factors and assumed real estate appreciation. This examination of the updated ROW estimate should look at the (1) net ROW estimate without contingency or inflation; (2) risk analysis and assigned contingency value; (3) assignment of a real estate appreciation factor; and (4) supporting documentation in the cost estimate file.

Tools

Understanding the effect of ROW complexity of real estate cost drivers influences the choice of estimate review methods. The formality of a ROW estimate review and the depth of that

review will vary depending on the complexity of the ROW situation. As with the Baseline ROW Cost Estimate review, routine projects without complex ROW issues can be satisfactorily examined by an internal review.

Internal Review. Consultation with in-house peers and subject matter experts can identify possible errors, omissions, and clarifications in the estimate basis and assumptions. Descriptions of three types of internal review techniques, formal committee (Tool E3.1), in-house/peer (Tool E3.3), and round table (Tool E3.4), are presented in Appendix A.

Right-of-way becomes an issue more often when adding system capacity, and the issues become more clearly defined as design proceeds. If a project is in a highly urbanized area, right-of-way may be costly, and acquisition of property can demand considerable time. Utilities can be a serious ROW issue in urban areas. Therefore, for projects with complex real estate issues, an external review is recommended.

External Review. Cost estimates for large projects or corridors in urban areas that have extremely complex ROW requirements should receive an external review by qualified professionals (Tool E2.1). Because certain critical elements of these estimates may require a unique expertise to verify estimated costs, agencies that fund their projects with bond money conduct reviews that consider the appraised value of each parcel and the associated costs for damages. This external review should include the results of a risk analysis that identifies the risks associated with these critical elements, the high and low cost limits for each critical element, and the assigned probability that the risk will occur.

Tips

To be successful, the review must closely examine the assumptions that form the basis of the estimation. This review should be conducted by knowledgeable, experienced individuals. The complexity of the ROW situation is the most important driver controlling the level of estimate review. A ROW estimate for a small project affecting a few parcels can be reviewed internally by peers and supervisors. Larger and more complex projects, such as those in urban areas and affecting access to commercial properties, may require an increased level of scrutiny. Reviews for these projects would require special group participation and an increased level of management review time.

Output

If the review finds no issues with the cost estimate and the estimated cost is less than the baseline estimate or current ROW budget, the estimate moves to the approval step. If the estimated amount is greater than the budget, then this result must be communicated to management for possible action to control project cost. All differences between updated cost estimates and the baseline estimate should be explained in a memorandum when the estimate is sent to management.

Approve and Communicate Updated ROW Cost Estimate

Budget control is critical to managing project costs as the design proceeds and there is increased pressure to expand the scope of a project. An authorized officer of SHA management must approved all cost estimates and certify that the project manager proceed with any change to scope that has affected cost. Some agencies place this approval authority with the Office of Financial Management so that it is completely removed from those directly responsible for project development.

Inputs

A summary of the reviewed and acceptable ROW estimate package goes forward to management for approval before the cost amount is communicated to the project manager and the design team.

Process Step Description

Completing all the cost estimation steps for updating a ROW cost estimate, as shown in Figure 6.1, leads to an Updated Baseline ROW Cost Estimate. The approval step is therefore very significant. Approval of an estimated increase in ROW cost, caused by a change in project scope, signifies concurrence with the change. Requiring approval ensures that agency management is aware of the implications of the proposed modifications and understands how such modifications will affect commitments. The approval process requirements should be structured to match the significance of the change as measured by the effect of project cost.

Non-Significant Changes. Any change to a project resulting in an increase or decrease in the total cost of right-of-way that is greater than the currently approved baseline estimate by some nominal amount (Missouri DOT says the annual inflation factor) is considered non-significant and may be approved by the project manager. Any series or combination of multiple non-significant changes that occur within the same fiscal year should be measured against the preceding baseline as a single change.

Significant Changes. When the changes cause the total estimated ROW cost to exceed the amount of ROW funding (existing approved baseline estimate) by an amount greater than some nominal amount (Missouri DOT uses the annual inflation factor) approval should be required by the District Engineer or the district engineer's designee. Additionally, approving the change will require coordination with and an approval from the agency's finance office. Any change to the elements of a project that changes the delivery of a project in the currently approved STIP to a different state-fiscal year should be considered significant. With either change, the details of any proposed change, the reasons why the change is necessary, and the projected effects on the project's budget and delivery schedule must be stated in the approval package.

Scope changes are the primary contributors to cost escalation, and these changes have to be monitored closely as design evolves. Requiring management to be responsible for approving an estimate ensures that the senior levels of an agency are aware (1) of the expected ROW cost based on specified assumptions about project design; (2) that the total estimated cost is a deterministic number that will probably be affected by the identified risk factors; (3) that the contingency amount left in the estimate is appropriate to counter-act the occurrence of the specific risks events and not an add-on amount to be used for scope changes; and (4) that a specific percentage has been used to account for real estate appreciation only to a specified date in the future.

Tools

Budgeting is a balancing act of meeting the agency's objectives—responding to transportation needs—to the fullest extent possible within the limits of its financial capacity. To optimize the agency's programs, it is better to establish **budget constraints** early in the project development process and to demand that estimate reviews and approvals be a critical component of all project decisions. Four budget control tools are presented in Appendix A: Constrained Budget (Tool B1.2), Standardized Estimation and Cost Management Procedures (Tool B1.3), Summary of Key Scope Items (Tool B1.4), and Variance Reports on Cost and Schedule (Tool B1.5).

Tips

As project design develops and more is known about project conditions, budget control is an important management function. Identifying changes and making necessary modifications to the project budget is reflected through the feedback loop shown on the right side of Figure 6.1. During design, scope definition is refined and there is clearer identification of cost affecting fac-

tors. Budget control is exercised by requiring different levels of approvals before a project can proceed in development.

Communication is predominantly focused on keeping all project team members and external parties informed and updated with respect to the current estimated cost of project right-of-way. Communication channels must allow clear and succinct exchange of information. Efforts must be made to ensure that the significance of cost information is interpreted appropriately. Communication of uncertainty and any discrepancies observed must be brought to the notice of peers immediately for remedial procedures. Estimate inputs from disciplines, third parties, and driven by project requirements have to be communicated without ambiguity.

Outputs

The output of the approval step is an Updated ROW Cost Estimate. This estimate is now used to manage changes in project scope and cost as the design team proceeds to translate the transportation solution into contract documents.

Chapter Summary

Update ROW Cost Estimation during Preliminary Design was the focus of this chapter. The general process for updating, reviewing, and approving this cost estimate was presented. The updated cost estimate is generally determined for a preferred alternative where parcels have been identified based on preliminary drawings. Historical data are not used for land values because land values are based on a market survey and verified sales data to reflect current market values. The effect of structures and other improvement to properties are known. Historical data are mainly used to develop the cost basis for other ROW elements. The cost data are specific to the element being estimated and are developed by expert ROW professionals. ROW estimating staff should update ROW risks to modify the contingency value, based on whether or not the risks occurred. Similar tools are used to update cost estimates. Finally, the project manager, ROW staff, and design team should work together to manage costs against the baseline budget or the latest updated budget adjusted for changes.

CHAPTER 7

ROW Cost Management

During the final design phase of project development, Plans, Specifications, and Estimate (PS&E) documents for the project are prepared and the ROW appraisal and acquisition process often begins. A transition of activities occurs between estimating ROW cost and managing real estate acquisitions during this phase of project development. Typically, no further ROW cost estimates are prepared. However, as ROW acquisition expenditures begin to occur, ROW personnel and the design team should be tracking how these actual expenditures compare with the current baseline ROW cost estimate. This comparison indicates whether the acquisition process is proceeding within the allocated budget or if there is a potential for a budget overrun or reduction.

Introduction

When real estate is necessary for a project, a key milestone that transitions ROW cost estimating activities to the appraisal and acquisition process occurs when final ROW plans are completed. This milestone generally initiates ROW appraisal and purchase activities. If SHA policy is to have right-of-way purchased before the start of construction, then this milestone may commence several years before the letting date for projects with significant ROW requirements (major projects). One Florida district, however, requires that ROW requirements be delineated at the 60-percent design stage so that acquisitions can begin earlier and not delay the project schedule. Any ROW changes after the 60-percent design milestone require a special ROW and design staff meeting to make a recommendation "for or against" the change and the recommendation must be approved by management.

The time required to purchase right-of-way for a moderately complex project probably would be less as a result of minimal ROW requirements. Florida reports that the acquisition process for a typical project is from 18 to 24 months in duration. The complexity of ROW acquisition actions will influence when acquisitions must begin to support a specified construction letting date.

During final design, project ROW budgets are included in the STIP. If cost changes are anticipated, a budget amendment may be necessary. Cost management is needed to determine when potential amendments to the STIP are required to cover ROW cost. The determination of the need for an amendment is based on a comparison of actual spending versus what is budgeted. This comparison will identify a potential budget overrun or reduction. When these comparisons are performed routinely during the acquisition process, the information will allow the project development team to manage the effect of these potential changes effectively. In this way, the project team is provided with an "early warning system" to aid in managing project funds and ultimately program funds.

ROW Cost Management Flowchart

Figure 7.1 represents the ROW Cost Management Process during final design. The initial step in this process focuses on assessing any changes to ROW requirements based on the final ROW plans. Changes in requirements are converted to estimated costs, then budgets or plans are adjusted accordingly. Once the appraisal and acquisition process begins, comparisons of actual costs versus budgeted costs are assessed periodically. These assessments may lead to potential cost adjustments in the budget or a reevaluation of design effects.

Before property appraisals begin, each parcel in the final ROW plan should be examined and compared with the most recent ROW requirements used to complete the latest updated ROW cost estimate. ROW personnel must identify whether there are potential changes in scope, general site conditions, or specific parcel conditions that will affect acquisition cost. For example, design changes that have occurred since the last Updated ROW Cost Estimate was completed qualify as potential changes that may affect final project ROW cost. This cost management step additionally provides a check to identify errors or omissions in previous estimates.

The decision milestone, shown in Figure 7.1, represents the decisionmaking process that must occur based on the output of the first step. If cost changes are discovered, their effect should be evaluated based on the latest updated ROW budget and a decision made to recommend a budget adjustment or possibly the necessity for design changes to control ROW cost. Additionally, a change might be considered if there is a potential for a reduction in project cost.

As appraisals and acquisitions are executed, actual cost data should be recorded for each parcel. This second step of ROW Cost Management involves checking the appraisal amounts and acquisition cost against the estimate values in the last updated ROW budget. As the appraisal and acquisition activities progress, appraisal data and acquisition costs should be recorded and tracked in a database system that provides up-to-date parcel expenditure information. This database system should be able to generate cost summaries easily. Tracking ROW acquisition costs as they occur enables SHA management to balance expenditures against the budget and to forecast the expected total ROW cost at the completion of all acquisition actions, including condemnations. This tracking should occur continuously throughout the appraisal and acquisition process.

The Cost Management Loop—shown as a dashed line in Figure 7.1—indicates the need for this management process to be cyclical. Acquisition summaries should be generated at milestones such as at the 30-percent, 60-percent, and 90-percent points of property acquisition or when the ROW manager deems pertinent. The cost management loop denotes this cyclical reporting and comparison between the actual expenditures and the budget.

If the forecasted cost is expected to exceed the current ROW budget amount, management must either institute a budget adjustment with the appropriate steps for requesting additional funds or develop a proposal for reducing either ROW cost or other project cost items. The project manager should be notified immediately, and the basis for the budget adjustment with supporting assumptions and calculations must be documented.

The cyclic ROW Cost Management process continues until all acquisitions are completed. Following the completion of all acquisitions, the project is ready to be let for construction. This ROW management process will eliminate or reduce ROW cost escalation problems and provides "lessons learned" data that can be applied to future ROW cost estimates.

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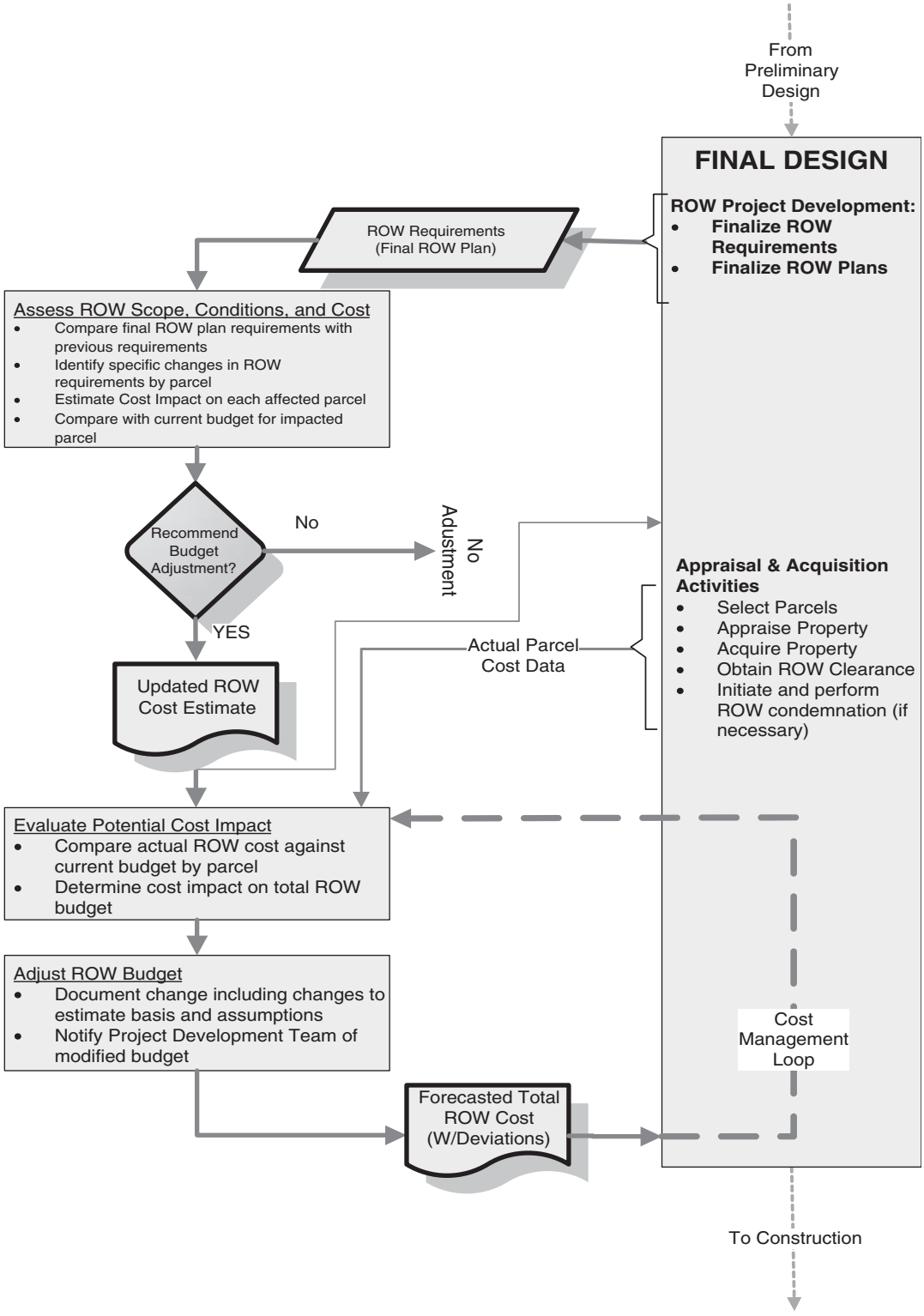

Figure 7.1. Right-of-way cost management flowchart.

Assess ROW Scope, Conditions, and Costs

Final ROW plans are completed during the final design phase of project development. These drawings must be checked against the ROW requirements that were the basis for the most recent updated ROW cost estimate. The intent of this assessment is to determine if there are significant changes in ROW requirements that affect the estimated cost. This assessment serves to verify the estimated cost for each parcel based on the description in the final ROW plans.

Project Complexity

Project complexity will influence the level of effort required to assess changes in ROW requirements. In addition, the amount of documentation will increase correspondingly for more complex projects. Complex and major projects probably will have more complicated parcel takes with the potential for damages and evaluation of existing improvements as well as increased cost risk because of administrative settlements. Moderately complex projects will normally require less effort and documentation. However, the extent of the effort and documentation is influenced not only by the number of takes but, to a large extent, by the complexity of the individual acquisitions.

Final Design and Cost Estimate Inputs

The key input for the ROW Cost Management process at this stage of project development is the final ROW plans generated by the design team. All necessary parcels should be identified at this time as well as the level of effect to each regarding remainder property, access, and compliance with local zoning regulations. The other two pieces of necessary information are the latest ROW cost estimate (the updated cost estimate generated by the ROW Cost Estimate System tool) and the Updated ROW Cost Estimate File.

Process Step Description

The ROW estimator should

1. Compare final ROW requirements as shown on the ROW plans against the previous statement of requirements. This step should be a final check of the ROW requirements expressed on the final plans against those that served as the basis for the most recent Baseline or Updated ROW Cost Estimate. This comparison should be performed on a parcel by parcel basis.
2. Identify specific changes in ROW requirements by parcel. As significant changes are identified, these changes should be documented in terms of their effect on a parcel such as more land required, effect on remaining access, and compliance with local zoning requirements.
3. Estimate cost impact on each affected parcel. Depending on the effect, a change in cost is estimated for each estimate element affected by the change (e.g., cost of additional land when more land is required then included in the previous parcel estimate).
4. Compare the new parcel estimate with the current budget. Once all changes in cost for a parcel are evaluated, the revised total ROW cost can be compared with the budget to see if the magnitude of the change warrants a budget adjustment.

Tools

The ROW Cost Estimate System could contain a workbook for easily tracking updated costs resulting from changes in requirements. The Updated ROW Cost Estimate File would be the repository documenting any requirement changes. The Tool Variance Reports on Cost and Schedule (Tool B1.5) describes a mechanism for tracking changes and alerting project personnel of changes.

Tips

Determine a standard percentage change, increase or decrease, to guide decisionmaking concerning the need to recommend a cost adjustment to the current budget (e.g., overall increase of 5 percent over or under the budget).

Outputs

If the forecasted ROW cost differs significantly from the budget, either by an increase or a decrease, a potential cost adjustment to the current baseline budget can be recommended by the ROW team. These changes should be supported by analyses using the ROW Cost Estimating System and data found in the Updated ROW Cost Estimate File.

Evaluate Potential Cost Impact

Once the appraisal and acquisition process begins, actual acquisition and other expenditures are recorded against purchased parcels. The process objective of the Evaluate Potential Cost Impact step is to identify potential changes to the latest updated budget based on a new forecasted cost of right-of-way derived from a projection of the actual acquisition costs.

Project Complexity

Similar to the first process step, project complexity influences the level of effort required to evaluate the forecasted ROW costs versus the current budget. In addition, the amount of documentation for tracking actual costs will correspondingly increase in the case of projects having complicated ROW requirements—complex projects.

Actual Acquisition Cost Inputs

Actual parcel expenditures are recorded as acquisition proceeds. Actual expenditures would include all costs related to acquiring the real estate (i.e., all estimate elements). The latest updated budget, including changes from the Assess ROW Scope, Conditions, and Cost process, is the other input.

Process Step Description

The ROW estimator should

1. **Compare the actual ROW cost for a parcel against the latest updated cost estimate for that parcel.** First, determine if all actual costs are known for the parcel. If so, then determine the deviation between the total actual costs and the budgeted amount for the parcel. If only part of the actual costs is known for a parcel, estimate the remaining costs required to complete the parcel acquisition. The expended costs plus the estimated costs to complete the acquisition is the total forecasted cost for the parcel. Compare the forecasted parcel cost with the latest updated parcel cost estimate (this could be a database summary that highlights differences greater than a set value). When there is a substantial deviation between the forecasted parcel cost and the updated cost estimate for the parcel, document the deviation.
2. **Determine the cost impact to the total ROW budget from changes in the forecasted cost for the individual parcel.** Summarize all parcel costs expended to date and all forecasted parcel costs. Compare the total forecasted cost (sum of all parcel forecasts) with the total budget with amendments. Determine whether a substantial difference exists between the total updated budget and total forecasted cost.

Tools

The ROW Cost Estimate System (Tool R2.8) contains a workbook (tab) that is used to track actual ROW costs as parcels are acquired. Within the worksheets of the system, cells should be provided by category for inserting estimated costs to complete an acquisition. This workbook should, both electronically and in printed format, be able to provide the difference between the parcel forecasted cost and the latest updated parcel cost estimate. A simple example of this type of worksheet is shown in Figure 7.1. This example is taken from the FDOT Right-of-Way Work Program Cost Estimating System (see R2.8). A ROW Formal Database (Tool R2.9) would be another tool that supports the steps of this process. These types of systems can track the cost of each parcel from appraisal through acquisition and provide reports for management information and decisions. Such a database is additionally a source of recent historical data and market trends for land values when preparing future ROW estimates.

The TxDOT uses a Geographic Information System (GIS)-based electronic tracking database to track the status of ROW acquisitions for its projects. The database stores information by parcel number and owner names and includes information on easements, rights-of-entry, special commissioner assignments, review status (e.g., date received, date approved), acquisition cost, and other pertinent information. (Cambridge Systematics, 2006)

GIS-based tools to track the status of individual properties, including the color-coded mapping systems used in Texas and Minnesota, are an easy and effective way to ascertain the status of individual parcel acquisitions. The cross reference of GIS, property maps, and property owner names helps not only during the acquisition process but also for future property management and disposal of excess land. (Cambridge Systematics, 2006).

Tips

Use actual expenditures as the basis for identifying overall cost trends related to ROW acquisitions. Actual land values can be determined and used to estimate the probable cost of the remaining acquisition actions. Administrative costs for relocating property owners based on early purchases can also be used to update estimated administrative cost. Perform updates early but probably not before 20 to 25 percent of the actual acquisition costs have been recorded.

Effective pursuit of innovative data management processes requires agency investment in personnel, document management systems, equipment, electronic monitoring, and training. Document management systems become more critical as knowledgeable employees leave, taking institutional history with them. MnDOT invested significant resources in turning its old ROW maps and utility permits into an electronic format, but believes that the investment has made data-gathering more efficient and effective. (Cambridge Systematics, 2006)

Outputs

This step can identify potential changes, resulting from forecasts projecting higher ROW costs, to the current budget. Conversely, this step might also reflect the effect of a declining real estate market with a potential project cost savings as a result. These changes would be highlighted in the ROW Cost Estimate System and would serve to guide management decisions.

If a cost increase is forecasted, the project development team should be responsible for developing and presenting solutions that will bring the ROW cost within the budgeted amount. As *NCHRP Synthesis 292* recommended; "Delegate authority for project decisions to project personnel, rather than retaining authority at a more remote level." Or, stated another way, make the project development team responsible for managing the budget (Waters, 2000).

Adjust ROW Budget

Once a potential budget deviation is identified, this process step documents the budget deviation and the actions by both the project development team and management. If a budget adjustment is necessary, such action will, in most SHAs, have to be coordinated with Program Management.

Project Complexity

Similar to the first and second process steps, project complexity influences the level of effort required to evaluate forecasted ROW costs versus the current budget. In addition, the amount of documentation for tracking actual costs will increase correspondingly because more cost items will probably be necessary for more complex projects.

Inputs

Specific potential cost changes in the ROW budget are identified in the ROW Cost Estimate System. The Updated ROW Cost Estimate File should be the repository for documenting the basis for estimated costs to complete the acquisition of each parcel and describing the reasons for potential changes to the current ROW budget.

Process Step Description

The ROW estimator should

1. Document changes, including changes to the estimate basis and assumptions. The Updated ROW Cost Estimate File is modified to include the basis for any potential changes to the current budget as a result of parcel forecasts that are either over or under the estimated values.
2. Notify the project development team of any potential budget modification, noting the reason for a ROW budget change, so that the team can respond appropriately.

Tools

The ROW Cost Estimate System provides the hardware for capturing potential cost changes, and the Updated ROW Cost Estimate File contains the basis for estimated costs to complete each parcel acquisition. A change management form is used to document the potential change in cost and the rationale behind the change (Tool B1.5).

Tips

Budget control is a collaborative process. ROW and other project development functions cannot operate in isolation, handing off their work product to the next downstream activity. Potential deviations in acquisition costs must be documented because this is critical to providing the project development team with current information on actual acquisition costs are affecting the total ROW budget. Early notification of budget deviations provides the project development team and management with information for making informed decisions to address potential cost overruns.

Outputs

The output of this step is a documented forecast of expected ROW cost and an analysis of potential deviations from the ROW budget. This forecast should accompany the project team's

proposal for addressing cost deviation and maintaining project cost within budget. The forecast is supported by documentation in the ROW Cost Estimate System and in the Updated ROW Cost Estimate File.

Chapter Summary

ROW Cost Management during Final Design was the focus of this chapter. The general process for tracking and managing actual ROW expenditures against the latest updated cost estimate (or budget) was presented. A final check of the latest updated ROW cost estimate is made based on final ROW plans. This check compares current cost estimates for each parcel with the latest budget for each parcel. As the appraisal and acquisition process begins and actual expenditures for properties occur, the total forecasted cost is updated periodically so as to reflect actual costs and costs to complete the purchase of remaining parcels. The total forecast is compared with the latest budget. Deviations are documented and actions taken as needed to manage ROW costs.

CHAPTER 8

Conclusions

SHAs face a major challenge in controlling project budgets over the time between project initiation and the completion of construction. ROW costs are among the most difficult to control and, therefore, necessitate disciplined estimating and cost management procedures. Yet, in many agencies, the existence of stovepipe divisional structures lead to failure in communicating important project information affecting scope, design, and cost.

The objective of this Guide is to assist SHAs in achieving better ROW estimate consistency and accuracy during planning and project development. It was developed after a focused review of current SHA ROW practices and an extensive examination of recent ROW estimation research. SHAs, representing all geographical sections of the country, provided input on their current practices and the problems they are experiencing. A critical review of the literature and SHA information served to identify viable and successful approaches to ROW cost estimation practice and ROW cost estimation management.

A Structured Approach

No single estimating technique or tool will ensure the development of accurate estimates. ROW cost estimation practice and cost estimation management require a structured approach and the completion of each step in the process. The cost estimation and estimation management process necessitates completion of five basic steps that are applicable to the process across each development phase. These cost estimation and management steps are usually performed sequentially and repeatedly as planning and project development proceeds:

1. Determine ROW estimate basis,
2. Prepare ROW base estimate,
3. Determine ROW risk and set contingency,
4. Review ROW Cost Estimate, and
5. Approve and communicate ROW Cost Estimate.

To achieve accurate ROW cost estimates, it is necessary to

1. **Complete every step in the estimation process** during all phases of project development.
2. **Document estimate basis,** assumptions, and back-up calculations thoroughly.
3. **Identify project risks and uncertainties** early, and use these explicitly identified risks to establish appropriate contingencies.
4. **Anticipate external cost influences** and incorporate them into the estimate.
5. **Perform estimate reviews** to confirm that the estimate is accurate and fully reflects the project scope.

Finally, it is important that, throughout the appraisal and acquisition process, the actual ROW expenditures are used as the basis for forecasting total ROW expenses. Comparing the forecast against the budget allows the project development team to respond to potential changes in cost. This cost management focus requires the following steps:

1. Assess ROW scope, conditions, and cost;
2. Evaluate potential cost effect; and
3. Adjust ROW budget.

Although cost management is more difficult at this time, the project development team should start when the first property acquisitions are made so as to establish cost trends and monitor these trends as they affect total forecasted ROW costs relative to baseline budgets. Decisions can still be implemented that will influence the effective use of project and program funds.

Collaborative Atmosphere

The 2006 *Best Practices in Right-of-Way Acquisition and Utility Relocation* scan-tour report stated that a common trait of those agencies that "experienced considerable success in improving their ROW acquisition and utility relocation processes" was a supportive institutional environment (Cambridge Systematics, 2006). Agency management should encourage a collaborative atmosphere where actions that affect more than one discipline receive full consideration from all affected parties. Supporting divisions such as ROW should have open communication with the project development team and project manager because alignment and design decisions affect ROW cost. In this context, management should insist that ROW activities are performed as much as possible in parallel with other functions, rather than waiting for a "hand-off" from an upstream function. Thus, management should do the following:

1. **Create an environment for success**
   - Dedicate resources to ROW estimator training and development of a ROW estimating procedures manual. Trained ROW estimators can efficiently produce accurate estimates.
   - Dedicate resources to creating accurate ROW databases and provide staff resources to manage the databases.
2. **Create procedures for establishing a Baseline ROW Cost Estimate**
   - Agencies must have procedures to support the establishment of a baseline ROW estimate for each project. The Baseline ROW Cost Estimate establishes a measure for project performance throughout project development.
3. **Create processes to identify risk and for setting appropriate contingency**
   - Early identification of ROW risk and uncertainty will help focus design efforts that mitigate ROW cost. Setting a contingency amount that reflects these risks and uncertainties will allow for the appropriate understanding and communication of estimate accuracy.
4. **Require ROW estimate reviews**
   - A peer review of every ROW estimate and the use of a formal approval process after the review will improve accuracy and accountability.
5. **Demand ROW estimate documentation**
   - Documentation provides the information necessary for managing the project and making informed decisions. Management cannot properly correct a problem without knowing how an estimate was prepared or what changes were made during project development.
6. **Create ROW cost control mechanisms**
   - The Baseline ROW Cost Estimate, together with the documentation supporting estimate updates, will provide management with the information to make timely decisions.

- Cost control continues throughout the appraisal and acquisition process as actual expenditures for right-of-way form the basis for comparing forecasted ROW costs with the updated baseline budget.

7. **Support good communication practices**
   - Identification and communication of a project's early stage uncertainty and the fact that unknowns can affect scope, costs, and time will help in managing project cost expectations.
   - The communication between disciplines of ROW estimate precision, uncertainty, and risks and to stakeholders can affect project success significantly.

Challenges

Implementing new concepts recommended in this Guide will involve facing the challenges that accompany change. Meeting those challenges will ultimately require a commitment by the agency's senior management to direct and support change. SHA executive management must provide the leadership to institute the practices described herein and provide members of their ROW staff with the resources to participate in training and AASHTO ROW activities that enhance their base of knowledge. The benefit of such commitment will be manifested in projects that are consistently within budget and on schedule and that fulfill their need and purpose, as defined by their scope. This benefit will also improve program management by allowing for better allocation of funds to projects to meet the needs of the ultimate customer: the public.

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APPENDIX A

Tools

Contents

Introduction

Background

This Appendix describes tools that are specific to right of way and tools that are generic for developing highway estimates as adapted from the Tool Appendix in *NCHRP Report 574.* The *NCHRP Report 574* Tool Appendix has 72 different tools that are described in terms of over 90 different applications. The tools support over 30 cost estimating and cost management methods. These methods in turn support eight strategies, six of which are described in Chapter 2 of this Guidebook. A strategy is defined as *a plan of action intended for accomplishing a specific goal.* A method is defined as *a means or manner of procedure, especially a regular and systematic way of accomplishing something (i.e., a strategy).* A tool is defined as *something used in the performance of an operation (i.e., a method).*

The strategies, methods, and tools are discussed in *NCHRP Report 574* with the intent of supporting development of a total cost estimate for a project. Total project cost is often defined as having three main components: (1) engineering/design, (2) right-of-way, and (3) construction. Construction typically covers direct construction costs, including environmental mitigation, and construction engineering. The tools in *NCHRP Report 574* support all three total project cost components, but their focus is often specific to one component (e.g., historical bid based estimating for construction, estimate communication, etc.). There are also cost management related tools that tend to be more generic and support cost management of all project components.

Tool Appendix Layout and Structure

The layout of this Tool Appendix follows the *NCHRP Report 574* approach. Prior to discussing a specific tool or set of tools, the method associated with the tool(s) is first described. For example, **Estimate Review—Internal** is a method that has three tools associated with it, **Formal Committee, Off-Prism Evaluation,** and **In-House/Peer.** Each method and its tools are described using an alphanumeric system. A letter and number describe the method, such as **E3 Estimate Review—Internal.** The tools used to perform the method are described using the method designator and a decimal number system. For example, **Formal Committee** is **E3.1.** This alphanumeric system is the same system used in the *NCHRP Report 574* Tool Appendix. This approach is used in the right-of-way Tool Appendix to ensure consistent referencing to the tools contained in *NCHRP Report 574.* Where new tools have been added as a result of the right-of-way cost estimating focus of this Guide, they are added under the existing *NCHRP Report 574* methods. For example, the **R2 Right of Way** method has four new tools designated **R2.7** to **R2.10.** The first six tools under this method are also covered in the *NCHRP Report 574* Tool Appendix, but these last four tools are new.

Tool Use

This Tool Appendix describes all the tools referenced in Chapters 4 through 7. The material presented in this appendix is a synopsis and distillation of good practices currently being used by SHAs to support their right-of-way cost estimating efforts. To be most effective, appropriate tools should be used to support the structured estimating approach presented in the body of this Guide. Use of individual tools in an "a la carte" fashion will have limited effect in improving the accuracy of right-of-way estimates and managing right-of-way costs. Implementation must occur within the context of a greater vision for integrating the total cost estimation practice, of which right-of-way estimates are one part.

The common informational structure for describing each tool is the following:

- What is the tool?
- What is the tool used for and why is the tool used?
- What does the tool do or create?
- When should the tool be used?
- What are examples or applications of the tool?
- What tips will lead to successful use of the tool?
- Where can the user find more information to support development of a specific tool?

This structure is also consistent with the structure of the tools described in the *NCHRP Report 574* Tool Appendix.

Right-of-Way Tool Selection

In Chapters 4 through 7, tools are identified in relation to each of the three focused estimating efforts and cost management efforts that occur over the planning, programming, preliminary design, and final design phases of project development. The methods and tools supporting each project development phase are selected based on their applicability to a particular phase of the project. In some cases, method and tool selection are influenced by project complexity. In every case, the discussion of the method and tool application in Chapters 4 through 7 is modified to fit the level of project definition that corresponds to a phase.

Many of the methods and tools that are identified for use in the context of right-of-way cost estimating and cost management are equally applicable to other project cost components. These methods and tools are described in the Tool Appendix in general terms with reference to right-of-way. Specific discussion of their application in the right-of-way area is incorporated in the relevant chapters. Users of the Guide are encouraged to review these more generic methods and tools and then adapt them for use as they fit in the culture of their SHAs. Generally, the more generic methods include the following:

- **B1 Budget Control**
- **C1 Communication**
- **E2 Estimate Review—External**
- **E3 Estimate Review—Internal**
- **I2 Identification of Risk**
- **R3 Risk Analysis**

Two methods and their tools, **D4 Document Estimate Basis and Assumptions** and **R2 Right of Way,** are more specifically focused on right of way. Their application is discussed throughout Chapters 4 through 7. However, actual use within an SHA may require modifications to fit the culture and approaches an SHA follows when performing right of way cost estimating and managing right of way costs.

B1 Budget Control

Budget control tools assist in providing a disciplined approach to decisions that affect project cost. Budget control must begin early in project development. Two simple but essential principles of the budget control process must be clearly understood: (1) there must be a basis for comparison, and (2) only future costs can be controlled.

B1.1 Budget by Corridor

Budget control tools assist in providing a disciplined approach to scope decisions that affect project cost. Budget control must begin early in project development. Good budget control means that management is informed about what (1) has been done; (2) has to be done; and (3) is wrong and why—informed early; so that management has the opportunity to take corrective action.

What Is It?

Budgeting by corridor involves estimating and managing right-of-way requirements in logical groups of smaller projects in transportation corridors. Transport corridors link major articulation points (e.g., hubs) on which freight and passenger movements converge. Most often, they lie at the intersection of economic, demographic, and geographic spaces as they perform both market-serving and market-connecting functions.

Why?

Developing right-of-way estimates and budgets by corridors can assist with the challenges of long-range planning. First, projects in a corridor can be closely related in their physical and temporal characteristics. There is a link between transportation corridors and economic activities that can help to predict the needs, and thus the cost, of transportation projects. Estimating the need for improvements and reconstruction of corridors can be more accurate than estimating smaller projects individually. Additionally, long-range planning tools (i.e., conceptual estimation tools) are aligned with corridor-scale estimates, rather than smaller individual projects.

What Does It Do?

In addition to providing a logical grouping of projects with similar physical and temporal characteristics for more accurate estimates, budgeting by corridor allows planners and estimators to better manage cost because they can budget a portfolio of projects and right-of-way cost rather than the cost for a single project. Project needs will change over time within the corridor. Budgeting by corridor allows planners to reallocate moneys from one project to another within the corridor as needs dictate and better scope information becomes available over time. Used in conjunction with the constrained budget and/or design to cost tools, budgeting by corridor can provide a means to manage a portfolio of projects in a logical manner.

When?

This tool is used for preparing long-range right-of-way estimates during the planning phase of project development.

Examples

The Washington State DOT has created an Urban Corridors Office in the Seattle Metro area to manage the state's largest corridors. The Seattle-based Urban Corridors Office directs six of the DOT's largest projects, including the SR 99 (Alaskan Way Viaduct and Seawall Replacement Project), SR 520 (Bridge Replacement and HOV Project), and SR 509 (I-5 Freight and Congestion Relief, Access Downtown [Bellevue], I-90 Two-Way Transit and HOV, and I-405 Congestion Relief and Bus Rapid Transit Projects). More information can be found at www.wsdot.wa.gov/consulting/Ads/UrbanCorridors/Misc/UCOOrganization.pdf.

Tips

An SHA may need to reorganize its management structure to effectively budget and control costs by corridor. This tool should be used in conjunction with other tools, such as constrained budget and design to cost.

Resources

Washington State DOT Urban Corridors Offices: www.wsdot.wa.gov/consulting/Ads/Urban Corridors/Misc/UCOOrganization.pdf.

B1.2 Constrained Budget

Prudence requires that individual project budget growth not destroy the agency's total program by requiring the diversion of funds to cover the deficit in one project. To optimize the agency's programs, it is better to establish budget constraints early in the project development process and to demand that cost-effectiveness be a critical component of all project decisions.

What Is It?

Highway projects often are authorized with resource limitations, particularly budget limitations. SHAs are often willing to undertake these projects with a specific cost commitment approach that means the projects have to be completed within a fixed budget. Scope definition including required right-of-way for such projects is directly related to the funds available. The constrained budget tool is perceived as a regulatory mechanism to evaluate and limit project scope to absolutely necessary items and to prevent cost overruns.

Why?

Highway projects involve large monetary resources and often there is a significant amount of consideration and give and take by legislators to control programs. The need and feasibility of a project has to be adequately justified while funds are being sought. In a resource-limited environment, some projects may be approved based on a limited resource allocation—budget. A mechanism is required to carefully monitor and use resources for such projects. The constrained budget tool was developed with these requirements in mind.

What Does It Do?

This tool is used to constantly evaluate whether or not the total project cost is within a predefined or mandated budget while attempting to scope and design the project within the fixed budget. The tool can also be perceived as a cost-cutting technique. The tool ensures that critical elements of the project, including right-of-way, are adequately included in the scope. This tool causes designers to seek innovative and low-cost designs as a means of meeting cost restraints.

When?

This tool is used early in the project development process—in the programming and preliminary design phase.

The tool is required when a budget has been mandated and when no increases will be allowed.

Examples

The State of Washington has recently passed several gas taxes that included legislated line-item budgets for projects. The budgets for these projects are considered fixed and cannot be increased. Cost estimates for many of these projects were prepared based on limited scope definition. WSDOT has initiated project control and reporting procedures to ensure that these projects are delivered at the constrained budget amounts or less.

Tips

When developing a project under a constrained budget, the agency should use several different tools to support this method. For example, design to cost, is an excellent tool to help ensure that the design is constantly being assessed from a cost estimate perspective. Value engineering, should also be used to evaluate different design alternatives to determine the lowest-cost option that provides the desired scope features. Other budget control tools should be used in conjunction with this tool. One issue that SHA estimators have to carefully consider under the constrained budget tool is artificially reducing costs to maintain the budget as the design and more is known about right-of-way requirements developed. The integrity strategy should be followed to prevent this pressure from occurring (see Chapter 2 for all strategies).

Resources

WSDOT (2006). Project Management On-Line Guide. www.wsdot.wa.gov/Projects/ProjectMgmt.
Project Management Institute (2004). *A Guide to the Project Management Body of Knowledge: PMBOK Guide,* Third Edition, Project Management Institute.

B1.3 Standardized Estimation and Cost Management Procedures

The objective of standardizing procedures is to establish a common basis for all SHA project participants to follow when preparing cost estimates and to manage costs consistently over the project development process. Change occurs frequently as projects are developed. Changes come from, for example, added scope, design development, and site conditions different than anticipated. Adopting standard procedures will aid project participants when making decisions regarding potential changes to current budgets, with the goal of controlling the project baseline budget. The integration of both cost estimation practice and cost estimation management through standardized procedures is a critical feature to successfully managing cost escalation.

What Is It?

This tool establishes a set of standards and procedures within a state highway agency to guide the preparation of all cost estimates, including right-of-way estimates, and for the management of project costs through the various stages of project development. The objective is to provide a coherent policy basis for alleviating cost escalation by consistently providing timely feedback on the potential effect of project changes to the budget. Procedures provide a basis for how costs are managed, including who has authority to make decisions regarding changes to current budgets.

Why?

Project changes often affect costs, and the necessity to constantly monitor these effects in relation to the budget is necessary to control cost escalation. The most effective cost management system is one that will allow the project team to develop designs and make decisions regarding design alternatives with full knowledge of the cost effect of the decisions. Standardized cost management procedures should facilitate controlling cost escalation throughout programming and design of project development. Such procedures also help establish a cost-conscious atmosphere within the project team environment.

What Does It Do?

These procedures formalize project cost control approaches followed throughout the project development phases. It is a standardized process for (1) monitoring project development for potential changes to the budget, (2) submitting potential changes, and (3) obtaining management approval of changes. This cost control process aids the project team in monitoring costs and alerts the team to any major effects with regard to the current budget.

When?

Standardized procedures must be established at an agency-level for guiding project development work, specifically for cost estimation and cost management. The procedures should be applied throughout the project development process. However, cost management can only begin when a baseline scope, cost, and schedule is set.

Examples

The Missouri DOT has developed a set of estimation and cost management procedures that are applied from need identification through to the final design stages. These procedures are closely tied to the Missouri DOT project development process. There are clear definitions of terms and the identification of a timeline for the different steps to be followed for a project to be realized. As a need is transformed into a real project, based on available information, appropriate estimation techniques are used to accurately derive cost estimates. Further, significant tasks—such as public input, environmental considerations, and the proper channels to obtain approvals as cost estimates are developed—have been incorporated in the Missouri DOT procedures. An outline of the contents of the Missouri DOT procedure is provided below:

1-02.1 PURPOSE
1-02.2 GENERAL OVERVIEW
1-02.3 NEEDS IDENTIFICATION
1-02.4 NEEDS PRIORITIZATION
1-02.5 INITIAL PROJECT ESTIMATES
1-02.6 PROJECT SCOPING
1-02.7 PROJECT SCOPING MEMORANDUM
1-02.8 PROJECT SCOPING CHECKLISTS
1-02.9 PROJECT PRIORITIZATION
1-02.10 STIP COMMITMENTS
1-02.11 SCOPE CHANGES
1-02.12 PROJECT COST ESTIMATES
1-02.13 ENGINEER'S ESTIMATE
1-02.14 BID ANALYSIS PROCESS
1-02.15 RECOMMENDATION FOR AWARD OR REJECTION OF BIDS

A tracking system for potential amendments to budgets is also covered in the Missouri DOT procedures to monitor changes and update the estimate accordingly. A set of submittal and approval forms, indicating changes and justification of these changes to current budgets, keeps key personnel informed of cost variations.

Tips

Real budget control can only begin once a baseline cost estimate is prepared for a project. Cost management procedures should include project control forms and directions on when and how to complete these forms. Further, the procedures should identify levels of approval for accepting changes to the budget based on dollar size of the change. Smaller cost changes can be approved at the project level, while larger cost changes would require region/district or headquarters' management approval.

Resources

Becker, Daniel (2003). "Controlling Construction Costs During Design," *AACE Transactions,* AACE International, Vol. F-5, 1–4.

Schloz, Michael J. (1977). "Project Cost Management During Conceptual Engineering," *AACE Transactions,* AACE International, 167–172.

Sturgis, Robert P. (1967). "For Big Savings—Control Costs while Defining Scope," AACE 11th National Meeting, AACE International, Vol. 67-C.3, 49–52.
Missouri DOT (2004). "Chapter 1, General Information: Needs Identification Project Scoping and STIP Commitments," Section 1-02, *Project Development Manual,* Revision April, 12, 2004. www.modot.org/business/manuals/projectdevelopment.htm.
Project Management Institute (2004), *A Guide to the Project Management Body of Knowledge: PMBOK Guide,* Third Edition.

B1.4 Summary of Key Scope Items (Original/Previous/Current)

Developing and tracking key scope items can aid in budget control by immediately indicating changes in those items as the project progresses through project development. Listing these key items at each project development phase and with each estimate assists in communication among all team members.

What Is It?

A summary of key scope items is a list or outline of the most important elements of a project. These items should be identified early, during the project scoping process. These items ultimately define the project budget and schedule.

Why?

Defining project scope clearly lays the groundwork for accurate estimation and more efficient project delivery by defining and setting project limits. Communication of these items makes tracking of project scope changes transparent.

What Does It Do?

Summarizing key scope items makes team members aware of the estimate basis and fundamental project assumptions. Each key scope item will represent a group of smaller tasks and scope components. Estimates can be prepared according to each key scope item or division of the project. When a new scope item arises, the team will be immediately aware of the change.

When?

The list of key scope items should be completed as early as possible in the project development process, preferably during the scoping process. If a project does not use a formal scoping process, a list can typically be completed during the conceptual estimation process. When right-of-way is a major component of project cost, it should be identified as a key item. The summary of key scope items should be used for conceptual estimation, budget control, and project control.

Examples

The Minnesota DOT uses a summary of key scope items to clearly define the project (see Figure B1.4-1, note the inclusion of right-of-way). Although simple, the summary of key scope items can be used extensively throughout project development to track budget and schedule progression.

Tips

As a means to monitor budget and schedule variances, compare original and current project scopes at key project development milestones and when changes arise.

Resources

California DOT Division of Design. *Project Development Procedures Manual.* www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm.
South Dakota DOT. Scope Summary—*Road Design Manual.* www.sddot.com/pe/roaddesign/docs/rdmanual/rdmch03.pdf.

PROJECT SCOPE SUMMARY FORM
FOR COST ESTIMATES

Purpose of this Form: To provide a summary record of the project scope associated with each project cost estimate Mn/DOT prepares.

Directions for Completing this Form: This form is set up as a checklist of the possible elements, which may be included in a roadway/bridge construction project. The checklist also includes a column/space for approximate quantities and/or comments regarding each element. The Length Width Depth (LWD) method for early project cost estimates requires very specific quantities in specified units for these project elements. In this form units and quantities should be identified in general terms which define the project in a way which can be easily understood by people who currently are not directly working on the project.

Date:
T.H.
S.P., if known:
From:
To:
Brief Project Description:
Cost Estimate Total:
Summary Author/Estimator:

	Project Scope		
Element	**Includes**	**Doesn't Include**	**Quantity/Comment**
Grading	☐	☐	
Aggregates	☐	☐	
Paving	☐	☐	
Bridge Approach Panels	☐	☐	
Mobilization	☐	☐	
Removal/Salvage	☐	☐	
Drainage	☐	☐	
Traffic Control	☐	☐	
Turf/Erosion	☐	☐	
Signing	☐	☐	
Lighting	☐	☐	
Temporary Construction	☐	☐	
Utilities	☐	☐	
Aesthetics	☐	☐	
Retaining Walls	☐	☐	
Noise Walls	☐	☐	
Bridges	☐	☐	
Signals/Traffic	☐	☐	
Management Systems	☐	☐	
Right of Way	☐	☐	
Project Development/ Delivery	☐	☐	

Figure B1.4-1. Minnesota scope summary form.

B1.5 Variance Reports on Cost and Schedule

Variance reports on changes in cost and schedule provide a mechanism for budget control through tracking changes and alerting project personnel of changes.

What Is It?

This is a tool for alerting project personnel, particularly management, to deviations from the project budget or plan. It enhances management's ability to control project cost and schedule.

Why?

Early identification of differences in project cost and schedule can help to ensure proper resource allocation. Discrepancies between estimated or planned costs or schedule can be harmful to the project. If a project's costs increase, additional funds will need to be allocated. If a project's schedule duration increases, additional funds may also have to be allocated to compensate for inflation, raising real estate values, or other time-related factors. If the project costs decrease, the additional resources can be allocated elsewhere. However, care should be taken to not redirect money that may be requested later due to emerging deviations that might arise in the future. If the project schedule duration decreases, the availability of funds and other resources needs to be assessed given the new time frame.

What Does It Do?

Variance reports create a transparent notification system for alerting project personnel of deviations in project costs or schedule.

When?

Variance reports need to be completed regularly throughout project development but especially when design or scope changes are made.

Examples

Cost containment tables are a simple but powerful form of variance reporting. Figure B1.5-1 can be used to create a variance report, which is simply a report that documents variances in cost to management as a project progresses through the development process. Variance reports are generated at key project milestones or when significant changes in the project occur.

Tips

Consider different variance report details and intervals depending on the level of complexity of the project or phase of project development. Intervals should be closer together on highly complex projects or projects that are in a phase of high activity. Even during periods of inactivity, projects should be regularly examined to ensure that there are no variances in project costs or schedule. Between variance reports, management experiences what is termed "a cost blackout period." If major variances occur, the agency has lost an opportunity to take appropriate cost reduction steps.

Variances should be reported to appropriate levels of management if the magnitude of the deviation warrants.

Consideration should be given to the effect of multiple small deviations that alone do not account for much difference from the budget or schedule but collectively amount to a problem. Safeguards should be in place to watch for this type of activity.

Resources

FHWA (2004). "Lessons Learned: Federal Task Force on the Boston Central Artery/Tunnel Project (Summary of 34 Recommendations)." www.fhwa.dot.gov/programadmin/mega/lessonsa.htm.

Federal Aviation Administration (FAA) uses "baseline instability" or variance from an origin to determine cost and schedule deviations. See www.faa.gov/acm/acm10/reports/Instability/introduction.htm.

Metropolitan Transportation Authority of New York, Sample of Variance Report can be found at www.mta.net/board/Items/2005/04_April/20050407OtherSectorWES_Item2D.pdf

Washington DOT, Set of Deviation Guidelines: www.wsdot.wa.gov/NR/rdonlyres/76FAB4F0-7EBD-4104-9441-B80D690DE4C1/0/DVP.pdf.

Cost Containment Table						
District:		Program Yr:				
County:		Project:				
		Short Title:				
Cost Containment	Milestone Estimate					
	Program Amount (PMC approved amount)	E&E Scoping Field View	30% (Design Field View)	75% (After Final Design Field View)	95% (Engineer's Estimate)	Bid Amount
Cost Breakdown	$	$	$	$	$	$
Engineering:						
Preliminary Engineering						
Final						
Design						
R/W						
Utilities						
Construction						
Total Cost:						
Scope						
Comments						

Figure B1.5-1. Cost containment table (Adapted from NCHRP Report 574, Tool C6.1).

C1 Communication

Proper communication of project cost estimates can help to solve many cost escalation problems. Key communication points are the *communication of importance* and the *communication of uncertainty*. A key question that must be communicated with each estimate is "what decisions will be made from this estimate?" Estimators need to know the purpose of an estimate to know the appropriate level of effort to expend on an estimate. The decisions that will be made from the estimate must be communicated at the time the estimate is being generated. Likewise, estimators have an obligation to communicate the level of uncertainty associated with an estimate so that inappropriate decisions are not made from the estimate.

C1.1 Communication of Importance

Every project estimate is important because cost is integral to project scope, and together cost and scope drive many of the project team's design and schedule decisions. Cost estimation must be viewed as an important and integral part of the project development function. Cost estimators should understand how their estimates are going to be used to support the project development process. Additionally, the estimated costs presented to stakeholders outside of the project team create third-party expectations, and these expectations can have many positive and negative implications to the project and the state highway agency.

What Is It?

This is a tool that ensures that all project team members understand the importance of a given cost estimate and/or the cost estimation function. This understanding is necessary if costs are to be managed appropriately. Communication of importance serves to correctly convey the accuracy and variability of an estimate.

Why?

During project development, team members, including right-of-way staff, and various stakeholders need scope and cost information to make decisions. Estimators should understand the nature of the decisions that will be made from their estimates. For example, a different level of importance—and a corresponding level of effort—should be placed on an estimate that is supporting a decision when comparing options versus an estimate that is being released to external stakeholders as an ultimate project cost.

What Does It Do?

The communication of importance creates an understandable and open communication path among all project participants. It lets estimators know the amount of effort they should expend on the estimate. It creates a transparency in the purpose of the estimate and helps to ensure that the wrong number will not be used for critical budgeting or design decisions.

When?

Communication of importance should happen throughout all phases of project development. It is particularly important during milestone updates and at critical points in the project development process.

Examples

The communication of importance is as much a philosophy as it is a tool. The simplest example is to always ask, "What decisions will be made from this estimate?"

The use of milestone estimates to convey importance is also very helpful. Pennsylvania DOT uses the following milestones in their estimating process:

- Program amount (amount approved by the Program Management Committee [PMC])
- Engineering and environmental (E&E) scoping field view
- 30% (design field view)
- 75% (after final design field view)
- 95% (engineer's estimate)
- Bid amount

By using these critical milestones, Pennsylvania DOT can convey the importance of these estimates. They know what decisions will be made at each of these milestones and what the current estimate is to communicate to external stakeholders. Estimates in support of design decisions will not be confused with milestone estimates. For more information on the Pennsylvania DOT system, see Figure B1.5-1, Cost Containment Table.

Tips

Through workshops and continued reinforcement of the concept, develop an agency understanding of how important it is to have accurate estimates and the effect that inaccurate estimates may have on a project and program.

Resources

The Construction Industry Institute has numerous tools available on its website. Search for "communication of importance" at www.construction-institute.org.

C1.2 Communication of Uncertainty

Properly communicating estimate uncertainty will help to ensure that appropriate decisions are made from the estimate. Estimate uncertainty can be communicated by providing a range estimate rather than a point estimate. Communication of estimate uncertainty can also be conveyed by simply listing the assumptions, allowances, unknowns, and contingencies included in an estimate. Some SHAs have the right-of-way estimator rank the accuracy of the estimate using a simple A, B, C, and D scale.

What Is It?

Communication of estimate uncertainty involves an explicit means of conveying the accuracy of an estimate. There are numerous means of conveying uncertainty. Presenting a cost range is common early in project development, and presenting a contingency is common during final engineering. At any point in the process, lists of allowances or project unknowns can be used to convey uncertainty. All means are intended to let designers and decisionmakers know the accuracy of, or potential error in, a cost estimate.

Why?

Projects are not well defined in the early stages of their development. Identification and communication of the project's early stage uncertainty and the fact that unknowns can affect scope and estimated costs will help in managing project expectations.

What Does It Do?

Communication of uncertainty creates transparency in the estimation process. It buffers estimators by conveying that estimates are not absolute, but rather predictions based on the best information known at the time. This tool allows for more prudent decisions to be made from cost estimates.

When?

The identification and communication of the uncertainty in relation to project scope and cost unknowns helps in managing project cost in all phases of project development, but particularly in the programming and preliminary design phase. As the project moves from programming through preliminary design, the amount of uncertainty in the estimate should diminish. Good cost management techniques communicate specifically how the design process has removed the uncertainty.

Examples

Examples of communication of uncertainty can be seen under the risk analysis method, Tool R3.1. The following illustration from Washington State DOT's Cost Estimate Validation Process (CEVP) program is an excellent example of how to convey uncertainty concisely to the project team and any number of stakeholders. The Washington State DOT CEVP summary is an excellent demonstration of how to convey estimate uncertainty. It provides a cost range, rather than a point estimate, for both cost and schedule. It lists the risks associated with the project so that readers understand what is driving the uncertainty in an estimate. It also lists changes from periodic or milestone estimates. Although the CEVP example may be too elaborate for most projects, the point of communicating estimates with a range or with a list of risks is applicable to most projects.

Tips

Transparently convey the uncertainty of each estimate. An estimate with uncertainty is not a bad estimate; it is a realistic estimate. Conveying uncertainty will allow better decisions to be made from estimate information.

Resources

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm.

Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3.

Washington State DOT (2006). Cost Estimating Validation Process (CEVP) website. www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment.

D4 Document Estimate Basis and Assumptions

Project complexity and the size of many projects today means that more issues must be considered in preparing the estimate. Additionally, estimates are commonly prepared in collaboration among many individuals and departments within the SHA. The decisions and assumptions behind the decisions the drive the estimate must be clearly stated and communicated to management and to those reviewing the estimate.

D4.1 Right-of-Way Cost Estimate File

Because right-of-way estimates are usually created by the collaborative effort of many individuals and sections within the SHA–real estate, land management, mapping and surveying, and right-of-way; the assumptions upon which the estimate is based must be traceable; and to preserve the real estate information for future efforts, there should be a structured system for accumulating all right-of-way estimates and their supporting documentation. Construction contractors use their project estimates both to create the budgets for successful bids and as reference sources for developing future estimates. The right-of-way sections in SHAs need information systems that allow the easy retrieval of historical estimate information and at the same time are designed to allow multiple individuals to collaborate on a single estimate.

What Is It?

The development team and the right-of-way estimator prepares and maintains a master reference file that contains the critical scope, policy, and supporting information (assumptions, methods, and procedures) that affect project real estate cost. This master file is maintained as a permanent reference file. The estimator when costing a parcel must reference specific costs affecting information documented in the file and as project development continues, additional information (e.g., surveys for right-of-way, legal land descriptions, revisions, and correspondence) will be added to the file.

Why?

Good documentation supports the cost estimate's credibility, aids in the analysis of changes in right-of-way cost, enables reviewers to effectively assess the estimate, and contributes to the population of SHA data for estimating future projects.

Each project should have an individual project right-of-way estimate file that is separate from the general project estimate file. The primary purpose of this requirement is to ensure that each right-of-way estimate has a well-documented and easily retrievable history of the assumptions, methods, and procedures used to estimate the costs associated with the project's specific real estate requirements and scope assumptions. Having this information contained in one location and separated from other project documentation will help ensure that the right-of-way estimate information is readily accessible and uncluttered with other project information.

What Does It Do?

A project right-of-way estimate file provides a corporate memory and historical data for cataloging the reasoning behind the original estimate of right-of-way cost and the reasons for subsequent cost revisions. Additionally, it usually provides descriptive information as project scope is developed and design progresses. Other descriptive information would include trends that affect parcel cost, historical cost from similar projects, and design features that affect cost. This historical file allows easy comparison of the current estimate to previous right-of-way estimates and identification of cost discrepancies

When?

The right-of-way estimate information should be retained in a central filing system from the time the initial right-of-way estimate is prepared until project close-out. The right-of-way estimate file should include all estimates prepared for the project up to and including any right-of-way estimates needed to support changes made during construction. Archiving right-of-way cost estimate files is good practice because the files are often useful in reconciling completed project cost, responding to future inquiries, and when developing future estimates.

Examples

For each right-of-way parcel and item cost element, describe the derivation of its estimated cost in sufficient detail to allow an independent reviewer to determine whether the estimate is complete, accurate, and realistic. The following information should be provided:

- Parcel Number and Title.
- Parcel Description.
- Methodology. Describe how the parcel's costs were estimated. Depending on the choice of methodology, the estimator could include one or more of the following practices:
  - The use of a historical database approach considering gross area by type. Under this approach, historical real estate data are summarized and adjusted for conditions (i.e., location, area, and remaining area) and general market conditions.
  - The actual parcel cost approach takes into consideration factors related to each individual parcel. This approach requires more time.
- Document
  - Historical district costs/factors.
  - Relocation costs (replacement housing costs, move costs, personal property).
  - Land improvements.
  - Severance damages.
  - Business damages.
  - Owner appraiser fees.
  - Other condemnation costs.
  - Appraisal fees.
  - Court reporter/witness fees.
  - Moving costs.
  - Attorney fees (outside counsel).
  - Experts.
  - Title search.
  - Hazardous waste asbestos.
  - Survey.
  - Utility owner reimbursement costs.
- Identify the base year of the cost calculation and expected date of acquisitions.
- Explain environmental items (requirements) in detail and with extreme clarity.
- Provide a description of how appraisal and condemnation costs are determined.

- Provide a written description for each contingency allowance assigned to the various parts of the estimate. If extraordinary conditions exist that call for higher contingencies, the rationale will be documented.
- All uncertainties and risks associated with the estimate should be listed.
- Level of knowledge about scope.
- Level of confidence. Not all cost estimates need to be prepared to the same level of confidence. The level of confidence should be identified using a standard agency system.

  Examples of confidence levels:

  (**a**) High level of confidence: right-of-way maps or other exhibits that accurately and clearly depict the project are approximately 100%. Parcels are identified and delineated and areas of parent tract, take, and remainders are shown. Potential relocation, property management, and environmental and business damage concerns have been identified. Information is readily available on which to base probable property cost and damages.
  (**b**) Average level of confidence: right-of-way maps or other exhibits are sufficient to identify individual parcels, areas of take, and remainders. There is sufficient identification of potential relocation, property management, and environmental and business damage concerns. Information is available on which to base probable property cost and damages.
  (**c**) Below average level of confidence: right-of-way maps or other exhibits are preliminary and may not identify individual parcels, areas of take, and remainders. There is preliminary identification of potential relocation, property management, environmental and business damage concerns. Market data are limited, but available.
  (**d**) Poor level of confidence: right-of-way maps are not available or are extremely preliminary. Other exhibits are of limited accuracy to depict the project. Parcels, proposed acquisitions, and remainders are not identified. Potential relocation, property management, environmental and business damage concerns have not been identified. Market data are limited, but available.

- Cost Traceability. When a prior cost estimate exists, a cost track should be prepared. The cost track should provide a concise explanation for any cost change to an item from the prior estimate.
- A list should be made of all participants in the development of the estimate.

Tips

The project right-of-way estimate file should, at a minimum, include any assumptions that have been made, the current project scope, right-of-way maps, aerial photos, and a copy of or reference to the cost data used to develop the estimate. This basic information should be included in each project estimate file, regardless of project development phase–the creation of the file begins with the very first right-of-way estimate. A sheet should be placed in the front of each estimate file so the project manger can record the date and current project milestone or project development phase each time the project estimate is changed, updated, or reviewed. A signature line should also be included to document the project manager's review of the estimate file.

Cost adjustment factors will never be considered as an acceptable substitute for preparing a well-documented and accurate estimate if adequate project information is available.

Depending on the level of project development that has taken place, the amount and type of documentation contained in the project estimate file will vary. Information used to develop the initial right-of-way estimate, such as gross area by land use type and historical real estate cost, should be well documented and included in the project estimate file. This information may consist of references to software databases, historical data, and real estate market data from outside sources or some other reputable resource.

The right-of-way estimating procedures manual should also establish general guidelines for the contents of the file.

The documents that serve, as the basis of the estimators should

- Describe site conditions (railroad through or adjacent, utilities, and environmental issues).
- Describe assumed partial and whole takes.
- Explain the decision criteria used for evaluating alternatives.
- List and explain all general assumptions that apply.
- List and explain all specific assumptions (e.g., percent of parcel that will go to condemnation).

Resources

The Florida DOT "Guidance Document for Right-of-Way Cost Estimates" offers guidance about files: www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/guide2.pdf

Chapter 4 of the Caltrans *Right of Way Manual* also offers guidance. It is available at: www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf

E2 Estimate Review—External

The most effective means of improving estimate quality is to refine the methods of identifying errors and omissions, not to refine estimation methods or computer software. No estimate should be released without a review. Estimate reviews should be conducted at strategic times during estimate preparation to improve accuracy and completeness. The formality of a project estimate review and the depth of the review at each stage in project development will vary depending on the type of project and project complexity. The first review of the estimate should be conducted by the team that prepared the estimate. This is essentially a screening review that ensures that the math is correct, the process is documented, and agency guidelines are followed. When very complex right-of-way situations are expected, management should require that there be an external review of the estimate by qualified professionals.

E2.1 Expert Team

Very complex and high-profile projects should have an external review of the estimate by qualified professionals. The most indispensable tool for estimate review is judgment. Judgment is what identifies mistakes, detects flawed assumptions, and identifies where the process has missed critical cost drivers. The surest way of conducting a successful external review is by selecting a panel of independent reviewers who have as broad a range of experience as the project demands.

What Is It?

External reviews concentrate on the estimation process and methodology. They are applied based on project scope and design development at the point in time when the review is conducted. An external review should include a risk analysis that identifies the critical elements of the right-of-way estimate and possible impacting risks.

Why?

Large projects with multiple interacting activities, urban projects with numerous stakeholders, and projects using new technology all test the right-of-way estimator's ability to properly account for all cost drivers when developing an estimate. Therefore, a review that brings a viewpoint completely external to that of the state highway agency should be part of an inclusive review process. This includes a requirement for internal reviews of the estimate calculations and the applied unit costs.

What Does It Do?

The reviewers seek to assess the reasonableness of the assumptions supporting the cost elements and assess the rationale for the methodology used. Reviewers receive a briefing from the project team and the estimators and are given access to all available documentation. By applying parametric techniques or ratios to analyze costs and schedule reasonableness, they check the completeness of the estimate. However, they usually do not re-estimate individual items. The result is a report that details findings and recommendations.

When?

Independent external reviews are more typically employed on later estimates of large complex projects. However, having such reviews conducted earlier in the design process can provide real benefits, because they often discern cost drivers that can be addressed by design changes, thereby reducing project cost.

Examples

Several SHAs have used retired personnel or other professionals to conduct estimate reviews. As an after-the-fact example, on December 13, 2001, Maryland DOT opened bids for the Woodrow Wilson Bridge superstructure contract and a single $860 million bid was received. That amount was more than 75% higher than the engineer's estimate for the contract. Maryland formally rejected the bid because it far exceeded the project's budget. An independent review committee (IRC) was organized to identify and evaluate the reasons for the large discrepancy between the engineer's estimate and the bid submitted.

The IRC determined that the owner-produced estimate was technically solid, based on the tangible factors such as the cost of steel, concrete, and other materials. But certain significant factors, particularly for large construction projects, are difficult to quantify in an estimate. The IRC went on to state that the estimate did not sufficiently take into account the intangibles of market factors, specifically the following:

- Contractors capable of bidding a project of that size were seeking larger margins to protect themselves due to recent experiences on other mega-projects and associated project risk.
- There several other large bridge projects were bidding in the same period, a completely external factor that caused a lack of competition.
- Equipment demands on projects of this size are substantial.

Maryland DOT took the advice of the IRC and repackaged the contract and rebid the project approximately a year later as three independent contracts. The first contract rebid came in 11% over the estimate, but there were five bidders and it was a workable bid. The other two contracts both came in below the estimates, one by 28% and the other by 25%.

Tips

In the case of right-of-way estimates the reviewers need to be experienced professionals who have an understanding real estate costs and the complexities of acquisition processes. Market conditions or changes in the macro-environment can affect the costs of a project right-of-way, particularly large projects.

Resources

Maryland DOT (March 1, 2002). "Summary of Independent Review Committee Findings Regarding the Woodrow Wilson Bridge Superstructure Contract." The full report is available from the MDOT.

Woodrow Wilson Bridge Project Bridge Superstructure Contract (BR-3): Review of the Engineer's Estimate vs. the Single Bid, February 28, 2002. This report is available from Maryland DOT.

Douglass, Robert, Robert Healy, Thomas Mohler, and Shirlene Cleveland (2004). "Adventures in Building Another Washington Monument: Rebid Outcomes of Woodrow Wilson Bridge Project. *Transportation Research Record 1900,* Transportation Research Board of the National Academies, Washington DC, pp. 114-121.

E3 Estimate Review—Internal

Estimate reviews should be conducted at strategic times during estimate preparation to improve accuracy and completeness. The formality of a project estimate review and the depth of the review at each stage in project development will vary depending on the type of project and project complexity.

No estimate should be released without internal reviews. The team that prepared the estimate should conduct the first review of the project estimate. This is essentially a screening review that ensures that the math is correct, the process is documented, and department guidelines were followed. In the case of straightforward right-of-way requirements, a formal review may not be necessary. However, as real estate complexity increases, it is necessary to conduct formal reviews with either an in-house/peer review or a formal committee review. When projects involve land acquisition in highly active markets, cost experienced by third parties, such as utilities and railroads, or special acquisitions, such as those from government sites, management should require that there be an external review of the estimate.

There can be several different approaches to estimate reviews: (1) a review of calculations and applied unit costs, (2) a review of the process and methodology, or (3) a very complete review that encompasses evaluation of both calculations and methodology. All reviews must closely examine the assumptions that form the basis of the estimate, internal logic, completeness of scope, and estimation methodology.

E3.1 Formal Committee

Certain SHAs use an "estimate review committee" approach to enhance estimate accuracy. Formal committees review each estimate at different stages in project development and prior to the bid letting. The committee structure used by the Georgia DOT to review project estimates consists of six people, including the state construction engineer, an FHWA representative, a contract administration engineer, a state maintenance engineer, and two project/field engineers.

What Is It?

A formal committee estimate review is a cost estimate validation tool. This cost validation tool entails an objective review of the estimate by a group of experienced third-party state highway agency individuals who did not participate in development of the estimate.

Why?

The most effective means of improving estimate quality is not to refine estimation methods or computer software, but to refine the methods of identifying errors and omissions. This is a tool to ensure that estimation criteria and requirements have been met and that a well-documented, defensible estimate has been developed.

What Does It Do?

The review committee seeks to subjectively determine estimate accuracy, based on the totality of the information available. In particular, the committee

- **Determines whether the estimate satisfies the project criteria.** The committee seeks to ensure that the estimate conforms to the project scope and design documents. The stated right-of-way requirements match the proposed design, including space for utilities.
- **Appraises the estimate methodology.** The committee must be able to follow and check the estimate methodology. Steps to do this would include verifying estimation techniques and sources of estimate data. The committee should be able to clearly understand the origin of all numerical data in the estimate. Sources of parcel cost data should be clearly stated.
- **Identifies uncertainties.** The committee should confirm all uncertainties documented in the estimate, such as number and cost of expected condemnation, and identify other uncertainties in the estimate that were missed or glossed over. It is good to note these uncertainties at this time so that an accurate estimate can be developed.
- **Documents the finding.** The findings of the estimate review must be documented. The committee may use an estimate review checklist or prepare a concise written report that documents the findings. A sample estimate review checklist is present here in the example part of this section.

When?

As the project design is developed and the revised estimates are generated, it is good practice to conduct a review of revised estimates, particularly at the major design development stages—30% and 60%. These reviews can provide real benefit because they often discern cost drivers that can be addressed by design changes and, in so doing, reduce project cost. It is still possible at these points in project development to find a least-cost solution that accommodates design requirements and at the same time minimizes real estate cost.

Example

Here is an example of a checklist used by a formal committee when conducting a review.

REVIEW CHECKLIST
Review Date:
Review Location:
Project Name:
Reviewers' Names and Organizations:
Background Data and Conditions:
Is there complete technical scope documentation, including the following elements?
____ Description of the work to be performed;
____ Performance criteria and requirements;
____ Discrete tasks and deliverables;
____ Resource requirements;
____ Sequence of events and discrete milestones;
____ Work not included in the scope.
Have milestone descriptions been developed for each milestone associated with the project?
Does the technical scope documentation for the estimate include descriptions of support associated with the work to be performed?
Is the technical scope for the estimate consistent with the site, regulatory requirements and constraints (e.g., permit conditions, regulations) identified during the planning process?

Cost Estimate
Are appropriate historical cost data used in the estimate?
Are direct costs that are associated with individual activities included in the cost estimate clearly and individually identified?
Are indirect, overhead, or other costs clearly and individually identified?

Has the cost estimate been updated in a timely manner in response to relevant changes in its basis, background data, or assumptions?
Are an appropriate change control document and an estimate development history attached to the cost estimate?
Does the estimate development history include an itemized and chronological list of the changes made to the cost estimate since initiation of its preparation and the rationale for each change?
Are activities, quantities, and unit costs associated with the work to be performed clearly identified and defined in the cost estimate?
Are the assumptions and exclusions on which the cost estimate is based clearly identified and defined in the estimate?
Are time and cost assumptions and cost elements associated with each activity clearly identified, defined, and documented in the estimate? Cost elements for program activities include

Quantities
Unit of measure
Material cost
Overhead rate
Total overhead allocated
Are significant estimator findings identified during preparation of the estimate documented?
Have factors been used to adjust the costs? If so, have they been adequately documented and appropriately applied?
Have escalation factors been used to escalate the estimate?
Are the escalation factors adequately documented and appropriately applied?
Are indirect rates used in the estimate adequately documented and appropriately applied?
Are estimate summary and detailed reports included, and do they provide cost totals for each cost element in the estimate?
Is a schedule included with the estimate?
Are activities included in the schedule consistent with those included in the technical scope?
Are milestones and deliverables included in the schedule consistent with those included in the technical scope documentation and the estimate?

Tips

Check the estimated cost of any parcel that represents an unfamiliar situation or items for which there is only a limited database of historical information. Investigate whether the percentages used to estimate overhead and other costs besides the direct cost are realistic.

It is good practice to include younger state highway agency staff as members of the committee so that they can learn from the discussion, but many times they will also contribute a completely new perspective.

Resources

FHWA (2004). *Major Project Program Cost Estimating Guidance.* While aimed at estimation for major projects, this document does contain many ideas that can be incorporated into a review process and stresses the need for review teams to have diverse membership composition.

E3.2 Off-Prism Evaluation

In the case of most conventional projects, engineers focus on technical solutions with little attention to community interest or the macroeconomic environment. Market forces and third-party interventions can have a major effect on project real estate cost and must be accounted for in the estimation process.

What Is It?

This is an estimate review that seeks to provide management with assurance that cost effects driven by macroeconomic and market conditions have been considered in developing the project's estimated cost.

Why?

Every project is executed in the context of a particular political, economic, and cultural environment. The legal system, labor practices, and even the global demand for construction materials are manifestations of a project's macroeconomics. The macroeconomy can affect cost growth in two ways: (1) by being unknown to some degree to estimators and managers and (2) by changes in the environment. Unlike understanding other aspects of project planning and estimation, understanding the macroenvironment has never been standardized as a part of project estimation.

What Does It Do?

An off-prism review is conducted from the perspective of external factors affecting cost and specifically considers the marketplace and macroeconomic factors affecting project cost. Perhaps the most difficult right-of-way costs to estimate are those associated with third parties, such as utilities and railroads. Third-party requirements have a high potential for risk and change. For example, major projects often are located in urban areas with a high concentration of existing utilities. Although it is best to locate and avoid as many utilities as possible during the design phase, appropriate contingencies for utility adjustments need to be included. Cost should be included for subsurface utility engineering. Mitigating effects to railroads or transit lines will need to be considered as well. If all utility and railroad adjustment work cannot be identified, appropriate contingencies for adjustments need to be included.

When?

Because reviews are the best means for ensuring estimate accuracy and for minimizing the potential for unanticipated surprises concerning the financial condition of the project, it is good practice to perform a review each time an estimate is revised. However, in the case of off-prism evaluations, an estimate review should also occur any time there is a change in macroeconomic conditions or the marketplace. When the underlying economic assumptions for the estimate change, the estimate will need to be revisited.

Examples

The FHWA document *Major Project Program Cost Estimating Guidance,* June 4, 2004, specifically calls attention to the following cost that must be included in a project's right-of-way estimate:

- Costs for stormwater management,
- Wetland mitigation, and
- Other work outside the roadway prism.

This includes the contractual obligations with property owners to relocate fencing, reconstruct gates, and reconstruct road approaches, and so on, if not included in the engineer's estimate. This also includes the cost of any required relocation assistance and benefits for displaced individuals, families, businesses, governments, and nonprofit organizations, as well as the administration costs of all right-of-way activities. If the extent of the right-of-way acquisition is not known, then a contingency should be added based on historical settlements and awards for condemnation cases, which must include costs for attorneys, engineering research, witness research, survey, and staff time.

The right-of-way acquisition schedule needs to be considered. Right-of-way acquisition costs will increase quickly in rapidly developing areas.

Special acquisitions, such as those from government sites can be time consuming and costly.

Tips

A value analysis should be performed on the project to determine the most economical alignment.

Resources

Arizona DOT (1989). Estimating Guidelines.
Schexnayder, Cliff (2001). "Construction Forum," *Practice Periodical on Structural Design and Construction,* ASCE, Vol. 6, No. 1.

E3.3 In-House/Peer

An objective estimate review can be accomplished by a group of experienced third-party state highway agency individuals who did not participate in developing the estimate. For large or complex projects, the review is usually conducted with the project team and estimator so that the reviewers can better understand the execution plan, estimate basis, and project challenges in regard to scope and pricing.

What Is It?

A peer review typically involves an estimate validation by a state highway agency estimator who has not worked on the estimate being reviewed. The state highway agency reviewer must have the experience and knowledge to carefully appraise the materials presented. In the case of larger projects, this peer validation may involve a peer team.

Why?

The foundation of a good estimate is the formats, procedures, and processes used to arrive at the cost. Poor estimation includes general errors, omissions, and technique inadequacies. It is easy for members of the state highway agency to conduct an estimate review because they are familiar with the formats, procedures, and processes that the agency has in place and therefore can easily spot deficiencies.

What Does It Do?

A peer review checks the estimate for completeness and correctness, including, but not limited to, the following:

- Check of mathematical extensions and correctness.
- Check of parcel list for omissions or oversights.
- Check for conformity between construction easements and the schedule durations to construction activities.
- Check of the calculations of the indirect costs.
- Compare the estimate with any similar project for an order-of-magnitude check.

When?

Each time a revised estimated is generated, there should be a review. An estimate review is the best means for ensuring accuracy and minimizing the potential for unanticipated surprises concerning the financial condition of the project.

Examples

North Carolina DOT uses a formal internal estimate review process. The process coincides with the project development process milestones.

Following is the approach used by Missouri DOT regarding timing of estimate reviews:

1-02.12 (4) REVIEW OF ESTIMATES. Project cost estimates should be reviewed and updated periodically. At a minimum, project cost estimates should be reviewed annually. A new or revised project estimate should be prepared at the following major milestones or stages of project development: project initialization, conceptual plan/environmental document completion, preliminary plan completion, and right-of-way plan completion. The estimated project costs should be submitted to General Headquarters (GHQ) Transportation Planning at least annually, at the above noted project development milestones/stages, or when significant project scope changes are identified using a Project Amendment Tracking System (PATS) form.

If an annual review of the previous estimate is conducted and it is determined that no change is necessary, the project estimate file should include documentation to indicate that the previous estimate has been reviewed and remains valid.

Revised cost estimates submitted for projects that are scheduled for expenditure of funds within the current fiscal year of the statewide transportation improvement program (STIP) will not be reflected in the STIP or the approved PATS database. For example, if the project is to be awarded during the current fiscal year, the construction cost reflected in the STIP will not be revised to account for project estimates prepared after the beginning of the fiscal year. Similarly, if a project has right-of-way funds included in the current fiscal year of the STIP, the right-of-way amount will not be revised based on a revised estimate submitted in the same fiscal year. Even though these costs will not be reflected in the STIP, the revised project estimates should still be prepared in accordance with the recommended schedule. However, the submission of a PATS form to GHQ Transportation Planning will not be required in this situation. This is the only exception that exists for not submitting a PATS form to GHQ Transportation Planning each time a revised estimate is prepared.

All estimated costs should be submitted in current dollars. GHQ Transportation Planning will make any necessary inflation adjustments. Estimate revisions will affect a district's funding balance and be used to calculate the current cost of the program, but not be used to determine any changes in the district funding distribution.

Tips

The peer review should consider the following:

- What is the basis for the assumptions made in developing the estimate?
- Are the assumptions made in the estimate consistent with the technical scope and schedule of the project?
- Are the activity durations in the schedule consistent with the estimated cost?
- Are indirect rates, escalation factors, and other factors used appropriately?
- Have the findings and recommendations of the peer review been documented in a peer review document?
- Is the peer review document included with the cost estimate documentation?
- Have the findings and recommendations of the peer review been addressed in revisions to the cost estimate?
- Are activities included in the schedule consistent with those included in the technical scope documentation and estimate?

Resources

Opfer, Neil D. (Fall 1997). "Construction Peer Review: A Technique for Improving Construction Practice," *Journal of Construction Education,* Vol. 2, No. 3, pp. 211–221. While this article discusses a peer review of contractor organizations, it includes several important peer review

fundamentals. One of these is the point that the technique's success depends on significant resource commitments, including time.

Missouri DOT (2004). "Chapter 1, General Information: Needs Identification Project Scoping and STIP Commitments," Section 1-02, *Project Development Manual.* www.modot.org/business/manuals/projectdevelopment.htm

I2 Identification of Risk

Risk identification involves the discovery of potential project risks and the documentation of their characteristics. In the context of cost estimation, an understanding of project risk will assist estimators in setting appropriate project contingencies. It will also assist managers in estimation management as the project progresses through project development. In the broader context of project risk management, risk identification is the first step in the following detailed process:

- Risk identification
- Risk analysis (qualitative and/or quantitative)
- Risk mitigation planning
- Risk monitoring and control

Red flag items, risk charters, and risk checklists are three tools that assist estimators in both identifying and monitoring risks throughout project development. These tools support risk identification early in the project development process to assist in setting appropriate project contingencies. The tools also support the risk monitoring and control process to assist in contingency resolution as the project scope, design, and project delivery methods become fully defined.

During the development of this Guide, NCHRP was developing a Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs (NCHRP Project 8-60). The goal of that effort was to develop a comprehensive guidebook on risk-related analysis tools and management practices for estimating and controlling transportation project costs. When complete, the NCHRP 8-60 guidebook will provide more detailed tools and techniques for risk identification and risk management. The readers of this Guide are encouraged to also review the completed NCHRP 8-60 guidebook for more information on risk-related estimating issues.

I2.1 Red Flag Items

A red flag item list is created at the earliest stages of project development and maintained as a reference document throughout project development. It is perhaps the simplest form of risk identification and risk management. The list helps estimators to better understand the required contingency and helps managers to more effectively control scope growth throughout the project development process. Not all projects will require a comprehensive and quantitative risk management process. A red flag item list can be used in a streamlined qualitative risk management process.

What Is It?

A red flag item list is a technique to identify risks and focus attention on critical items with respect to critical cost and schedule effects to the estimate. Issues and items that can significantly affect project cost or schedule are identified in a list—or "red flagged"—and the list is kept current as the project progresses through development.

Why?

By listing items that can affect a project's cost or schedule, and by keeping the list current, the project team has a better perspective for setting proper contingencies and controlling cost esca-

301.6 Red Flags
***Red Flags**, including environmental and engineering issues, are locations of concern within the study area. Red Flags do not necessarily identify locations that must be avoided, but rather, identify locations that will entail additional study, coordination, design, right-of-way, or construction cost. Locations that must be avoided are referred to as "fatal flaws." The project manager should ensure consultation with the appropriate specialists to determine the level of concern for each Red Flag item. Both environmental and design Red Flags are identified on the Red Flag Summary.*

Figure I2.1-1. Ohio DOT Red Flag example.

lation. Occasionally, items considered a risk are mentioned in planning but soon forgotten. The red flag item list facilitates communication between estimators and designers concerning these items. By maintaining a running list, these items will not disappear from consideration and then later cause problems.

What Does It Do?

At the earliest stages of project development, an agency develops a list of affecting items, based primarily on engineering judgment or historical records of problems. The red flagging of these items may not involve any formal qualitative or quantitative risk analysis of the factors, but it keeps the team mindful of their existence. The list also helps the team to remove contingency from the project cost estimate as the design progresses and risk issues are resolved.

When?

The composition of a red flag item list is completed in the earliest stages of project development. The list should then be updated at each major milestone or as new items are identified. The list will be most useful if it is maintained and updated throughout the project development process.

Examples

The Ohio DOT includes the identification of Red Flag Items in their comprehensive approach to right-of-way cost estimating. Figure I2.1-1 is an excerpt from their Project Development Process (PDP) manual concerning Red Flag Item identification on right-of-way estimates for minor projects:

Tips

The list of red flag items should be developed in an interdisciplinary team environment. This activity works well during the planning and programming processes. Consider brainstorming sessions with representatives from multiple discipline areas for creation of a list of red flag items. In addition to scoping documents, individuals should use their own knowledge of the project and consult with others who have significant knowledge of the project or its environment. Additionally, risk checklists can be consulted to learn from risks encountered on past projects (see I2.3).

Resources

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

Curran, Michael W. (1998). *Professional Practice Guide #2: Risk.* Association for the Advancement of Cost Engineering International.

FHWA (2004). *Major Project Program Cost Estimating Guidance.*

Grey, S. (1995). *Practical Risk Assessment for Project Managers.* John Wiley and Sons, Chichester, England.

Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3.
NCHRP (2005). NCHRP Project 20-7/172 Final Report, "Recommended AASHTO Design-Build Procurement Guide," Washington, D.C.
Ohio DOT (2004). *Project Development Process (PDP) Manual.*

I2.2 Risk Charter

The creation of a risk charter is a more formal identification of risks than the listing of red flag items (Tool I2.1). This tool is typically completed as part of a formal and rigorous risk management plan. The risk charter helps to set estimate contingencies and monitor potential cost escalation. It provides estimators with a list of significant risks and includes information about the potential cost and schedule effects associated with these risks. It also supports the contingency resolution process by tracking changes to the magnitude of potential cost and schedule risk effects as the project progresses through the development process and the risks are resolved.

What Is It?

A risk charter is a document containing the results of a qualitative or quantitative risk analysis. It is similar to a list of red flag items (see Section I2.1), but typically contains more detailed information concerning the potential effect of the risks and the mitigation planning. The risk charter contains a list of identified risks, including description, category, and cause. It may contain measurements of magnitude such as the probability and effect of occurrence. It may also contain proposed mitigation responses, "owners" of the risk, and current status. This method may be more effective than simply listing the potential problem areas, as with the red flagging, since it is integrated into the risk monitoring and control processes. The terms "risk charter" and "risk register" are synonymous in the industry.

Why?

A risk charter is used to identify, communicate, monitor, and control risks. It provides assistance in setting appropriate contingencies and managing the cost estimation process. As part of a comprehensive risk management plan, the risk charter can help to control cost escalation. It is appropriate for large or complex projects that have significant uncertainty.

What Does It Do?

The charter organizes risks that can affect project cost and project delivery. A risk charter is typically based on either a qualitative or quantitative assessment of risk, rather than simple engineering judgment. The identified risks are listed with relevant information for quantifying, controlling, and monitoring. The risk charter may include relevant information, such as the following:

- Risk description
- Status
- Date identified
- Project phase
- Functional assignment
- Risk trigger
- Probability of occurrence (%)
- Impact ($ or days)
- Response actions
- Responsibility (task manager)

When?

This technique can be used throughout project development. At the earliest stages of project development, the risk charter will be helpful in a risk identification capacity. As the project progresses, more rigorous and quantitative risk management can be performed and the charter will become an even more valuable tool for cost estimation management and risk monitoring and control.

Examples

Washington State DOT has built a Cost Estimating Validation Process (CEVP). The CEVP uses a risk charter (or risk register) as a fundamental tool in its comprehensive validation process. The CEVP is explained in more detail in Section C1.2. Figures I2.2-1 and I2.2-2 show two aspects of the CEVP that are relevant to describing a risk charter. Figure I2.2-1 provides a summary example from a risk identification exercise that is part of the CEVP. Figure I2.2-2 provides a summary of risk descriptions in the risk charter for the CEVP analyses. For more information on these first nine projects, see K. R. Molenaar's 2005 article, "Programmatic Cost Risk Analysis for Highway Mega-Projects," in the ASCE *Journal of Construction Engineering and Management,* Vol. 131, No. 3, pp. 343–353.

For more information on the current CEVP, see the Washington State DOT's 2006 CEVP website at www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

Tips

The risk charter should be developed in conjunction with a comprehensive risk management plan. It should be developed in an interdisciplinary team environment and may require external facilitation.

Resources

Curran, Michael W. (1998). *Professional Practice Guide #2: Risk.* Association for the Advancement of Cost Engineering International.

FHWA (2004). *Major Project Program Cost Estimating Guidance.*

Risk Issue: Commercial Property Value

Issue: Project ROW costs were developed by applying a percentage increase to the assessed valuations for each parcel. During the CEVP review the estimated cost of commercial properties carried in the ROW estimate for the project have been updated, and the multiplier increased to 75% of the assessed value, to better reflect current market conditions. There is a low level of confidence in the updated values and it is estimated that actual market conditions may be as high as 100% of the assessed valuations.

Impacts: The actual market conditions will increase the cost of acquiring commercial properties by an average of $25M. There are no significant schedule impacts.

Probability: 85%.

Mitigation: Monitor the commercial real estate market and track the actual cost of recent transactions. Keep the project ROW estimate up to date and reflective of the current commercial property real estate market. Buy early if appropriate.

Figure I2.2-1. Summary example of risk event identification exercise that is part of WSDOT's CEVP.

Grey, S. (1995). *Practical Risk Assessment for Project Managers.* John Wiley and Sons, Chichester, England.

Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3.

NCHRP (2005). NCHRP Project 20-7/172 Final Report: Recommended AASHTO Design-Build Procurement Guide. Project Management Institute (2004). *A Guide to Project Management Body of Knowledge* (PMBOK Guide).

Washington State DOT (2006). Cost Estimating Validation Process (CEVP) website: www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment.

Market Conditions

Implementing several mega-projects at the same time may create a shortage in management, contractors, financing/funding, labor, and material.

Labor Disruptions

Labor shutdowns are likely.

Storm Water Treatment and/or Quantities

Stricter requirements in the future would require additional cost to provide additional detention ponds, the collecting and treatment of all runoff, which may have a base amount in the estimate but there may be higher amounts of treatment required or higher then expected volumes.

Changes in Permitting

Permit requirements may change over the long duration of some projects.

Off and On Site Wetlands

There is a chance that conditions actually encountered in the field may be different than assumed when the base estimate was compiled and the measures used my also change requiring additional mitigation.

Environmental Impact Statement

Disagreement between WSDOT and resource agencies and/or among agencies and the public on project impacts and associated disagreement on mitigation approaches may prompt impacts.

NEPA/404 Merger Process

Failure to reach concurrence on the range of alternatives and a preferred alternative could delay the environmental process.

Utility Issues

Routine investigations and coordination with utility companies can identify and relocate conflicting utilities throughout the project. However, unforeseen discovery of previously unknown utilities, and the need to relocate these utilities after the job is awarded and construction has started can be a significant cost and schedule liability to the project. Utilities, adjacent landowners, and other affected parties may demand "betterment" or excessive mitigation.

Rail Lines (Regular and Light)

Regional and national offices may need to approve new railroad alignments and ROW or the encroachment of new highway alignment on existing rail ROW.

Figure I2.2-2. Summary risk charter risk descriptions from the WSDOT CEVP analysis.

Right of Way Acquisition Problems

Changing property values, revolving funds, etc. may cause problems along with property owners who may hold out and cause economic problems and/or delays.

Right of Way Value and Impact

Several risks may be encountered such as property owner relocation, sudden growth, and area development, which may cause monetary and time impacts.

Program Management

The organizational make-up of WSDOT is being revised to accommodate mega-projects. This management structure will need constant care and feeding to ensure that decisions and information are growing in a responsible way.

Geotechnical Conditions

Inadequate geotechnical investigations during the conceptual and alignment selection phases can cause unforeseen conditions during excavation and construction of tunnels, bridges, walls, etc. This could be compounded by inadequate characterization of groundwater conditions.

Design Change in Seismic Criteria

The American Association of State Highway Transportation Officials (AASHTO) is developing new seismic design criteria for bridges. The timing of the release of this criteria and WSDOT's adoption of the criteria is uncertain.

Bridge Foundations

The foundation type for bridges in the project may need to be adapted to new information that becomes available as the project progresses.

Local Arterial Improvements and Access

Local agencies may demand additional improvements to local arterials as a condition for support of the project.

Inadequate Design/Design Uncertainty for Interchanges

Interchanges may be planned but there may be some uncertainty from the design (i.e. unit cost, inadequate design, deviation approval, municipality involvement, etc.)

Traffic Demand

Traffic demands may not be accurate in some areas (i.e. inconsistent growth patterns, age of traffic projections).

Contaminated Soil

It is possible that even after thorough due diligence and the identification of contaminated sources during design of the project, new contaminated soils or groundwater may result in discovery of new or unknown conditions that need to be taken care of during construction.

Natural Hazards

Storms, floods, earthquakes, etc. can cause damage to work under construction and may result in shut down during construction. Such conditions damage the temporary water pollution controls, temporary structures, and earthwork, which must then be repaired.

Work Window

There may be restrictions in conducting some activities (i.e. earthwork) during some parts of the year (i.e. winter).

Auxiliary Lanes

There may be uncertainty regarding if auxiliary lanes are going to be used/constructed temporarily during construction and/or permanently.

Staging Areas

Due to limitations in ROW and traffic flow staging areas may be inadequate for construction.

Figure I2.2-2. (Continued).

I2.3 Risk Checklist

Risk Checklists are a tool for risk identification that can be used at the earliest stages of risk identification to learn from past projects and past team member experience. The list helps estimators to better understand the required contingency and helps managers to more effectively control scope growth throughout the project development process. The use of a Risk Checklist is the final step of risk identification to ensure that common project risks are not overlooked.

What Is It?

A Risk Checklist is a list of risks identified or realized on past projects. Risk Checklists are meant to be shared between estimators and discipline groups on all projects.

Why?

The benefit of maintaining Risk Checklists is to capture corporate knowledge within a state highway agency and ensure that common risks are not overlooked in the estimating or management process. Risk Checklists are simple to maintain if the agency has a central estimating or risk management function. Risk Checklists can also be maintained by individual estimators or project managers.

What Does It Do?

Risk Checklists serve as a final step in the risk identification process to ensure that common risks are not overlooked.

When?

Risk Checklists should be used only after the team has identified risks on their own (e.g., through an examination of scope and estimating assumptions, brainstorming of issues and concerns, or the creation of a Red Flag List). Risk Checklists should not be used as the first step in risk identification, because they may not contain important project-specific risks. If a project team relies too heavily on a Risk Checklist, the team could easily overlook project-specific risks and the risks might not be phased correctly for the unique aspects of the project.

Example

Right-of-way risks specifically from various projects conducted by Caltrans and the Washington State DOT follow:

- Accelerating pace of development in project corridor;
- Changes in land use/demographics in project corridor;
- Difficult or additional condemnation;
- Excessive relocation or demolition (including unanticipated remediation) (either globally or for particular parcels);
- Right-of-way staffing shortages;
- Process delays (e.g., ROW plan development by team; plan approval process);
- Railroad coordination/acquisition problems;
- Utility coordination/relocation delays;
- Objections to right-of-way appraisal takes more time and/or money;
- Variations in estimate quantities such as acres by land use; and
- Variations in cost basis used for estimate elements.

Caltrans has developed a sample list of risks in its *Project Risk Management Handbook.* The list is provided in Tables I2.3-1 through I2.3-4. This sample list of risks can be used as the basis for creating a list of red flag items for an individual project. The Caltrans list is quite comprehensive, and

Table I2.3-1. Caltrans sample technical risks list.

Risk Category	Individual Risks
Technical Risks	❒ Design incomplete
	❒ Right of Way analysis in error
	❒ Environmental analysis incomplete or in error
	❒ Unexpected geotechnical issues
	❒ Change requests because of errors
	❒ Inaccurate assumptions on technical issues in planning stage
	❒ Surveys late and/or surveys in error
	❒ Materials/geotechnical/foundation in error
	❒ Structural designs incomplete or in error
	❒ Hazardous waste site analysis incomplete or in error
	❒ Need for design exceptions
	❒ Consultant design not up to Department standards
	❒ Context sensitive solutions
	❒ Fact sheet requirements (exceptions to standards)

any single project's list of Red Flag items should not include all of these elements. Washington State DOT also uses a "Sample Risk Elements" checklist for its cost risk assessment process.

Tips

Maintain the Risk Checklist in a central location and capture risks from multiple projects and disciplines. Categorize the Risk Checklist into major headings to facilitate data collection and checklist application. Use the Risk Checklist only after the project team has exhausted other risk identification options.

Resources

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3.

R2 Right-of-Way

Right-of-way administrators have reported a number of challenges routinely encountered in right-of-way cost estimation: (1) early estimates are typically based on planning-level maps, so the extent of takings must be anticipated based on limited information; (2) often there is limited time to prepare early estimates, thereby restricting the amount of research that can be undertaken for complex parcels; and (3) right-of-way estimates are usually prepared years in advance of actual right-of-way acquisition, and significant inflation in between estimation and acquisition results in property and damage appreciation.

R2.1 Acres for Interchange

A chronic problem in estimating the right-of-way cost, for either new interchanges or reconstructed interchanges, is establishing the land requirements, including the requirements needed

Table I2.3-2. Caltrans sample external and environmental risk list.

Risk Category	Individual Risks
External Risks	❒ Landowners unwilling to sell
	❒ Priorities change on existing program
	❒ Inconsistent cost, time, scope, and quality objectives
	❒ Local communities pose objections
	❒ Funding changes for fiscal year
	❒ Political factors change
	❒ Stakeholders request late changes
	❒ New stakeholders emerge and demand new work
	❒ Influential stakeholders request additional needs to serve their own commercial purposes
	❒ Threat of lawsuits
	❒ Stakeholders choose time and/or cost over quality
Environmental Risks	❒ Permits or agency actions delayed or take longer than expected
	❒ New information required for permits
	❒ Environmental regulations change
	❒ Water quality regulation changes
	❒ Reviewing agency requires higher-level review than assumed
	❒ Lack of specialized staff (biology, anthropology, archeology, etc.)
	❒ Historic site, endangered species, wetlands present
	❒ EIS required
	❒ Controversy on environmental grounds expected
	❒ Environmental analysis on new alignments is required
	❒ Formal NEPA/404 consultation is required
	❒ Formal Section 7 consultation is required
	❒ Section 106 issues expected
	❒ Project in an area of high sensitivity for paleontology
	❒ Section 4(f) resources affected
	❒ Project in the Coastal Zone
	❒ Project on a Scenic Highway
	❒ Project near a Wild and Scenic River
	❒ Project in a floodplain or a regulatory floodway
	❒ Project does not conform to the state implementation plan for air quality at the program and plan level
	❒ Water quality issues
	❒ Negative community impacts expected
	❒ Hazardous waste preliminary site investigation required
	❒ Growth inducement issues
	❒ Cumulative impact issues
	❒ Pressure to compress the environmental schedule

for construction operations. This problem is most acute during the preparation of planning and programming phase estimates.

What Is It?

This tool encourages early consultation between the agency's design, construction, and right-of-way sections in order to better define interchange land requirements and the cost of

Table I2.3-3. Caltrans sample organizational and project management risk list.

Risk Category	Individual Risks
Organizational Risks	❒ Inexperienced staff assigned
	❒ Losing critical staff at crucial point of the project
	❒ Insufficient time to plan
	❒ Unanticipated project manger workload
	❒ Internal "red tape" causes delay getting approvals, decisions
	❒ Functional units not available, overloaded
	❒ Lack of understanding of complex internal funding procedures
	❒ Not enough time to plan
	❒ Priorities change on existing program
	❒ New priority project inserted into program
	❒ Inconsistent cost, time, scope and quality objectives
Project Management Risks	❒ Project purpose and need is poorly defined
	❒ Project scope definition is poor or incomplete
	❒ Project scope, schedule, objectives, cost, and deliverables are not clearly defined or understood
	❒ No control over staff priorities
	❒ Too many projects
	❒ Consultant or contractor delays
	❒ Estimating and/or scheduling errors
	❒ Unplanned work that must be accommodated
	❒ Communication breakdown with project team
	❒ Pressure to deliver project on an accelerated schedule
	❒ Lack of coordination/communication
	❒ Lack of upper management support
	❒ Change in key staffing throughout the project
	❒ Inexperienced workforce/inadequate staff/resource availability
	❒ Local agency issues
	❒ Public awareness/support
	❒ Agreements

acquiring that land. During the programming phase of project development, the estimators and designers must understand that average interchange acreage requirements are frequently not an appropriate methodology for estimating the cost of the necessary takings. When estimating an interchange acreage requirement, consideration must be given to effects on utilities (e.g., water, sewer, gas, electric, cable, and fiber-optic lines), the need for space to accommodate utility relocations, and, often, space for noise walls. The concepts developed for each interchange should be evaluated to identify engineering issues, environmental concerns, construction requirements, and maintenance requirements. The concepts developed should be evaluated for

- Acquisition of developed properties;
- Reconstruction of other facilities;

Table I2.3-4. Caltrans sample right of way, construction, and regulatory risk list.

Risk Category	Individual Risks
Right of Way Risks	❒ Utility relocation may not happen in time ❒ Freeway agreements ❒ Railroad involvement ❒ Objections to Right of Way appraisal take more time and/or money
Construction Risks	❒ Inaccurate contract time estimates ❒ Permit work windows ❒ Utility ❒ Surveys ❒ Buried man-made objects/unidentified hazardous waste
Regulatory Risks	❒ Water quality regulations change ❒ New permits or new information required ❒ Reviewing agency requires higher-level review than assumed

- Traffic operation issues on or into private property (access management);
- Significant acquisition of right-of-way from the protected areas (i.e., environmentally sensitive areas); and
- Effects (economic, traffic, and environmental) on existing facilities.

Why?

Many SHAs have design guidelines that describe the elements of a typical highway interchange and required land area. Right-of-way estimates (including those for interchanges) that are prepared based on both typical acreage requirements and an average per-acre price are often inaccurate because they fail to consider impacting cost drivers and the fact that interchanges, while following standard designs, must almost always be fit into the unique physical setting of their locations.

What Does It Do?

This is a tool to help project managers and estimators appreciate the fact that, as projects become more complex, there is a greater need for coordination and communication between the disciplines participating in developing the project's design and estimate. This is particularly important in the case of initial right-of-way estimates for interchanges. In such a case, many more supporting groups—multiple utility companies, agencies that grant environmental permits, construction, and maintenance—must be consulted before the area required for the interchange can be determined and the right-of-way cost estimated.

When?

This tool supports the estimate process for projects (new alignment or reconstruction) involving interchanges, either interchange-only projects or projects where interchanges are part of a large total scope. This tool should even be applied to projects where, during early programming, it is believed that no additional right-of-way will be required, because consultation with supporting sections (utilities relocation, environmental, and construction) may lead to a different conclusion.

Examples

The Mid-Ohio Regional Planning Commission issued a report, *Historical and Projected Transportation Funding in Central Ohio,* in 2004 (available online at http://transportation.

morpc.org/tplan/finalTPlan04Funding.pdf). Section 5 of the report, "Right-of-Way Costs," provides the following guidance for that region of the country. Although the cost data are probably not appropriate to SHAs, the format could be used to establish interchange *reality check figures* for both acreage and land cost.

If a ROW acreage estimate is provided, that number is used. Otherwise, estimate ROW needed according to type of project. For the regional Transportation Plan, two methods have been used to estimate the ROW costs. The simplified method generally assumes a project is in a high (A), medium (B) or low (C-default) cost-per-acre area. A more complex method based on actual county auditor valuations for the adjacent parcels has also been used. For this study the simplified approach will be used. The three cost-per-acre categories are $620,000/ac, $235,000/ac and $75,000/ac. Other costs such as utility relocation vary depending on the individual project and are not included. The following ROW acreage assumptions are made based on the improvement type:

Intersection Improvement:

a) Turn lane 2 approaches
   - Major Intersection: 0.5 acre
   - Minor Intersection: 0.25 acre

b) Turn lane 4 approaches
   - Major Intersection: 1 acre
   - Minor Intersection: 0.5 acre

Interchange Upgrade:

a) Basic Diamond/Partial Clover: 5 acre
b) Complex with directional Ramp: 10 acre

New Interchange:

a) Basic Diamond or Partial Clover: 30 acre
b) Complex with directional Ramp: 70 acre

For the right-of-way cost, project-specific estimates are made. First, for each project, the parcels are identified through which ROW is needed. Second, using the county auditor's data set, the cost per acre for each parcel is determined. The total ROW cost is calculated by multiplying the estimated ROW acreage and the cost per acre of the parcel. The minimum cost per acre is fixed at $75,000.

Tips

Based on a project description detailing the limits of all alternatives, a primary impact area should be established. This primary impact area identification should include work completed during concept development, scoping, public involvement, and interagency coordination. Secondary impact areas, where applicable, should also be identified and discussed. A graphic detailing the primary and secondary impact corridors and proposed right-of-way limits should be developed. Another graphic should be developed mapping the existing land use and zoning within the primary impact area of each alternative. The graphics should delineate industrial, commercial, single-family residential, multifamily residential, public and quasi-public uses, and vacant land. Pursuant to the Farmland Protection Policy Act of 1984 (FPPA) (Public Law 97–98—Subtitle I of Title XV, Section 1539–1549), all agricultural lands, defined as agricultural soils considered prime farmland soils, soils of statewide or local importance, and unique soils, affected by the proposed action must be identified and quantified. The acreage of agricultural soils acquired by the proposed right-of-way must be determined. Additionally, it should be noted if this total exceeds 3 acres per mile of roadway improvements or 10 acres per interchange or intersection. The results of these calculations will be forwarded to the State Soil Conservation Service.

Early project alignment drawings may not show the required right-of-way width or area for interchanges. Use a typical section width under the worst-case scenario—maximum right-of-way needed. In the conceptual plans, look at the existing constraints so that alternatives that limit right-of-way requirements (e.g., retaining walls or steeper side slopes) can be explored.

Resources

Florida DOT right-of-way estimation guidance can be found on the web at www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/ch06s03.pdf

Computer-aided design and drafting (CADD) systems use computer graphic technologies to design and map projects and to quickly consolidate many different design aspects, such as right-of-way maps, into a common database or base map. A 1999 U.S. General Accounting Office study found that 43 SHAs use CADD systems on more than half their projects. CADD-generated project right-of-way maps present an opportunity to enhance knowledge concerning required right-of-way requirements and to improve right-of-way estimation.

Global positioning systems (GPS) are used for mapping purposes. A 1999 survey found that 15 SHAs use GPS on more than half their projects. GPS-generated project right-of-way maps present an opportunity to enhance knowledge concerning required right-of-way requirements and to improve right-of-way estimation. Wisconsin DOT's document "Design, Real Estate and Construction Delivery Estimates" identifies the portion of dollars that should be set aside for design, real estate, and construction delivery. The web address is www.dot.wisconsin.gov/localgov/highways/docs/delivery.pdf. Estimates are derived by taking a certain percentage of actual real estate acquisition costs for real estate delivery or an actual percentage of total construction costs for design and construction delivery.

R2.2 Advanced Purchase (Right-of-Way Preservation)

To facilitate the construction of a public improvement, the necessary real property interests must be acquired expeditiously and in compliance with governing rules and regulations. Proactive access management and corridor preservation strategies may reduce right-of-way cost. However, transportation agencies must be very careful to avoid preemptive takings (i.e., takings in which land use rights are prematurely restricted) in long-term anticipation of projects involving right-of-way acquisition.

What Is It?

This tool educates project managers and estimators about advance purchasing of real estate and the effect of such actions on project cost estimates. For years, corridor preservation for highway projects has been a goal of the FHWA and other governmental agencies. Various activities have been undertaken in support of this goal, and legislative support was provided in ISTEA. Protective buying may be approved only after (1) the acquiring agency has given official notice to the public that it has selected a particular location for the project alignment or (2) a public hearing has been held or an opportunity for such hearing has been afforded.

Why?

The goal of the tool is to eliminate one of the major uncertainties from the project cost estimate by purchasing right-of-way in a future corridor to protect the corridor from further development that could substantially increase the cost of real estate.

What Does It Do?

In the case of estimates prepared during early project development, it may be necessary to predict real estate values as much as a decade in advance, which is a very difficult task. Advance purchase of right-of-way can eliminate or at least moderate this volatile component of early project cost estimates and therefore improves the accuracy of the estimate.

When?

This tool should be used in the earliest stages of project development in order to avoid inflation and escalating property values caused by development within the alignment of a corridor or project. It is a good tool for a limited number of parcels. However, in the case of a long corridor, its application is limited.

Examples

The Texas legislature has given the Texas Department of Transportation (TxDOT) the authority to acquire right-of-way to preserve a corridor. Both TxDOT and the FHWA understand that such an acquisition would not negate the requirement to complete NEPA. The I-69/Trans-Texas Corridor Project in Texas will be evaluated using a tiered approach. At Tier 1, corridor-level decisions will be made. After the Tier 1 right-of-way acquisition, TxDOT can acquire right-of-way at its own risk, knowing that when the Tier 2 NEPA evaluations are initiated, the ownership of the previously acquired right-of-way cannot and will not influence the Tier 2 alternative location decision. Since the I-69/TTC corridor will be approximately 1,000 miles long, common sense would lead one to believe that only the parcels in eminent danger of being developed would be acquired. See the FHWA's March 2004 *Environmental Streamlining Newsletter* for more information on the I-69 project.

Minnesota DOT (Mn/DOT) policy requires environmental documentation prior to purchase. Additional information can be found in Appendix J of Mn/DOT's *Interregional Corridors: A Guide for Plan Development and Corridor Management* (available online at http://www.oim.dot.state.mn.us/IRC-Guide.html). Also included is information on the environmental review and documentation process as it relates to right-of-way preservation. Mn/DOT also conducted a research project to identify circumstances under which it is optional to purchase right-of-way in advance and those in which it is not. The final report of this research project, titled *The Final Benefits of Early Acquisition of Transportation Right of Way,* is available at http://www.research.dot.state.mn.us/detail.cfm?productID=1998. Improvements to Florida's Strategic Intermodal System (SIS), a statewide network of high-priority transportation facilities, envisions acquisition of right-of-way for the following:

- The future widening of I-595
- The widening of I-4
- Future improvements to SR 79
- Future US 331 reconstruction to a four-lane facility

Florida DOT's *Right of Way Manual* (effective April 15, 1999; acquisition revised December 11, 2000), "Section 8.1 Advance Acquisition," can be found at www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/ch08s01.pdf

Tips

Brief summary of the process. To use the protective purchase option (advance purchase), there must be at least a draft environmental document (which means that the initial public hearings must have been held). An individual categorical exclusion (CE) document will be required for the protective purchase. The state highway agency will ask the FHWA division office to review and approve a protective purchase package. The package will include (but may not be limited to) a CE document, copies of property valuation appraisals, preliminary design maps, and written justification for the protective purchase.

If the FHWA division office concurs with the protective purchase, the approval will indicate that the state highway agency may incur costs that will be eligible for reimbursement at such time as a final environmental document is approved. The state highway agency may use its own funds to make the purchase and request reimbursement from the FHWA after the final environmental document is approved.

There is the potential for a decrease in the value of abutting parcels (e.g., who would want to purchase a home in an area knowing that there is a major highway project planned?). Adjacent property owners could also demand compensation at this time, and there really is no appropriate way to compensate properties not within the corridor for a property value stigma associated with a nearby project.

However, limited studies at Illinois Department of Transportation (IDOT) looking at the effect of highway improvements on adjacent property did not show evidence of property value decreases. IDOT often received comments from property owners who were not directly affected by right-of-way acquisition that the highway would damage them even though no right-of-way was taken from them. When sales prices of properties next to and away from a major highway were examined, it did not appear that the highway had a negative effect on property values. When using this tool, the agency might want to look at some examples in its area to see if properties next to major roadways sell for less than comparable properties a block or two away.

A study conducted by a national realtors organization that surveyed 2,000 homebuyers nationwide on what issues were most important in choosing a home location found that access to transportation infrastructure was cited most often (43%).

Transfer of development rights. Some agencies have negotiated with property owners to transfer right-of-way dedication for future roadways for increased development densities on remaining portions of the parcel. This enables the developer to get the same number of lots or units and also enables the agency to obtain the needed right-of-way.

Resources

See the hardship/protective purchasing sections of the 23 Code of Federal Regulations. Specifically, refer to Sections 23 CFR 630.106(c)(3), 23 CFR 710.503, and 23 CFR 771.117(d)(12).

The Missouri Department of Transportation (MoDOT) *Engineering Policy Guide* combines the Right of Way, Design, Bridge, Construction, Traffic and Maintenance Manuals of the Department and provides a single reference for all engineering guidance. The MoDOT policy is as follows:

236.13.1.12 Advanced Right of Way Acquisition

At times it is in the public interest to buy right of way resulting from hardship cases, total acquisitions, or protective buying prior to the time the right of way plans have been fully developed. When this occurs, it is possible to obtain authorization for right of way acquisition based on the approved final preliminary plan. This procedure is restricted to special cases. It is initiated by the district's request and supported with adequate justification for approval. District right of way will request approval from the Right of Way Division for all hardship and protective purchases.

Also see the Texas Department of Transportation's *Project Development Process Manual,* "4410: Perform Advance Acquisition for Qualified Parcels," at http://onlinemanuals.txdot.gov/txdotmanuals/pdp/right_of_way_appraisals_and_acquisition.htm#i1005267

R2.3 Condemnation

Typically, right-of-way acquisition, especially in urbanized areas, includes other costs besides land purchase, such as costs related to takings, condemnations, relocations, damages, and courts. As a result, it is necessary to estimate these additional costs associated with actual acquisition of land needed for projects. From FY 91/92 to FY 94/95, Florida DOT had to initiate condemnation proceedings in 42.9% of its right-of-way parcel acquisition actions.

What Is It?

This is a tool to educate project managers and estimators about the schedule changes, which can affect the overall project estimate, and the direct right-of-way cost impacts of using con-

demnation to acquire right-of-way. When right-of-way must be secured by condemnation through eminent domain procedures, it typically involves the transition of control of the settlement from the agency's right-of-way department to its legal department. At that point, issues of time, cost, and jury process are relevant to establishing the estimated cost of the right-of-way parcel.

Why?

Because of the high costs and the potential for project delays, most right-of-way offices make it a high priority to resolve and settle right-of-way parcel disputes before resorting to litigation and most of the cases where condemnation proceedings have been initiated are settled before actually going to court. However, estimators must have an understanding of the potential necessity of resorting to condemnation proceeding to acquire right-of-way and of the cost consequences of such procedures.

What Does It Do?

This tool educates estimators about the direct and indirect cost of right-of-way acquisition, particularly the cost associated with condemnation proceedings, and the effect that condemnation proceedings can have on a project's timeline. If a state highway agency is unable to agree with the owner on a price for a parcel of property, the agency files a condemnation suit and the court determines the property's value. Other costs in many cases can include the landowner's attorney fees, appraiser fees, technical expert fees, and relocation expenses, if necessary. If the state takes a portion of a business property, it may also have to pay business damages for permanently lost profits and the reduced profit-making capacity of the business. Estimators need to understand these ramifications of right-of-way cost in order to prepare accurate project estimates.

When?

This tool should be a continuous estimator education process for all estimators who are involved in estimating the cost of right-of-way. The tool particularly supports early estimates developed when the exact project alignment is imprecise and right-of-way issues lack focus.

Examples

Oregon DOT (ODOT) holds statewide right-of-way meetings every 18 months, where all right-of-way staff assembles for training sessions and to share best practices with each other. In addition to formal training programs, individual training plans are prepared at the regional level and approved by the central office as part of its business plan. Portions of the right-of-way manual are available online on a shared directory, and policy memos, clarifications, and relocation meeting minutes are frequently circulated and stored electronically. Something like this could be expanded to include training for right-of-way estimators. The AASHTO Right-of-Way and Utilities Subcommittee sponsor's conferences addressing many of the subjects that right-of-way estimators need knowledge about.

Tips

In terms of condemnation rates, those states that require payment of litigation costs and give property owners more than 30 days to make a decision tend to fare some what better [Shadi Hakimi and Kara M. Kockelman, Right-of-Way Acquisition and Property Condemnation: A Comparison of U.S. State Laws, *Journal of the Transportation Research Forum* 44 (3): 45–58 2005].

Most areas of dispute involve severance damages to the remainder of the property and business damages. Therefore, these issues must be fully understood when estimating right-of-way cost.

Consider the effect that relocation has on a business. Does the business have specific requirements that may hinder relocation?

When the right-of-way land requirement does not require all of an owner's business property, other facts should be considered:

- Will the proximity of the proposed facility affect the operations of any businesses, in terms of access disruption, or parking loss, which could result in loss of business?
- Will the proposed action disrupt current accessibility to businesses, thereby having a potential for loss of clientele?

Resources

States usually determine compensable items through right-of-way statutes or previous court cases (Meltz, R., D. H. Merriam, R. M. Frank. *The Takings Issues,* 1999). The extent of state law flexibility on compensable items varies across the United States. The nature of early negotiations can be a key issue in condemnation proceedings (Netherton, 1963). Some states require that there be an attempt to negotiate in good faith; others require only a failure to agree; and some require no negotiations at all.

The Uniform Act impact on Condemnation Rates as it only applies to federally aided projects (49 CFR Part 24). State laws must be in accordance with the Uniform Act, unless required permission is obtained (49 CFR Part 24).

The FHWA report, "Evaluation of State Condemnation Process," summarizes the legal and procedural framework for acquiring real property for right-of-way, focusing on five specific states. It provides information on the statutory authority and case law relevant to the acquisition of real property in each of those five states. It reviews each state's approach to negotiations and valuation, the use of alternative dispute resolution or other administrative procedures used to establish value, and the payment of the property owner's attorney fees and related expenses. This FHWA report can be found at www.fhwa.dot.gov/realestate/cndmst.htm

Also see the AASHTO Standing Committee on Highways, Strategic Plan 4-4, Right-of-Way and Utilities Guidelines and Best Practices, Jan. 2004, http://cms.transportation.org/sites/rightofway/docs/aabp%20report%20 final.pdf

R2.4 Relocation Costs

In 1999, $100 million in federal and state funds were paid to displaced business and property owners for reestablishment and relocation assistance. The Uniform Relocation Act (Uniform Act) and FHWA regulations address the benefits and protections for persons displaced by highway projects funded, at least in part, with federal money.

In 1987, as part of the Surface Transportation and Uniform Relocation Assistance Act (STURAA), Congress amended the Uniform Act to increase payment levels, to add benefits for small businesses, and to designate the U.S. DOT as the lead agency for the Uniform Act for all federal and federally funded programs and projects. The FHWA has the responsibility to act for the U.S. DOT. The Uniform Act was once again amended on November 21, 1997, to incorporate Public Law 105-117 by prohibiting an alien who is not lawfully present in the United States from receiving assistance under the Uniform Act.

What Is It?

This tool ensures that those estimating the cost of project right-of-way fully understand the legal requirements of parcel acquisition to include relocation costs. The Uniform Act provides relocation payments for residential occupants and for businesses, farms, and nonprofit organizations. These payments include moving expense payments and certain supplementary payments for replacement housing for residential occupants. In addition, the Uniform Act requires the availability of replacement housing for displaced persons, sets minimum standards for such housing, and

requires notices and information to be provided to all property occupants. The law also requires that advisory services be provided to occupants so as to help them relocate successfully.

Why?

It is important to understand that the project schedule can be affected by relocation actions and that there are indirect costs associated with securing right-of-way. Without the relocation of those occupying the project site, the project cannot proceed to actual construction and the schedule will be extended, thereby adding cost to the project. Estimators must understand the timing effects of relocation actions, particularly in relation to construction timing (midpoint of construction for estimation purposes), and the cost of relocation actions must be included in a project right-of-way cost estimate.

What Does It Do?

This tool seeks to educate estimators and project managers about the legal requirements that affect the right-of-way cost and the effect that relocation actions have on project schedule so that estimators and project managers can estimate project cost based on realistic schedules and can include all subsidiary (i.e., indirect) right-of-way costs in the estimate.

When?

This tool should be used when projects involve the relocation of individuals in residential properties or nonresidential relocations, businesses, farms, and nonprofit organizations. One of the main purposes of the Uniform Act is to prevent affected persons from bearing an unfair share of the burden of public projects. The act provides relocation assistance payments in addition to relocation assistance advisory services. Relocation assistance payments are designed to compensate displaced persons for costs that result from acquisition of the property on which they reside.

Examples

Residential relocation payments are intended for persons who move (or move personal property) from a dwelling as a result of a highway project receiving federal financial assistance. These payments fall into three types:

- **Moving expense payments** are designed to compensate for the moving and related costs that a person incurs as a result of having to move from his or her dwelling or to move personal property for a project.
- **Replacement housing payments** are designed to help eligible displaced persons occupy housing that is decent, safe, sanitary, adequate for their needs, and comparable to what they had before the project required their move. There are three categories of replacement housing payments: purchase supplements, rental assistance, and down payment assistance.
- **Housing-of-last-resort payments** are payments in excess of statutory maximums or payments involving other, unusual methods of providing comparable housing. See the Caltrans brochure, "Your Rights and Benefits as a Displaced Business, Farm or Nonprofit Organization Under the Uniform Relocation Assistance Program," on the Internet at www.dot.ca.gov/hq/row/pubs/business_farm.pdf

Tips

Consider the effect that relocation has on a business and answer the question: Does the business have specific requirements that may hinder relocation?

Resources

See the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646), as amended (42 U.S.C. 4601 et seq.).

Also see the Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally Assisted Programs (49 CFR 24).

If the project has Federal-aid funding, the FHWA's memorandum *Policy and Guidance for Acquisition and/or Relocation Incentive Programs-Voluntary* (2006) should be consulted. It can be found at http://www.fhwa.dot.gov/realestate/acqincentguid.htm

R2.5 Right-of-Way Estimator Training

A "Highway Construction Cost Comparison Survey" conducted by the Washington State DOT in 2002 found that right-of-way costs typically vary. SHAs reported that variability rates for right-of-way ranged from 10% or less to over 30% of project cost. Such variability makes the use of historical cost averages for estimating right-of-way cost very unreliable. Estimators need to be trained to recognize the factors that affect right-of-way cost.

Why?

It is important that right-of-way acquisition be handled expeditiously and that project managers and estimators have a solid understanding of right-of-way acquisition processes and costs, both direct and indirect.

What Does It Do?

This tool seeks to specifically educate estimators concerning the factors that influence right-of-way cost and to provide the estimators with the information necessary to handle the challenges associated with developing right-of-way estimates. Right-of-way estimators must be trained to

- Develop early estimates based on planning-level maps with limited information on the extent of takings.
- Adjust right-of-way estimates for the significant inflation and speculation that can occur between the time when the estimate is initially prepared (typically several years in advance of actual right-of-way acquisition) and when the parcels are purchased. Right-of-way estimates are prepared based on year of parcel purchase, not midpoint of construction.
- Account for the uncertainties associated with damages and court costs that result from condemnation proceedings.

When?

Because all SHAs are continually involved with projects requiring right-of-way, the right-of-way estimator training tool should be standard practice to every state highway agency. However, it has been found that court costs are highly variable and are particularly high for projects in highly developed commercial corridors, where condemnation proceedings are common. Thus, the tool may be of greater benefit to SHAs that regularly engage in urban commercial corridor projects.

Examples

An example of right-of-way estimation guidance can be found at www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/ch06s03.pdf. Another example of a training course developed by the Ohio DOT can be found at the following: http://www.dot.state.oh.us/real/—Click on Manuals & booklets, Click on *Cost Estimating—PowerPoint* under POWERPOINT PRESENTATIONS.

The FHWA's Office of Real Estate Services has a Right-of-Way Outreach and Program Research website (www.fhwa.dot.gov/realestate/research.htm), which lists available professional training and technical assistance.

Tips

Train estimators to red flag areas in proposed corridors [e.g., major streams, Federal Emergency Management Agency (FEMA) flood zones, residential and commercial structures, cemeteries, wetlands, historic properties, hazardous waste sites, and parks] that can affect right-of-way cost.

Also train estimators to recognize removal items that will affect right-of-way cost (e.g., trees, buildings, and abandoned slabs). Revisit the right-of-way estimate as design proceeds and the construction limits are refined. Each time, identify total takes, relocations, and noise wall locations, and then check the cost estimate.

Understand whether the acquisition process for compensating renters differs from the process for compensating property owners.

Real estate sales prices along a corridor of several individual projects are affected by the order in which projects are accomplished.

A study of residential property prices from 1979 to 1997 along an urban corridor in Texas revealed significant price effects of the corridor improvement phases. During the pre-planning phase, housing prices in the immediate vicinity of the freeway were negatively affected, while those farther away were positively affected. During the planning phase, houses in the corridor appreciated at twice the rate of other Dallas properties. Prices declined more rapidly in the corridor than elsewhere in Dallas during the early construction phases. However, prices again improved during the final construction phase, as sections of the freeway began to reopen and access improved.

During the early phase of a project development, the right-of-way needs may not be defined clearly enough to differentiate between what will be a whole take and what will be a partial take. If it is helpful, cost estimates may be limited to whole parcel acquisition. Costs of partial acquisitions, including damages to the remaining properties and project overhead, can be factored into an estimate.

A right-of-way estimator training program should cover the following:

- Cost-escalated/real estate appreciation to year of expenditure dollars.
- Risk assessment processes.
- Documentation.
- Estimate validation.
- Estimate consistence with project scope.
- Right-of-way administrative costs.
- Estimating third-party (e.g., utility or railroad) costs.
- Planning or conceptual estimates, consideration to expressing the estimate as a range.
- Contingency based on stage of design.

Resources

The Florida DOT right-of-way estimation guidance can be found at www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/ch06s03.pdf

Executive Order (EO) No. 12898 (1994), "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," requires that federal agencies be responsible for reviewing their programs and other activities to determine and prohibit any disproportionately high adverse effects on the human environments in low-income or minority communities. In the case of transportation projects, EO 12898 is implemented through the U.S. DOT and the FHWA. The U.S. DOT strategy ensures that the provisions of EO 12898 are integrated into the relevant existing guidelines used in the project planning

and public participation processes. The FHWA's order requires that specific research and related data collection be conducted to provide information on environmental justice concerns.

The FHWA's Office of Real Estate Services has a *Project Development Guide* that contains a practical approach to project right-of-way. This document presents best practices of state and local agencies and others in the right-of-way field. The guide can be found on the Internet at www.fhwa.dot.gov/realestate/pdg.htm

"The Costs of Right of Way Acquisition: Methods and Models for Estimation" is a paper presented at the 83rd Annual Meeting of the Transportation Research Board, January 2004. The paper reviews the literature related to right-of-way acquisition and property valuation. It describes the appraisal process.

R2.6 Separate Right-of-Way Estimators

Right-of-way is not merely a financial transaction to acquire real estate. It is a human endeavor that requires the highest level of tact, understanding, and respect from the people who represent the State. SHA right-of-way sections have the mission to deliver real estate services essential for public transportation projects that support the economic, environmental, and social vitality of their state. Completion of the right-of-way function is the last stage before construction commences, but to reach that point in project development, accurate right-of-way estimates must be prepared years before. Predicting the future is always difficult and in the case of right-of-way estimates it is necessary to understand all of the costs associated with obtaining parcels together with the intimacies of acquisition law and FHWA guidelines in real estate matters. A right-of-way estimate predicts the cost to research and acquire right-of-way for the project, including easements. It includes right-of-way costs for stormwater management, wetland mitigation, and other work outside the roadway prism. This issue of specific right-of-way knowledge to address the multi-variant nature of right-of-way estimating has led some agencies to establish a separate group of right-of-way estimators.

What Is It?

This is a group, usually within the right-of-way section of an SHA, specifically trained in techniques for estimating right-of-way cost. Its primary function is to estimate the right-of-way cost portion of a project estimate. Additionally, it is tasked to construct and maintain right-of-way cost models. While most SHAs position this group of right-of-way estimators in the agency's right-of-way section, some have located it in design or estimating sections. Location in the agency structure is not as important as developing a group having the unique skill set needed to accurately estimate right-of-way cost and who can mentor and support one another in this important task.

Why?

It is extremely important that individuals attempting to estimate the cost of real estate acquisition be intimately familiar with the applicable State laws and implementing regulations. States have over the years enacted eminent domain laws governing public acquisitions under their jurisdiction. Since the enactment of the Federal Uniform Relocation Assistance and Real Property Policies Act of 1970 (Uniform Act) and passage of the various State consent laws, basic public acquisition policy has become more uniform. However, several States have enacted laws and regulations that go beyond Federal law, which provide property owners entitlements not considered generally compensable under Federal law. Therefore, those responsible for estimating the cost of real estate for right-of-way must possess knowledge concerning a unique set of rules and regulations and understand the lead time requirements that follow from the rules and regulations.

Aside from property acquisition costs, right-of-way estimators must also estimate administrative costs, including labor costs for environmental assessments, title research, appraisals or

updated appraisals, lengthy negotiations and closings, as well as the hiring and managing right-of-way consultants.

What Does It Do?

It ensures that the agency has individuals who are knowledgeable and specifically trained to prepare right-of-way cost estimates and who are dedicated to monitoring changes in the real estate market place. In addition, separate right-of-way estimators provide the agency with the staff personnel having the necessary competencies to evaluate right-of-way cost estimates prepared by external consultants.

When?

The establishment of separate right-of-way estimators could be of great benefit to SHAs that regularly have projects penetrating urban environments. It has been found that court costs associated with acquiring right-of-way are highly variable and are particularly high for projects in highly developed commercial corridors, therefore estimating the cost of real estate for these projects is very challenging.

Examples

The Virginia Department of Transportation (VDOT) is currently doing right-of-way estimates through the right-of-way department. VDOT has incorporated right-of-way estimating into the in-house computer program. There has been some resistance because the right-of-way people think that the computer cannot match the expert judgment.

Caltrans has realized that right-of-way funds to acquire parcels needed to construct their projects are typically expended during the design phase; for this reason, it is the agency's policy to have close coordination with the Right-of-Way Branch during the design phase of project development.

The Florida DOT has recommended (Guidance Document 2 Right of Way Cost Estimates, Revised: April 2004) the use of right-of-way cost estimating teams for certain projects. "It is suggested that the district consider appointment of a team to participate in the preparation of the estimate on large or complex projects." www.dot.state.fl.us/rightofway/documents/ROWmanual/Acrobat%20files/guide2.pdf

Tips

Real estate sales prices along a corridor of several individual projects are affected by the order in which projects are accomplished. A study of residential property prices from 1979 to 1997 along an urban corridor in Texas revealed significant price effects of the corridor improvement phases. During the pre-planning phase, housing prices in the immediate vicinity of the freeway were negatively affected, while those further away were positively affected. During the planning phase, houses in the corridor appreciated at twice the rate of other Dallas properties. Prices declined more rapidly than prices elsewhere in Dallas during the early construction phases. However, prices again improved during the final construction phase, as sections of the freeway began to reopen, and access improved. Right-of-way estimators need to be including construction data based on such information to use as aids in estimate preparation.

Resources

Executive Order (EO) No. 12898 of 1994: *Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations,* requires that federal agencies be responsible for reviewing their programs and other activities to determine and prohibit any disproportionately high adverse effects on the human environments in low-income or minority communities.

In the case of transportation projects, EO 12898 is implemented through the USDOT and the FHWA. The USDOT strategy ensures that the provisions of EO 12898 are integrated into the relevant existing guidelines used in the project planning and public participation processes. FHWA's order requires that specific research and related data collection be conducted to provide information on environmental justice concerns.

The FHWA's Office of Real Estate Services has a *Project Development Guide,* which contains a practical approach to project right of way. This document presents "best practices" of State and local agencies and others in the right-of-way field. The *Guide* can be found on the Internet at www.fhwa.dot.gov/realestate/pdg.htm

The Costs of Right-of-Way Acquisition: Methods and Models for Estimation is a paper presented at the 83rd Annual Meeting of the Transportation Research Board, January 2004. The paper reviews the literature related to ROW acquisition and property valuation. It describes the appraisal process and the influence of federal law on acquisition practices. It provides hedonic price models for estimation of costs associated with taking property using recent acquisition data from several Texas corridors and full-parcel commercial sales transactions in Texas' largest regions. Results indicate that damages depend heavily on parking, access, and location; the size of the taking is not as important as the value of improvements; and utility costs are highly variable.

See also the following research:

Buffington, J. L., M. K. Chui, J. L. Memmott, and F. Saad, 1995. "Characteristics of Remainders of Partial Takings Significantly Affecting Right-of-Way Costs." TXDOT Research Report. FHWA/TX-95/1390-2F.

Carey, J. 2001. "Impact of Highways on Property Values: Case Study of the Superstition Freeway Corridor." *FHWA Report No. FHWA-AZ-01-516.*

Gallego, A. V., 1996. "Interrelation of Land Use and Traffic Demand in the Estimation of the Value of Property Access Rights." Thesis for Masters of Science in Civil Engineering, The University of Texas at Austin.

See the following federal laws governing acquisition:

Uniform Relocation and Real Property Acquisition Policies Act of 1970 (42 U.S.C. 4801 et seq.)
Section I of the Civil Rights Act of 1866 (42 U.S.C. 1982, et seq.)
Title VI of the Civil Rights Act of 1966 (42 U.S.C. 2000d et seq.)
Title VIII of the Civil Rights Act of 1968 (42 U.S.C. 3601 et seq.) as amended
The National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or Superfund) as amended by the Superfund Amendments and Reauthorization
Act of 1986 (SARA) (42 U.S.C. Section 9601 et seq.)
Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 790 et seq.)
The Flood Disaster Protection Act of 1973 (Public Law. 93-234)
The Age Discrimination Act of 1975 (42 U.S.C. 6101 et seq.)
Executive Order 11063: Equal Opportunity and Housing, as amended by Executive Order 12259
Executive Order 11246: Equal Employment Opportunity
Executive Order 11625: Minority Business Enterprise
Executive Order 11988: Floodplain Management
Executive Order 11990: Protection of Wetlands
Executive Order 12250: Leadership and Coordination of Non-Discrimination Laws
Executive Order 12259: Leadership and Coordination of Fair Housing in Federal Programs
Executive Order 12630: Governmental Actions and Interference with Constitutionally Protected Property Rights

R2.7 Cost Estimate Map

Early scope definition of right-of-way requirements is often viewed as an important approach to improving the accuracy of cost estimates. The problem with determining right-of-way requirements early is the lack of information on specific parcels that may be within the proposed right-of-way boundaries. One approach to enhancing the information available regarding the effect of right-of-way on existing properties is to obtain aerial mapping, mosaics, or as-built plans covering affected properties and showing all improvements. This information can form the basis for early cost estimating.

What Is It?

Cost Estimate Maps show the approximate land requirements for a project in advance of precise design requirements. The map is typically developed based on aerial photos of the proposed project location. Other information is used to show specific ownerships, limits and sizes of parcels and assessor's parcel numbers. A map can also be prepared based on schematic plan view drawings. Cost Estimate Maps are used for studying alternative route locations, studying alternative design features, producing cost estimates consisting of

- Land (ownership and area),
- Improvements,
- Severance damages,
- Special benefits,
- Demolition,
- Relocation assistance, and
- Utility relocation.

Why?

Cost Estimate Maps provide a complete view of the desired location at a single glance. Critical right-of-way information is added to the map depicting requirements, including potential areas where improvements may be necessary or damages will result from takes. Special features, which are sometimes not even noticeable by field visits, are often captured when using aerial photographs. The topographic maps show the level of the area, which provides the user with an indication of the type of terrain immediately in the vicinity of the right-of-way to be acquired. This level of information shown on these maps will aid in enhancing the accuracy of early right-of-way estimates.

What Does It Do?

Arial maps portray the land use properties of the site to be acquired. The field properties like datum, terrain, and marsh lands can be identified. The estimators can easily establish boundaries for the right-of-way to be acquired. These boundaries provide a general idea of the number and type of parcels to be acquired. Structures, utilities, and potential access points are some of the features of concern when considering the cost of right-of-way. The right-of-way items can be broadly denoted for the estimation purpose. The maps of present sites are used to superimpose on them the proposed facility. Communication of project issues between different divisions within the SHAs can be improved with the use of Cost Estimate Maps.

When?

A conceptual level Cost Estimate Map can be used during the planning phase as a basis for preparing a Conceptual ROW Estimate. This early use of the map can focus on potential alignments showing approximate right-of-way boundaries. It may also give an indication of structures and access points that may be affected by the proposed right-of-way boundaries. The Cost Estimate Map is more often used to support cost estimates during programming or early in the

preliminary design phase. The use of this tool may be critical when setting the Baseline ROW Cost Estimate. In its more advanced state, the map will help identify potential parcels and provide insights into improvements and damages as a result of whole or partial takes.

Example

At Caltrans, a cost estimate map is provided that usually consists of an aerial photo, right-of-way boundaries, and affected parcels of each of the alternatives at the programming stage of project development. This map is designated as "For Estimate Purposes Only" with respect to early estimating. Based on the Cost Estimate Map, a Cost Data Sheet is completed. The Cost Data Sheet is a workbook in Microsoft Excel that includes all areas of right-of-way by parcel. Following completion of the data sheet, the sheet is circulated to other affected divisions such as utilities, railroads, and environmental. This estimate is completed on a parcel-by-parcel basis. After the data sheet is completed, it is re-circulated through each of the divisions for review and approval.

Figure R2.7-1 shows the details of right-of-way on Route 49 at Loganville, Uninc Sierra County, California. The green lines along the route are the existing right-of-way boundaries. Three areas are shown where right-of-way is needed for the project.

Tips

During the estimation process when using maps, special attention should be given to the scale of the map. Calculations should be rechecked before finalizing the cost estimate. When preparing an early right-of-way estimate and time is limited, the use of a Cost Estimate Map can provide a picture of the right-of-way requirements without a site visit. This can aid the estimator in adjusting cost to better reflect anticipated conditions.

Resources

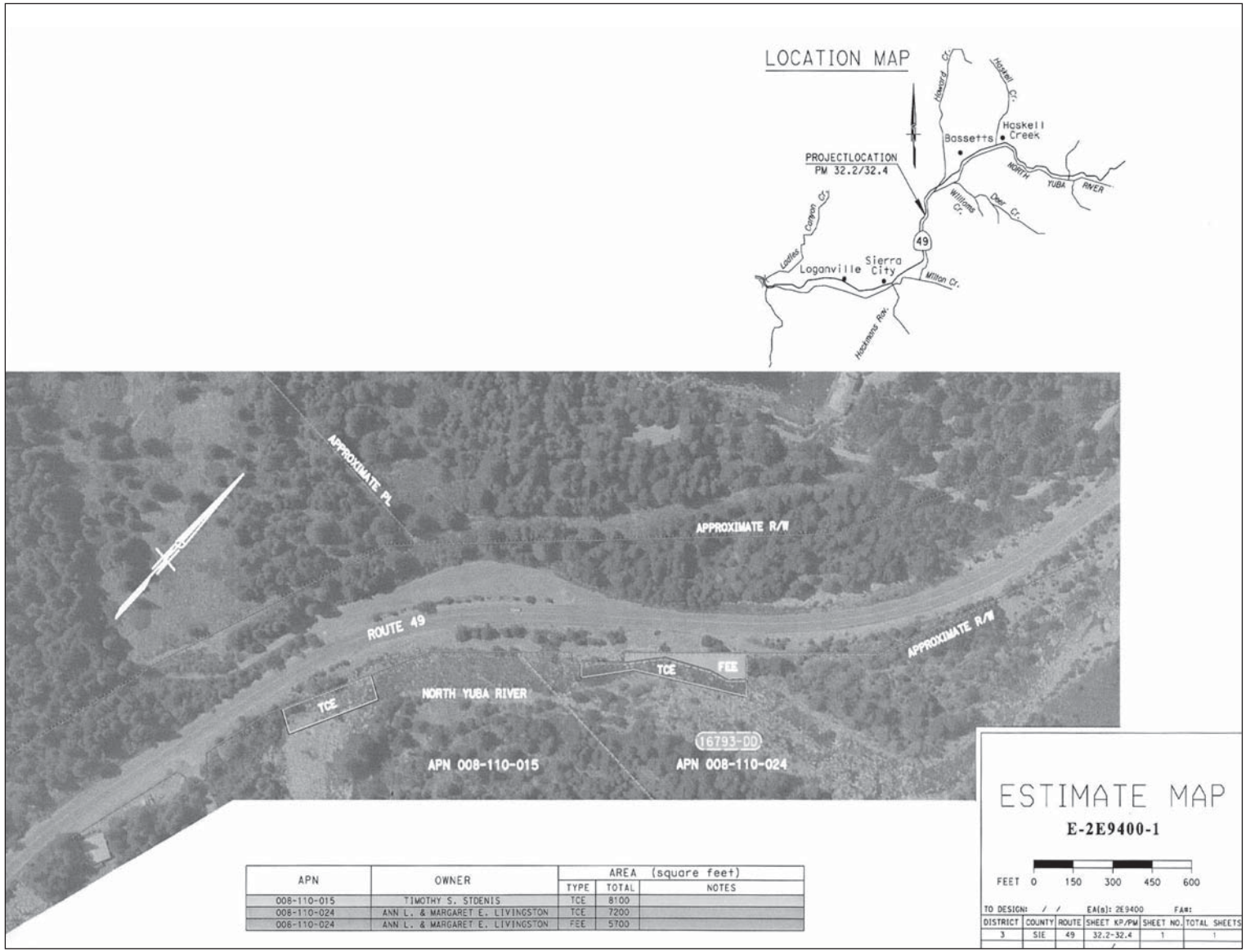
Caltrans: see Right of Way Engineering http://www.dot.ca.gov/hq/row/rowman/manual/ch6.pdf on Cost Estimate Maps and http://www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf on Cost Project Estimate Mapping.

R2.8 Cost Estimate System

The real estate that will become the right-of-way for any project is subject to changes in land use or value over very short time spans. Additionally, the value of individual right-of-way parcels is greatly affected by changes to adjoining parcels. At the planning stage of project development, the right-of-way estimate is being developed several years before the actual real estate acquisition and it, therefore, includes a presumption about value appreciation. Assumptions for market price changes, the possible development in the adjoining areas, potential costs for condemnations, and the changes in governmental policies must be made so that the estimate reflects a future cost. To make these assumptions, right-of-way estimators use historical cost data to identify future trends. A large amount of historical data allows the estimator to make better predictions; therefore, computer-aided estimation software is an excellent support tool. Consequently, transportation agencies in many states use computer software for estimation of right-of-way cost.

What Is It?

Right-of-way cost estimation software can be sophisticated or a simple spreadsheet, customized to meet specific agency objectives. Generally, sophisticated software requires training and highly skilled people to use effectively. As a result, estimators need to spend more time in learning the system before they can fully use its potential. Electronic spreadsheets, on the other hand, are simple to operate and edit and repetitive calculations can be easily performed.



APN	OWNER	AREA (square feet)		
		TYPE	TOTAL	NOTES
008-110-015	TIMOTHY S. STDENIS	TCE	8100	
008-110-024	ANN L. & MARGARET E. LIVINGSTON	TCE	7200	
008-110-024	ANN L. & MARGARET E. LIVINGSTON	FEE	5700	

Figure R2.7-1. Caltrans cost estimate map for a proposed project.

Why?

Computer software can handle large data sets. The calculation speed is enhanced greatly and accuracy is improved. Historical data plays an important role in the estimation of right-of-way cost and the use of computer software for right-of-way estimates makes the storage and retrieval of historical data easy and rapid. The historical data are retrieved by the software to prepare a right-of-way estimate. Computer software gives consistency in estimation, which is very important at every level of estimation. Consistency gives a definite pattern of estimation which is easy to recognize and to edit for future estimates. Using the computer software gives flexibility to calculations. Electronic spreadsheets consist of small blocks called cells. These cells store formulas and values, hence when one value is changed it automatically changes the other values coupled with the cell. This makes editing very easy. The computerized right-of-way estimation program can be easily improved over time as use demands enhancements.

What Does It Do?

The electronic spreadsheet uses a step-by-step approach to prompt the estimator for information in creating the estimate. The estimators feed the available information, from survey and field visits, into the electronic spreadsheet and calculations performed by the spreadsheet program. The program allows the estimator to view and use data or information from historical right-of-way estimates. Complicated calculations involving Monte-Carlo simulation, risk assessment, and probabilistic estimation can be easily incorporated in the program performed. Standard reporting templates are available to generate reports. Maintaining records of the reports and right-of-way estimates thus becomes easier. Communication of the right-of-way estimate at various phases of project development is one of the key factors for successful right-of-way estimate preparation. The consistency and standardized pattern of calculations and reports makes it easy to communicate the estimated right-of-way cost. The inflation rate and environmental issues related to the parcel are communicated with the costing details.

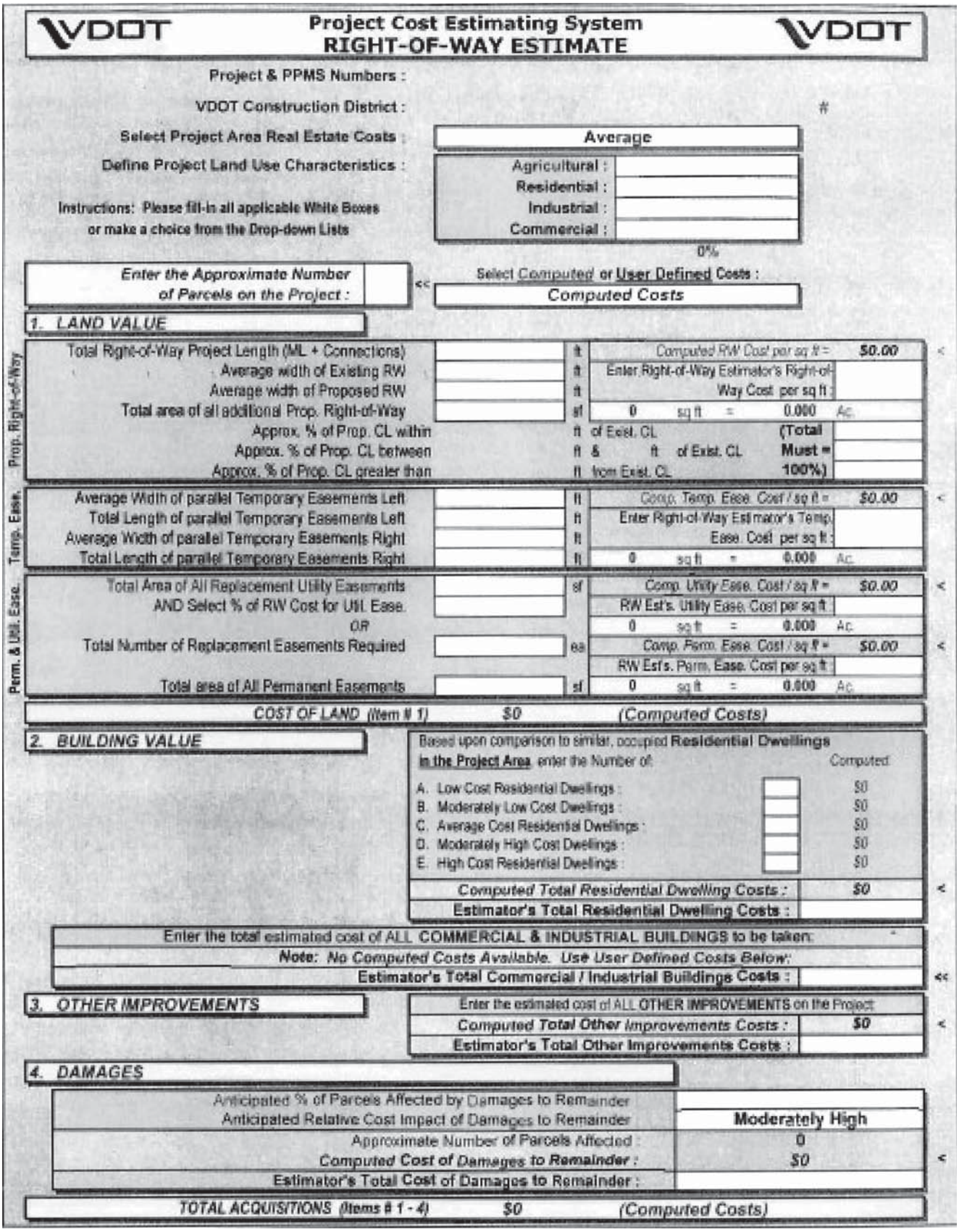
When?

Electronic spreadsheets are an effective way to estimate right-of-way cost for all types of projects. Estimation of right-of-way is often a complex procedure because it includes many details about the real estate, which may differ from parcel to parcel. From the start of project planning until project construction, the right-of-way cost estimates are prepared at various stages. As a result the right-of-way cost estimate needs to be constantly updated. Any change in the scope of the project requires an update of the estimate. Hence, electronic spreadsheets make it easier to update, incorporate changes, and ensure consistency in data entry.

Examples

VDOT has developed an in-house estimating system called the Project Cost Estimating System (PCES). This cost estimating program covers all project-related costs, including right-of-way. The system was initially developed by engineering as an early estimate tool. PCES appears to be somewhat cumbersome for right-of-way; however, it does address all areas of the right-of-way component. The system requires input for all of the cost areas of right-of-way to produce an estimate; therefore, it serves as a tool to ensure that all cost elements of right-of-way are considered. Estimators prepare an estimate in present dollars and the system automatically applies inflation. Screen captures of the estimating system are shown in Figures R2.8-1 through R2.8-3.

The Ohio Department of Transportation (ODOT) has a manual, "Cost Estimating Procedures for Acquiring Right of Way" (2300 Cost Estimation . . . 2007). The ODOT procedure focuses on right-of-way cost estimating for major projects and minor projects. This classification of projects is defined in ODOT project development process (PDP) procedures. Major projects have 14 steps. Right-of-way cost estimates are prepared at several of these steps. The first estimate is prepared



VDOT **Project Cost Estimating System** VDOT
RIGHT-OF-WAY ESTIMATE

Project & PPMS Numbers :
VDOT Construction District : #
Select Project Area Real Estate Costs : Average
Define Project Land Use Characteristics :
Agricultural :
Residential :
Industrial :
Commercial :
0%
Instructions: Please fill-in all applicable White Boxes or make a choice from the Drop-down Lists
Enter the Approximate Number of Parcels on the Project : <<
Select Computed or User Defined Costs : Computed Costs

1. LAND VALUE

Prop. Right-of-Way
Total Right-of-Way Project Length (ML + Connections) ft — Computed RW Cost per sq ft = $0.00 <
Average width of Existing RW ft — Enter Right-of-Way Estimator's Right-of-Way Cost per sq ft :
Average width of Proposed RW ft
Total area of all additional Prop. Right-of-Way sf — 0 sq ft = 0.000 Ac
Approx. % of Prop. CL within ft of Exist. CL (Total
Approx. % of Prop. CL between ft & ft of Exist. CL Must =
Approx. % of Prop. CL greater than ft from Exist. CL 100%)

Temp. Ease.
Average Width of parallel Temporary Easements Left ft — Comp. Temp. Ease. Cost / sq ft = $0.00 <
Total Length of parallel Temporary Easements Left ft — Enter Right-of-Way Estimator's Temp. Ease. Cost per sq ft :
Average Width of parallel Temporary Easements Right ft
Total Length of parallel Temporary Easements Right ft — 0 sq ft = 0.000 Ac

Perm. & Util. Ease.
Total Area of All Replacement Utility Easements sf — Comp. Utility Ease. Cost / sq ft = $0.00 <
AND Select % of RW Cost for Util. Ease. — RW Est's. Utility Ease. Cost per sq ft :
OR — 0 sq ft = 0.000 Ac
Total Number of Replacement Easements Required ea — Comp. Perm. Ease. Cost / sq ft = $0.00 <
RW Est's. Perm. Ease. Cost per sq ft :
Total area of All Permanent Easements sf — 0 sq ft = 0.000 Ac

COST OF LAND (Item # 1) $0 (Computed Costs)

2. BUILDING VALUE

Based upon comparison to similar, occupied **Residential Dwellings** in the Project Area, enter the Number of: Computed
A. Low Cost Residential Dwellings : $0
B. Moderately Low Cost Dwellings : $0
C. Average Cost Residential Dwellings : $0
D. Moderately High Cost Dwellings : $0
E. High Cost Residential Dwellings : $0
Computed Total Residential Dwelling Costs : $0 <
Estimator's Total Residential Dwelling Costs :

Enter the total estimated cost of ALL COMMERCIAL & INDUSTRIAL BUILDINGS to be taken:
Note: No Computed Costs Available. Use User Defined Costs Below:
Estimator's Total Commercial / Industrial Buildings Costs : <<

3. OTHER IMPROVEMENTS

Enter the estimated cost of ALL OTHER IMPROVEMENTS on the Project:
Computed Total Other Improvements Costs : $0 <
Estimator's Total Other Improvements Costs :

4. DAMAGES

Anticipated % of Parcels Affected by Damages to Remainder
Anticipated Relative Cost Impact of Damages to Remainder : Moderately High
Approximate Number of Parcels Affected : 0
Computed Cost of Damages to Remainder : $0 <
Estimator's Total Cost of Damages to Remainder :

TOTAL ACQUISITIONS (Items # 1 - 4) $0 (Computed Costs)

Figure R2.8-1. Screen capture of VDOT's cost estimating system (PCES).

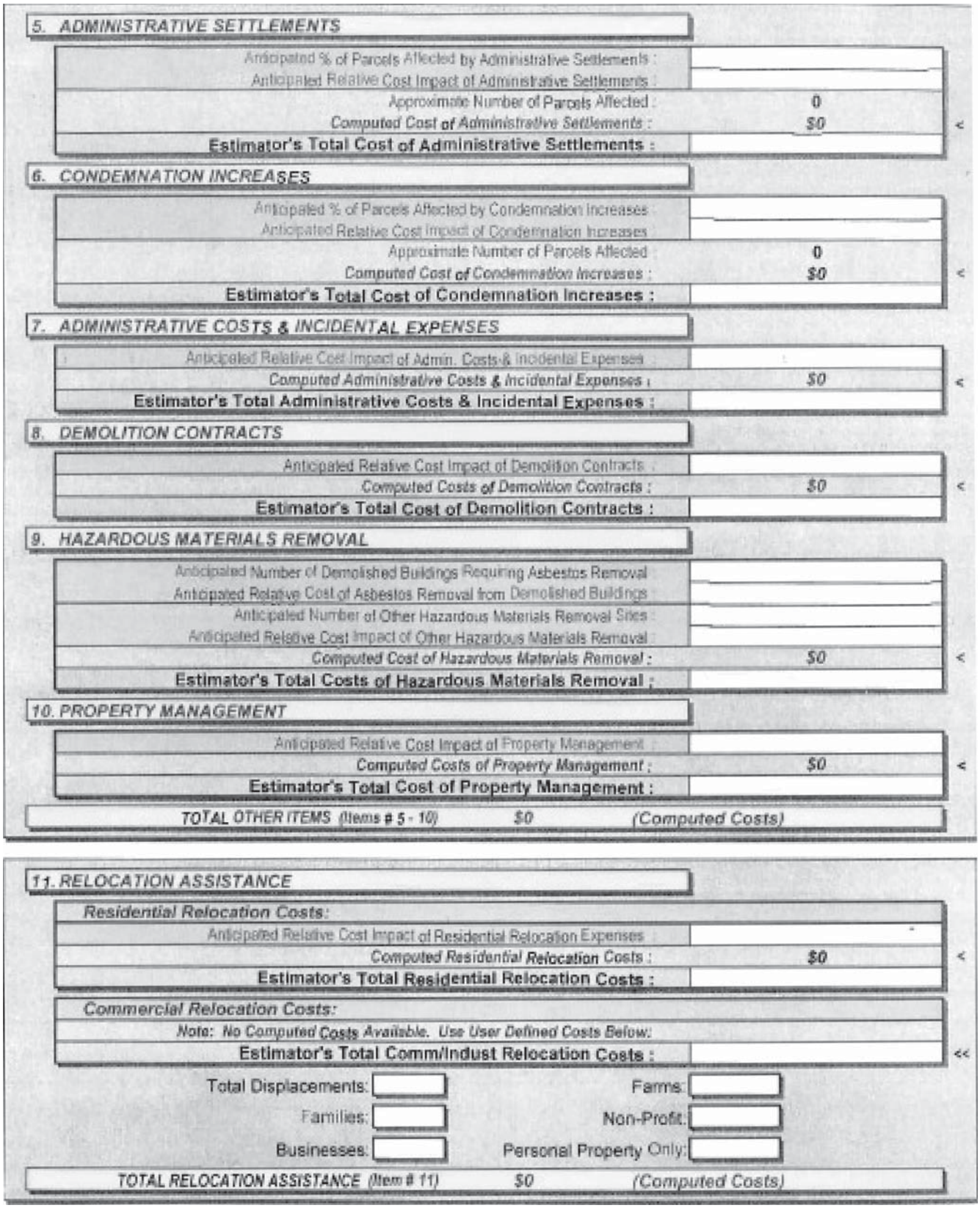


Figure R2.8-2. Screen capture of VDOT's cost estimating system (PCES).

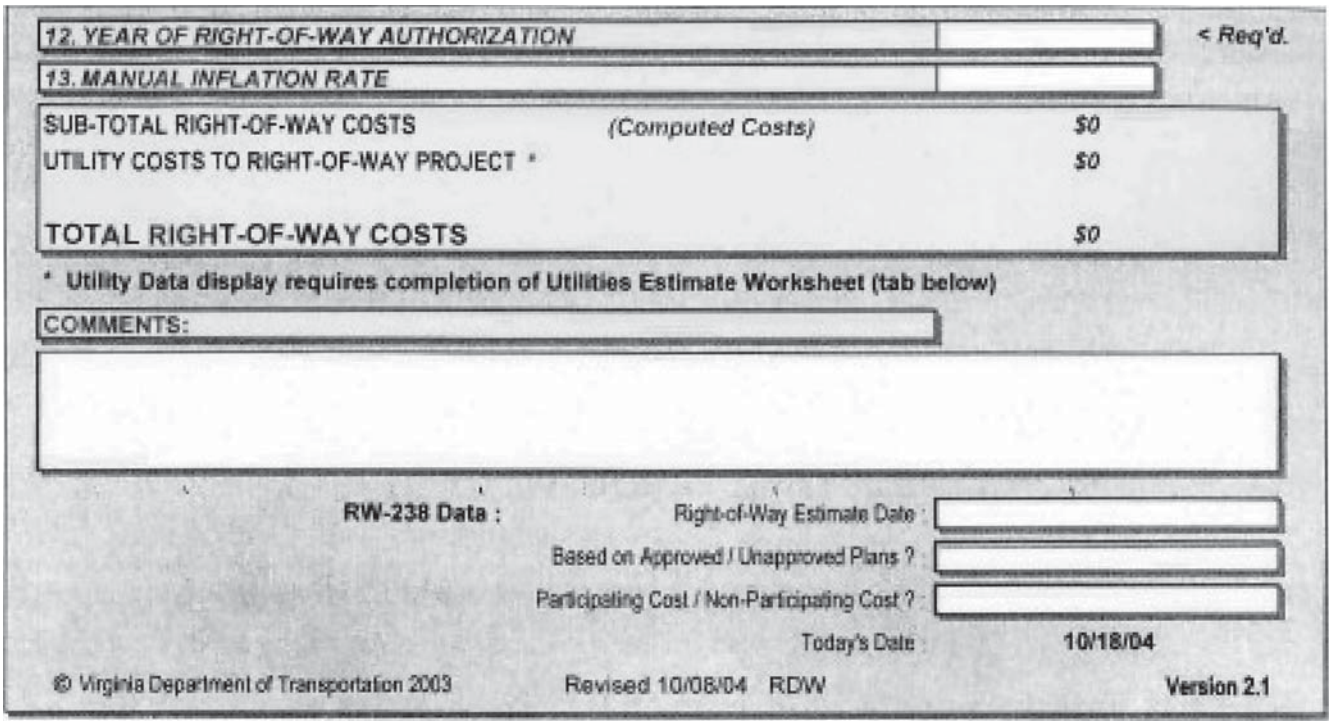


Figure R2.8-3. Screen capture of VDOT's cost estimating system (PCES).

to coincide with the first PDP step. Subsequent right-of-way estimates are updated based on the first estimate. The level of detail regarding right-of-way requirements increases as the PDP steps are performed. Multiple updates of the right-of-way estimate are prepared to support alternative selection, for example. On minor projects, fewer right-of-way estimates are prepared because the alignment is not subject to alternative analysis. Similar estimating approaches are followed. In general, right-of-way cost estimating techniques are discussed and the use of supporting information is identified. Cost values are provided for many estimate elements. An estimate form is used to capture all costs and summarize costs for a total right-of-way estimate. This estimate form is shown in Figure R2.8-4.

California DOT (Caltrans) has developed an in-house electronic spreadsheet for right-of-way estimation. This software is easy to use because the templates for the input of data are available at every stage of the estimation process. The data acquired from the field survey are used as input for the calculations. The electronic spreadsheet used by Caltrans for right-of-way estimate has many information and data entry sections. The most important of these are the instructions (Figure R2.8-5), information about data available, mitigation, railroad, utilities, USA land information, mitigation details, and reports.

The instructions page includes all the technical information required at various levels of the estimation process. The instructions tab gives information about how to use the spreadsheet; this gives the spreadsheet user flexibility in creating the estimate. Even a less experienced estimator can read the instruction and create an accurate right-of-way estimate for Caltrans.

The "Basic Input" sheet (Fig. R2.8-6) is a template for entering the basic project information. This would include the project description, extend, project number, details of the maps acquired, name of the estimator, type of work, and contingencies of the project. The information entered in this tab is used by the spreadsheet as the title information and descriptive data displayed on reports.

PID 24334 County PAU Route US 24 Section 0.00 This R/W Acquisition cost estimate is prepared for Alternative Preferred Allignment

Macro View

Acquisition	Unit (SF) or (Acreage)	X	Cost/Unit ($$/SF) ($$/Acre)	Subtotal Land Value	+	Structure Values (if Taken)	+	Damages (Loss in Value to the Residue)	Subtotal Structures & Damages	=	Total Non Labor Acquisition Costs	Attributes: Parcel Count	Total Takes	Partial Takes	No. of Structures Impacted
-Residential	12	X	7,700		+	1,244,500	+			=	1336900	12	3	9	12
-Commercial	.063	X	7,450		+	10,500	+			=	10,969	1	0	1	0
-Industrial	1	X	10,000		+		+			=	10,000	1	0	1	1
-Agricultural	498.5	X	2,500		+		+			=	1,246,250	74	0	74	0

Relocation	Unit (Displacement)	X	*RHP/*RSP	+	Move Cost	+	Reestablishment	=	Total Non Labor RAP Costs
- Residential									
Owner Occupant	12	X	$34,000	+	$ 6,000			=	480,000
Tenant	0	X	10,000	+	1,750			=	0
- Commercial/Farm/NPO									
Owner	1			X	$15,000	+	$10,000	=	25,000
Tenant	0			X	15,000	+	10,000	=	0
- Personal Property	1			X	$ 1,000			=	2,000

Estimate amount of time necessary to relocate all RAP parcels = (months)_____

Estimated number of years until project wide R/W acquisition begins = _____

[(total of acquisition cost) x 0.90] x 0.025] + [(total of acquisition cost) x 0.15] x 1.20] +[(total of acquisition cost) x 0.10] x 1.50] = Contingency

Contingency (Incidentals, Admin. Review & Appropriation)	917,951
Total Non Labor R/W Costs	4,029,070

*RHP - Replacement Housing Payment
*RSP - Rent Supplemental Payment
*NPO - Non-Profit Organization

Instructions for Acquisition & Relocation Cost Estimates

Estimate the total number of acres involved in the project and allocate those acres into the four categories shown.

Assign an average unit price for each category. These unit prices are typically taken from the auditors tax card data. Cost Estimates prepared at Step 4 (Step 7 on Major projects) and thereafter must base unit prices on a project sales data book instead of tax card data.

Add structure values from the auditors tax cards only if the structures are taken.

Damages must be assessed by a pre-qualified expert with experience in Before & After analysis. This usually occurs at Step 4 for Minor projects (Step 6 on Major Projects) and requires some knowledge of the impacts of the project on structures.

Relocation Cost Estimates must consider the complexity of the move process. All move estimates that involve a business or a multi-tenant residential structure should use the services of a relocation Assistance professional to accurately gauge costs.

Macro View

Labor (External)	Unit (Parcels)	X	Unit Price	=	Total Cost
Titles	88	X	$ 400	=	35,200
Appraisal					
–Simple	30	X	$ 750	=	22,500
–Detailed	58	X	$4,500	=	261,000
Appraisal Review					
–Simple	30	X	$ 500	=	15,000
–Detailed	58	X	$2,000	=	116,000
Negotiations	88	X	$1,100	=	96,800
Relocations					
–Personal Property	1	X	$1,500	=	1,500
–Residential	12	X	$5,200	=	62,400
–Commercial/Farm/*NPO	1	X	$5,600	=	5,600
Closings	88	X	$ 400	=	35,200
Project Management	88	X	$ 550	=	48,400
Asbestos Testing & Abatement		X		=	
	Total Labor Costs				699,600

*NPO=Non-Profit Organization

This R/W Cost Estimate Prepared by	Date
R.K. O'Grady H. Norton	9/26/2004

This R/W Cost Estimate was performed at Step 9 of the PDP

for Major Projects using Preliminary R/W Plans

Total Labor Costs	699,600
Total Non Labor R/W Costs	4,029,070
Inflation Adjustment	
Total R/W Costs	4,728,670

P.D.P. R/W Cost Estimator

Instructions for Labor Cost Estimates

Labor costs are a function of time, distance and talent. Labor costs estimates should reflect the complexity of the project and the talent necessary to acquire the right of way in a timely manner. The person making the cost estimate may adjust the figures given for the particular project being estimated to reflect local labor costs. It is critical that the estimate be labeled to reflect the alignment alternative, the step in the PDP process and the person(s) performing the estimate.

Comments

Figure R2.8-4. Ohio DOT estimating sheet.

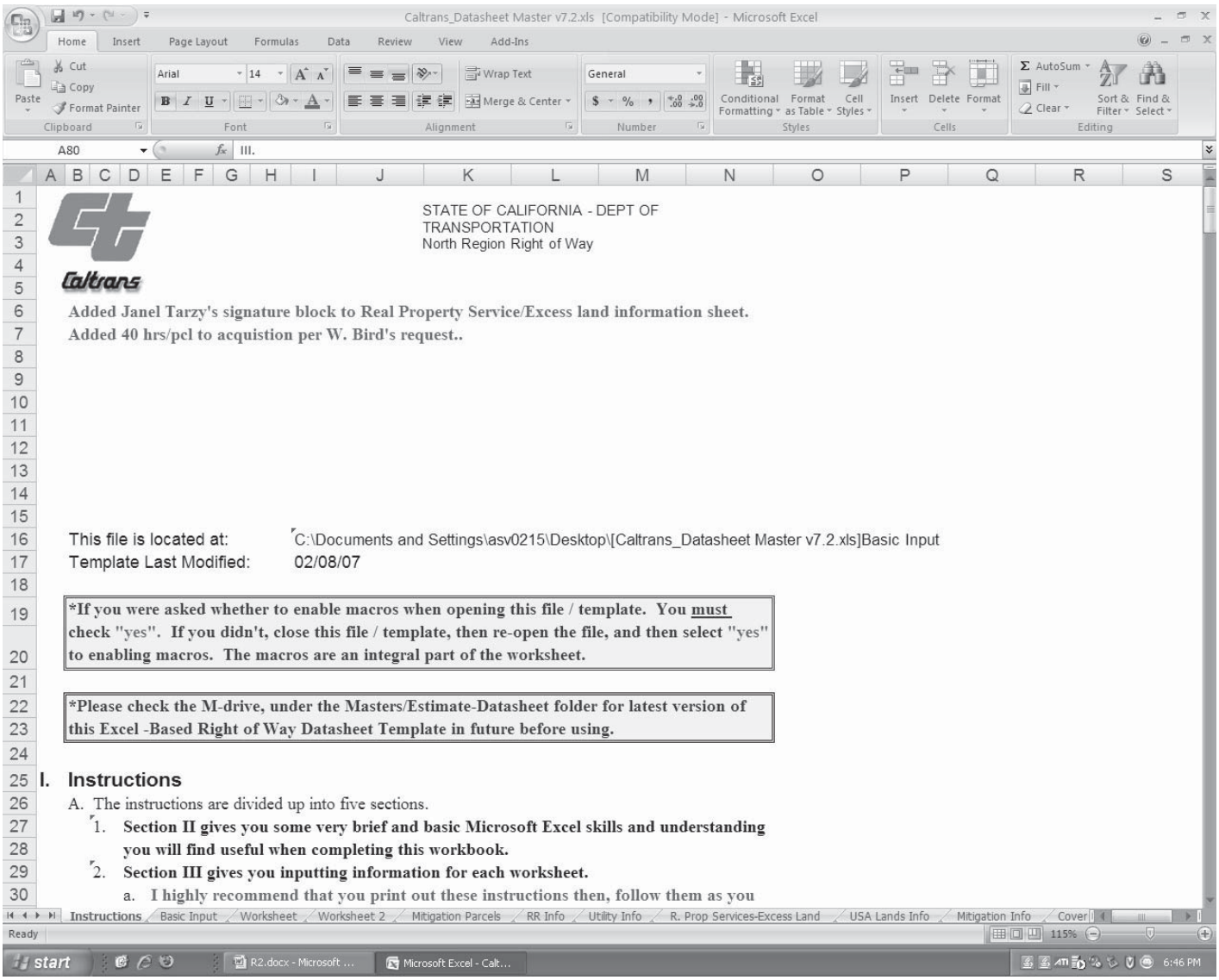


Figure R2.8-5. Caltrans electronic spreadsheet for right-of-way estimating.

The "Worksheet" tab (Fig. R2.8-7) is where the data acquired from the field visits are entered. These data are used in the calculations of real estate cost. The details of input include items such as the type of parcel, parcel number, the estimated cost, relocation assistance program cost, demolition cost, and appraisal fees. This worksheet is also used to enter the escalation rates and environmental permits.

Additional tabs include details about railroads in the right-of-way, utilities in the right-of-way, and rentable properties. The mitigation details about some parcels can also be entered in the Mitigation information tab. From these data input, the worksheet automatically prepares the data sheet and the cover letter. Figure R2.8-8 shows a data sheet from the Caltrans electronic spreadsheet.

The output of the right-of-way estimate is printed and sent to the team leader for review. If changes are recommended, they can easily be entered into the spreadsheet.

The Florida DOT has two spreadsheets that are comprehensive in terms of right-of-way cost estimating. One spreadsheet, Right of Way Long-range Cost Estimate, has three tabs and is used

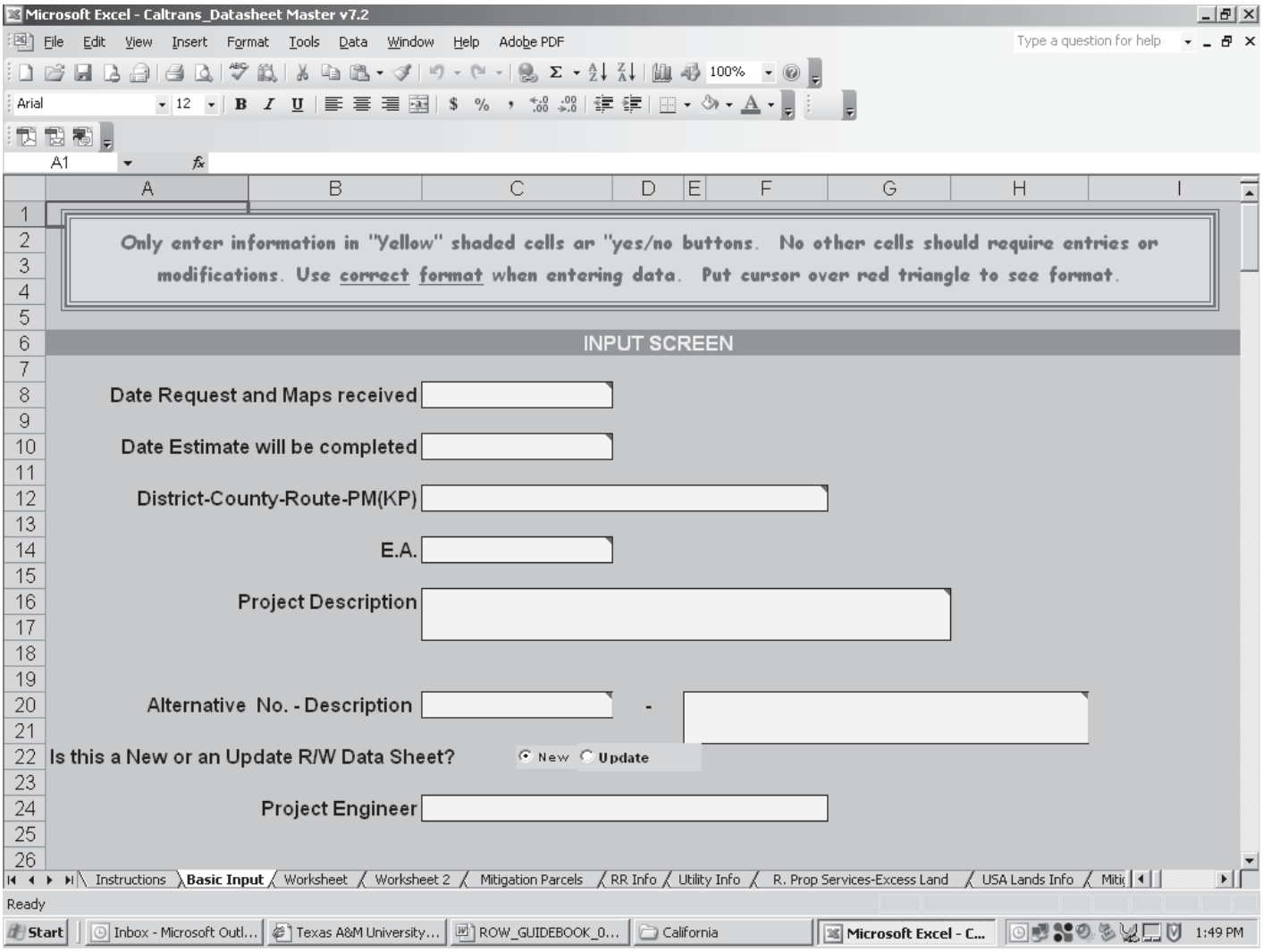


Figure R2.8-6. Basic input sheet for the Caltrans right-of-way electronic spreadsheet.

to support planning right-of-way estimates. It does require an estimate of the total number of parcels. Historical cost data are included on a Factor Sheet where the cost estimate is generated automatically based on key inputs. The second spreadsheet, Right of Way Work Program Cost Estimating Software System, has nine tabs. The program is based on individual parcel input and impacts to each parcel. Cost data are also provided, either through historical information or current inputs. This spreadsheet also has a tab that helps track estimated costs of a parcel versus acquisition costs. The spreadsheet is very comprehensive in its treatment of right-of-way cost estimates.

Tips

Entering data in the electronic spreadsheet can sometimes be confusing and hence the data should be checked to avoid unexpected errors. Spreadsheet calculations should be verified. The right-of-way estimate must be able to override cost data embedded in the program.

Resources

Virginia DOT—Contact Virginia DOT to obtain further information about the PCES program: http://www.vdot.virginia.gov/default_noflash.asp

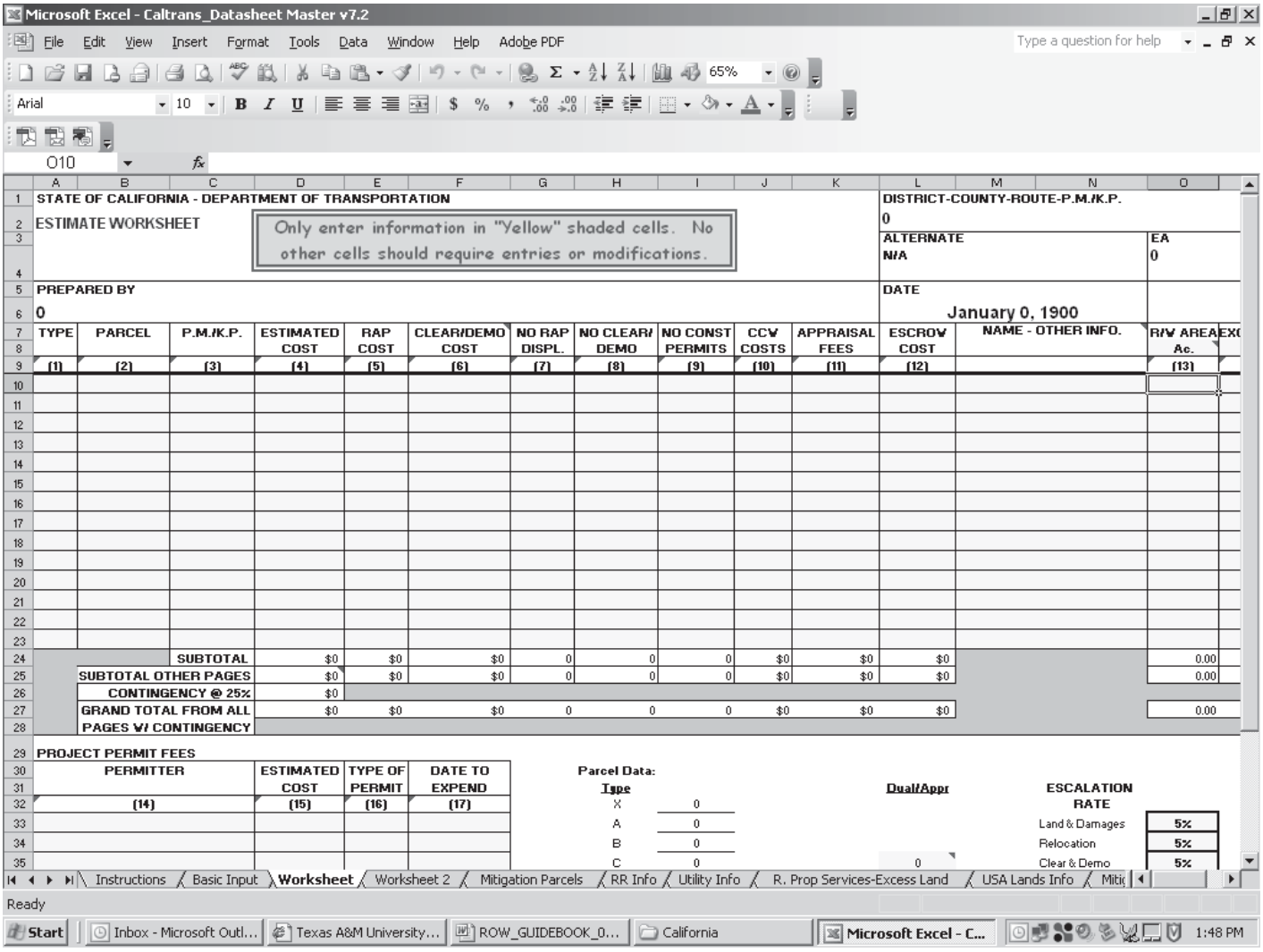


Figure R2.8-7. Worksheet for the Caltrans right-of-way electronic spreadsheet.

Ohio DOT: http://www.dot.state.oh.us/real/—Click on Manuals & booklets, Click on 2300, Cost Estimating Procedures for Acquiring Right of Way under 2000 Series.

Caltrans: Right of Way Engineering, http://www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf on Estimating.

Florida DOT: "Right of Way Long Range Cost Estimate (Estimate_LongRange_Version_4.xls)" and "Right of Way Work Program Cost Estimating Software System." The FDOT Office of Right of Way is located at: http://www.dot.state.fl.us/rightofway/default.htm

R2.9 Formal Database

Historical bid based estimation is the most common type of cost estimation used by SHAs. This approach relies on data from previous work. SHAs typically have databases that store historical acquisition and other costs information. Many SHAs have internally developed software that allows an estimator to selectively sort and analyze historical cost data before assigning cost to real estate estimate elements and assembling a project or program estimate. Although such databases are common for construction work items in many SHAs, they are not as sophisticated in the right-of-way cost estimating area. There is a need for a cost database that can provide historical cost

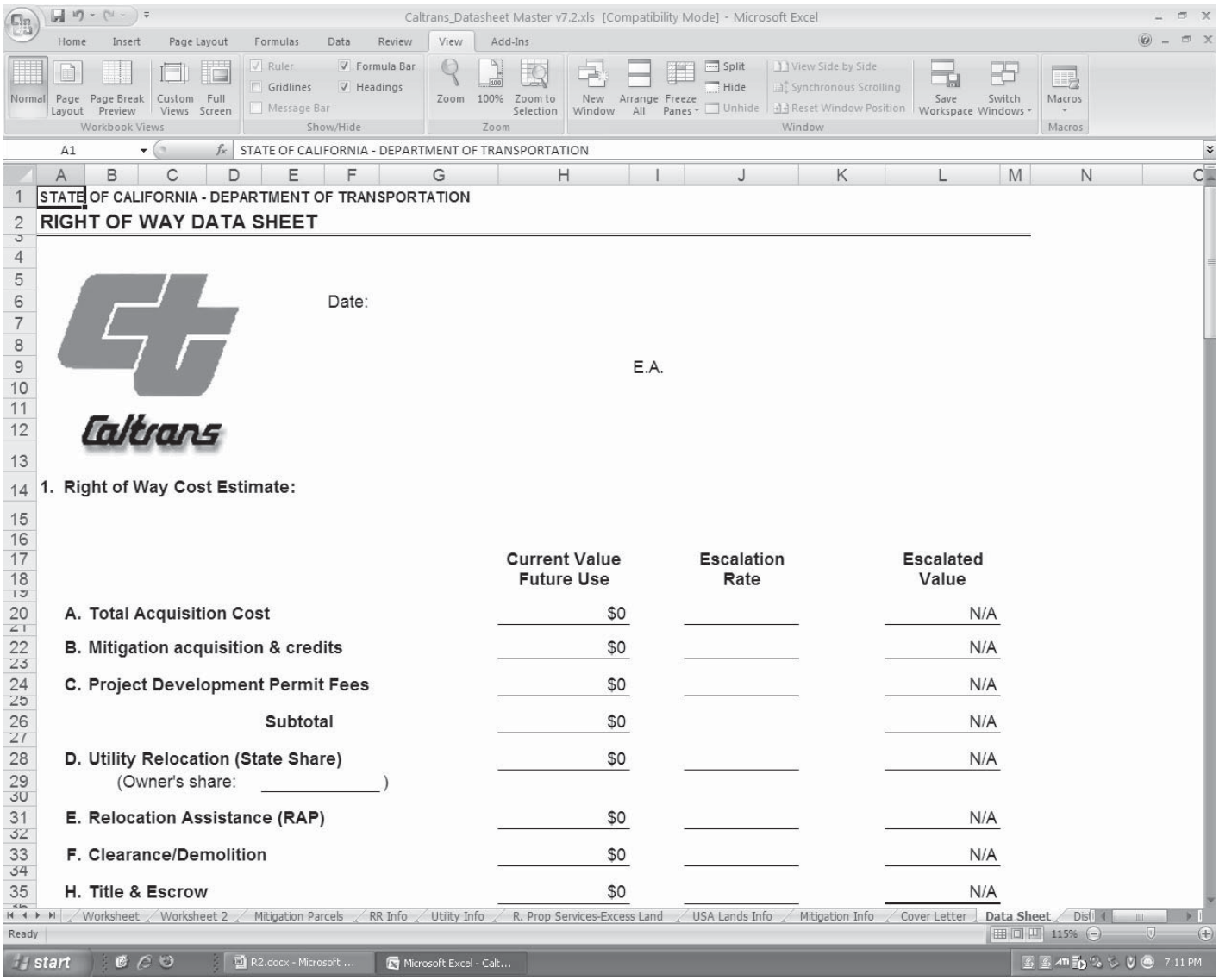


Figure R2.8-8. Data sheet from the Caltrans right-of-way electronic spreadsheet.

data to support the assignment of cost to certain right-of-way cost elements. Such databases may be particularly helpful when creating estimates early in the project development process.

What Is It?

In general, a right-of-way database is a tracking system containing information on individual real property parcels. The system provides a means for assembling and retrieving parcel information easily. Right-of-way functional areas are usually conducted by the different functional divisions within the SHA, including but not limited to the Division of Real Estate, Land Management, Mapping and Surveying, and Right of Way. A database can ensure that all parties are using the same and most current information. When the database is tied to a geographic information system (GIS), a software Data Query feature of GIS can be used to identify parcels and their associated attributes (including owners and their contact information) located within established rights-of-way and to create output files of affected property owners to be contacted for Property Acquisition negotiation.

The database provides users with statewide historical and parcel information and can be used to review recent comparable sales, for predicting possible inflation rates and condemnation rates, or to analyze other right-of-way–specific parameters and/or statistics. Instant access and availability of the forms, reports, and data contained in such databases are major advantages of these systems, particularly when managing costs during parcel appraisal and acquisition actions.

Why?

Right-of-way estimators use historical data to estimate various cost elements of a right-of-way action. When preparing estimates using historical data, it is important to have all the data ready available and structured in an easy-to-access format. Hence, the development of a formal database is an important support tool for estimation of right-of-way cost. The easily accessible data assist estimators, and project management is available to conduct studies of previous rights-of-way costs and to structure improvements in the estimation process. The database also helps to maintain and track actual expenses incurred as real estate is evaluated and purchased. The staff retirements or even changes in right-of-way staff within an agency usually mean the loss of corporate knowledge. By implementing a database system, the history of right-of-way acquisitions and utility relocations and adjustments can be easily referenced or queried.

What Does It Do?

A formal right-of-way database is a structured collection of information from right-of-way actions. Details portrayed in a database might include the status of a project, estimated costs, active estimates, construction limits, details of permits and, when integrated with a GIS, site environmental and contaminated can be shown graphically. The database probably would store information about individual real estate parcels acquired, including information such as parcel maps, contacts, and cost of the parcel as well as condemnation and mitigation details. This type of database provides information for the users, which is critically important during the appraisal and acquisition process and is very helpful when preparing future cost estimates. Special cases of right-of-way acquisition can be studied by users to gain valuable information and experience. The database provides the information necessary for the preparation of cost comparison tables and can improve accuracy of a project cost forecast.

Commercial database systems are available that track

- **Property ownership** and encumbrances
- **Title information,** name of owners and other contacts
- **Easement acquisition** across properties along the route of a right-of-way
- **Permission to enter** properties for civil surveys and other land studies (e.g., environmental, cultural, wetlands, and endangered species)
- **Permit acquisition** from local, county, state, and federal agencies
- **Relocation assistance efforts**
- **Damage claims**
- **Special instructions and provisions** which must be observed in crossing the properties
- **Legal rights** obtained from the easements (i.e., due diligence)
- **Document maintenance** for due diligence
- **Contact with owners** and other interested parties

When?

Currently, most right-of-way databases are used to track real estate appraisals and acquisitions. In this capacity, the database probably would be used during the final design phase of project development when right-of-way cost management is performed. However, the information within such as database can support the preliminary design phase of project development when cost estimate updates are being prepared and especially when a parcel-by-parcel estimating approach is used.

Examples

Minnesota DOT: A ROW tracking system has been developed by the Minnesota DOT (MnDOT) identified as the Right-of-Way Electronic Acquisition Land Management System (REALMS). At this time, REALMS capability only includes cost reporting and tracking of each parcel from appraisal through acquisition. It is not used as a cost estimation tool, but offers the potential to provide a source of recent historical data and market trends for land values. REALMS does track condemnation rates and costs. For example, data over the past 5 years indicate that 24 percent of the parcels in Minnesota have proceeded to condemnation with an average cost that is 58 percent over the appraisal price.

REALMS software provides easier access to historical data and supports right-of-way acquisition, utility relocation, and cost adjustments. MnDOT wants all their employees to use REALMS as it improves not only right-of-way cost estimation but provides historical data from previous projects. REALMS acts as a source of information for all personnel in the MnDOT system. Historical data are now available on every employee's desktop and hence reviewing and understanding right-of-way projects has become easier with this single authoritative source of information. REALMS has a provision for data storage from the initial planning phase to the final design which provides a complete overview of the project.

Virginia DOT: The Right of Way and Utilities Division (RW&U) and VDOT wanted software that would provide leaders with a single, comprehensive view of project and land parcel status and enable them to track key dates efficiently. The Right of Way and Utilities Management System (RUMS) was developed as a tool to track the acquisition process on a project-by-project basis. RUMS supports the right of way and utilities business from the estimate stage through condemnation by tracking evaluations, negotiations, legal functions, the relocation of families and businesses, disposition of improvements, the execution of utility easement agreements, and the relocation of utility facilities. Additionally, it is used in the management and disposition of surplus/residue properties and in managing consultant contracts. RUMS replaced a mainframe system that was awkward for the users. Ad hoc reporting using this legacy system was difficult to produce, resulting in lost time and an increased chance for errors. Moreover many RW&Us functions were not being tracked. Modifying the legacy system was becoming more difficult and limited. RUMS enables employees of VDOT and its agents to manage their work efficiently, thereby meeting critical project advertisement dates. Through an innovative graphical user interface design, which uses business-intelligent icons, RUMS enables management at all levels to quickly determine project statuses at-a-glance and make informed business decisions. Not only can users quickly assess whether projects are in danger of missing the advertisement date, but also which parcels and/or disciplines are causing the delay. Formal reports complement the at-a-glance features of RUMS by providing more detailed status information, while powerful ad hoc reporting features empower the users in their business analysis.

While RUMS provides management-level employees with real-time project status, the system supports the business of right-of-way by enabling the end users to manage their workflow. All pertinent right-of-way data are tracked and contribute to VDOT's ability to drive their business through informed decisionmaking. Furthermore, RUMS provides assignment-tracking through the entire business process, enabling users to track, manage, and perform their work within the same software tool and enabling management to determine how the workforce is being used. The system includes a document management feature whereby forms and letters are generated and stored. Forms and letters are pre-populated by date from RUMS, eliminating the time and errors associated with data duplication. Upon completion, the forms and letters are retained in the system's database and are readily available for viewing by all with appropriate access rights.

The system was designed using the input of field personnel and their knowledge of the workflow. The ideas of the people in the field were incorporated and continue to be incorporated to make this system work for them. RUMS was designed to be their workhorse and the backbone of the day-to-day right-of-way process. RUMS supports the following:

- Improved work flow and expedited processes,
- A repository of forms and letters that pre-populates repetitive data,
- An intuitive interface that highlights critical dates,
- Ease and flexibility for data searching and filtering,
- Ad hoc reporting capabilities,
- Formal reporting capabilities,
- Valuation history of parcels,
- Contextual assignment tracking, and
- Web-based reporting capabilities.

Utah DOT: The Utah DOT (UDOT) Right-of-Way Division has an Electric Project Management (ePM) Right-of-Way Tracking program. This database tracks reports for current and past right-of-way projects. Searches can be made by owner, project number, parcel number, and other project attributes. Data can be exported to create Microsoft Excel spreadsheets and imported into Microsoft Project for project scheduling purposes. The system shows the ownerships that have been cleared for construction, those in condemnation, and those in the process of relocation.

Envisioned electronic enhancements to the systems include the ability to store electronic appraisals and generate relocation documents, deed descriptions, and project drawings for each property within the right-of-way database. Eventually, the UDOT Document Management (DM) system will be linked to the ePM Right-of-Way Tracking program.

New Hampshire DOT: The New Hampshire DOT (NHDOT) has developed a Risk Assessment and Site Characterization for Appraisal of Land (RASCAL) system to facilitate the collection and management of data for contaminated sites it proposes to acquire for transportation purposes. This web-based system integrates personal digital assistants (PDAs), global positioning systems (GPS), and digital cameras for rapid contamination data collection. The data are uploaded to a database that interacts with other databases (e.g., right-of-way databases) to eliminate data redundancy and are easily accessible through the web site. This accessibility allows consultants to access the database from outside the NHDOT firewall. The collected data automatically rank the contamination risk threshold for each site and flag key issues. The data are also used to generate cost estimates for remedial action, for use in determining property values during the right-of-way appraisal process. Reports can automatically be generated from the database. RASCAL reduces field time, standardizes data collection and reporting, and provides NHDOT with more accurate and more easily retrievable data, which allows for prioritization of sites for remediation. It is intended that this approach to data collection and management will be applied to other environmental disciplines in the future (e.g., historic resources and wetlands).

New Jersey DOT: The Department began a Right of Way Database/Document Management System project in FY 2008. That project will update the existing Access database with a system approved and supported by the Department's Division of Information Technology. This "next-generation" system will have scheduling, document production, management control, GIS, and extensive reporting capabilities. All information of the proposed system has been presented to Information Technology and has the advocacy of CPM's senior management as well as the Department's Office of the Inspector General.

The New Jersey DOT uses its current database to track the progress and status of cases during condemnation. The progress and status of each new case, amendment, withdrawal and/or

additional deposit is tracked via the Right-of-Way Database. Proper and timely maintenance of the database facilitates the generation of reports that detail the progress in processing cases to final judgment to management. The database aids the Department in ensuring that property acquired through condemnation is secured by established right of way availability dates.

Tips

Right-of-way estimation is complicated and estimates must be created during all phases of project development. From the conceptual phase to the final design phase, the parcels of land to be acquired may change with the change in project design and route. A database of previous projects forms a learning foundation and makes it easier to cost when historical data are available. The increasing ability to access the data increases the accuracy and speed of right-of-way estimation. Right-of-way estimation and acquisition is subjected to changes until the completion of construction.

Database software should be linked with the estimation software and compatible with sources of GIS data. New GIS tools allow earlier input of right-of-way data to aid in project decision-making. New technology that allows web-based systems to be developed while incorporating state-of-the-art aerial and 3-D stereo imagery is available (GIS in Right of Way Scan, Tallahassee, Florida: www.fhwa.dot.gov/realestate/scans/talafreport.htm)

Resources

"Cashing In" about the development of VDOT's RUMS database can be found at www.govtech.com/gt/print_article.php?id=92321

Minnesota DOT, "REALMS for Dummies: Workbook." Right of Way Acquisition, January 1, 2007.

Although not specifically done for right-of-way purposes, the *Portage County Land Information Modernization Plan 2005–2010* has a good discussion of database components. (http://www.doa.state.wi.us/docview.asp?locid=9&docid=6037).

A presentation on the integration of a right-of-way database with GIS resources can be found at http://www.fhwa.dot.gov/realestate/scans/talafreport.htm#sess4. This presentation shows the methods used to view and query properties of interest and overlay them with other informational layers (e.g., aerial photography, wetlands, and land use).

R2.10 Purchase Values Database

Producing accurate right-of-way cost estimates and managing real estate acquisition cost can be challenging. Usually programming and even planning right-of-way estimates which are developed years before real estate acquisition are based on gross definitions of right-of-way requirements. The second issue in developing an accurate forecast of right-of-way cost once acquisition begins is that, in many cases, management is a secondary task to purchasing property and there is limited time to prepare the forecasts. Time constraints restrict the development of accurate forecasts of cost once acquisition begins. Therefore, managers need structured databases of the actual cost of acquired right-of-way parcels that permit easy development of cost forecast based on the estimate and completed acquisitions.

What Is It?

This is a real estate activity database that includes information on property location and spatial dimensions, improvements, year of construction, and most important the agency's actual cost to acquire. Properties should be coded into land use classes. These classes may match codes used by Appraisal Districts. If the database has a geographic information system (GIS) component, it is possible to unite comprehensive maps with ownership, value data, and experienced cost to acquire.

Why?

Property owners must be treated fairly where real property is taken for project right-of-way. Therefore, determining "just compensation" is a major component of estimating the cost of right-of-way. Just compensation means that the estimate reflects the fair market value for the real estate taken. Comparable sales data for determining the fair market value may be obtained from appraisal districts, title companies, private appraisers, and/or online data services. Such data are used to create the right-of-way cost estimate. Additionally, once acquisition begins, it is possible to create a more accurate forecast of the final cost to purchase the right-of-way if actual costs are substituted for the fair market values used in the estimate.

Collecting data and forecasting can be performed independently for each estimate. Independently collecting data is common practice in many SHAs. In this case, the information resides with the individual estimator when it would be better to have a managed database structured for easy retrieval of data that supports forecasting and which can be used to develop future estimates.

What Does It Do?

This database provides the managers of project right-of-way activities with a structured source of easily retrievable data on actual real estate cost as experienced by the agency. It is not the fair market value, which is defined as the price that a willing buyer will pay a willing seller for a piece of real estate. Fair market value data are used to develop right-of-way estimates. This is a record of actual cost experienced by the SHA. This actual cost data facilitates development of cost forecasts as acquisition proceeds. By analyzing the actual cost record, management can update the cost estimate—make a forecast–and act to control project cost.

When?

During acquisition, the purchase cost data residing in this database are use to make forecast of the total dollar expenditure to acquire all of the right-of-way needed for a project. It is a management tool for controlling and assessing acquisition and for gauging the accuracy of right-of-way estimates.

Example

TXDOT and other SHAs have right-of-way information systems that include maps, costs, and parcel detail for their projects. This Purchase Values Database can be a subpart of these existing systems or much simpler database software can be adapted specifically to the needs of an SHA right-of-way section.

Tips

Information Technology (IT) personnel can create onscreen forms to facilitate data entry and establish input controls to increase the likelihood that data are entered correctly. In some agencies, personnel stated that using databases could be difficult and frustrating. Therefore, it is important that right-of-way personnel have a voice with IT when the software is developed to make the system user-friendly. It is also necessary that the department provide training on the use of such systems. If the software that supports the database is not user-friendly, personnel will revert to compiling information independently. Such a practice wastes time that should be dedicated to gaining a better understanding of the factors affecting the cost of individual parcels.

Commercial database software is available that is currently used by businesses and government organizations.

System controls can increase the likelihood that personnel enter accurate and complete data. It maybe necessary to restrict who may enter data into specific fields or to require that data entry meet established criteria.

Resources

Data to populate such a database come from actual acquisitions but sheets similar to those used for making evaluations can serve to collect the raw data. See Ohio DOT Condemnation Appraisal data sheet (Fig. R2.8-4) or information at: www.dot.state.oh.us/real/pdf/appraisal/4100%20Managing%20the%20FMVE%20Delivery%20Process.pdf

R3 Risk Analysis

Risk management is concerned with future events, whose outcome is unknown, and how to deal with uncertainties by identifying and examining a range of possible outcomes. The objectives are to understand risks and mitigate or control risks. Understanding the risks inherent with each potential project alternative is important to controlling cost and developing estimates that reflect the cost of accepted risks.

Risk management and an understanding of project uncertainty will assist estimators in setting appropriate contingencies for each individual project. This understanding is important to managers of estimation processes. Cost estimation is one tool in a comprehensive risk management process. In the broader context of project risk management, risk analysis is the second step in a comprehensive risk management process that includes the following:

- Risk identification,
- Risk analysis (qualitative and/or quantitative),
- Risk mitigation planning, and
- Risk monitoring and control.

During the development of this Procedures Guide, NCHRP was developing a Guidebook on Risk Analysis Tools and Management Practices to Control Transportation Project Costs (NCHRP Project 8-60). The goal of that effort was to develop a comprehensive guidebook on risk-related analysis tools and management practices for estimating and controlling transportation project costs. When complete, the NCHRP 8-60 guidebook will provide more detailed tools and techniques for risk identification and risk management. The readers of this Procedures Guide are encouraged to review the completed NCHRP 8-60 guidebook for more information on risk-related estimating issues.

R3.1 Analysis of Risk and Uncertainty

Analysis of risk and uncertainty involves quantifying identified risks. In a comprehensive risk management process, risk analysis is used to prioritize the identified risks for mitigation, monitoring, and control purposes. In the context of cost estimation, risk analysis can be extremely helpful for understanding project uncertainty and setting appropriate contingencies. Risk analysis can be accomplished through qualitative or quantitative methods.

What Is It?

In the context of cost estimation, this tool quantifies project risk and uncertainty to provide a better understanding of contingency and the ultimate project cost. It involves evaluation of risks in terms of their likelihood of occurrence and their probable consequences. Likelihood of occurrence and the associated consequences can be expressed qualitatively or quantitatively. If risks can be quantified, they can provide for a better understanding of project uncertainty and assist in the cost estimation management process.

Risk analysis can be performed through qualitative or quantitative procedures. In a qualitative analysis, the project team assesses each identified risk for its probability of occurrence and

its relative magnitude of impact on project objectives. Often, experts or functional unit staff assess the risks in their respective fields and share these assessments with the project team. The risks are then sorted into high-, moderate-, and low-risk categories (in terms of time, cost, and scope). The objective is to rank each risk by degree of probability and impact. The rationale for the decision should be documented for future updates, monitoring, and control.

Quantitative risk analysis procedures employ numeric estimates of the probability that a project will meet its cost and time objectives. It is common to simplify a risk analysis by calculating the expected value or average of a risk. The expected value provides a single quantity for each risk that is easier to use for comparisons. Although this is helpful for comparisons and ranking of risks, estimators must take care when using the expected value to calculate project costs or contingencies. For example, if there is a 20-percent chance that a project will need a $1 million stormwater upgrade, the estimator will include $200,000 in contingency using the expected value. If the stormwater upgrade is required, this value will not be enough. Unfortunately, a great deal of information is lost in this oversimplified contingency analysis. More comprehensive quantitative analysis is based on a simultaneous evaluation of the impact of all identified and quantified risks. The result is a probability distribution of the project's cost and completion date based on the risks in the project. Quantitative risk analysis involves statistical simulations and other techniques from the decision sciences. Tools commonly used for these analyses include first-order second-moment (FOSM) methods, decision trees, and/or Monte Carlo simulations.

Why?

Highway project delivery, particularly the estimation of right-of-way cost, is a complex task heavy with uncertainty. Traditional methods of cost estimation often overlook risks or deal with them deterministically. Using the analysis of uncertainty and other risk tools in the cost estimation process has many advantages. The Federal Transit Administration's 2004 Risk Assessment Methodologies and Procedures cited several advantages:

- Better understanding of the project delivery process, including timelines and phasing, procedural requirements, and potential obstacles.
- More realistic estimates of individual component costs and durations, thereby allowing more reasonable expectations of total project cost and duration.
- Better understanding of what the project contingency is, whether it is sufficient, and for what it may need to be used.
- Information support to other project or agency activities, such as value engineering and strategic planning.
- Potential to improve the project budget and scheduling processes, possibly for the immediate project in development but certainly for future projects.

What Does It Do?

This tool quantifies the effect of potential risks in terms of their consequences to cost and schedule. It provides a systematic evaluation of project uncertainty, helps estimators in setting appropriate contingencies, and assists project managers in controlling project cost, schedule, and scope issues that can arise from uncertain or occurrence of risky events.

When?

Risk analysis can be used throughout the project development process. At the earliest stages of project development, risk analysis will be helpful in developing an understanding of project uncertainty and in developing an appropriate project contingency. As the project progresses, risk analysis can be used in a comprehensive risk management monitoring and control process to help manage cost escalation resulting from either scope growth or the realization of risk events.

Examples

Caltrans has documented a qualitative risk analysis procedure in its 2007 *Project Risk Management Handbook: Threats and Opportunities.* The Caltrans process is largely based on the Project Management Institute's 2004 publication, *A Guide to Project Management Body of Knowledge* (PMBOK Guide). The Caltrans handbook calls for a quantitative assessment of project risk items representing the highest degree of exposure. This quantification is important for updating the contingency amount to be included in the project estimate. Figure R3.1-1 shows the Caltrans risk ranking process, published as Appendix E of the handbook, as an example of a qualitative risk analysis method.

The Caltrans example demonstrates a sound process for qualitative risk analysis. The outcome of the qualitative analysis is typically a ranked list of risks that can be used as red flag items or in a risk register. Quantitative analysis typically begins in a way similar to the quantitative analysis describe above, but then applies a direct and more accurate assessment of probability and impact and incorporates these assessments into a probabilistic cost-risk model.

Appendix E: Risk Ranking

Using established methods and tools, qualitative risk analysis assesses the probability and the consequences (impact) of each identified risk to determine its overall importance. Using these tools helps to correct biases that are often presented in a project plan. In particular, careful and objective definitions of different levels of probability and impact are the keys to the credibility of the results.

▸ To rank risks by probability and impact:

For more information about risk ranking, see chapter 11 of the PMBOK.

Step 1: Set up a matrix to match a percentage (probability of risk) to a ranking number. Department project managers often use the matrix shown below, but they can set up a different matrix if it would better suit the project.

Risk Probability Ranking	
Ranking	**Probability of Risk Event**
5	60–99%
4	40–59%
3	20–39%
2	10–19%
1	1–9%

Step 2: Set up a matrix to match the objective (time, cost, scope, quality) to a defined impact. Department project managers may use the impact ratings shown in the following matrices for risks, but they can choose values other than those shown below if the Sponsor and the PM think it would better suit the project.

Impact matrices for threats and for opportunities follow:

Figure R3.1-1. Caltrans process of risk ranking.

Evaluating Impact of a Threat on Major Project Objectives						
Impact		**Very Low**	**Low**	**Moderate**	**High**	**Very High**
OBJECTIVE	**Time**	Insignificant Schedule Slippage	Delivery Plan milestone delay within quarter	Delivery Plan milestone delay of one quarter	Delivery Plan milestone delay of more than 1 quarter	Delivery Plan milestone delay outside fiscal year
	Cost	Insignificant Cost Increase	<5% Cost Increase	5-10% Cost Increase	10-20% Cost Increase	>20% Cost Increase
	Scope	Scope decrease is barely noticeable	Changes in project limits or features with <5% Cost Increase	Changes in project limits or features with 5-10% Cost Increase	Sponsor does not agree that Scope meets the purpose and need	Scope does not meet purpose and need
	Quality	Quality degradation barely noticeable	No safety issues, C, O, M deficiencies approved by project team	No safety issues, C, O, M deficiencies require District management approval	Quality may be made acceptable through mitigation or agreement (i.e. Fact Sheet)	Quality does not meet one or all of the following Safety, C, O, & M

Legend: C – Constructability, O – Operability, M – Maintainability

Evaluating Impact of an OPPORTUNITY on Major Project Objectives						
Impact		**Very Low**	**Low**	**Moderate**	**High**	**Very High**
OBJECTIVE	**Time**	Insignificant Schedule Improvement	Delivery Plan milestone does not improve but float is added	Delivery Plan milestone improves but still within the quarter	Delivery Plan milestone improves by 1 quarter.	Delivery Plan milestone improved by more than one quarter
	Cost	Insignificant Cost reduction	<1% Cost Decrease	1% - 3% Cost Decrease	3%-5% Cost Decrease	>5% Cost Decrease
	Scope	Scope effect is not noticeable	Improves chances to achieve project limits or features with cost increases of 10% or more	Improves chances to achieve project limits or features with cost increases of 5%-10%	Improves chances to achieve project limits or features with cost increases of 2%-5%	Improves chances to achieve project limits or features with cost increases of < 2%
	Quality	No quality improvement noticeable	C, O, M improvement noticeable by project team	C, O, M improvement can be seen and measured	Quality improvement can be claimed for the project	Quality improvement is "best in class"

Legend: C – Constructability, O – Operability, M – Maintainability

Figure R3.1-1. (Continued).

Step 3: Each identified risk is assessed based on its:

- Probability of occurring, rated 1 to 5 based on the Risk Probability Ranking table. The probability remains the same for all four objectives (cost, time, scope and quality) of a risk.
- Impact if it does occur, and is rated separately for each objective (cost, time, scope and quality) based on the Evaluating Impact of a Risk (threat or opportunity) on Major Project Objectives.

The output of this exercise is, for each risk, a probability and up to four (4) impacts corresponding to the objectives that the risk would impact.

Step 4: Create the Probability and Impact Matrix and choose which matrix layout is appropriate for each objective.

The output from Step 3 is combined to determine whether the activity is high risk (RED), moderate risk (YELLOW) or low risk (GREEN) for each objective. Establish a PxI Matrix for each main objective that reflects project stakeholders' views of what combination of probability and impact makes a risk to each objective low, moderate or high.

Organizations and sponsors often choose to put a large emphasis on mitigating risks with high or very high impacts. For this purpose they give a greater-than-linear weight to impact levels as they go up (from left to right in the Evaluating Impact of a Risk (threat or opportunity) on Major Project Objectives from very low to very high impact. The greater-than-linear scores higher impacts may apply to any or all objectives – hence it is likely that different objectives may have different scoring systems applied to them.

	Impact Scoring	
	Degree of Focus on Risks with High and Very High Impacts	
	Significant (Non-linear)	Moderate (Linear)
Very High	16	5
High	8	4
Moderate	4	3
Low	2	2
Very Low	1	1

The PDT uses a PxI matrix to combine each risk's probability and impact. These matrices establish whether a risk with a certain combination of probability and impact is of high, moderate, or low priority for that objective, based on combinations of probability and impact as established by project management and other stakeholders. There are potentially 4 such matrices, one for each objective, although in practice the patterns of red, yellow and green may be the same for some or all of the objectives. Two candidate matrices for threats and two for opportunities, using the non-linear and linear impact scoring, are shown as follow:

Figure R3.1-1. (Continued).

Option 1: PxI Matrix for Significant Focus on High and Very High Impacts (Non-linear Impact Scoring)

Probability	Threats				
5	5	10	20	40	80
4	4	8	16	32	64
3	3	6	12	24	48
2	2	4	8	16	32
1	1	2	4	8	16
	1	2	4	8	16
	Impact on Selected Objective				

Option 2: PxI Matrix for Moderate Focus on High and Very High Impacts (Linear Impact Scoring)

Probability	Threats				
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5
	Impact on Selected Objective				

Option 1: PxI Matrix for Significant Focus on High and Very High Impacts (Non-linear Impact Scoring)

Probability	Opportunities				
5	5	10	20	40	80
4	4	8	16	32	64
3	3	6	12	24	48
2	2	4	8	16	32
1	1	2	4	8	16
	1	2	4	8	16
	Impact on Selected Objective				

Option 2: PxI Matrix for Moderate Focus on High and Very High Impacts (Linear Impact Scoring)

Probability	Opportunities				
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5
	Impact on Selected Objective				

Translate Score to Risk Rank

Score	Risk
1 – 6	Low
7 – 14	Moderate
15 – ++	High

The risk scores shown in the Risk Register for each objective reflect the PxI matrix chosen for impact on that particular objective. In the Risk Register the risks can then be displayed by high, moderate, and low groupings for each of the four objectives (time, cost, scope, quality) and for threats as well as opportunities. Department project managers often use the PxI matrices shown above, but they can set up a different matrix and assign different scores if it would better suit the project.

Some Department project managers use a PxI matrix based on narrative probabilities and impacts (very low, low, moderate, high, very high) rather than numerical ones.

Figure R3.1-1. (Continued).

The goal of the quantitative risk analysis is to create a probabilistic cost-risk model to represent the uncertainties affecting project cost and schedule. It ultimately identifies a likely range of costs or durations that bracket potential risk impacts to cost or schedule.

Tips

Conduct the risk analysis early in the project development process. Involve a multidisciplinary team to conduct the risk analysis. The team may benefit from outside experts to generate the list of risks and assist in the analysis. If a project requires a quantitative risk analysis, consult expert modelers. Most SHAs do not have in-house capabilities for performing quantitative risk analyses.

Resources

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

Federal Transit Authority (2004). *Risk Assessment Methodologies and Procedures.* Project Management Oversight under Contract No. DTFT60-98-D-41013.

Federal Highway Administration (2004). *Major Project Program Cost Estimating Guidance.* www.fhwa.dot.gov/programadmin/mega/cefinal.htm

Grey, S. (1995). *Practical Risk Assessment for Project Managers.* John Wiley and Sons, Chichester, England.

Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3.

Project Management Institute (2004). *A Guide to Project Management Body of Knowledge* (PMBOK Guide).

Washington State DOT's Cost Estimating Validation Process (CEVP) website: www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

R3.2 Contingency—Identified

The common SHA method for assigning contingency has been either to apply standard percentages for the varying stages of project development or to rely solely on the project estimator's experience. The enumeration and qualitative assessment of a project's contributor risks offers a more effective method for determining project contingency than does the standard SHA practice of broad-based percent add-on contingency amounts. Attention to technical complexities, construction execution, and the macro-environment focuses estimator attention on project risks.

What Is It?

This tool creates a process whereby the contingency amount included in an estimate is set on the basis of identified risks and the probability of their occurrence. Ideally, this tool should be used in conjunction with a comprehensive risk management process. When this tool is used in conjunction with a qualitative risk assessment, the contingency is set using the cost estimator's judgment and the information generated from the risk identification and analysis process. Even this contingency assignment should be in compliance with SHA policy. When this tool is used in conjunction with a quantitative risk analysis, the contingency is set using an acceptable confidence interval for the project (i.e., the difference between the 50% and 80% confidence intervals of a range estimate).

Cost estimation methods and tools must be understood in terms of the design definition (i.e., detail) available during the various phases of project development. More generally, at any stage in the development of a highway project, cost estimates will consist of three components for which there are different amounts of information: "Known/Knowns" (known and quantifiable costs), "Known/Unknowns" (known but not quantified costs), and "Unknown/Unknowns" (as yet unrecognized costs); these con-

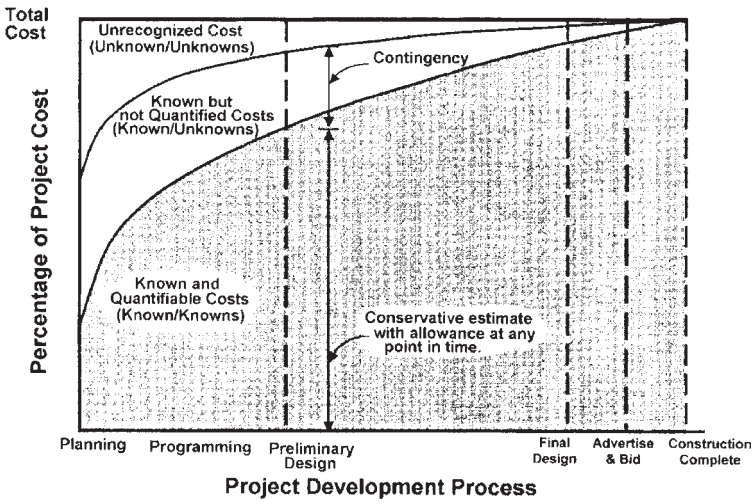


Figure R3.2-1. Components of a cost estimate.

cepts are illustrated in Figure R3.2-1. In this figure the contingency cost component extends into the known/known cost percentage. Also, at the "Advertise & Bid" point, there still can be unrecognized costs (a very small gap) and known but not quantified costs (a small gap). Only when construction is completed are all costs known. All too often, if the cost of an item is not known, it is not included in early cost estimates. There is also opportunity for other items (e.g., environmental mitigation costs) to be entirely left out of early estimates. The costs associated with the three components—known/knowns, known/unknowns, and unknown/unknowns—require different methods and tools to define and quantify their possible contribution to the estimate at any particular time in the project development process.

Figure R3.2-2 illustrates how identifying, quantifying, and managing cost and schedule uncertainty relates to refining the cost estimate (i.e., managing the final project cost). This figure illustrates two crucial points that apply to situations where the scope is unchanged and where an estimate, at some early stage in the programming process, has included uncertainty. The first point is that the range of cost or schedule uncertainty should decrease as a project proceeds from concept to final design. Estimate accuracy improves as design develops, cost variables are better

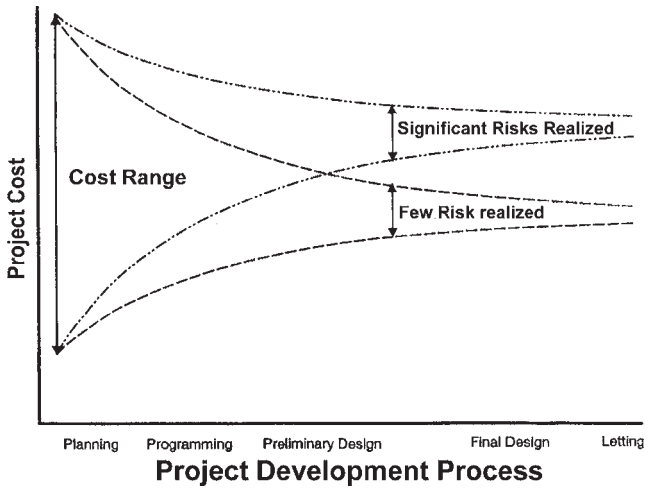


Figure R3.2-2. Refinement of a cost estimate.

defined, and uncertainty is eliminated. The second point is that if the uncertainties included in the estimate, as a contingency amount, in the early stages of project design materialize, then the estimated total will still be as expected. However, as risk management and other cost control processes are applied to the identified uncertainties, it is often possible to mitigate risks (i.e., contingency costs) and deliver the project at a lower cost.

The Association for the Advancement of Cost Engineering International (AACEI) has developed a cost estimate classification system that defines five estimate classifications. This system, shown in Table R3.2-1, provides an expected range of accuracy for each project development phase. A Class 5 estimate is prepared at the earliest stage of project definition, and a Class 1 estimate is prepared closest to complete project definition and final design. Table R3.2-1 also describes the methodological approach to the estimate as either stochastic or deterministic, depending on the level of design and information available. A deterministic estimate contains no random variables, while a stochastic estimate contains one or more random variables. The result of a deterministic estimate is a single point of total cost, while the result of a stochastic estimate is a range of total cost. The AACEI recommends that Class 1 through 3 estimates be developed primarily as stochastic estimates, which are not commonly employed by SHAs, but are being described in this section on risk analysis.

Why?

The identification of project risks gives the estimator a much firmer basis for developing a reliable contingency amount than the typical top-down assignment of a percentage based on the estimated direct cost of the project.

What Does It Do?

Because risks are specifically delineated as a project is developed, unique strategies can be implemented to mitigate, transfer, or avoid significant risks. In addition, with the risks identi-

Table R3.2-1. AACEI generic cost estimate classification matrix.

Estimate Class	Primary Characteristic	Secondary Characteristic		
	Level of Project Definition Expressed as % of complete definition	**End Usage** Typical purpose of estimate	**Methodology** Typical estimation method	**Expected Accuracy Range** Typical +/– range
Class 5	0% to 2%	Screening or Feasibility	Stochastic or Judgment	+40/–20 to +200/–100
Class 4	1% to 15%	Concept Study or Feasibility	Primarily Stochastic	+30/–15 to +120/–60
Class 3	10% to 40%	Budget, Authorization, or Control	Mixed, but Primarily Stochastic	+20/–10 to +60/–30
Class 2	30% to 70%	Control or Bid/ Tender	Primarily Deterministic	+10/–5 to +30/–15
Class 1	50% to 100%	Check Estimate or Bid/Tender	Deterministic	+10/–5

Adapted from the Association for the Advancement of Cost Engineering International's *AACE International* Recommended Practice No. 17R-97: Cost Estimate Classification System, 1997.

fied and quantified, control and tracking procedures can be implemented to monitor risk items on an ongoing basis. These concepts are more fully explained in Section R3.5.

When?

The tool should be employed early, and risks should be tracked throughout the project development process. Unusual or complex projects require a more in-depth evaluation of potential risks and their effect on estimated cost. The opportunities to expand the identification and quantification of risks should be pursued as design progresses and as more is known about potential exogenous risk factors.

Examples

The Cost Estimating Validation Procedure (CEVP) developed by the Washington State DOT (WSDOT) is a peer-level review on the scope, schedule, and cost estimate for transportation projects throughout the state of Washington. The objective of the CEVP is to evaluate the quality and completeness, including anticipated uncertainty and variability, of the projected cost and schedule.

The outcomes of the CEVP include

- An estimate validation statement in the form of a CEVP project summary sheet that represents the project cost ranges and the uncertainty involved (see Tool C1.2).
- Findings and recommendations that allow WSDOT project teams and senior management to better understand the basis, content, and variability of cost estimates.
- Identification and characterization of the high-risk project elements (this outcome will allow project teams to address appropriate mitigation strategies).

The CEVP is also discussed in Sections C1.2, R3.1, and R3.5.

The Caltrans *Risk Management Handbook* calls for a quantitative assessment of project risk items representing the highest degree of exposure. This quantification is important for updating the contingency amount to be included in the project estimate. The handbook is available online at www.dot.ca.gov/hq/projmgmt/documents/prmhb/project_risk_management_handbook.pdf.

The Federal Transit Administration commissioned a report on risk assessment technologies and procedures that discusses the application of risk-based contingency, *Risk Assessment Methodologies and Procedures.* The Regional Transportation District (RTD) in Denver, Colorado, is also using a risk-based contingency process in its Fastracks transit program. See Denver RTD's 2006 "Risk Assessment Quantification," available online at www.rtd-denver.com/fastracks/documents/SB_208_Submittal/Risk_Analysis.doc.

Tips

To successfully address the effects of project risk, risk analysis must take a broad view of risk—concentrating on only the technical risks can lead to oversights in other project dimensions. The analysis should consider local authority/agency impacts, industry and market risks, elements of political uncertainty, and public and/or permit approval processes that might affect timing.

Scope changes must also be considered from a broad perspective. Identification of risk goes beyond the internal project risks (e.g., pile driving depth) and includes exogenous factors (e.g., market conditions, business environment, global construction activities/demand, and the macro-economic environment). Any major uncertainties that might influence the primary project outcomes of cost, schedule, or quality should be included.

Resources

Association for the Advancement of Cost Engineering International (2004). "AACE International Recommended Practice No. 10S-90: Cost Engineering Terminology." www.aacei.org/resources/rp.shtml.

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

Denver Regional Transportation District (2006). "Risk Assessment Quantification." www.rtd-denver.com/fastracks/documents/SB_208_Submittal/Risk_Analysis.doc

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Federal Highway Administration (2004). "Major Project Program Cost Estimating Guidance." http://www.fhwa.dot.gov/programadmin/mega/cefinal.htm

Owen, P. A., and J. K. Nabors (1983). "Quantifying Risks in Capital Estimates," *AACE Transactions,* B.5.1–B.5.7.

Stevenson, J. J. (1984). "Determining Meaningful Estimate Contingency," *Cost Engineering,* AACE International, Vol. 26, No. 1.

Washington State DOT (2006). Cost Estimating Validation Process (CEVP) website, www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

R3.3 Contingency—Percentage

As shown in Figures R3.2-1 and R3.2-2 and Table R3.2-1, contingency percentages should decrease from the early stages of project development through final design. This theoretical idea of contingency has led some SHAs to apply fixed contingencies that decrease with project development milestones. However, it is poor policy to use fixed allowances for contingencies without good reasons. So even if the contingency amounts included in an estimate are justified based on published tables of practice, the risk driving the inclusion of those amounts should still be documented in writing. This requirement for documentation becomes even more important when fixed allowances or guide ranges for contingency are not followed. If extraordinary conditions exist that call for higher contingencies, the rationale and basis must be documented in the estimate.

What Is It?

Recognizing that cost estimation is inherently difficult because estimators are trying to predict the future, it is prudent to provide contingency allowances in the estimate. These contingency allowances represent the typical cost escalation experienced on similar projects as design progresses. The contingency amount can be set as a percentage of the project's direct cost with the percentage being established by analysis of historical cost experience from past projects.

Why?

At any stage in the development of a project, cost estimates will consist of three components for which there are differing amounts of information: "Known/Knowns" (known and quantifiable costs), "Known/Unknowns" (known but not quantified costs), and "Unknown/Unknowns" (as yet unrecognized costs). These components are illustrated in Figure R3.2-1. What the contingency amount is supposed to account for is the total of the "Known/Unknowns" and "Unknown/Unknowns" of the estimate.

What Does It Do?

A contingency allowance included in an estimate is meant to provide funds for cost growth resulting from necessary but unforeseeable project scope changes, underestimation of real project costs, or errors in projecting the rate of inflation. Increases in the prices for construction services—inflation—are not to be considered covered by the contingency amount. Inflation should be handled by applying an appropriate inflation rate to the calculated project cost.

When?

Contingency amounts, added to an estimate, are a valid means of reflecting the uncertainties that remain to be defined as design progresses. A contingency amount should be included in every project estimate from the earliest planning stage of project development to the final PS&E; however, as shown in Figure R3.2-1, the magnitude of the contingency amount decreases as the scope is defined and the design progresses.

Examples

Many SHAs use standard percentages, such as the Maryland DOT percentages shown in Table R3.3-1, to develop estimate contingency amounts. Historical experience shows that SHAs can establish contingency percentages to be applied to an estimate's direct cost, but research shows that, in many cases, the applied percentages do not reflect actual conditions. SHAs should only use the percentage contingency approach for projects that are similar in character to a large number of past projects for which good cost data are available. Figure R3.3-1 displays a graduated contingency estimating scale used by the Ohio DOT on their major projects. Table R3.3-2 summarizes guidance on contingency in Chapter 20 of the *Caltrans Project Development Procedures Manual* (available online at http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm). The table is offered as guidance for a graduated contingency. However, it should be noted that Caltrans also offers guidance on applying risk-based contingency when appropriate, as described in Section R3.1.

Tips

When an SHA chooses to establish an estimate contingency by means of the relationship between contingency amount and project direct cost, two steps are needed to make the process work effectively:

1. The purpose of the contingency amount needs to be carefully defined. Estimators and management must understand that the contingency is intended to account for very specific unforeseen, unexpected, unidentified, or undefined costs. The project risks that cause the occurrence of these costs must be delineated in the SHA's estimation manual with the percentages. Examples of risk factors early in design are provided in Section I2.3. Examples of possible risk factors near the final design period include

   - **Number of bidders:** The availability of contractors willing to bid the work will affect the bid prices. Caltrans has found that, for projects in the $1 million to $10 million range, if

Table R3.3-1. Maryland DOT graduated contingency estimating scale.

Project Phase	Contingency
Planning	35-40%
Programming and Preliminary Design	25-35%
Final Design	0-25%

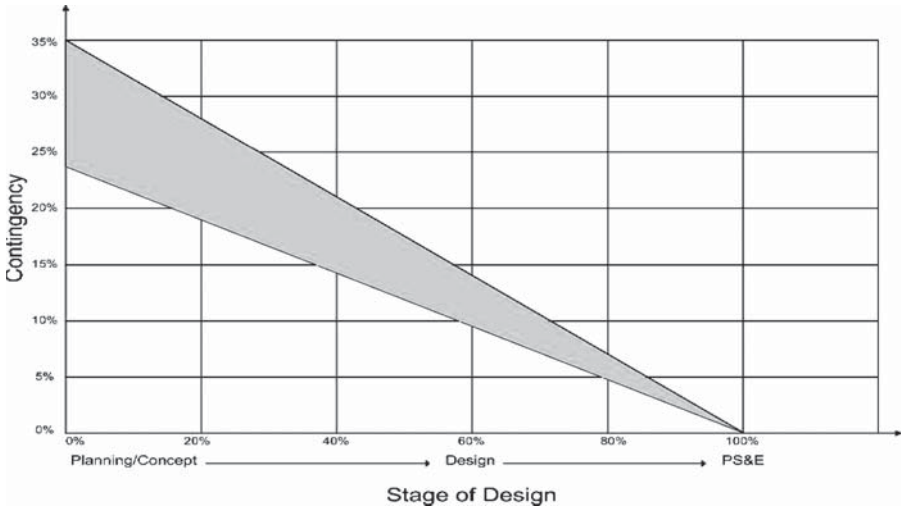

Figure R3.3-1. Ohio DOT design completion contingency guidelines for cost estimating of major projects.

there is only one bidder, the price will on average be 5% above the engineer's estimate, and the effect of each additional bidder is a 2% reduction in bid price compared with the SHA estimate.

- **Contractor perception of project risk:** The perceptions of risk by contractors vary widely, but underground work will normally increase a contractor's bid because of geotechnical unknowns. For one-of-a-kind projects, contractors will apply more risk to their bid.
- **Right-of-way unknowns:** Early in project development it is almost impossible to know the number of partial takes, the exact appreciation to apply, or the number of parcels that will go to condemnation.
- **Construction unknowns:** This risk factor might be addressed with a reserve to cover construction change orders due to differing site conditions and other construction issues.
- **Contracting method:** A range of risk management strategies affect project cost, risk transfer, risk reduction, and even financial treatments. Using lump sum or even unit price contracts to transfer risk to a contractor when project complexities exist that cannot be completely addressed until construction commences will add cost to the project. The constructor will

Table R3.3-2. Caltrans graduated contingency estimate scale.

Design/Estimation Milestone	Percent Contingency
Project Feasibility Cost Estimate	30% to 50%
Project Study Report Cost Estimate	25%
Draft Project Report Cost Estimate	20%
Project Report Cost Estimate	15%
Preliminary Engineer's Cost Estimate	10%
Final Engineer's Cost Estimate	5% or less

Adapted from Chapter 20 of the *Caltrans Project Development Procedures Manual* (available online at http://www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm).

add higher overhead and profit markup to the bid, and there will still be difficult-to-resolve change orders.
- **Material price escalation:** Sometimes material price escalation is carried in the individual items of the estimate, and sometimes it is supposed to be part of the estimate contingency. The proper accounting should be defined in the SHA's estimation manual.

2. The established contingency percentages should be based on actual experience (i.e., historical data). It is important for both the SHA estimators and SHA management to know the level of accuracy achieved with the prescribed contingency percentages. Statistical analysis of past projects provides a means for measuring that accuracy and adjusting the employed percentages.

Resources

FHWA (2004). "Contingency Fund Management for Major Projects." www.fhwa.dot.gov/programadmin/mega/contingency.htm

FHWA (2004). "Major Project Program Cost Estimating Guidance." www.fhwa.dot.gov/programadmin/mega/cefinal.htm

Chapter 20 of the *Caltrans Project Development Procedures Manual,* www.dot.ca.gov/hq/oppd/pdpm/pdpmn.htm

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

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Ohio DOT (2007). *Ohio Procedure for Budget Estimating.* www.dot.state.oh.us/contract/estimating/default.htm

U.S. Army Corps of Engineers. "Military Program-Specific Information—REF8011G," http://bp.usace.army.mil/robo/projects/pmbp_manual/PMBP_Manual/REF8011G.htm

Uppal, Kul B. (Ed.) (2005). Professional Practice Guide #8: Contingency (CD), Association for the Advancement of Cost Engineering (AACE) International. www.aacei.org/technical/ppg.shtml

R3.5 Programmatic Cost Risk Analysis

State highway and transit agencies are beginning to realize the value of integrating cost estimation practice and cost estimation management with comprehensive risk management processes. Programmatic cost risk analysis involves all four steps of the classic risk management process—risk identification, risk analysis, risk mitigation and planning, and risk monitoring and control. The risk analysis component focuses on the quantitative risk analysis process and uses probabilistic cost models to drive the risk management process. The term "programmatic" refers to applying this process across multiple projects within the state highway agency. This form of risk management is the most comprehensive and resource-intensive manner with which to deal with project uncertainty of all the tools described in this guide.

What Is It?

A programmatic cost risk analysis is a systematic project review and risk assessment method, including probabilistic estimation, to evaluate the quality of the information at hand and to identify and describe cost and schedule uncertainties. It involves risk identification, risk analysis, risk mitigation and planning, and risk monitoring and control. It systematically combines all of the risk identification, analysis, and communication tools described in this guide (see Sections C1.2, I2.1, I2.2, I2.3, R3.1, R3.2, and R3.3).

A successful cost risk analysis program has the following characteristics:

- Feasible, stable, and well-understood user requirements
- A close relationship with user, industry, and other appropriate participants
- A planned and structured risk management process, integral to the acquisition process
- Continual reassessment of project and associated risks
- A defined set of success criteria for all cost, schedule, and performance elements
- Metrics to monitor effectiveness of risk-handling strategies
- Formal documentation

Why?

Programmatic cost risk analysis can be used to change an agency's culture and to combat systemic cost escalation. It allows cost estimates to be conveyed transparently to management. It reveals risk and uncertainty involved with the project at each stage of the process. It provides a tool to model both the technical and non-technical nature of the challenges in quantifying capital costs early in the project lifecycle.

What Does It Do?

Programmatic cost risk analysis can help to create a culture of risk management that is forward-looking, structured, informative, and continuous. Through the generation of risk-based probabilistic cost and schedule estimates, the process can assist agencies in anticipating and mitigating potential cost escalation. The process can produce prioritized lists of cost and schedule risks. It can provide estimates of these individual risk costs and their potential effects on project component schedules. Ultimately, the process can produce prioritized risk mitigation strategies, including their estimated implementation costs and cost/schedule savings, which can be incorporated in a comprehensive risk management plan.

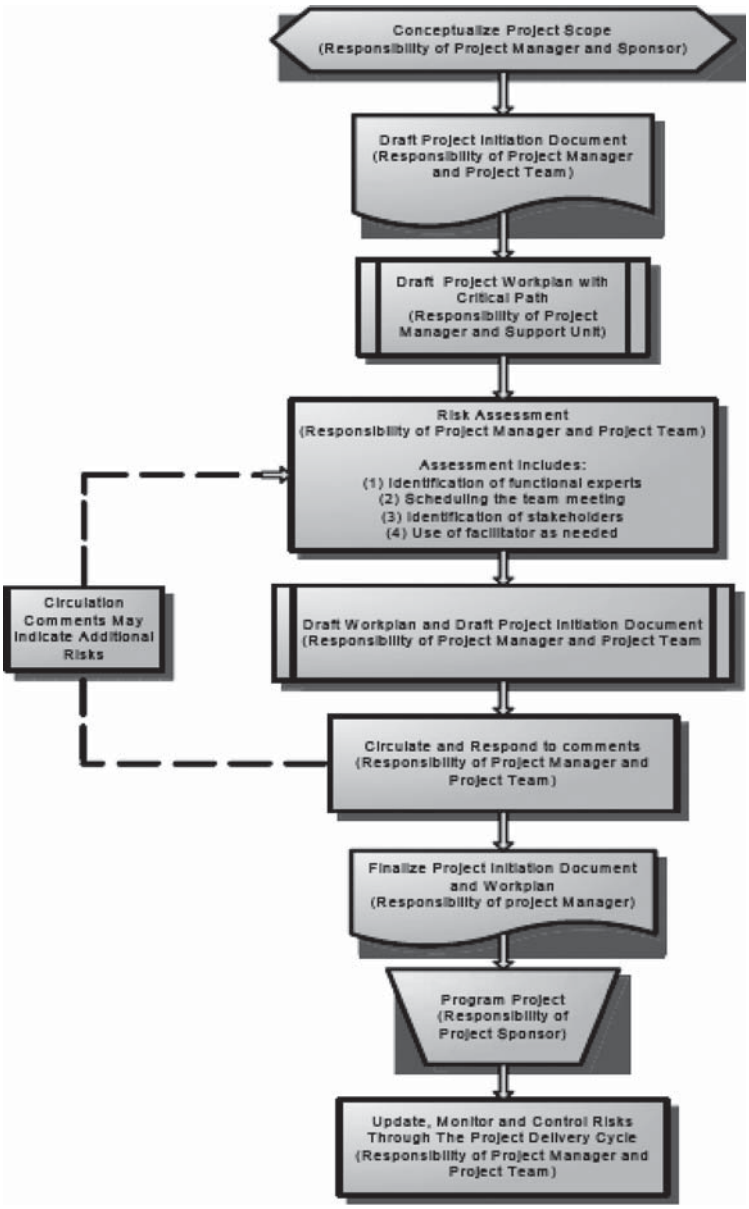
When?

A programmatic cost risk analysis should be applied in all phases of the project development process. In the earliest phases of project development, the tool focuses on risk identification and risk analysis to produce meaningful contingencies and prioritized rankings of risks. As project development progresses, the process supports risk mitigation and is managed though an active risk charter. In the final stages of project development, the tool supports the contingency resolution process though active monitoring and control.

Examples

Caltrans has developed a comprehensive risk management process and documented it in Caltrans's 2007 *Project Management Risk Management Handbook.* The Caltrans process is largely based on the Project Management Institute's *Guide to Project Management Body of Knowledge* (PMBOK Guide). In the Caltrans process, the project team completes the risk management plan before the project initiation document (PID) component ends. The team updates the plan in each subsequent lifecycle component and continues to monitor and control risks throughout the life of the project. Figure R3.5-1 shows the process flowchart. Table R3.5-1 shows the two main process tasks, the four subtasks, and all of the deliverables associated with project risk management. Table R3.5-2 shows all of the process tasks and the roles associated with each task.

Caltrans has summarized its process into a risk management plan worksheet. The worksheet is available in Microsoft Excel format. It is intended to act as a risk charter for the process (see Section I2.2). The worksheet provides a tool to organize risks from the risk identification process. It provides a color-coded function for conducting qualitative risk assessments. It also provides space for inputting the results of a quantitative risk assessment. Additionally, the risk manage-



Source: Project Risk Management Handbook, Caltrans Statewide Office of Project Management Improvement, 2007.

Figure R3.5-1. Caltrans risk management flowchart.

ment planning worksheet provides tracking mechanisms for risk mitigation strategies as well as risk monitoring and control. An electronic version of this sample spreadsheet is available on the project management guidance website at www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htm

Washington State DOT (WSDOT) developed the Cost Estimating Validation Process (CEVP) to assist in evaluating the quality and completeness of project estimates, including the anticipated uncertainty and variability of the projected cost and schedule. The CEVP uses systematic project review and risk assessment methods, including statistics and probability theory, to evaluate the quality of the information available and to identify and describe cost and schedule

Table R3.5-1. Caltrans risk management tasks and deliverables.

Process	Output(s) (deliverables)
Risk management planning	Risk Management Plan (RMP)
Risk identification	Risk Register (Register)
Qualitative risk analysis	Risk Register (updates) Prioritized list of risks classified as high, moderate, or low.
Quantitative risk analysis	Quantitative Risk Analysis Reports Numerical analysis of the project's likelihood of achieving its overall objectives (Risk Register updates)
Risk response planning	1- Risk Register (updates) 2- Project Management Plan (updates) 3- Project Risk Management Plan (updates) 4- Risk-related contractual agreements The outcome may result in one or more of the following: residual risks, secondary risks, change control, contingency reserve (amounts of time or budget needed).
Risk monitoring and control	Risk Register (updates) The outcome may result in workaround plans, corrective actions, programming change request (PCR), and updates to risk identification checklists for future projects

Source: Project Risk Management Handbook, Caltrans Statewide Office of Project Management Improvement, 2007.

Table R3.5-2. Caltrans risk management responsibility matrix.

Process Tasks	Role					
	Sponsor	Deputy District Director, Program and Project Management	Project Manager	Project Manager Support/ Risk Officer	Project Team	Risk Owner
Risk management planning	C	C	R, A	S	S	
Risk identification	C	C	R	S	S	
Qualitative risk analysis			R	S	S	
Quantitative risk analysis (As applicable)			R	S	S	
Risk response planning	C	C	R, A	S	S	R
Risk monitoring and control			R	S	S	R

Legend: R = responsible, S = support, A = approve, C = concur

Source: Project Risk Management Handbook, Caltrans Statewide Office of Project Management Improvement, 2007.

uncertainties. The CEVP recognizes that every project cost estimate will be a mix of the very likely, the probable, and the possible. Importantly, the process examines, from the very beginning, how risks can be communicated and lowered and cost vulnerabilities managed or reduced. In other words, a dividend of the CEVP is to promote activities that will improve end-of-project cost and schedule results. The CEVP process integrates into the entire project development process in a way similar to that of the Caltrans method previously described.

The CEVP process begins with a workshop to facilitate the risk identification and quantitative risk analysis phases of the process. A rigorous peer review and uncertainty analysis is the foundation of the CEVP process. A multidisciplinary team of professionals from both the public and private sectors examines the project. Table R3.5.3 presents the seven phases in the WSDOT CEVP process.

Although the workshop is a key component of the CEVP process, the CEVP process involves many other components that are integrated into the cost estimation, risk management, and project management processes at WSDOT. Other elements of the CEVP process are described in Sections C1.2, I2.2, R3.1, and R3.4 in this guide. More information can be found on the WSDOT CEVP and Cost Risk Analysis website at www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

Table R3.5-3. CEVP workshop format.

CEVP Process Phase	Summary Description
Phase I – Project Identification and Preparation	• Project data compilation • CEVP training and education
Phase II – Workshop Initiation	• Establishment of the workshop goals, workshop scope, and project alternatives being explored • Project team presentation of: 1) scope and assumptions for each decision alternative; 2) cost and schedule estimate; and 3) major issues and concerns • Development of project flow chart or schedule (the basis for the cost and schedule risk and uncertainty model)
Phase III – Cost Validation and Risk Identification	• Cost validation team breakout activities • Risk team breakout activities • Environmental costing team breakout activities • Modeling team breakout activities
Phase IV – Integration and Model Construction	• Breakout team reports • Reconciliation of breakout assumptions • Construction of cost and schedule risk and uncertainty model
Phase V – Presentation of Results	• Oral presentation of workshop results • Written presentation of workshop results
Phase VI – Validation of Results and Generation of Alternatives	• Project and CEVP teams validate workshop results • Alternative project scenarios are explored and evaluated
Phase VII – Implementation and Auditing	• Development of risk mitigation planning and integration into project management • Reviewing and updating of workshop results and predictions as compared with actual project results

Tips

Implementation of a programmatic cost risk analysis tool will involve significant changes to most SHAs' cost estimation and project management procedures. In fact, the process will likely require a cultural change within the organization. To be successful, this tool will require management's full support and commitment of resources.

Resources

Caltrans Office of Statewide Project Management Improvement (2007). *Project Risk Management Handbook: Threats and Opportunities,* 2nd ed., May 2007, Caltrans, Sacramento, CA. http://www.dot.ca.gov/hq/projmgmt/guidance_prmhb.htmwww.dot.ca.gov/hq/projmgmt/documents/prmhb/project_risk_management_handbook.pdf

Federal Transit Authority (2004). *Risk Assessment Methodologies and Procedures,* report under Contract No. DTFT60-98-D-41013.

Federal Highway Administration (2004). *Major Project Program Cost Estimating Guidance.* Molenaar, K. R. (2005). "Programmatic Cost Risk Analysis for Highway Mega-Projects," *Journal of Construction Engineering and Management,* Vol. 131, No. 3, American Society of Civil Engineers.

Project Management Institute (2004). *A Guide to Project Management Body of Knowledge* (PMBOK Guide).

Washington State DOT (2006). Cost Estimating Validation Process (CEVP) website: www.wsdot.wa.gov/Projects/ProjectMgmt/RiskAssessment

APPENDIX B

Definitions

Acquisition: The act or process of acquiring fee title or some interest therein other than fee title of real property (real estate).

Allowance: An amount included in an estimate for items that are known (expected) but the details of which have not yet been determined.

Appraisal: A written statement independently and impartially prepared by a qualified appraiser setting forth an opinion of defined value of an adequately described property as of a specific date, supported by the presentation and analysis of relevant market information.

Base Estimate: The most likely project estimate, exclusive of Project Contingency, for known costs for all known design, engineering, cooperative agreements, right-of-way, environmental, utilities, preconstruction, and construction work.

Baseline Cost Estimate: The most likely Total Cost Estimate, which serves as the approved project budget and the basis for Cost Control. The approved budget must correspond to an approved scope of work and work plan.

Condemnation: The legal process of acquiring private property for public use or purpose through the acquiring agency's power of eminent domain. Condemnation is usually not used until all attempts to reach a mutually satisfactory agreement through negotiations have failed. An acquiring agency then goes to court to acquire the needed property.

Contingency: An estimate of costs associated with identified uncertainties and risks, the sum of which is added to the Base Estimate to complete the Project Cost Estimate. Contingency is expected to be expended during the project development and construction process.

Cost Control: The process of controlling deviations from the estimated project costs and monitoring the risks and contingencies associated with changes. Two principles apply: (1) there must be a basis for comparison (e.g., the Baseline Cost Estimate); and (2) only future costs can be controlled.

Cost Estimate: A prediction of quantities, cost, and/or price of resources required by the Scope of a project. As a prediction, an estimate must address risks and uncertainties. The cost estimate consists of the Base Estimate for known costs associated with identified uncertainties and risks.

Cost Estimating: The predictive processes for approximating all project costs such as design, engineering, cooperative agreements, right-of-way, environmental, utilities, preconstruction, and construction work. As a predictive process, estimating must address risks and uncertainties. Project cost estimating generally involves the following steps: determine Estimate Basis, prepare Base Estimate, determine Risk and set Contingency, and review total estimate.

Cost Management: The process for managing the cost estimate through reviews and approvals, communicating estimates, monitoring of scope and project conditions, evaluating the effect of changes, and making estimate adjustments as appropriate.

Damages: A loss in value of the remaining property caused by the acquisition, planned use, or construction. Normally, the value of the damage is based on the before-and-after appraisal or cost to cure. An owner is entitled to payment of damages and receives this payment as a part of just compensation.

Easement: In general, an easement is the right of one person to use all or part of the property of another person for some specific purpose. Easements can be permanent or temporary (i.e., limited to a stated period of time).

Eminent Domain: The right of a government to take private property for public use. In the United States, just compensation must be paid for private property acquired for federally funded programs or projects.

Estimate Basis: A documentation of the project type and scope for each Cost Estimate, including items such as drawings that are available (defining percent engineering and design completion), project design parameters, project complexity, unique project location characteristics, and disciplines required to prepare the cost estimate.

Fair Market Value: Fair market value is the market value that has been adjusted to reflect constitutional and other legal requirements for public acquisition.

Forecasted Cost: The sum of actual expenditures through a given time period plus the estimate cost to complete the activity to 100 percent expended.

Highest and Best Use: The legal use (or development or redevelopment) of a property that makes the property most valuable to a buyer or the market.

Just Compensation: The price an agency must pay to acquire real property. The price offered by the agency is considered to be fair and equitable to both the property owner and the public. The agency's offer to the owner is just compensation and may not be less than the amount established in the approved appraisal report as the fair market value for the property. If it becomes necessary for the acquiring agency to use the condemnation process, the amount paid through the court will be just compensation for the acquisition of the property.

Market Value: The sale price that a willing and informed seller and willing and informed buyer agree to for a particular property.

Negotiation: The process used by acquiring agencies to reach amicable agreements with property owners for the acquisition of needed property. An offer is made for the purchase of property in person or by mail, and the offer is discussed with the property owner.

Parcel: Any plot of land. For the purposes of this report, "parcel" generally refers to the part being acquired, but it may also be used in association with original or remainder parcels.

Partial Taking: Acquisition in which the original property is severed to form two parcels, leaving a "remainder." Damages are most often associated with partial takings, which may require the removal of access, parking, buildings, or other improvements.

Project Management: Coordinating the organizing, planning, scheduling, directing, controlling, monitoring and evaluating of prescribed activities to ensure that the stated objectives of a project are achieved.

Qualitative Risk Analysis: Performing a qualitative analysis of risks and conditions to prioritize their effects on project objectives. It involves assessing the probability and impact of project

risk(s) and using methods such as the probability and impact matrix to classify risks into categories of high, moderate, and low for prioritized risk response planning.

Quantitative Risk Analysis: Measuring the probability and consequences of risks and estimating their implications for project objectives. Risks are characterized by probability distributions of possible outcomes. This process uses quantitative techniques such as simulation and decision tree analysis.

Rehabilitation: The act or process of returning a property to a state of utility through repair or alteration that makes possible an efficient contemporary use while preserving those portions or features of the property that are significant to the property's historical, architectural, and cultural values.

Restoration: The act or process of accurately recovering the form and details of a property and its setting as it appeared at a particular period of time by means of the removal of later work or by the replacement of missing earlier work.

Right of Way: A linear corridor of land used for transportation or other facilities, such as highways, roads, streets, railroads, trails, light rail, and utilities.

Risk: An uncertain event or condition that, if it occurs, has a negative or positive effect on a project's objectives.

Risk Assessment: A component of risk management that bridges risk identification and risk analysis in support of risk allocation. Risk assessment involves the quantitative or qualitative analysis that assesses effect and probability of a risk.

Risk Identification: Determining which risks might affect the project and documenting their characteristics. Tools used include brainstorming and checklists.

Risk Management: All of the steps (phases) associated with managing risks: Risk Identification, Risk Assessment, Risk Analysis (Qualitative or Quantitative), Risk Planning, Risk Allocation, and Risk Monitoring Control.

Risk Management Plan: A document detailing how risk response options and the overall risk processes will be carried out during the project. This is the output of Risk Planning.

Risk Monitoring and Control: The capture, analysis, and reporting of project performance, usually as compared with the risk management plan.

Risk Planning: Analyzing risk response options (i.e., Acceptance, Avoidance, Mitigation, or Transference) and deciding how to approach and plan risk management activities for a project.

Risk Register: A document detailing all identified risks, including description, cause, probability of occurring, effects on objectives, proposed responses, owners, and current status.

Scope: Encompasses the elements, characteristics, and parameters of a project and work that must be done to deliver a product with the specified requirements, features, and functions.

Scope Changes: Changes in the requirements, features, or functions on which the design or estimate is based. Examples would include changes to project limits, work types, or changes to capacity factors such as traffic loads, vehicles per lane, or stormwater factors.

Scope Creep: An accumulation of Scope Changes that incrementally change project scope and cost.

Total Cost Estimate: The sum of the Base Cost Estimate and Contingency.

Whole Taking: An acquisition that involves the taking of the original parcel in its entirety.

APPENDIX C

Project Development Phases

Source

Anderson, S., K. Molenaar, and C. Schexnayder (2007a). *NCHRP Report 574: Guidance for Cost Estimation and Management for Highway Projects During Planning, Programming, and Preconstruction,* TRB. http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_574.pdf

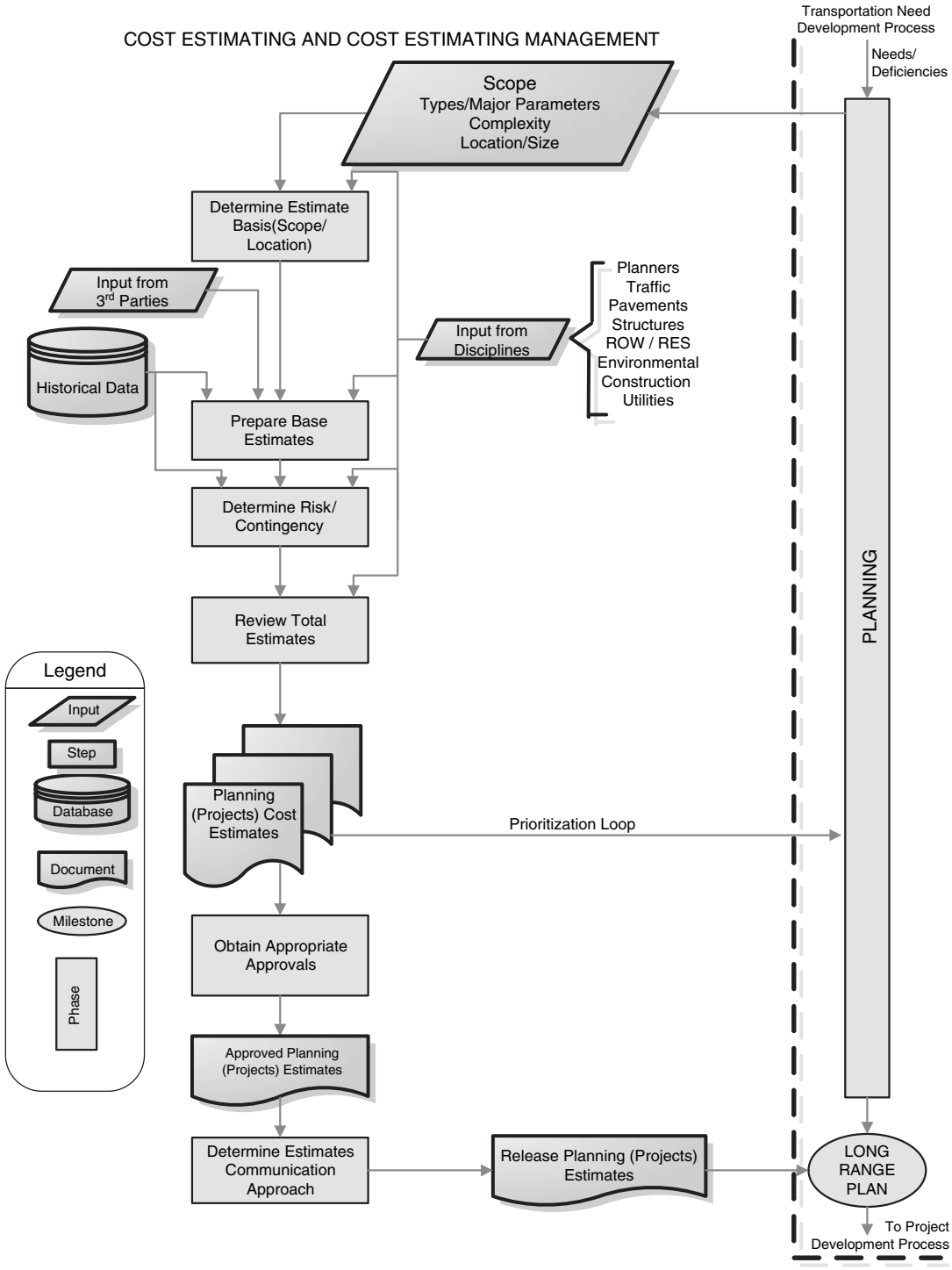


Figure C-1. Cost estimation practice and cost estimation management during planning (NCHRP Project 8-49, Phase I).

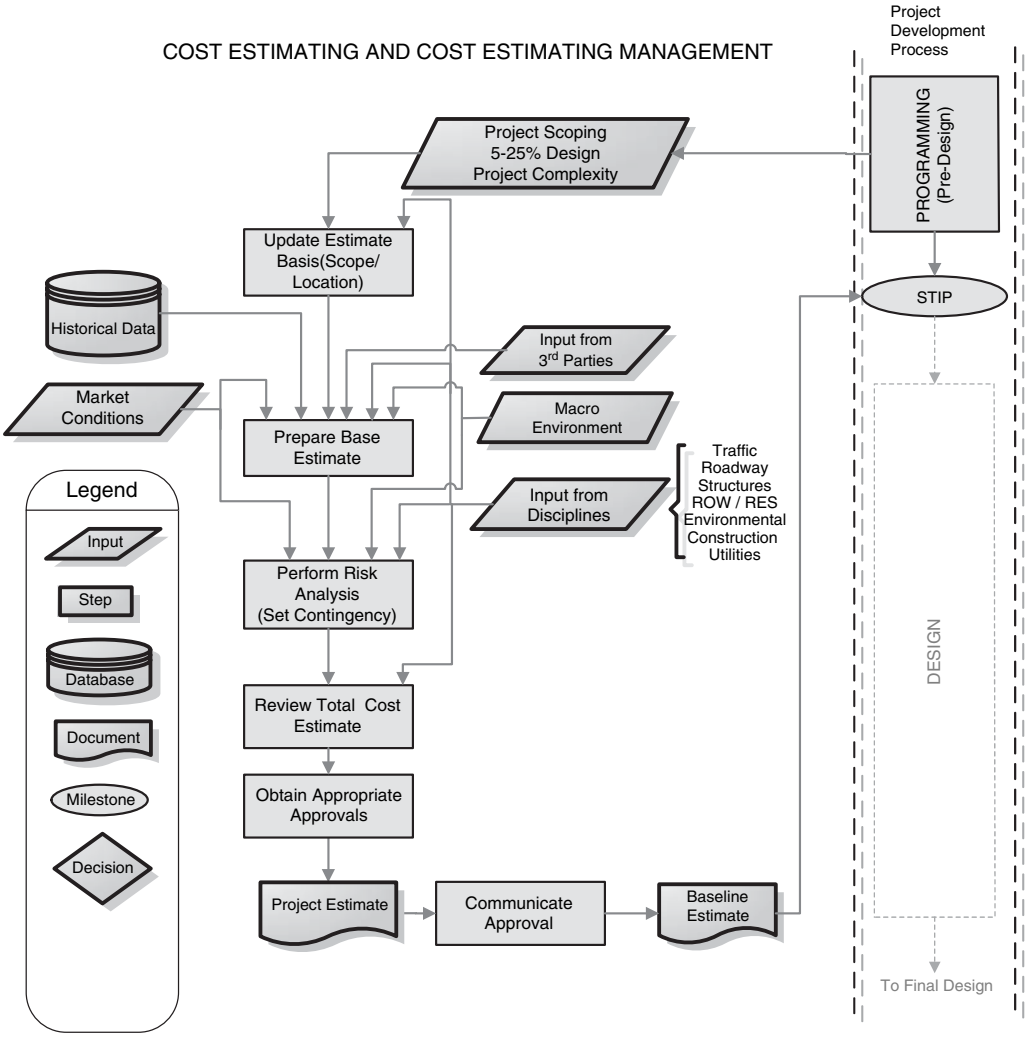


Figure C-2. Cost estimation practice and cost estimation management during programming (NCHRP Project 8-49, Phase I).

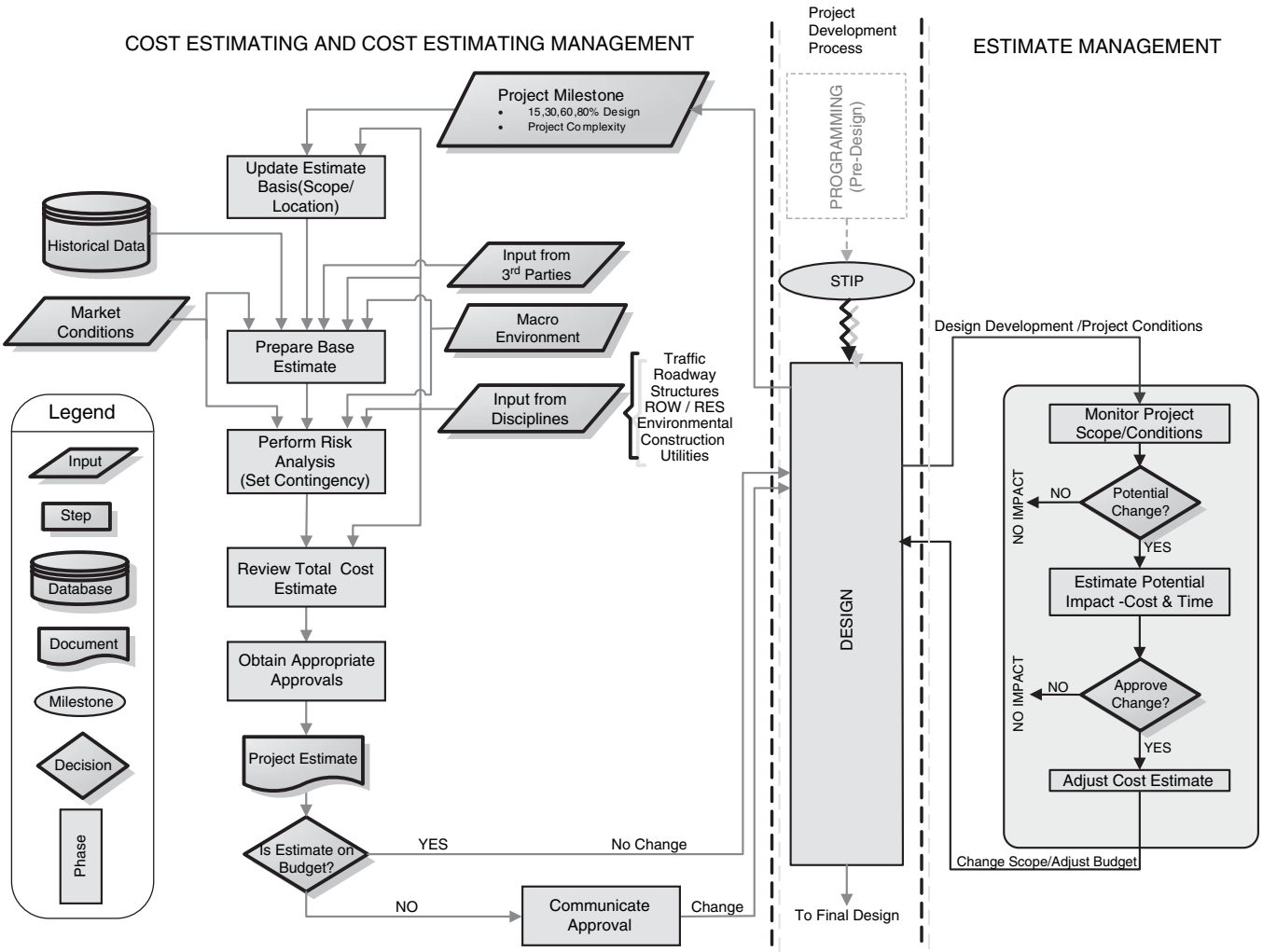


Figure C-3. Cost estimation practice and cost estimate management during preliminary design (NCHRP Project 8-49, Phase I).

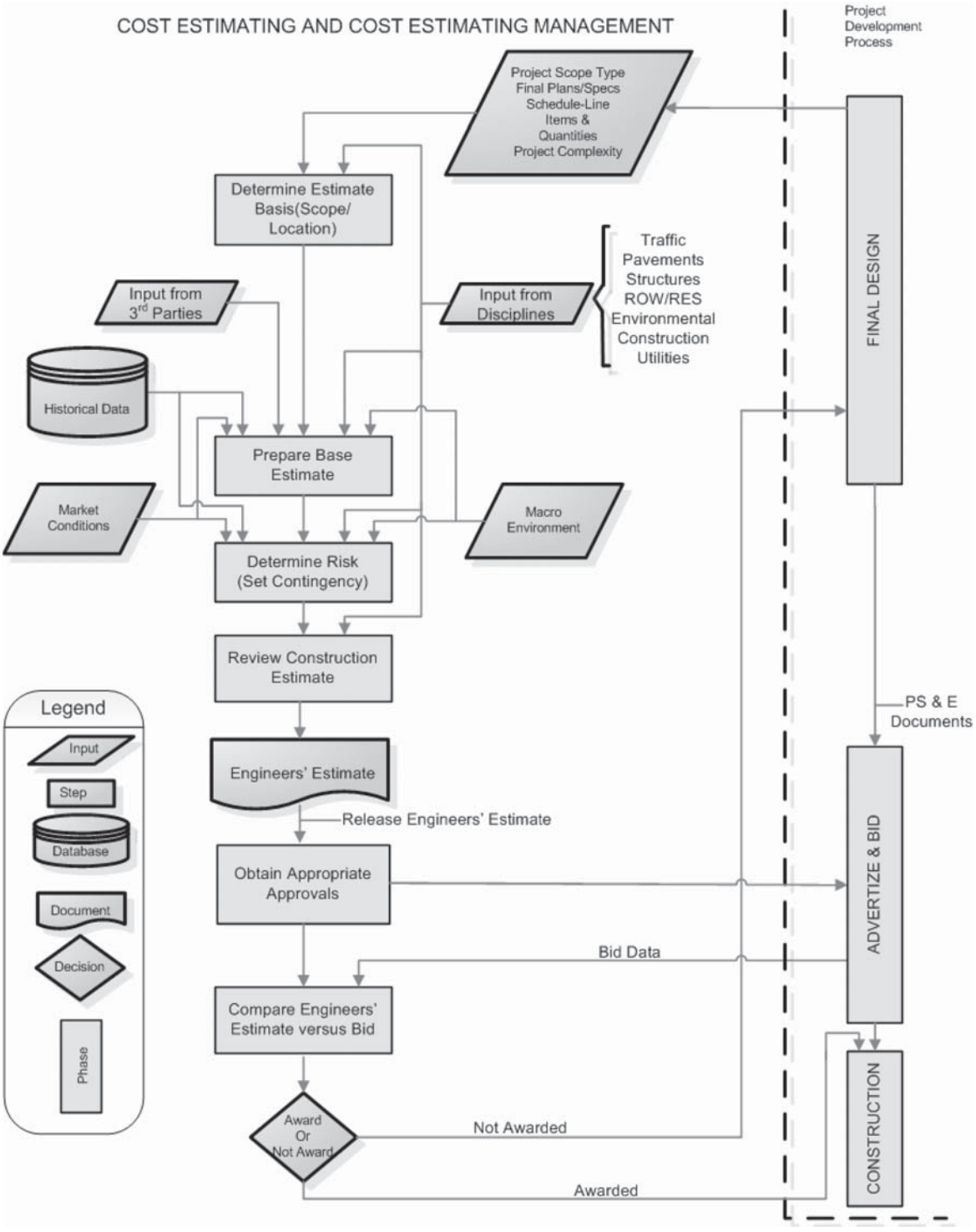


Figure C-4. Cost estimating and cost estimation management during final design (NCHRP Project 8-49, Phase I).

APPENDIX D

Critical Review of the State of Practice

All of the agency ROW practices discussed in the following sections are from the literature review or the agency interviews. Successful practices discovered during the state of practice review are discussed in detail followed by a summary of those practices.

Methodology

The review consisted of evaluating the information presented in the literature and the data collected during the agency interviews. The review process led to the identification of the successful practices discussed here and in the Procedures Guide. The research team focused primarily on the agency interviews when completing the review because the literature search revealed little information on ROW cost estimation and cost estimate management. The review and analysis of practices were accomplished by the project team relying on their individual cost estimating expertise. Decisions were made by team consensus.

The research team used a process-focused approach to review the materials because the main objective of the research was to "Develop an all-inclusive set of ROW cost estimation and cost estimate management procedures." Within the project phases the research team considered general cost estimation and cost estimate management steps reflected in *NCHRP Report 574* (Anderson et al., 2007a). These steps are

1. Determine Estimate Basis;
2. Prepare Estimate;
3. Determine Risk/Contingency;
4. Review Estimate;
5. Obtain Appropriate Approval;
6. Determine Estimate Communication Approach;
7. Monitor Project Scope/Project Conditions;
8. Communicate Estimate and Approval; and
9. Adjust Cost Estimate.

The first four of these steps are defined in *NCHRP Report 574* as cost estimating steps, while Steps 5 through 9 are cost estimating management steps. Although how these steps are performed varies depending on the project development phase, the distinction between estimating and management steps is important. These steps are integrated throughout the ROW flowcharts developed as a product of this research. These steps are critical to preparing consistent and accurate estimates throughout all phases of project development. The practices of SHAs were evaluated for effectiveness in view of the need to have a structured process that contains all of the listed estimate steps.

General ROW Cost Estimating Procedure

Before reviewing SHA practices, it is necessary to outline the general process behind completing a ROW cost estimate. The process steps are a consequence of the general project cost estimating steps detailed in *NCHRP Report 574* and current SHA practice as revealed through the interviews. The ROW-specific steps summarized here in generic form are used, to some degree, for each of the ROW cost estimates prepared during project development.

ROW requirements, which are defined by the project scope, establish the ROW estimate basis. These requirements are an input to the ROW cost estimation process and therefore establish the basis for the cost estimate. They typically include information such as the width of the project or number of lanes (dictates minimum ROW width) and other physical parameters that define what real estate will be required. Receipt of this information marks the beginning of the cost estimating activities. The preparation-of-estimate activities are

- Gathering data through field visits and from other sources of information to include assessment of improvements, land values, real estate inflation rates, condemnation rates, and possible damages;
- Quantifying estimate parameters such as total real estate or parcel areas;
- Computing cost by applying values to estimate parameters and other line items, including damages, property improvements, etc; and
- Adjusting the estimate for inflation, uncertainties, and risk.

After the cost estimate is computed, it is reviewed (usually by a ROW supervisor or manager) and then after approval, it is communicated to the appropriate project or program management staff.

ROW Cost Estimation

ROW cost estimates are completed during the first three project development phases: planning, programming, and preliminary design. There is some variance between SHAs regarding when estimates are performed relative to a specific SHA project development process and the number of estimates prepared in each of the development phases. The following section covers the practices used in each phase to prepare ROW cost estimates; both tools and general estimating approaches used by SHAs are presented. Planning will be covered first, followed by programming, and then preliminary design.

Planning Estimate

The ROW planning estimate is generally the first estimate produced to quantify ROW cost. The typical timeline for the planning estimate is 10 to 20 years prior to the forecasted construction letting time. These estimates are generally based on tentative ROW requirements given that the project is being projected to occur in the distant future. Another factor that contributes to the uncertainty of these early estimates is the inability to predict future changes in real estate values caused by issues such as government-introduced zoning changes, market conditions, and varying appreciation rates.

In many agencies, this estimate is not prepared by the ROW section, but by the planning division and the ROW section is consulted as needed, if consulted at all. Four of the nine interviewed agencies do not involve their ROW personnel at this point and resort to gross historical costs, comparable projects, or a percentage of the estimated construction cost to create the ROW estimate.

ROW requirements at the planning phase are usually based on a preliminary or conceptual project scope definition; therefore, ROW requirements are imprecise and will likely change. In addition, often several project alignments being considered, which adds uncertainty to the estimate. Five interviewed agencies (three SHAs and the cities of Chicago and Phoenix) develop a bottom-up ROW cost estimate completed by ROW personnel as part of their planning estimate. They believe this effort provides them with a more accurate prediction of future project cost.

This subsection discusses and reviews four practices used by SHAs for the planning-level ROW cost estimate:

1. Early Scope Definition;
2. Conceptual Cost Estimate Map;
3. Percent-based ROW Cost Estimate; and
4. Unit Cost Estimate Approach.

In general, project scope definition is an integral part of establishing the estimate basis; this also holds true for the ROW cost estimate. Many of the SHAs interviewed do not spend much time defining the project scope during the early stages of project development and consequently, this lack of definition increases the uncertainty with respect to ROW requirements. Another problem identified was the failure to communicate ROW requirements to ROW staff. A tool that may be useful in communicating ROW requirements effectively is a conceptual cost estimate map, which is discussed following early scope definition. Planning-level ROW cost estimates are typically completed by a unit-cost approach or a percent-based approach. These approaches will be discussed last in this section to highlight the pros and cons of each. These approaches lack accuracy and consistency since there are many complexities inherent in estimating the cost of ROW.

Early Scope Definition

Scope definition is critically important to the development of a cost estimate. In the case of a ROW cost estimate, scope definition is directly related to the completeness of the stated project ROW requirements. Consequently, if project scope does not explicitly define the ROW requirements, an accurate ROW cost estimate cannot be produced.

One SHA attempts to increase the exactitude of early project scope definition through a field visit of the project site (or multiple sites if there is more than one potential alignment). This visit is completed by an individual from the planning division along with the project manager. During the visit, likely project designs and pertinent project scope information such as the facility type, the number lanes, and access points are discussed. Following a thorough study of the information gathered as a result of the site visit, the planner communicates the ROW requirements to the ROW estimator. In this agency the estimate is completed based on research of land values (tax assessor records), condemnation rates, and other location specific attributes. The level of effort and detail used by this agency is in contrast with percent-based or unit-cost estimate approaches used by other agencies, which do not consider location-specific attributes. It has been shown through the literature and is evident through the interviews that location specific attributes have a large effect on estimate accuracy.

Some SHAs argue that developing this level of detail during the planning process is a waste of staff resources, since there are likely to be many future changes to the project scope. In the case of the Chicago and Phoenix and at least two of the SHAs, this is not true because they work hard early in planning to develop a definitive project scope. In many cases SHAs could significantly improve project estimates if an increased effort was made to better define the project scope including ROW requirements. This commitment does, however, dictate a greater investment of

time and resources early in project development, but according to those agencies that make the investment, it enhances control of project cost.

Conceptual Cost Estimate Map

The conceptual cost estimate map is a tool used by designers to communicate ROW requirements to ROW personnel. This map is used in conjunction with early scope definition. The term "conceptual" is used since it captures the early "conceptual" scope. Typically, the project designer provides the ROW estimator with an aerial photograph or drawing of all possible project alignments. The approximate ROW boundaries are drawn on these documents to communicate the ROW limits to the estimator. This easy-to-read tool clearly portrays the ROW requirements. One caution with this method is that the clear representation may convey more accuracy than is the case at such an early stage of planning.

One SHA does not complete early scope definition but still uses a conceptual cost estimate map to show the proposed location of the project. This SHA provides an aerial photograph to the ROW division, but the photograph does not include any lines denoting ROW boundaries. Approximate cross sections are then applied by the ROW division to determine the ROW approximate requirements.

Percent-based ROW Cost Estimate

Three of the SHAs interviewed use a percent-based ROW cost estimate procedure to develop a planning cost estimate. The percent-based cost estimate involves applying a percentage value to the estimated construction cost to determine the ROW cost portion for the planning estimate. During the interviews it was not clear how these percentages were determined. It seems that the percentage value was established so far in the past that staff could not explain how the percentage value was derived. The percent-of-construction estimate approach is advocated by SHAs for planning estimates based on the supposition that a more detailed ROW cost estimate would increase staff workload and require a more complete definition of scope. Using a percentage provides a quick and easy method for computing a ROW cost estimate when ROW requirements are lacking.

Although the percentage-based approach is quick and easy, two SHAs are of the opinion that these estimates are usually inaccurate and contribute to the cost escalation experienced on projects. The research findings seem to support this belief, as this percentage based estimate does not take into account location specific factors that effect ROW cost.

One SHA in particular used this percent based method as recent as 2004 but has transitioned away from such a procedure. The percentages were published in a state-wide estimating guide, which defined the percentage to be used based on project type. Another SHA completed a study on past planning estimates with the objective of exploring the basis and accuracy of planning level ROW cost estimates. This SHA is one of those where the ROW section does not provide the planning-level ROW estimate. The study was initiated by the ROW section as a result of some inconsistency related to cost escalation issues between planning estimates and later ROW estimates. This was really an attempt to understand the approach used by the planning division. The agency found that these percent-of-construction estimates are only a close approximation about half of the time.

Unit-Cost Approach

Another method utilized during planning to develop a ROW estimate, again typically where the ROW section is not charged with creating the estimate, is the use of unit-cost values (per acre or sq. ft). These unit costs are typically derived from historical data or by simply contacting the district/region where the project is located and asking for a cost value. Such values are often little more than a guess. Like percentage-based ROW estimates, these can prove to be poor

approximations of ROW cost as the issues that affect costs such as improvements, damages, and access issues (all location-specific attributes) may not be addressed using the unit-cost approach.

Programming and Preliminary Design Estimates

NCHRP Report 574 found that project cost estimates completed during the programming and preliminary design stages of project development are similar (Anderson et al., 2007a). The communication of ROW requirements, the cost estimation process steps, and the cost estimation tools that are used to create these estimates are similar. Therefore, the critical review in this section discusses programming and preliminary design ROW cost estimation together.

In general, and depending on project complexity there may be a number of cost estimates prepared during the programming phase. The last programming estimate is usually completed based on a preferred alternative. Once this estimate is approved, the project is placed in a priority program. This authorized priority program may span a period of 5 to 10 years prior to the construction letting date. It should be noted that the length of the priority program varies from state to state depending on both the structure of the agency and the state laws that govern SHA business. During preliminary design several estimates may be developed. At some point, the ROW cost estimate is typically completed for inclusion in the State Transportation Improvement Program (STIP). After its inclusion in the STIP, the project is fiscally constrained. In some states, the priority program is the same as the STIP or perhaps 1 year further out from letting than the STIP (4 years for federally funded projects).

Although there are many similarities between ROW cost estimates completed during programming and the cost estimates completed during preliminary design, there are several differences that are noted in this section. These differences typically stem from: (1) the level of scope definition (i.e., ROW requirements) upon which these estimates are based; and (2) the level of detail and information used to prepare these estimates (e.g., acres versus parcel estimates).

Scope definition is refined as the project development process proceeds, therefore the ROW requirements become better defined as the project moves from programming through preliminary design. The preferred highway alignment is typically chosen during the programming phase and ROW boundaries and rough parcels are known with more certainty than at the planning phase. These ROW requirements are identified on aerial photographs or schematic drawings, which are provided to the ROW section by the project manager or the lead designers. By the time the preliminary design estimates are developed, the majority of ROW boundaries are definite and exact parcels are identified.

In general, this section covers the critical review of the different practices, tools, and approaches used to complete the preliminary design and programming estimates found through the research. Specific tools covered in this section are the cost estimate map employed to communicate ROW requirements; estimate documents utilized in preparing estimates; estimate accuracy definition to communicate the certainty/uncertainty in estimates; and estimating software. The remainder of this section covers the practices and approaches which include the use of historical data in estimates; the use of appraisers as estimators; a parcel-by-parcel cost estimate approach; estimate reviews; and specific risk analysis and application of contingency practices.

Cost Estimate Map

The cost estimate map provided to ROW estimators at programming and preliminary design is similar in format to the conceptual cost estimate map discussed in the previous section on planning, but it provides more project detail. ROW boundaries are now specified but with greater certainty. Additionally at programming, the map should include rough parcel boundaries and approximate ROW areas. The map provided at preliminary design will include even more detail

with greater certainty as a function of the project development evolution. Parcel boundaries and ROW areas of each parcel are identified. The map shows other details relevant to the ROW such as access points to the highway, the type of takings, and access rights that are needed for construction. A cost estimate map is a good tool that aids the ROW estimator in understanding the real estate requirements and in establishing a basis for the ROW estimate.

Parcel-by-Parcel Cost Estimate Approach

A parcel-by-parcel cost estimate approach is characterized by the feature that the cost of each parcel is estimated on an individual basis. By treating each parcel as a unique piece of real estate it is possible to capture site specific unique cost affecting conditions. The alternative approach is to complete the estimate on an overall basis (total acres) at a macro-level by considering only gross parcel area and land type (e.g., residential, commercial, etc.). When completing a parcel-by-parcel estimate, the cost estimator determines a cost for each individual parcel, capturing ROW quantities and parcel attributes in detail. This estimate approach is similar to completing an appraisal since parcels are appraised one by one. The interviews found that the parcel-by-parcel cost estimate approach is used by only one SHA for the programming estimate; at the same time, the majority of SHAs interviewed utilized it for developing a preliminary design ROW cost estimate.

It appears that this approach to ROW cost estimating may produce a more accurate cost estimate because it incrementally captures the individual values in manner similar to property appraisals, and therefore more realistic acquisition values are used to develop the estimated. This causes the estimator to consider the required ROW real estate in more detail. For example, this is especially effective for estimating costs of damages because the cost effect must be considered for each individual parcel. It is difficult to accurately place a value on the damages from a partial taking unless one considers the effect on the particular business or residence located on the parcel.

Documented Cost Estimate Procedures

All SHAs interviewed have a published set of ROW procedures and these procedures are typically posted on the Internet. The majority of these procedures focus on the agency's appraisal and acquisition processes. Very few of the documented procedures discussed ROW cost estimation or ROW cost estimate management processes. Caltrans is one agency that has a ROW manual which includes ROW cost estimation. Chapter 4 of the Caltrans ROW manual (www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf) discusses ROW estimating. The chapter has four sections, the first of which outlines the general purpose and procedures behind the ROW cost estimation and management process. Section 2 discusses preparation of the actual estimate including all cost parameters. The chapter discusses in detail each aspect of ROW that may affect cost and provides specific guidance on each while the third section focuses on real estate inflation. The last section covers updating estimates, which focuses on management of the cost estimates.

The Ohio Department of Transportation (ODOT) has a manual titled, "Cost Estimating Procedures for Acquiring Right of Way" (2300 Cost Estimation . . . 2007). The ODOT procedure focuses on ROW cost estimating for major projects and minor projects. This classification of projects is defined in ODOT project development process (PDP) procedures. Major projects have 14 steps. ROW cost estimates are prepared at several of these steps. The first estimate is prepared to coincide with the first PDP step. Subsequent ROW estimates are updated based on the first estimate. The level of detail regarding ROW requirements increases as the PDP steps are preformed. Multiple updates of the ROW estimate are prepared to support alternative selection, for example. On minor projects fewer ROW estimates are prepared as the alignment is not subject to alternative analysis. Similar estimating approaches are followed. In general, ROW cost estimating techniques are discussed and the use of supporting information is identified. Cost val-

ues are provided for many estimate elements. An estimate form is used to capture all costs and summarize costs for a total ROW estimate.

Due to the lack of published guidance, ROW estimators, managers, and supervisors rely heavily on their experience to guide them in developing estimates. Experienced estimators are critically important to creating good cost estimates, but the ROW process is a complex undertaking and an effective set of procedures is essential in providing a reference for ROW estimators. Many experienced estimators are close to reaching retirement age. Therefore, the need for well defined and documented processes is becoming more important.

ROW/Design Tradeoffs

ROW staff can provide valuable insight about the cost effects of design decisions. Using such information the project design team can actively control cost escalation problems and may even reduce overall project cost. However, very few of the SHAs interviewed maintain effective coordination mechanisms between the design team and ROW staff, specifically communication to discuss the effect of design decisions on ROW costs. Even minor design changes can have significant effects on ROW cost, both increasing cost but just as importantly in reducing cost. One of the major factors in cost escalation is related to condemnation costs and awards greater than the appraised value following a court decision. ROW/Design tradeoffs offer the advantage of potentially affecting fewer properties and fewer condemnations. Another advantage of such cooperation is the ability to reduce the overall cost of projects and potentially provide funds within the SHA budget for more projects. Additionally, project delays caused by delayed ROW acquisitions can be a large contributor to project cost escalation even greater than the increase in ROW cost. Involving ROW personnel in design analyses can help to avoid costly project delays resulting from delays in ROW acquisition.

Historical Data

Most SHAs do not use robust historical data when preparing a ROW cost estimate during programming and preliminary design of a project. With the exception of one SHA, no interviewed agency use historical data. A major reason that historical data plays only a minor role in cost estimates is the recognition that the real estate values are volatile. When determining real estate values for ROW, it is necessary to use the most recent comparable sales in the area. Year-to-year inflation is not constant and can even differ by area; therefore, dated historical data is of little value when attempting to estimate real estate values. Historical data is only useful in areas where prices are relatively stable. However, when scope definition is not definitive (i.e., during planning), recent historical data may offer the best estimating methodology, but such data should not be the sole basis for the estimate. Whenever historical data is used, contingency should be applied for the uncertainty involved in predicting future values based upon past behavior, but even this is difficult.

Historical data is more useful in estimating demolition costs, relocation costs, and support costs (indirect costs). These items tend to correspond with historical data and lack the complexity associated with estimating real estate values, condemnations, and real estate inflation. Support costs include the work-hours and costs related to completing the cost estimates, appraisals, and acquisitions which must be charged to the project. These costs can be estimated relatively easily and accurately based upon the size of the project, number of parcels, and other project attributes.

It is difficult to predict cost estimate parameters such as condemnation or real estate inflation using historical data, but some insight may be gained by understanding the general trends and tendencies shown by historical data. Condemnation rates can be predicted with some accuracy since they are governed by state laws and SHA policies, but there is still uncertainty, especially related to the human factor. Historical data showing past real estate inflation rates may offer some

insight into predicting the future inflation rate, but the historical relationship is tenuous as land values are volatile and dependent on many factors including government zoning decisions.

Estimate Documents

To ensure that all major cost items for ROW are included in the estimate, several SHAs utilize standardized cost estimate sheets or data sheets. All aspects of the ROW estimate are listed as line items on these sheets. Such standardized sheets help the estimators track all cost items and serve to present the cost estimate data in an easy to understand format. Standard formatting is important for reviewing and updating estimates. Although most SHAs use some sort of estimating sheet, it is important to standardize these so that when reviews and communication of the estimates occur, the estimates are easy to read and understand. As discussed in previously, cost estimate sheets vary from one SHA to another, but the main elements of the estimate are typically (1) land; (2) improvements; (3) relocation costs; (4) damages; and (5) condemnations. Other costs that may be included are support costs, demolition costs, and utility relocation. How these costs are documented depends on SHA policies and procedures. Figure 1 shows an example of a partial cost estimate sheet used by Caltrans.

Appraisers Employed as Cost Estimators

The ROW cost estimators at one SHA are licensed and experienced appraisers. This does not seem to be a common agency practice. Employing appraisers as ROW estimators appears be effective for this SHA as the appraiser turned estimator brings valuable knowledge and experience to the cost estimating process. These estimators can potentially produce better estimates because they understand the actual appraisal process and how the appraisers in the field derive a value for each parcel.

Risk Analysis

ROW cost risks are associated with schedule, real estate inflation, condemnations, damages, and potential future development. This risk issue is critical when preparing estimates in general and can be particularly important to determining contingency amounts for a ROW cost estimate. Performing a risk analysis alerts the project participants of cost risks during the estimating process. Only two SHAs out of the nine interviewed complete a detailed or formal risk analysis for the ROW cost estimate. A formal risk analysis is one in which a systematic approach is used to identify major risks. The risk analysis completed for ROW cost consists of considering schedule risks, risks associated with real estate value inflation, and condemnation risks, plus others that are deemed critical to a particular project. Based on the risk analysis the estimator would add an appropriate contingency amount to the cost estimate.

The Washington State DOT (WSDOT) requires that projects follow its formal Cost Risk Assessment (CRA) or its Cost Estimate Validation Process (CEVP) in the case of projects of significant size (greater than $20 million for CRA and greater than $100 million for CEVP at the time of this report). Both of these processes focus on the total project cost estimate. As part of both the CRA and CEVP risk assessment processes, ROW personnel participate in risk workshops when the project involves purchase of ROW. This workshop first validates the cost of the project and its component parts (including ROW) and then assesses estimate uncertainty in terms of cost variation and potential risk events. Through this process, the ROW cost estimate is reviewed and then specific risks are identified. These risks are assessed in terms of probability of occurrence and the magnitude of effect. The cost effect of the ROW risks are then included with the overall project cost estimate as a form of contingency. The ROW risks are highlighted in the workshop report and managed by the project team, which includes ROW personnel.

Another SHA completes an in-depth look at all project risks, which begins with the field visit completed by the estimator. This field visit is used by the estimator to "size up" the project. It

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
RIGHT OF WAY DATA SHEET
(Form #)

EXHIBIT
4-EX-1 (REV 3/2004)
Page 1 of 6

To:
Attention:

Date
Dist ____ Co ____ Rte ____ P/M (K/P) ____
EA
Project Description

Subject: Right of Way Data

Alternate No.

This Alternate meets the criteria for a Design/Build project: Yes ☐ No ☐

1. Right of Way Cost Estimate: To be entered into PMCS COST RW1-5 Screens.

		Current Value Future Use	Escalation Rate		Escalated Value
A.	**Total Acquisition Cost**				$ 1A1
	Acquisition, including Excess Lands, Damages, and Goodwill.	$ 1A2	1A3	%	$ 1A4
	Project Permit Fees.				$ 1A5
B.	**Utility Relocation** (State Share)	$ 1B1	1B2	%	$ 1B3
C.	**Relocation Assistance**	$ 1C1	1C2	%	$ 1C3
D.	**Clearance/Demolition**	$ 1D1	1D2	%	$ 1D3
E.	**Title and Escrow**	$ 1E1	1E2	%	$ 1E3
F.	**Total Estimated Cost**	$ 1F1			$ 1F2
G.	**Construction Contract Work**	$ 1G	*(These are construction costs that are to be included in the projects PS&E.)*		

2. Current Date of Right of Way Certification 2

3. Parcel Data: To be entered into PMCS EVNT RW Screen.

Type 3A	Dual/Appr 3C	Utilities 3D	RR Involvements 3E
X		U4-1	None
A		-2	C&M Agrmt
B		-3	Svc Contract
C		-4	Design
D		U5-7	Const.
E XXXX		-8	Lic/RE/Clauses
F XXXX		-9	

Total 3B

Misc. R/W Work
RAP Displ 3F
Clear/Demo 3G
Const Permits 3H
Condemnation 3I
Excess

Areas: R/W ____ No. Excess Parcels ____
Entered PMCS Screens ___/___/___ by ____
Entered AGRE Screen (Railroad data only) ___/___/___ by ____

Figure 1. ROW cost estimate sheet used by Caltrans.

provides the opportunity to judge the complexity and severity of effects that will result from takings. The estimator must make a judgment call of "high," "medium," or "low" in terms of invasiveness relative to the takings. This will later affect how parcel specific costs and risks are quantified such as damages and improvements. Also during the field visit, the estimator takes note on the geography of the land and current land use as well as trying to make assumptions for possible future development. It should be noted that analyzing the possible future development in an area can be difficult to predict, especially on vacant parcels, but the estimator has a better grounding for making a judgment to account for risk. Following the field visit, the estimator will complete the risk analysis by identifying and evaluating all factors that may affect the project. Contingencies are applied based upon the risk analysis. Specifically related to condemnations,

the estimator will estimate a percentage of parcels that go to condemnation versus a percentage that will settle. These percentages are a direct reflection the estimator's rating of "high," "medium," or "low" in terms of invasiveness as made during the field visit. A contingency is then applied for the costs of litigation. Risks are considered for environmental issues, title issues, or other miscellaneous issues where a dollar amount will be applied to the estimate based upon the probability of occurrence and severity. The potential risks of real estate inflation are considered in addition to considering any unknowns that have not been addressed throughout the risk analysis.

Application of Contingency

Contingency should be applied to cost estimates to account for the unknown or uncertain events (Anderson et al., 2007b). Only four of the SHAs interviewed confirmed the use of contingency amounts in their ROW estimates. Each SHA uses percentages for contingency values, except in the case of WSDOT, which uses range estimates when conducting a CRA or CEVP risk analysis.

One of SHA is restricted by agency policy from applying contingency to anything but condemnation. A second SHA applies contingency as a rate that ranges from 20 to 25 percent depending on the judgment of the estimator. The third agency applies a set factor for three separate cost areas in the programming phase ROW estimate. These are: (1) schedule; (2) administrative; and court costs; and (3) market appreciation. These contingency rates are built into the agencies estimating sheets and therefore are applied to every ROW estimate. Although these contingency factors are not the product of a risk analysis, the agency reports that they appear to be basically accurate for most projects.

The issue of risk analysis and the setting of contingency were raised during the original NCHRP Project 8-49 study and is a concern when considering ROW cost estimating. Contingency funds are typically applied in response to some project uncertainty or to account for inadequate scope definition (Anderson et al., 2007b). This should especially be the case for early estimates, particularly during Planning where there are many uncertainties and project scope is extremely broad. Condemnations should be one of the major areas looked at for risk and the application of an estimate contingency, but there are others including real estate inflation/appreciation, potential future development, and project schedule.

Estimate Accuracy Definition

In addition to a detailed risk analysis and the application of contingency, one SHA attempts to quantify estimate confidence for the benefit of those that use the estimate. This is not a formal risk analysis but only the estimator's personal assessment. After completion of the estimate, the ROW estimator assigns a rating of A, B, C, or D. A letter grade of 'A' indicates the highest level of confidence while 'D' is the lowest. This becomes important when an estimate must be updated as a result of SHA policy or a design change because it communicates to others the estimator opinion of the cost estimate's accuracy. Therefore, in the event of an update or change, the estimator (either a new estimator or the original one) will have a general idea of where the estimate stands while giving them a point of reference to begin the update. For the same reason it is also important to note that limitations and assumptions should be recorded for each estimate.

Estimating Software

Standard ROW-specific estimating software was not discovered to be in use by the seven SHAs and two cities interviewed. However, several SHAs have developed ROW cost estimating programs or spreadsheet workbooks. The Virginia DOT (VDOT) has developed an in-house estimating system called Project Cost Estimating System (PCES). This cost estimating program covers all project related costs including ROW. The system was initially developed by engineering as an

early estimate tool. PCES appears to be somewhat cumbersome for ROW; however, it does address all areas of the ROW component. The system requires input for all of the cost areas of ROW to produce an estimate therefore it serves as a tool to ensure that all cost aspects are considered. Estimators prepare an estimate in present dollars and the system automatically applies inflation. Screen captures of the estimating system are shown in Figure 2, Figure 3, and Figure 4.

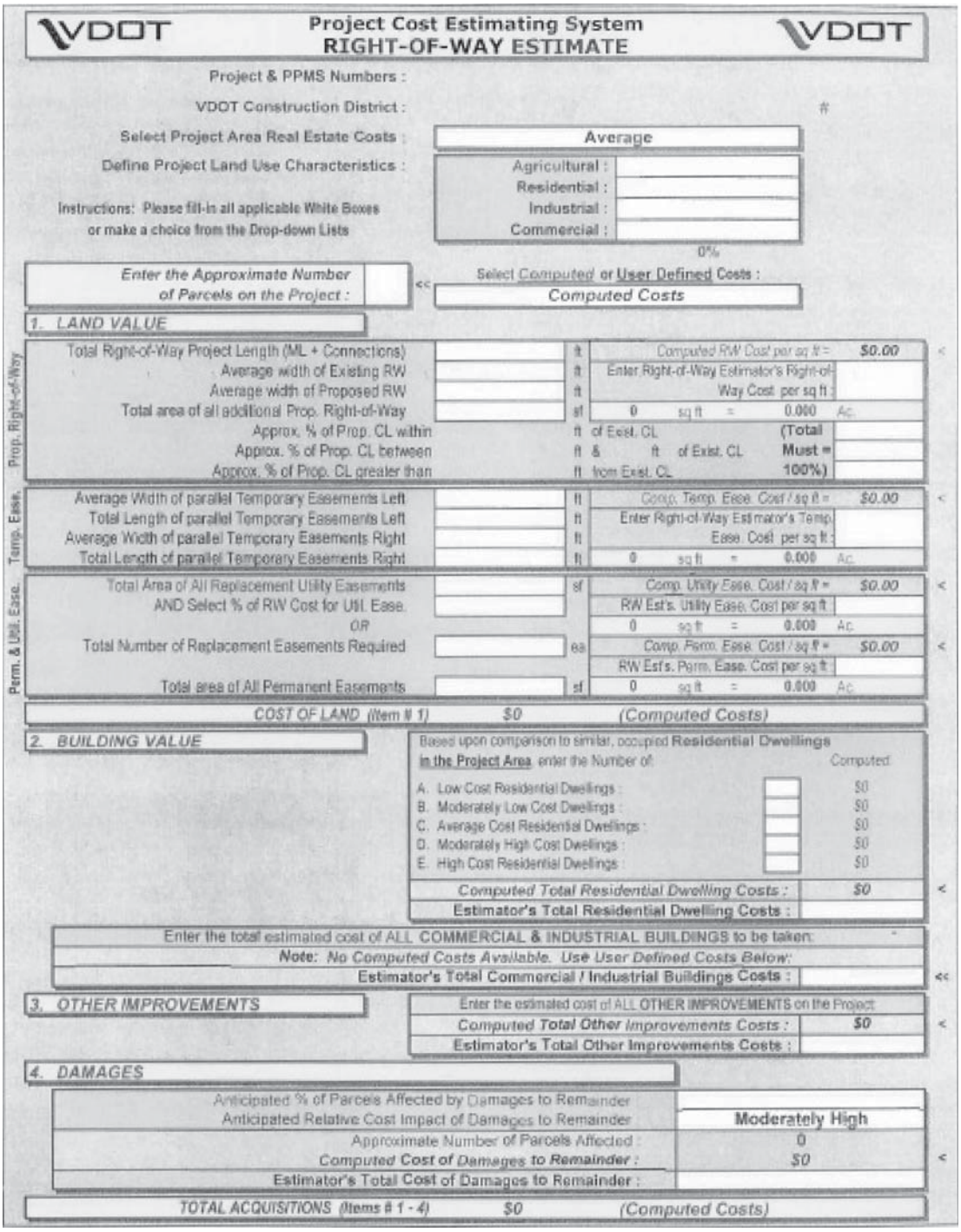


Figure 2. Screen capture of VDOT's cost estimating system (PCES).

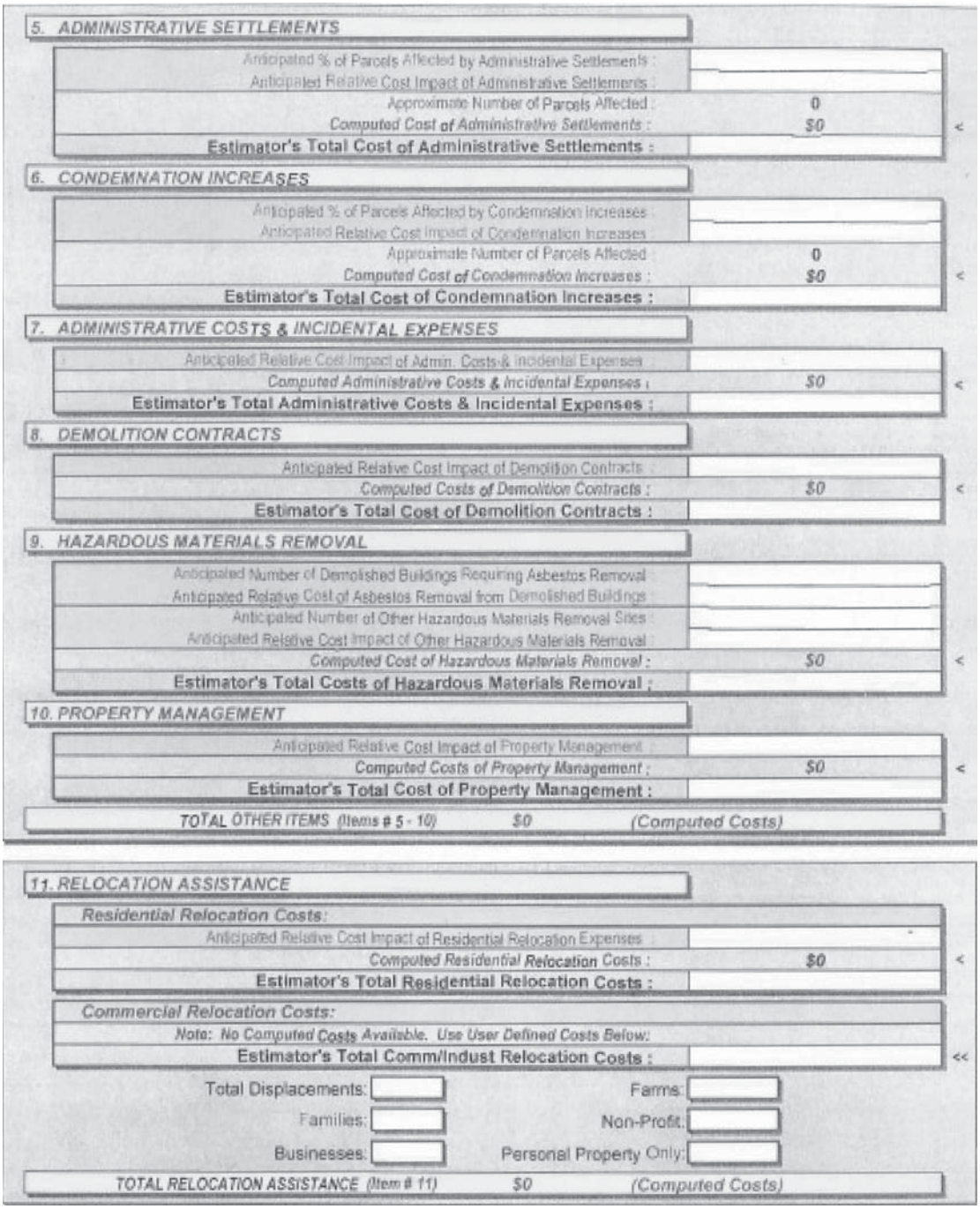


Figure 3. Screen capture of VDOT's cost estimating system (PCES).

In addition to the cost estimate system described above, individuals in several SHAs have developed detailed spreadsheet systems to complete their ROW cost estimates. In general, the workbooks cover all aspects of the ROW that are covered in the above screen captures and appear to be used for the same function. Estimating software and the use of estimating workbooks tend to structure the estimating process and provided consistency from estimate to estimate. This is especially favorable in large SHA organizations.

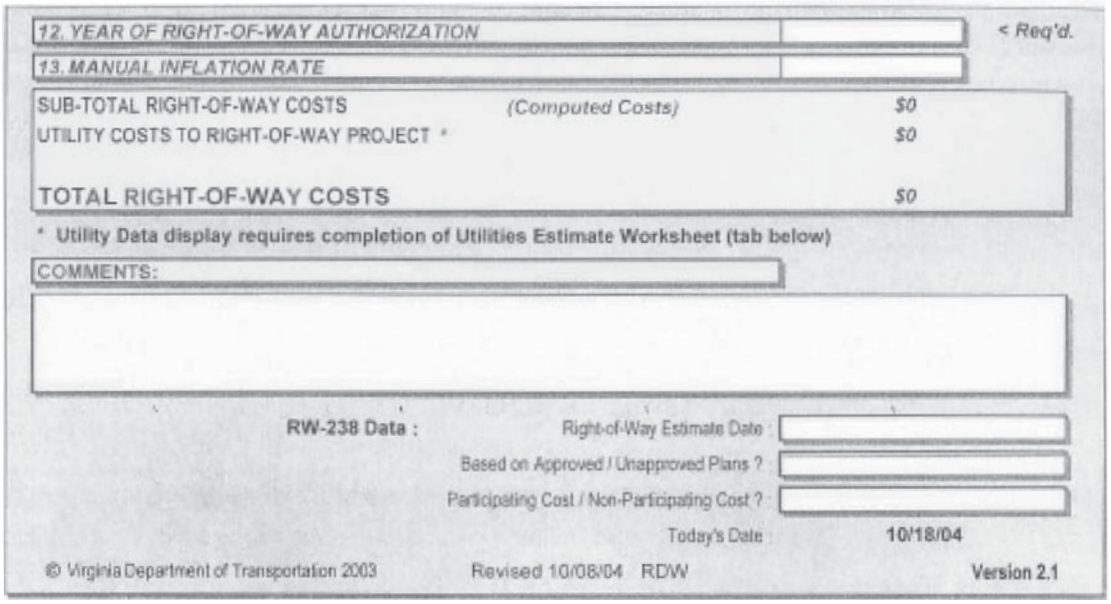


Figure 4. Screen capture of VDOT's cost estimating system (PCES).

Estimate Reviews

Review of ROW estimates is typically limited to an examination by the immediate supervisor of the estimator. The majority of SHAs require that a supervisor or ROW manager sign off on the estimate. In most cases the supervisor or manager will perform a quick review of the estimate to check whether major component costs seem reasonable. For the preliminary design estimate, one SHA reported performing a number of "mini estimate" checks on project parcels. A "mini estimate" is an estimate completed on several parcels within the project that may have a high effect on the ROW cost. High effect parcels are those where a large damage amount is expected or ones having many improvements. These mini estimates are checked against the corresponding parcels within the actual estimate. Based on the results of this comparison, the cost estimate is either (1) approved and communicated to design, or (2) it is sent back to the ROW estimator for further work. Another SHA uses a weekly one-hour meeting involving program managers along with the director, assistant director, budget supervisor, and engineering supervisors to review "critical projects." Critical projects are those in which budget, utility, or ROW problems exist. This allows all of the agency's upper management to consider the projects and their estimates and to provide input.

Every ROW estimate should be reviewed by management. This research and previous NCHRP Project 8-49 research documented in *NCHRP Report 574* confirms this. However, it was found that the level of review at some agencies is minimal. Especially in cases of large projects, a higher level review that includes more of an effort by management to scrutinize and evaluate estimates should be undertaken.

Final Design

When a project transitions from preliminary design into final design, ROW requirements are not usually restated. In essence, the ROW process must be completed ahead of other design elements in the project development process to ensure that all ROW real estate is acquired prior to construction. Another estimate or estimate update is not typically required since appraisal and

acquisition have begun. In the case of an ideal project, all parcels will be acquired before construction begins, but this is not always the case. When construction is scheduled to begin, most states first require one of three things: (1) that all property be acquired, (2) a right of entry is granted to the SHA by the property owner; or (3) the parcel is in the condemnation process. Otherwise, construction may have to be delayed and that has the potential of affecting overall project costs and other aspects of the project. Cost estimating practices relative to final design were limited to the use of ROW tracking systems which are now discussed. The interviews did not identify any cost estimating practices that occurred during final design. At this point in project development, the SHA has begun making appraisals and acquiring properties.

ROW Tracking Systems

ROW tracking systems are currently in use by several of the SHAs interviewed. In general, a ROW tracking system is a data base containing information on individual parcels. They provide a means for assembling and retrieving parcel information easily. Out of the nine interviewed agencies, three SHAs have ROW tracking systems. These are (1) the Virginia DOT's Right-of-Way and Utilities Management System (RUMS); (2) the Washington State DOT's Real Estate Information System (REIS); and (3) the Minnesota DOT's Right-of-Way Electronic Acquisition Land Management System (REALMS), which is the most advanced of the three identified. Following the approval of the ROW estimate at the preliminary design phase, the dollar value for ROW is input into the system. Further data is input after appraisal and acquisition. These systems serve as a database of past and up-to-date parcel data across the state and have the potential to be used for recent comparable sales, predicting possible inflation rates, predicting condemnation rates, or other ROW-specific parameters or statistics. Instant access and availability of these forms, reports, and data is a major advantage of the systems, particularly when managing costs during appraisals and acquisitions, which is discussed in the next section under ROW management. The Minnesota system is mapped to the business structure of the SHA with approximately 150 forms and 90 reports that are used throughout the ROW division. This allows all employees of the SHA to access the forms and reports used in daily operations. Consultants are also being trained on the system to allow the SHA the versatility to contract out ROW appraisals and acquisition and still track the parcels.

ROW Estimate Management

This research considered ROW management practices in addition to cost estimation practices. This is reflected in the list of nine steps. ROW Cost Management uncovered through this research may be divided into two related but separate categories: (1) cost estimation management and (2) ROW cost management. Cost estimation management is defined by *NCHRP Report 574* as "a process for evaluating changes in scope and other issues that affect project cost." These evaluations should be preformed for each cost estimate prepared during the project development process (Anderson et al., 2007a). In other words, the evaluation serves as a check-and-balance system for all estimates by checking each estimate for changes that affect cost and then evaluating those changes to determine whether the changes are necessary and/or acceptable. Although similar in many ways, *ROW cost management* can be described as the process in which the actual ROW costs reflected in appraisal and acquisition are managed to the dollar amount established as the baseline budget. Both of these ROW management processes are discussed in this section.

ROW Cost Estimation Management During Preliminary Design

ROW cost estimates prepared during programming become part of the project estimate that is approved for the construction program, consequently used for establishing the baseline cost

estimate. Following the establishment of the baseline cost estimate and thus at the beginning of preliminary design, the basis for cost estimation management is established. Any future cost estimate updates should be checked and managed against this baseline. In particular, *NCHRP Report 574* defines two steps as falling within the realm of cost estimation management, which usually occur after an estimate is completed. These are

- Obtain appropriate approvals and
- Determine estimate communication approach.

These two steps follow the review of an estimate. Appropriate approvals should be sought only after an estimate has been reviewed. By signing off on the estimate, management is agreeing that the cost estimate is completed to the best possible level of accuracy based upon project complexity, scope definition, availability of cost data, and other constraints. If the estimate is not approved and needs to be changed, it will be return to the estimator. In addition, project scope and project conditions should be constantly reviewed for any changes that affect estimated cost. As these changes are identified they should be evaluated for cost effects and the cost estimate should be adjusted accordingly. After approval, the estimate communication approach used to communicate the estimate amount to design personnel should be chosen and should consider the degree of estimate uncertain and the intended use of the estimate.

Only a limited amount of evidence of cost estimation management surfaced during interviews, but every estimate completed at the preliminary design phase should go through some type of cost estimation management process. Cost estimation management should be practiced to control project cost, schedule, and scope (Anderson et al., 2007a). For example, in the event that a cost increase is identified in subsequent estimates following the baseline estimate, the reason for this should be examined and evaluated. The SHA should look at the change in cost and see if it is really necessary. If it is necessary and acceptable, other areas within the estimate should be examined to find areas where ROW dollars can be saved to bring the estimate back within the budget set by the baseline estimate. This examination applies both to managing ROW cost and total project cost.

ROW Cost Management During Final Design

For ROW the final design phase of project development typically marks the point where cost estimation is phased out and appraisal and acquisition actions begin. As plans and specifications are nearing completion, final ROW plans are usually released. Up to this point in project development, the cost management function of ROW should have consisted of managing cost estimate amounts against the baseline estimate (the baseline estimate is often used to program the project in the STIP). Beginning at final design, the cost management function should transition from managing subsequent estimates to managing the actual costs (or cost control). These costs are reflected in acquisitions and should be compared with the preliminary design cost estimate. In other words, parcel-specific cost estimate data should be compared with the parcel-specific acquisition costs to determine how actual costs compare with the estimated amounts. If a cost does not match the estimate, deviations should be evaluated and projections of total final cost made accordingly. *NCHRP Report 574* identified three steps related to Cost Management. They are

- Monitor project scope and project conditions;
- Evaluate potential effect of change; and
- Adjust cost estimate.

It is the goal of ROW Cost Management to complete acquisitions on budget with the estimates, but even if the management process cannot change the effect of the immediate

cost escalation problem for that project, lessons can be learned by this process for future projects.

Summary of Notable Practices

Although many of the SHAs interviewed for this research are struggling with project cost escalation, particularly with the effects of ROW cost escalation, there were some successful practices identified during the interviews. Table 1 summarizes the noteworthy SHA practices identified through interviews. The table does not include all practices critically reviewed, but only summarizes the most successful practices identified by this research.

Table 1. Summary of notable practices identified through SHA interviews.

Project Development Phase	Best Practice	Description
Planning	Conceptual Cost Estimate Map	Aerial photo or map of each potential alignment showing approximate ROW boundaries.
	Early Scope Definition	A Planner and Project Manager (or Design Engineer) performs a field visit to discuss probable design parameters relative to ROW. Basic parameters such as the number of lanes, the number of retention basins, potential access issues, and expected ROW/Design tradeoff issues should be provided to the ROW estimator.
Programming and Preliminary Design	Cost Estimate Map	Aerial photo or detailed map consisting of overall ROW boundaries, parcel boundaries, and ROW areas. The map is provided by the Project Manager or Project Engineers to the ROW division when requesting a ROW cost estimate. Maps will most likely vary in detail between the Programming and Preliminary Design estimates.
	ROW/Design Tradeoff	ROW personnel provide input into design to discuss effects of design decisions on ROW costs.
	Appraisers as Estimators	Employ experienced and knowledgeable ROW appraisers as ROW cost estimators for improved ROW cost estimates.
	Cost Estimate Sheet	A cost estimate document usually in spreadsheet form which includes line items for all cost items of the ROW estimate.
	Risk Analysis	A thorough risk analysis is completed for each cost estimate completed by the ROW division to include such risks such as time, property value inflation, and condemnations among others. In addition, ROW risks are captured through the WSDOT CRA and CEVP workshop process.
	Estimate Accuracy Definition	An approach to quantify confidence in each estimate that is completed throughout Project Development. After completion of the estimate, the ROW estimator assigns a rating of A, B, C, or D. A letter grade of 'A' indicates the highest level of confidence while 'D' is the lowest.
	Cost Estimating System	A cost estimating tool used throughout the agency's estimation process for all areas of the project. Particularly for ROW, it addresses all areas of ROW (e.g. land value, building value, other improvements, damages, etc.) and requires that a value for each of these areas must be input. This serves to account for all cost items affecting ROW cost.
Final Design	ROW Tracking Systems	The system has the ability of cost reporting and tracking of each parcel from appraisal through acquisition and can support forecasting of cost to complete the acquisition process (i.e., cost management). It is not used as cost estimation tool but may offer potential as a source of recent historical data and market trends for land values.
	ROW Cost Management	A technique of managing actual costs reflected by tracking appraisals and acquisition costs against the preliminary design cost estimate.

Appendix Summary

Cost estimation and cost estimate management practices currently used by SHAs were reviewed during the research and analyzed in relation to the project development phases. This appendix discusses these SHA practices in reference to ROW estimates completed at the various phases of the project development process. The appendix also discussed ROW management in relation to both the management of the estimates completed during preliminary design and the management of actual costs during final design. Additionally, the appendix summarizes the successful practices discovered through agency interviews.

APPENDIX E

State of Practice

This appendix discusses the methodology and findings of Tasks 1 and 2 of the research effort. The purpose of Task 1 was to complete a comprehensive literature review relative to ROW cost estimating while Task 2 involved examining and documenting successful ROW cost estimation and cost management practices.

The literature review completed by the research team for NCHRP Project 8-49 served as the foundation for additional searches of published information concerning ROW estimation. It was necessary to update the original literature review because there has been additional work around the country directed at estimation accuracy since the NCHRP Project 8-49 literature review was conducted. The present literature review specifically targets ROW issues. Therefore, the main objective of Task 1 was to identify documented practices in the area of cost estimation and cost estimate management specifically relevant to the ROW component of project development. This review primarily focused on current literature and established the basis for the later stages of the research.

The main objective of Task 2 was to gain an overview of SHA ROW practice. Additionally, the practices of several other agencies engaged in estimating the cost of future ROW purchases were examined. Consequently, successful SHA and local public agency practices in estimating and managing ROW costs were examined in detail. The research team assembled data on state-of-practice cost estimating and cost estimate management techniques, including process steps and tools in relation to the project development phases presented in Chapter 1.

Literature Review

The objective was to identify documented practices in the area of cost estimation and cost estimate management specifically relevant to the ROW component of project development. The literature review included locating and reviewing information found in technical papers, reports, and documents. The sources were

- General internet search engines;
- The Transportation Research Board's TRIS Online;
- Academic databases, such as LexisNexis and Engineering Village 2;
- The ASCE Civil Engineering database;
- Selected SHA websites; and
- Presentations and papers posted on AASHTO's Subcommittee on Right-of-Way and Utilities website.

The literature review concentrated on documenting and comparing factors and variables that affect ROW cost estimating such as project type, property value prior to the project, anticipation

of future land use change, timeline, information available at the time of the estimate, and type of acquisition. Information related to the ROW cost estimation and cost management processes and tools in the literature were surveyed. The accumulated information was reviewed, analyzed, and summarized. Although there is an abundance of literature on appraisal and acquisition of ROW, the research team discovered only a limited amount of information that specifically related to ROW cost estimation and cost estimate management.

ROW Cost Estimation and Management

The initial NCHRP Project 8-49 research identified ROW costs to be a critical highway project cost escalation driver. This was further confirmed by the literature review. ROW cost estimation is a complex undertaking dependent on a magnitude of parameters that are difficult to quantify, even in the case of an identifiable date only a few years in the future. ROW cost estimates must capture all costs that affect the expense of acquiring the needed property. This is exceedingly difficult due to the uncertainties involved in many aspects of ROW acquisition. It is typically necessary to capture deterministic values for each parcel in the following categories:

- Land;
- Property improvements;
- Damages to property in partial takings;
- Utility relocation; and
- Relocation assistance.

The literature particularly stresses the difficulty in estimating ROW cost due to uncertainty in real estate appreciation and the issue of damages resulting from a partial take. Land values constantly fluctuate and future values are difficult to assess, especially in the case of estimates completed during the earliest stages of project development. Damages are affected by the size and shape of the remainder area, location of the remaining access points, reductions in highest and best use, and length of remaining frontage (Buffington et al., 1995).

In addition, takings by eminent domain or condemnation must be considered when developing an estimate—that process increases the cost of an acquisition because of legal fees and the court's sympathy toward a land owner. Eminent domain proceedings add cost uncertainty because real estate value is determined by judges or juries instead of by definitive market information. Almost 80 percent of all acquisitions are completed without condemnation (CTC Associates and WisDOT, 2006) leaving about 20 percent of parcels, on average, that proceed to eminent domain. However, the percentage of properties proceeding to eminent domain increases when owner's legal fees are paid by the SHA (FHWA, 2006).

The US Supreme Court case of Kelo versus City of New London, which was decided on June 23, 2005 (Kelo, 2005), affected eminent domain expense throughout the nation (Cambridge Systematics, 2006). The Kelo case involved the use of eminent domain by the city of New London, Connecticut, for a community redevelopment project that benefited a private entity. The Court ruled 5 to 4 that the city's action was permissible under the Takings Clause of the Fifth Amendment. Following wide criticism of the ruling, during the period immediately following the ruling and through July 31, 2006, 29 states enacted changes to their eminent domain laws in one or more of three ways: (1) restricting the use of eminent domain to certain situations; (2) requiring additional procedures when using eminent domain; and/or (3) defining or redefining certain terms associated with eminent domain (U.S. Government Accountability Office, 2006). Federal legislation was also passed in 2006 to address the issue of using Federal funds in eminent domain. Section 726 of *The Transportation, Treasury, Housing and Urban Development, The Judiciary, and Independent Agencies Appropriations Act of 2006* established that federal funds can only be utilized for public use where "public use" excludes economic redevelopment (Towcimak, 2006).

Public use is further clarified with the wording that is should "not be construed to include economic development that primarily benefits private entities" (Transportation, 2006). While the language of the 2006 Appropriations Act was applicable only to projects funded by the act there is similar language in the 2008 Act (PL. 110-161).

New compensation requirements benefiting property owners have also been passed by some states since the Kelo decision (Feldman, 2007). These state acts address

- Acquisition costs, including appraisal fees, attorney fees, and expert witness fees;
- Relocation costs, including actual costs of rebuilding structures and compensating business for loss of business; and
- "Supercompensation" payments, meaning paying a certain percentage over fair market value.

The accuracy of an estimate is also affected by time constraints placed on completing the estimate, the quality of information available, and project and parcel complexity. Accuracy suffers under estimate preparation time constraints because the estimator has a limited amount of time to research the project and appraisal data. Similarly, the quality of available information can have a negative effect on the estimate because the estimate can only be as accurate as the information upon which it is based. In an attempt to improve ROW cost estimates, several tools and models for ROW cost estimation have been developed. Recently a cost estimation model was developed by Kockelman et al. (2004) in cooperation with TxDOT. Based on data from TxDOT and a commercial property database (CoStar), three models were developed. The accuracy of these models in predicting parcel acquisition cost was acceptable in the case of agricultural and vacant parcels, but the model lacked accuracy in the area of commercial and residential takings. Although the models were not accurate predictors in these areas, the authors argue that the tool may be used in budgeting for gross total ROW cost in a TxDOT District (Kockelman 2004).

Early ROW estimates are often only gross approximations arrived at by using a percentage of the estimated construction cost (CTC Associates and WisDOT, 2006) or some other order-of-magnitude estimating technique. Project definition is frequently nebulous during the planning phase of project development; therefore, ROW boundaries at this point are not well defined. Furthermore, there may be multiple project alternatives being considered during the planning stage of project development. Alignment changes are likely, and these may significantly affect the ROW cost estimate.

It was reported that early public involvement in the form of public meetings is beneficial because it allows the SHA to gauge the level of support for a project. This can serve as an indicator of the rate of condemnations and even the amount of contingency to include in the estimate (CTC Associates and WisDOT, 2006). A larger ROW cost contingency might be necessary if public support is absent because this may be an indicator as to the number of condemnation parcels that can be expected.

Selected SHA websites, including those of California, Florida, Georgia, Minnesota, Ohio, Wisconsin, and Virginia, were searched for procedures and manuals on cost estimation of ROW and other aspects of ROW procurement. Much of the material found on the SHA websites related to appraisal and acquisition of property, including procedures and forms used throughout the process. Caltrans devotes a chapter of its Right of Way Manual (Right, 2007) to ROW cost estimating. This information can be found on line at www.dot.ca.gov/hq/row/rowman/manual/ch4.pdf (Estimating, 2007). The manual specifically discusses aspects of the estimate and general estimate information. The Ohio DOT has a specific procedure for estimating cost of ROW (2300 Cost Estimation . . . 2007). This procedure is tied to the Ohio DOT project development process.

ROW Appraisal and Acquisition

It should be emphasized that much of the literature focuses on the appraisal and acquisition of the parcels rather than directly discussing cost estimation and cost estimate management. Kockelman discusses how the dollar amount for appraised property values is established through three methods: (1) the Sales Comparison Approach; (2) the Income Approach; and (3) the Cost Approach (Kockelman et al., 2004). These approaches vary in methodology and application. The Sales Comparison Approach in which comparable sales in the area establish the base dollar value of the property is, by far, the most common approach. The Income Approach is typically used in commercial or investment properties. It attempts to estimate the income that will be realized from the property. The Cost Approach is used when comparable sales cannot be found in the area and calculates the cost of replacement minus any depreciation of the existing structure.

The Uniform Act of 1970 (Uniform, 1997) governs the treatment of property owners for all federally funded projects by providing a set of procedures and standards for ROW acquisition. The major implementation of this act is that all property owners be justly compensated for their property and receive relocation assistance.

Condemnations are a concern when acquiring property because they can increase costs and delay the project. Condemnation rates (or the percentage of properties that move to condemnation proceedings) vary from state to state. The FHWA notes that the percentage of parcels proceeding to condemnation can be reduced by (1) the use of mediation methods between the property owners and public agency; (2) the use of well-trained ROW agents handling acquisitions who are authorized to negotiate settlements; and (3) the use of quick settlements in lieu of allowing the property owner a long period of time to consider the offer (FHWA Office of Real Estate Services, 2006).

Hakimi and Kockelman (2006) discuss best acquisition processes while considering the uniqueness of each state in terms of political, social, environmental, and other factors. They recommend that the public should be contacted early in the process and that states should update laws and statutes to outline compensable items so as to streamline the acquisition process. Additionally, special acquisition techniques, such as land exchange, land consolidation, and advanced acquisition, should be used. Such techniques may not be available in all states; however, such techniques should be considered to the extent allowed under state law. A few such techniques are outlined in the "European Right of Way and Utilities Best Practices" report (*European,* 2002).

In summary, the method of ROW appraisal and acquisition can affect the accuracy and consistency of cost estimation and cost estimate management. Appraisal and acquisition methods must be understood by those who prepare ROW cost estimates. The appraisal and acquisition methods should be integrated into the overall project development process. As noted in the literature review of cost escalation factors completed in the NCHRP Project 8-49 research, inaccuracies and/or delays in ROW acquisitions can affect project cost escalation profoundly.

Literature Review Summary

The literature review provided a basis for further research. ROW appraisals and acquisitions constitute much of the ROW literature. The ROW cost estimation literature that was discovered was limited to several statistical estimating models, discussion of the effect of the Kelo case, and several piecewise descriptions of the line items of an estimate. It provided selected information on the effects of condemnations, land appreciation, and damages.

Research Methodology

In addition to the literature review, a series of onsite and telephone interviews were conducted with agencies across the United States. The goal of these interviews was to collect data on current successful ROW cost estimation and cost estimate management practices. Seven SHAs and two local public agencies were interviewed.

Interview Protocol

An interview protocol was developed to guide data collection during interviews. The objective of the interview protocol was to capture successful practices, including ROW cost estimation process steps and tools. It was modeled after the interview protocol used for NCHRP Project 8-49. Questions were developed based on findings of the literature review. In particular, the literature review findings identified problem areas that needed to be addressed through the interviews.

The interview protocol covered six areas and consisted of 15 questions. The areas of interest to this research were similar to those in the original NCHRP Project 8-49, but were more specific to ROW issues. The interview questions examined six areas within ROW cost estimation and cost estimating management:

1. Determining ROW Requirements;
2. ROW Cost Estimate Preparation;
3. ROW Cost Estimate Reviews;
4. ROW Cost Estimate Communication;
5. ROW Cost Estimate Management; and
6. State Laws and Other Factors that Affect the ROW Process.

The six areas of interest governed the organization of the interview protocol. Section 1 of the protocol explored the process steps and tools used by the SHAs to determine ROW requirements. Based on these steps and tools, Section 2 examined how ROW estimators produced estimates for the defined ROW requirements. More specifically, it addressed policies and procedures guiding estimate preparation, the elements of each estimate, how environmental issues were handled in the estimate, whether risk and uncertainty were considered, and if contingency was applied to the estimate. Estimate review processes and practices were the focus of Section 3 of the protocol. Section 4 addressed the issue of estimate communication and included training of estimators and communication of estimating procedures. Section 4 also covered the issue of contacting property owners. Section 5 of the protocol focused on how differences were reconciled between estimates, the procedures for handling changes in ROW requirements, and triggers for an update to ROW cost estimates. The effect of state laws and other factors such as environmental, political, and social issues on the ROW process and estimates were addressed in Section 6. The effects of acquisition techniques such as advanced acquisition, incentive offers, and other non-standard techniques on estimating ROW costs were also explored in Section 6.

The protocol was prefaced by several introductory pages that confirmed the interview time and date, described the background of the research, and provided instructions and interview expectations. The background material covered previous NCHRP Project 8-49 findings relative to ROW, including a discussion of the typical project development phases relevant to ROW and the basis for the ROW research. The instruction and interview expectation sections outlined such aspects of the interview as the phased approach to be employed relative to each of the questions during the interview and other details. Included in the interview package were the project development phase flowcharts for planning, programming, preliminary design, and final design that had been developed during the earlier NCHRP Project 8-49 work. These flowcharts were

included to bridge the terminology differences that exist among agencies and address some of the factors limiting this research, which were discussed in Chapter 1.

Interview Participants

The seven SHAs interviewed were California, Florida, Georgia, Minnesota, Washington State, Wisconsin, and Virginia. These SHAs were selected based on input provided in Phase I of NCHRP Project 8-49. Each appeared to have systematic and relatively successful ROW cost estimation practices from which the research could benefit. As noted in the methodology, interviews were completed with participants from both the central office and with ROW administrators in districts/regions around the state. In addition to interviewing SHAs, the City of Phoenix Street Transportation Department and the O'Hare Modernization Program Office of the City of Chicago were interviewed to provide further perspectives on ROW cost estimation and cost estimate management. A list of interview participants by position from each agency is provided in Table E.1.

Interview Process

Because of the complexity of the ROW cost estimation process and the information being collected from SHAs, onsite interviews were the main activity used for data collection. The option of a survey was ruled out because surveys would not provide adequate information describing the ROW cost estimation process. Most issues could not be answered with yes/no or multiple-choice answers. It was necessary to acquire in-depth information about the cost estimation process that included some elaboration and explanation on the part of the interview participants. Onsite interviews provided the opportunity to clearly communicate specifics about the process and provide the detail necessary for developing the ROW cost estimation and cost estimate management flowcharts.

Interviews were conducted with SHAs and other organizations having experience with ROW acquisition. The interview process focused on the four phases of project development to provide a frame of reference for linking the application of successful ROW practices to the project development timeline. This enabled effective data collection and helped to identify differences as project development progresses. Contacts were acquired through Phase I of the NCHRP Project 8-49 Project, and the FHWA Office of Real Estate Services also provided suggestions. Eighteen formal SHA interviews (Anderson et al., 2007b) were conducted during the earlier phase of the NCHRP Project 8-49. Experience from the previous research and recommendations provided the research team with valuable contacts possessing considerable experience and knowledge of successful practices. Some SHAs, especially large states, are highly decentralized and rely on the districts/regions within the state to manage projects and perform estimates. Therefore, when interviewing SHAs, the research team attempted to capture perspectives from both central office ROW administrators and other administrators in districts/regions around the state. This provided diverse perspectives on ROW cost estimation and related issues.

The first step in the interview process was to contact the agencies. Upon initial contact with the potential interview participants, the interview protocol was transmitted by email to the participants several days prior to the scheduled interview. This enabled the participants to review the protocol and prepare for the interview. Interviews were set up in 2- to 3-hour blocks to allow ample time to cover the entire process from the first planning estimate to the activities required during final design.

In most cases, the interview was conducted by two individuals from the research team. One member would typically act as facilitator while the other took detailed notes. Both team mem-

Table E.1. Agency interview participants.

Highway Agency	Interview Participants
California	Senior ROW Agent – Headquarters Office Senior ROW Agent – Headquarters Office Senior ROW Agent – North Region Senior ROW Agent – North Region Senior ROW Agent – District 3 ROW Manager – South Region Senior ROW Agent – South Region Associate ROW Agent – South Region ROW Agent – South Region ROW Estimator – South Region ROW Estimator – South Region
Georgia	Appraisal & Review Manager Manager, ROW Cost Estimates
Florida	Manager, Appraisal & Appraisal Review Director, Office of ROW Deputy State Manager, Appraisal & Cost Estimating State Cost Estimating Administrator District One Cost Estimates Administrator (Bartow/Lakeland) District Seven Cost Estimates Administrator (Tampa)
Minnesota	ROW Program Manager – Central Office Assistant Director, R/E & Policy Development – Central Office ROW Engineer – District 1 ROW Engineer – District 2 ROW Engineer – District 3 ROW Engineer – District 4 ROW Engineer – District 5 ROW Engineer – District 6 ROW Engineer – District 7 ROW Engineer – District 8 ROW Engineer – Metro
Washington State	Assistant Director for Appraisal and Appraisal Review Program Appraisal Specialist, Olympia Region Appraiser, Olympia Region
Wisconsin	Real Estate Supervisor – SE Region Real Estate Supervisor – SE Region Real Estate Supervisor – NW Region Real Estate Supervisor – District 3 Real Estate Supervisor – District 5 Division Realty Office – FHWA
Virginia	Assistant Director ROW Manager
City of Chicago	Projects Administrator Relocation Manager Director of Public Affairs
City of Phoenix	Traffic engineering Supervisor Acting Assistant Real Estate Administrator

bers took an active part in the interview. The first 15 minutes of the interview typically consisted of introductions, a summary of the research background and framework, the objective of the research, and statement of the research team's expectations of the interview. Additionally, the status of the project and findings of previous interviews were summarized to provide the participants with the current status and direction of the research project. Following the introductory portion of the interview, the participants were probed for information regarding the SHA's project development process and any special terminology. This served to give the research team a basis for further questions and to relate participant answers to project development phases (planning, programming, preliminary design, and final design). Then, the facilitator would guide the interview toward the first ROW estimate completed during planning. From this point on, a discussion proceeded in which interview participants would tell the "story" behind the SHA's ROW

cost estimation process. As the interview drew to a close, issues not yet covered were addressed using the interview protocol as a checklist. The members of the research team would typically use the time following the interview to make additional notes on general impressions of the interview. All details were recorded in the interview protocol under the related questions.

In lieu of proceeding straight through the interview questions one by one, most interviews began with general discussions, which led to specific topics within the context of ROW cost estimation and cost estimate management. This practice was adopted during the first interview with the Minnesota DOT. That interview served as a "test" dialogue for the newly developed protocol. Consequently, the protocol questions served more as a checklist to ensure that all issues were covered. Shortly following the interview, an interview report was prepared which consisted of filling out the protocol based on the interview notes. This allowed the team to capture and understand the process for ROW cost estimation and cost estimate management used by the SHAs throughout all phases of project development. In addition to the on-site interviews, conference calls via telephone were used to follow up on any issues unclear after the initial interview.

Documents Collected

SHA ROW estimating tools were documented during interviews, and any documents describing the tools or examples of the tools that the agency used were requested at the time of the interviews or in follow-up emails and telephone calls. The documents gathered ranged from cost estimate maps used to determine ROW requirements to cost estimate spreadsheets used in completing estimates. Screenshots of ROW tracking and estimate systems were also requested and provided by the SHAs. The SHAs were always asked for copies or web addresses of manuals, policies, and procedures that supported their ROW cost estimation and cost estimate management processes.

State-of-Practice Characteristics

Critical issues relating to ROW estimating were identified during the interviews as those most difficult to estimate or issues that may have a significant effect (good or bad) on creating an accurate estimate. Based on the responses of the interview participants, the most notable critical issues include (not presented in an order of importance or priority rank)

- Condemnations
- Damages
- Inflation and other market conditions
- Risk analysis and assigned contingency
- Scope definition
- Estimating tools
- Estimator experience and knowledge

Condemnations

Estimating the costs of condemnations is very difficult because of two major factors. First, there is the issue of determining the number of condemnations, or what percentage of parcels will move to condemnation proceedings. The FHWA Office of Real Estate Services' report on state condemnation practices (2006) indicated that approximately 80 percent of acquisitions are completed without condemnation while FHWA online data reported a 12.5 percent condemnation rate for 2004 and a 12 percent condemnation rate for 2005 (FHWA, 2007). This variable is study specific and may vary drastically between projects, between regions/districts, or even

within regions/districts. As discussed previously in the literature review, the condemnation rate is heavily dependent on state laws governing the process and whether the public agency is responsible for paying acquisition costs of the property owner such as appraisals, expert witnesses, and other legal fees (FHWA Office of Real Estate Services, 2006).

The second issue is the actual cost of the condemnation proceedings. Condemnation expenses include engineering, appraiser, and economists' fees plus attorney and court costs, and the final condemnation award amount. The fee portion, together with legal costs, may add significantly to the cost of a condemnation proceeding. Additionally, states have specific laws concerning condemnations. In one state it is the financial responsibility of the acquiring agency to reimburse the property owner for an independent appraisal if such is requested by an owner. This stipulation is a result of the Supreme Court Kelo decision. Condemnations may cost a project more than just money: the proceedings may cost the project valuable time. Proceedings can delay a project schedule. Time delays then affect estimated construction cost. The cost and rate of condemnations is heavily dependent on state laws and social factors that exist in a particular local.

Damages

Damages due to partial takings of a property were indicated by agencies to be one of the most difficult aspects of ROW estimating. The definition of the term under 23 CFR Ch. I (4–1–02 Edition) § 710.105 Definitions is

> *Damages* means the loss in value attributable to remainder property due to severance or consequential damages, as limited by State law, that arise when only part of an owner's property is acquired.

Damages are primarily an issue in acquiring a portion of a business. Assigning a cost to damages can be very subjective and, many times, the accuracy of the estimated cost is dependent on the experience of the estimator.

Real Estate Inflation and Other Market Conditions

Assessing the potential effect of inflation/appreciation and other related real estate market conditions is a challenge. This is an issue in preparing cost estimates during every project development phase. Property values increase at rates different than the inflation rates for construction materials and labor. Properties in highly urban areas or areas where there is substantial growth potential may be subject to substantial increases in the market value of land. The results of the interviews in this project were consistent with the interviews and data collection in Phase I of NCHRP Project 8-49 concerning inflation and other market conditions.

Risk Analysis and Assigned Contingency

The majority of agencies interviewed made no attempt to conduct a formal detailed risk analysis of items that could affect ROW cost, although most agencies did assign contingency amounts in some manner. A detailed risk analysis can be defined as a systematic method of identifying and evaluating risks using a formalized agency procedure. The majority of agencies reported that they did not specifically address risk analysis in a formalized and documented procedure. Only two SHAs reported performing detailed risk analyses where specific project risks are identified and then addressed by some application of contingency. Risks affecting ROW derive from the schedule, property appreciation, condemnations, damages, and other issues that exhibit uncertainty or may be unknown. Moreover, the use of contingencies was an issue throughout the SHAs interviewed. Four SHAs reported the regular practice of applying a contingency to their

ROW estimates: the two aforementioned states using detailed risk analysis and two others who explicitly assign a contingency. Other SHAs may apply contingency values subjectively based on the estimator's opinion or judgment about the cost estimate.

Scope Definition and Estimating Tools

Determining a project's ROW requirements early in the development process is problematic, particularly during the planning phase (e.g., 10 to 20 years out from the estimated construction letting year). Phase I of NCHRP Project 8-49 found that actual cost of project ROW is frequently greater than the estimated cost projected during the early stages of project development. Two primary factors can explain this: (1) inadequate scope definition and (2) the absence of effective tools and methods to complete ROW cost estimates. ROW estimates made during the planning phase of project development are often based solely on a percentage of estimated construction costs. Agencies using this method maintain that the cost benefit is not substantial enough to invest staff effort in more detailed ROW estimates at this early stage because (1) limited project scope information is available, (2) there are multiple alignments to consider, and (3) there will be inevitable changes to the project as scope is refined as the project moves through development. This is not the case, however, with the Cities of Chicago and Phoenix, which finance their projects with bond money and therefore must have accurate cost estimates before going to the bond market. Both cities work hard to define project scope in detail early in project development and to develop accurate early ROW cost estimates.

Estimator Experience and Knowledge

Estimator experience was consistently noted as heavily affecting the quality and accuracy of ROW cost estimates. In achieving estimate accuracy, the estimator's knowledge of the project area and market plays a role in many subtle ways. SHAs are facing issues related to personnel turnover, especially related to employees with 15 to 20 or even 30 years of experience in ROW cost estimating. These people are quickly reaching retirement and when they depart, invaluable experience and knowledge will be lost.

Overview of Current Practice

A ROW cost estimate is produced during each of the first three phases of project development: planning, programming, and preliminary design. Before preparing the estimates, ROW requirements must be provided by planners or the project design team to establish the basis of the estimate. Following preliminary design, appraisals and acquisition typically commence. Typically, no further cost estimates are generated at final design, but ROW cost management should continue as purchases are executed. ROW cost management occurs during final design and is completed by comparing actual costs reflected in the appraisals and acquisitions to the estimated costs. If actual costs exceed the estimated amount, the project manager is notified and action is taken to either request additional funds or to make design changes that might reduce ROW cost. Additional ROW needs are sometimes identified during construction. When this occurs, the staff members responsible for ROW cost management must work closely with the agencies construction and design sections to minimize the effect of these new ROW requirements.

The following subsections discuss the current and general state of practice relative to each of the project development phases. Current practices are discussed in a general manner that outlines the overall state of practice in the SHAs interviewed. Later in this appendix, specific successful practices will be covered and critical review of these practices is presented.

Determining ROW Requirements

The basis of a ROW cost estimate is the ROW requirements and this is dependent on the level of project scope definition. Even in the case of a planning-level ROW cost estimate where the estimate is based on a percentage of estimating construction cost, the ROW estimate is dependent on the planner's ability to develop a reasonable scope definition to confirm the percentage applied. Typically, scope definition is clarified as the project development process proceeds from the initial planning phase to final design and construction.

The need for a project is typically defined in the initial project development phase of planning where scope definition is often nothing more than a statement of purpose and need. The scope at this point is expressed in very general or broad terms and usually consists of only an approximate number of lanes or a width or several potential alignments, with little definitive supporting information available. A ROW estimator typically is not involved at this stage, and it was found that ROW estimates are often completed within the agency's Planning Division and are not the responsibility of the ROW Division. As previously stated, a percent of the estimated construction cost is often used at this point in the process.

At the programming phase of project development, the scope of the project has been further defined and usually an alignment relating to ROW needs has been determined. In the case of most SHAs, the ROW division or group will receive a request from the project manager for a ROW cost estimate. This request is often accompanied by an aerial map or other visual representation of the project site with approximate ROW boundaries indicated. This aerial map defines the ROW requirements for the project. The total area to be acquired may also be indicated. In some cases, SHAs reported that rough parcels would be indicated along with parcel areas, but this is not common practice at programming.

ROW requirements during preliminary design are reflected in an updated aerial map or a preliminary drawing provided by the design engineers. The map typically shows the refined ROW boundaries, defines each parcel, shows parcel boundaries, and provides the areas required for each parcel.

Final ROW plans exist at the final design phase in which all ROW requirements are explicitly defined as parcels. No further estimates are completed at this point as ROW appraisals begin, followed by acquisition of parcels. It is likely that some changes may occur during final design that will affect the ROW requirements; while such changes are typically minor in extent, they can affect ROW cost significantly. In that case, new ROW plans may be released and reconciliation of the cost changes occurs, if necessary.

General ROW Cost Estimating Practices During Planning

During planning, ROW estimates in many SHAs are usually based on percentages of construction costs. Historical ROW costs from general databases or ROW cost from comparable projects may also be used to produce this early estimate. Construction costs for planning estimates, as outlined in *NCHRP Report 574,* are frequently based on lane-mile cost factors and prepared by planners. If ROW is required, the estimate for this project cost component often does not involve the ROW division. Planners also prepare the ROW estimate. In general, planning estimates are used for long-term budgeting. The ROW amount defined in the planning estimate appears to have minimal bearing on later estimates.

General ROW Cost Estimating Practices During Programming

When preparing the programming estimates, a field visit to the project location is usually completed by the estimator. The ROW estimator assigned to complete this early estimate generally

will either walk or drive the project and note pertinent details such as improvements to be removed, potential damages due to partial takings, and the general topography of the project area. Improvements to be removed include any structure, pavement, outdoor sign, or any other enhancement to the property that is necessary to remove before construction begins. A determination must be made by the estimator related to the current use of the property because the land values may be drastically different for each use. The estimator must determine whether the use of the property is residential, commercial, industrial, or agricultural. The ROW estimator will prepare the estimate based on the ROW requirements per the aerial map and any data obtained during the project site visit.

SHAs typically have a cost estimate sheet or checklist to ensure that all elements affecting ROW costs are considered. This is the case for the estimates completed during programming, which usually sets the baseline budget (the estimate by which all other estimates are compared for cost management purposes). A cost estimate sheet will have line items for all elements to be included in the estimate. Typically, the major estimate elements are (1) land, (2) improvements, (3) relocation costs, (4) damages, and (5) condemnations.

Land values are established by comparable sales in the general project area using resources such as the tax assessor's records, area realtors, or commercial realtor databases. At this point in project development, the estimate is normally completed on a gross area basis. Therefore, the estimator is looking to establish a value to apply to the total ROW area on a price per acre or price per square-foot basis, depending on property use.

Improvements to the raw land and the condition of the existing site improvements must be included in the cost estimate. In addition to justly compensating land owners for their properties, improvements (e.g., buildings, outdoor signs, and parking lots) must be included in the compensation.

Relocation costs for all displaced individuals and their belongings are included in the estimate. Most SHAs appear to have reasonable data for estimating relocation costs and apply a set dollar amount, based on recent historical costs and depending on the type of displacement (business, residential owners, or residential tenants).

Damages are hard to estimate in almost every case. Estimating such costs requires judgment on the part of the estimator. A value must be assigned based on the size, shape, and use of the parcel remainder. The estimator's experience and knowledge of the area are very important in establishing this amount.

Condemnations are based on historical data and/or previous experience of the estimator in the project area. The condemnation rate (or the percentage of parcels that will proceed to condemnation) must be estimated in addition to the actual costs of those parcels that may proceed to condemnation. The condemnation rate differs drastically from state to state because of state laws adjudicating property rights and state laws governing condemnation proceedings. Condemnation rates are estimated based on recent project experience in the area, but estimating the condemnation rates is still very subjective given that a human factor is always involved. The human factor can be defined as the uncertainty and unpredictability related to dealing with property owners when an agency is attempting to acquire their property. The reaction of individuals to an agency acquiring property is difficult to predict. If the condemnation rate is estimated accurately, the cost of condemnations will usually be accurate because they are primarily based on state laws.

General ROW Cost Estimating Practices During Preliminary Design

At the preliminary design phase of project development, the ROW cost estimate is further refined. In most cases, this is a completely new estimate developed by the ROW division person-

nel, but it may be an update of a previously developed estimate. This varies by SHA. The estimator usually makes a project site visit to explore any issues not apparent from aerial photos or preliminary plans defining the ROW requirements. The project manager or project engineer will often accompany the ROW cost estimator to provide input on probable design scenarios that will affect the ROW requirements and cost, and the potential trade-offs between ROW and design may be discussed.

Again, a cost estimate sheet is used in producing the estimate to ensure that all aspects of ROW cost are included in the estimate. The same line items included in the programming estimate sheet are examined for this estimate but now are examined in more detail (e.g., parcel information should be available by this point in project development). The preliminary design estimate is completed using parcel-by-parcel data where a cost is estimated for each individual parcel. This is the last cost estimate completed before the project is programmed in the State Transportation Improvement Program (STIP).

Other than the estimates described here, update estimates may occur when major changes occur in project design. These changes, though, must be communicated to the ROW Division by the project manager or project engineer. Communication becomes important in this case. Many SHAs attempt to update estimates annually, but some SHAs noted that the size of their ROW offices or groups of individuals is too small for a comprehensive annual update.

General ROW Practices During Final Design

Final ROW plans are released during the final design phase—appraisals begin, followed by acquisition. No further cost estimates are prepared. ROW acquisition can begin in earlier phases through protective buying, hardship acquisition, and other early acquisition actions, but most SHAs responded that these were seldom used because of bureaucratic issues such as state laws restricting the length of time ROW can be held after purchasing and prior to construction on the property.

In general, the ROW agents in charge of appraisals and acquisition will be aware of cost overruns, but requesting more funds seems to be the current practice instead of attempting to manage costs to a previously set budget.

Estimate Review and Approval Practices

Review of a completed estimate during any of the project development phases is typically limited to a visual scan by the estimator's supervisor. In specific cases where the cost of ROW is extremely high in value, a division head may be required to sign off on the estimate. The SHAs contacted had no formal and documented review process covering ROW cost estimates. ROW supervisors typically have many years of experience with ROW estimates and perform high-level reviews of the cost estimate by using "rules of thumb" and heuristics that they have developed through their years of estimating experience. This is completed by examining the major elements of the estimate that have a large effect on ROW cost. The supervisor then determines whether these elements of the estimate appear consistent with past cost experience and subsequently approves or disapproves.

State Laws and Other Factors

State laws and environmental, political, and social factors affect the ROW cost estimation process and affect ROW cost. The effects of these laws and factors vary by state. The Kelo versus City of New London case which went to the U.S. Supreme Court seems only to have affected

SHAs to a limited extent given that most highway agency practices were in conformance with the requirements prior to the case result. However, changes have been made to the eminent domain laws in several states. Interviews confirmed that some state legislatures have passed laws requiring the SHAs to reimburse property owners for private appraisals, attorney fees, and/or other acquisition costs up to a certain value. Furthermore, some states have tightened ROW condemnation requirements in the areas of notification and time to respond to SHA actions. All states have a defined process for condemnation proceedings and, depending on the state, condemnation actions can delay project construction starts.

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation