NCHRP

REPORT 451

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Guidelines for Warranty, Multi-Parameter, and Best Value Contracting

TRANSPORTATION RESEARCH BOARD

NATIONAL RESEARCH COUNCIL

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Guidelines for Warranty, Multi-Parameter, and Best Value Contracting

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SUBJECT AREAS
Materials and Construction

Research Sponsored by the American Association of State Highway and Transportation Officials
in Cooperation with the Federal Highway Administration

TRANSPORTATION RESEARCH BOARD — NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY PRESS
WASHINGTON, D.C. — 2001

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

In recognition of these needs, the highway administrators of the American Association of State Highway and Transportation Officials initiated in 1962 an objective national highway research program employing modern scientific techniques. This program is supported on a continuing basis by funds from participating member states of the Association and it receives the full cooperation and support of the Federal Highway Administration, United States Department of Transportation.

The Transportation Research Board of the National Research Council was requested by the Association to administer the research program because of the Board's recognized objectivity and understanding of modern research practices. The Board is uniquely suited for this purpose as it maintains an extensive committee structure from which authorities on any highway transportation subject may be drawn; it possesses avenues of communications and cooperation with federal, state and local governmental agencies, universities, and industry; its relationship to the National Research Council is an insurance of objectivity; it maintains a full-time research correlation staff of specialists in highway transportation matters to bring the findings of research directly to those who are in a position to use them.

The program is developed on the basis of research needs identified by chief administrators of the highway and transportation departments and by committees of AASHTO. Each year, specific areas of research needs to be included in the program are proposed to the National Research Council and the Board by the American Association of State Highway and Transportation Officials. Research projects to fulfill these needs are defined by the Board, and qualified research agencies are selected from those that have submitted proposals. Administration and surveillance of research contracts are the responsibilities of the National Research Council and the Transportation Research Board.

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.

Note: The Transportation Research Board, the National Research Council, the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the individual states participating in the National Cooperative Highway Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of this report.

NCHRP REPORT 451

Project 10-49 FY'96

ISSN 0077-5614

ISBN 0-309-06669-7

Library of Congress Control Number 2001-131333

Price $46.00

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The project that is the subject of this report was a part of the National Cooperative Highway Research Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

Published reports of the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

are available from:

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

and can be ordered through the Internet at:

http://www.national-academies.org/trb/bookstore

Printed in the United States of America

FOREWORD

By Staff
Transportation Research Board

This report contains comprehensive guidelines for implementing selected nontraditional contracting methods for highway construction projects; it includes guidelines for warranty, multi-parameter, and best value contracting. The contents of this report will be of immediate interest to state transportation agency personnel and others involved in the administration of construction contracts.

Highway agencies have developed a system of contracting practices that specifies and stipulates exactly what is built, how it is built, what materials are used, and how traffic is maintained during construction. While this contracting practice tends to minimize the risks to the private contractor who is building a public project, it demands a substantial involvement by state highway agency personnel, which translates into high administrative costs. For this reason, this type of contracting method is being challenged, and other options are being sought by many agencies. Construction warranties, multi-parameter bidding, and best value are contracting methods not typically used in highway construction but could be refined and developed for successful use in highway construction contracts.

Under NCHRP Project 10-49, "Improved Contracting Methods for Highway Construction Projects," the Texas A&M Research Foundation was assigned the task of developing guidelines for implementation of warranty, multi-parameter, and best value contracting. To accomplish this objective, the researchers reviewed relevant domestic and foreign literature; surveyed the construction industry; and identified and evaluated contracting practices with consideration to compatibility with the low-bid system, impact on SHA resources, product quality, and risk allocation. Finally, the researchers developed guidelines for three nontraditional contracting methods: warranty, multi-parameter, and best value. The report presents these guidelines and provides case studies and examples for their use in highway construction.

Warranty, multi-parameter, and best value are viable options for contracting of highway construction projects. The guidelines highlight the advantages and disadvantages of these three contracting methods and present a systematic approach for their implementation. These nontraditional contracting options will be particularly beneficial in specific situations and, therefore, should be given appropriate consideration in the selection of the contracting method.

UNPUBLISHED REPORT

The research agency's final report, prepared as part of this NCHRP project is not published herein. This report contains the findings of the literature review, discussions of current use, and analysis of survey results. For a limited time, copies of that report, "Improved Contracting Methods for Highway Construction Projects," will be available on a loan basis or for purchase ($15.00) on request to NCHRP, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C., 20418.

CONTENTS

AUTHOR ACKNOWLEDGMENTS

The research and guideline development were performed under NCHRP Project 10-49 by the Texas Transportation Institute (TTI) and the University of Wisconsin–Madison (UWM). TTI was the prime contractor and UWM was a subcontractor. Dr. Stuart D. Anderson (TTI) served as the principal investigator and Dr. Jeffrey S. Russell (UWM) and Dr. Awad S. Hanna (UWM) as the co-principal investigators.

This work could not have been accomplished without the dedication and persistence of several graduate research assistants associated with TTI and UWM. Specifically, the authors would like to thank Mr. Suhel Rahman and Ms. Laura Hogue of TTI, and Ms. Dena Noble, Mr. Pat Wisely, and Mr. Ben Thompson of UWM for their efforts.

The authors wish to express their appreciation to all those who responded to questionnaires and to those agencies that participated in telephone or on-site interviews. We specifically would like to thank Mr. Tom Smith, Utah DOT; Mr. Steve DeWitt, North Carolina DOT; Mr. Jay Steele, Caltrans; Mr. Lauren Gaduno, Texas DOT; and Mr. Gary Whited, Wisconsin DOT. We would also like to thank the Oregon DOT and Wisconsin DOT for providing case study information that was used in the guidelines.

We want to especially thank members of our Research Team. These individuals provided many hours of their time to help develop practical and useful guidelines for the contracting practices evaluated and developed under this research project. This team included: Mr. Byron Blaschke, Research Engineer for TTI; Mr. Chuck Hughes, Quality Consultant; and Mr. Bob Smith, Wickwire Gavin. Special thanks are given to Mr. Byron Blaschke for assisting the researchers in developing all of the material contained in the guidelines and especially the model specifications. His many years of professional experience with the Texas DOT and more recently with TTI are reflected throughout this report and guidelines. We wish also to thank Mr. Chuck Hughes. His expertise in the quality area was instrumental in developing a conceptual framework for a biddable quality parameter. We appreciate the legal perspective and insights provided by Mr. Bob Smith.

The authors would like to thank the NCHRP Panel and our Senior Program Officers, Dr. Amir Hanna and Mr. Lloyd Crowther (retired) for their timely input, critical comments, and helpful suggestions as this research developed.

CHAPTER **1**

OVERVIEW

BACKGROUND

State highway agencies (SHAs), as most agencies and organizations, are experiencing pressure to improve cost, time, and quality in project development and execution of facilities. At the same time, many agencies continue to downsize, restructure their organizations, and, as a consequence, reduce personnel. Some agencies have already downsized and are simply working with fewer personnel than in the past. Concurrently, outsourcing of project-related functions is being used to shift more responsibilities and therefore more project risks to the design, consulting, and construction contracting community.

To address these issues, SHAs must be proactive in pursuing innovative practices when programming and executing projects. Innovations must be pursued in all areas of project programming and execution. One area where many agencies are encouraging innovation is construction contracting.

Over time, SHAs have developed a system of contracting practices that stipulate exactly what is built, how it is built, what materials are used, and how traffic is maintained during construction. These traditional practices minimize the risks of the private contractor who is building a public project; however, they require substantial levels of SHA human resources. As a result, many SHAs are challenging traditional practices.

In 1990, the FHWA began to encourage states to implement new contract methods for improving the efficiency of delivering transportation projects through the Special Experimental Project-14 (SEP-14) program. The objective of SEP-14 was to evaluate project-specific innovative practices that have the potential to reduce the life-cycle cost (LCC) of facilities, while maintaining product quality.

Construction warranties and multi-parameter bidding (cost-plus-time-plus-other parameters) are two contracting methods that are not typically used in modern highway construction. Both methods have been declared operational by the FHWA; however, they require further refinement and development for consistently successful implementation in highway construction contracts. In addition, there may be other methods used in nonhighway construction that could benefit SHAs. These methods need to be identified, evaluated, and refined for use in highway construction. The objective of this report is to provide comprehensive guidelines for implementing three alternate contracting methods for highway construction projects (warranty, multi-parameter bidding, and best value).

SCOPE

NCHRP Project 10-49, *Improved Contracting Methods for Highway Construction Projects*, was initiated in January 1997 to evaluate alternate contract methods applied in both the highway and nonhighway construction industries. The intent of the research was to fully develop three contract methods for implementation on highway projects. The following six critical issues provided a focal point for the initial analysis and then the final development of each contract method proposed:

- Selection criteria—Some projects may be better suited for one type of contract method over another based on project size, complexity, and type.
- Bidding system—Alternate contract methods should be compatible with the low bid system of contracting.
- Agency resources—Many SHAs are reducing staff; therefore, contract methods that are compatible with reduced agency resources are desirable.
- Risk allocation—A contract assigns risks to those parties involved in the project. Ideally, an alternate contract method would assign more risk to the contractor and less to the SHA.
- Bonding requirements—Bonding requirements change with some alternate contract methods and may affect other project criteria such as quality and cost.
- Quality aspects—Improved quality of finished products and long-term facility performance should be fundamental objectives of any alternate contract method.

The research was performed in two phases.

In Phase I, a survey of current practice was conducted in the areas of warranties and multi-parameter bidding. Also, contract methods used in nontransportation construction industries were surveyed, studied, and analyzed in detail. The analysis resulted in a short list of potential contract methods that could be implemented by SHAs. Seven different products were proposed for warranty contracting. Eight parameters were recommended for inclusion with the cost-plus-time with incentives/disincentives (A+B+I/D) contract method. Four additional methods were proposed based on their application in the nontransportation industry environment.

Each of the 19 methods were described and discussed in terms of the critical issues. Based on the results of Phase I, the following three methods were selected:

- Warranties with emphasis on hot-mix asphalt concrete (HMAC) paving,
- Multi-parameter bidding with a quality parameter (A+B+I/D+Q), and
- Best value.

In Phase II, guidelines were developed for each contracting method. The scope of this effort is summarized here for each method.

Warranty

- Develop generalized guidelines and specifications for implementing warranty contracting. These guidelines would include the salient features applicable to any warranted product except for specifics unique to a product. A general discussion will accompany these guidelines.
- Develop in-depth, detailed guidelines for HMAC warranty as a case study. Issues to consider include selection criteria (when to use an asphalt warranty) and evaluation of the effectiveness of the warranty (how does the user know it works). Thus, a methodology for selection and evaluation should be included in the guidelines.

Multi-Parameter Bidding—A+B+I/D+Q

- Develop a general approach or methodology to implementing a multi-parameter contract method where a fourth parameter, quality (Q), is included. The Q parameter should be a measurable product-related, not management-related, parameter. Criteria for selecting a Q parameter should be provided.
- General approach/methodology should attempt to make the Q parameter biddable (increase or decrease the contractor's bid for the purpose of the contract award). The Q parameter should also be developed to impact the contractor's performance (reward for better performance and reduce compensation for unacceptable performance against the Q parameter bid). Performance adjustments could be used in pay equations as an adjustment and/or established as a post-construction incentive or disincentive.
- Development of the Q parameter should identify and consider test parameters related to quality for constructed products and process control (statistical measurements such as percent within limits).
- Use asphaltic concrete overlay as a type of product that would illustrate the application and implementation of the Q parameter with A+B+I/D. A parameter such as smoothness may be selected as an example to illustrate how this method may work in practice.

Best Value

- Develop a methodology for implementing the best value contract method in both a low bid environment and an environment unencumbered by low bid restrictions. Modify the best value approach so that it may fit within the low bid system and be consistent with state statutes (e.g., use best value to narrow the field of potential bidders to the top three contractors, then select from the three contractors on a low bid basis).
- Evaluate weights assigned to price and quality (technical and management plan).

The development of each method was based on extensive data collection, detailed evaluation, and the formulation of implementation steps. Model specifications were developed for an asphalt warranty and A+B+I/D. Case studies were compiled for an asphalt warranty and a best value application. An example is provided that demonstrates the feasibility of a Q parameter for modifying bids. These features are documented in Chapter 2 (Guidelines for Warranty Contracting), Chapter 3 (Guidelines for Multi-Parameter Bidding and Contracting), and Chapter 4 (Guidelines for Best Value Contracting). These guidelines were developed from an agency perspective.

GENERAL IMPLEMENTATION ISSUES

When deciding to apply a new contract method, certain implementation issues must be assessed. Implementing new methods often requires changes in a SHA's approach to contract administration. Agency decision makers must recognize what changes are required and the impact these changes may have on agency personnel and the design consulting, testing laboratories, and contracting community with which agency personnel will work. Several general issues that should be evaluated when deciding to implement a new contract method are presented in Table 1. These issues are framed around the six critical issues that guided the development of each contract method and other issues that were considered important to guideline development. The guidelines presented in the subsequent sections of this report address these implementation issues as specifically related to warranty, multi-parameter, and best value contracting.

In addition to considering these general implementation issues, agency support for any new contract method must start with senior management. Without this support a sustainable implementation effort will not succeed. The agency must also have an internal champion who supports "pilot" implementation of new contract methods and who will provide the requisite resources to ensure successful application.

TABLE 1 General implementation issues for applying new contracting methods

General Issue	Major Considerations in Implementation
Fit Within Low Bid System	• Method meets existing statutory requirements for low bid system • Special requirements for implementation to ensure contract method fits within low bid system (prequalification) • Requires enabling legislation for implementation because method will not meet low bid laws
Impact on Budget, Schedule, and/or Quality	• Increase, decrease, and/or no impact on project cost and/or project time • Enhances long-term performance of finished product
Impact on Agency Personnel Resources	• Increase, decrease, and/or no impact on number of agency personnel required for project • Increase, decrease, and/or no impact on project work hours required of agency personnel for project • Requirement for new knowledge, abilities, skills, and experience of agency personnel
Selection of Appropriate Project for Application	• Factors that drive use of method must be understood and evaluated in decision to implement on specific project • Characteristics of projects must be congruent with agency objectives/ requirements for implementing contract methods
Affect on Bonding	• Additional requirements for bonding • Impact on surety companies and contractors
Allocation of Risk to Each Project Participant	• Shift more risk to contractor in areas of cost, time, and quality • Impact of risk shifting on agency project development and execution process
Ease of Implementation	• Training requirements for successful implementation • Type of expertise/qualifications of personnel leading the implementation effort • Information system needed to support method requirements • Changes required in project development and execution procedures
Acceptance by Industry	• Impact on open competition—number of bidders and size of contractors bidding projects • Establishing industry cooperation and involvement in implementing new contracting process
Impact on Legal Environment	• Understanding legal ramifications of new contract method • Contract requirements with appropriate legal language incorporated

GUIDELINE STRUCTURE AND FORMAT

The purpose of the guidelines for warranty, multi-parameter, and best value contracting is to provide SHA personnel with sufficient information to successfully implement each method. The contents of the guidelines reflect this purpose.

User Perspective

The guidelines for the three contract methods covered in Chapters 2, 3, and 4 present a broader focus, which includes steps that an SHA should consider for first time implementation. In this way, the guidelines must also incorporate senior agency management, whose support is critical to program success. They must also ensure that resources are available for pilot projects and that criteria are established to evaluate the effectiveness of the program. Other agency personnel, such as programming and design personnel, will be impacted. The decision to use one or more of these three contracting methods must be made early in project development, because their implementation can affect the design process.

Layout

Each chapter is organized in a similar fashion. First, a brief description of the contract method is provided. Next, advantages and disadvantages of the method are presented. This discussion is based on the critical issues that guided the development of the material. An explanation is provided for each issue in terms of whether or not the critical issue is an advantage or disadvantage. For each critical issue, the potential impact on the contracting community is also discussed.

Steps and decision points for implementing the contract method are presented using flowcharts. Each step is described in some detail using bullet text, tables, figures, and examples as appropriate. The flowchart steps are presented in terms of

the following four general categories, which reflect the implementation process of a new contract method:

1. Conceptual planning;
2. Program planning;
3. Bid, contract award, and construction; and
4. Evaluation of pilot project(s) and program.

Model specifications are developed for asphalt pavements and A+B+I/D and are included with the appropriate step. Example "Request for Proposal" language is provided for best value contracting by means of a case study.

Each section concludes with a brief overview of those factors critical to successful implementation of the method. These factors must be considered by the agency when applying each step of the flowchart process.

Comprehensive case studies are provided for asphalt warranty and best value application. These case studies are based on actual application of the contract method by two different state highway agencies. The presentation of the case studies follows the steps in the flowchart process. Finally, an example application of a biddable quality or "Q" parameter for asphalt paving is provided to illustrate a methodology for implementing this type of parameter within the context of A+B+I/D contracting.

How to Use the Guidelines

The guidelines are designed for first time users of the contract method. However, experienced users will find that the guidelines provide a reference from which they can compare their practice with that proposed in the guidelines. This may lead to modifications to an SHA's current approach or may confirm that their current approach is consistent with the process proposed in these guidelines. For the first step in the process the user is asked to identify their experience level with the contract method (none, moderate, or high). Based on the experience level, the user is directed to different steps in the implementation flowchart.

The case studies for an asphalt warranty and best value project and the example for the Q parameter are included in Appendixes. The user is encouraged to review this information after studying the flowchart process for each method.

Each contract method is contained within a single chapter. The user can select one method and work with the appropriate chapter and appendixes

CHAPTER **2**

GUIDELINES FOR WARRANTY CONTRACTING

METHOD DESCRIPTION

Warranty contracting has been implemented in an attempt to reduce the amount of SHA resources required on a highway project, to reallocate performance risk, to increase contractor innovation, to increase the quality of constructed products, and ultimately to reduce the LCCs of highway projects. Warranty contracting places a greater emphasis on the quality of the constructed product than the traditional design-bid-build contracting method, and shifts some of the post-construction performance risk for facility products from the SHA to the contractor. Under a warranty specification, quality is measured based on actual product performance and not on the properties of construction materials. A warranty is defined as "a guarantee of the integrity of a product and of the maker's responsibility for the repair or replacement of deficiencies. A warranty is an absolute liability on the part of the Warrantor, and the contract is void unless it is strictly and literally performed" (Hancher 1994).

A warranty could include a combination of quality control (QC)/quality assurance (QA) specifications with performance-based specifications. Warranty specifications are a form of performance specifications ("Glossary of Highway . . ." 1996), but they also often contain QC requirements. Similar to performance-based specifications, the contractor is responsible for the performance of their product and must have experience with QC procedures to monitor the production. With a warranty, the contractor assumes both construction and post-construction performance risk. Annual inspection of the end product by the SHA replaces the construction QA portion of the typical QC/QA specification. However, statistically based QC/QA procedures such as stratified random sampling may be used to monitor the performance of the end product.

Under a warranty program, a contractor has more freedom to select the materials and construction methods than under a traditional methods-based specification. A contractor may develop a tailored QC program to fit each project. With warranty contracting, a contractor's knowledge and experience may be fully used without the restrictions inherent in methods-based specifications.

ADVANTAGES AND DISADVANTAGES

Current practice regarding the warranty contracting method was studied using survey questionnaires and interviews with state agencies. Data from these sources were compiled into a table describing the advantages and disadvantages of the warranty method. Table 2 lists 10 critical issues related to the use of alternate contracting methods (column 1). Columns 2 and 3 indicate whether the critical issue represents an advantage or disadvantage with respect to the warranty method, column 4 offers a brief explanation of this associated advantage or disadvantage, and column 5 discusses the possible impact on the contracting community associated with the critical issue. It is very important for a SHA contemplating implementation of the warranty process to consider the impacts of the method on their agency and contractors.

FLOWCHART

A warranty process model was developed and refined based on data collected from SHAs, as well as from studying individual specifications, programs, and projects. The format selected to represent the guidelines was a graphical flowchart, shown in Figure 1. This figure is subdivided into the following phases: Conceptual Planning, Program Planning, Bidding, Contract Award, Construction, Maintenance and Evaluation of Performance, Pilot Project Evaluation, and Organizational Program Evaluation. Each phase contains detailed steps that a SHA can take to develop and implement a warranty contracting program. Although the flowchart was designed for the use of SHAs with little or no experience using warranties, users may enter at different points, depending on their level of experience with warranty contracting. Experienced users of warranty contracting can use these guidelines to examine and make improvements to their process.

A case study based on the Wisconsin Department of Transportation's (DOTs) asphalt pavement warranty program is included as Appendix A. The case study follows the applicable steps of the flowchart process.

FLOWCHART DISCUSSION

To effectively use the warranty process model flowchart, the user will require explanations for each phase within the flowchart. Explanations for each step were gathered from SHAs that have warranty contracting programs and combined into a single guideline process model that is presented here.

TABLE 2 Advantages and disadvantages of warranty contracting

Critical Issue	Advantage	Disadvantage	Explanation	Impact
Compatibility with Low Bid System	√		The warranty method is compatible with the low bid system.	If an A--B system as described in the accompanying model specifications is used, contractors will need to develop a method and rationale for developing the 'B' parameter to use in their bids.
Impact on Open Competition		√	The number of bidders on warranty projects may decrease compared to traditional methods-based specification projects.	Some contractors, particularly small contractors, may be hesitant to bid warranties. This trend may reverse itself once contractors better understand warranties and the risks associated with them. Contractors located considerable distances from the site may also be discouraged from bidding, due to the possibility of being required to return for maintenance activities.
Reduction of Agency Human Resources	√		Warranties reduce the number of SHA inspection and testing personnel required on a project. Since the contractor is responsible for quality control, the agency need not perform the quality assurance function.	A contractor's inspection and testing personnel requirements may decrease due to elimination of a SHA-mandated minimum quality control program. The contractor may run as many or as few quality control tests as deemed necessary.
Reduction in Project (Bid) Cost	√	√	At this point definitive conclusions are not possible, but there is some indication that warranty contracts may cost less per ton of asphalt than standard contracts. This is based on preliminary data from a small number of asphalt pavement projects.	At this point definitive conclusions are not possible, but there is some indication that contractors may increase items such as "mobilization" in their bids to offset the increased risk they believe they are taking in bidding on a warranty project, as well as the increased cost they may factor into their bids for possible remedial work.
Improvement in Quality of Constructed Project	√		Warranty contracting appears to increase the quality of the completed project. Since the contractor runs the risk of returning to repair or replace work that fails to meet product threshold levels, there is a greater incentive to construct a high quality product from the beginning, rather than merely meet the minimum levels set by a specification requirement.	Contractors may have to estimate some percentage in their bid for future remedial actions. However, if the product performance meets or exceeds the threshold levels set by the SHA in the specifications, the contractor will not have to spend that money, and therefore profit may increase.
Reduction of Project Completion Time	–	–	Warranty contracting may increase project completion time. Contractors will be reluctant to complete their work until all other factors that may affect performance of their product have been addressed. For example, a paving contractor may not want to pave over a flaw in the sub-base, as this may cause the roughness of the finished pavement to increase. Innovative construction methods, however, may help reduce project completion time.	Contractors may need to take into account and document all factors that may affect the final performance of their final product.
Shifting of Risk from Agency to Contractor	√		The agency shifts some of the post-construction performance risk of the warranted product to the contractor.	The contractor assumes more post-construction risk than under a traditional methods-based specification.

(*continued on next page*)

TABLE 2 (Continued)

Critical Issue	Advantage	Disadvantage	Explanation	Impact
Ease of Implementation with Respect to Resources, Data, Systems, and Expertise		√	The establishment of a warranty contracting program requires resources to be invested up-front for training. Additional expertise is also required to write and implement the warranty specifications. Large amounts of data are also required. In particular, the establishment of threshold levels for distress indicators for some products such as pavements requires a large amount of research, or a well-kept product management system from which to extract data.	The contractor will also need to spend some time and resources in training personnel and becoming familiar with the warranty method. In addition, the contractor may need to conduct some research in developing quality control methods often required for warranty projects.
Contractor Innovation	√		Contractors are not restrained by traditional SHA methods-based specifications. Thus, they have the latitude to use alternative or innovative construction methods and techniques that would otherwise not be allowed under traditional specifications. In the long run, innovation by contractors may increase product quality and decrease life-cycle cost. Also, manufacturers promoting new products may benefit from a warranty requirement as SHAs will be more likely to allow the use and evaluation of new products if a reasonable warranty is provided.	A contractor may use a cost-saving innovative construction method under a warranty specification, but not under a traditional methods-based specification. This may be beneficial to small contractors with innovative ideas who are unable to incorporate these ideas within the traditional specification.
Project Applicability	–	–	Warranties appear to be most applicable to small or medium-sized projects that are not overly complex. However, they have also been applied to large, complex projects. To build a program, a SHA should probably start with smaller projects, and build on these successes to expand the program.	Smaller, less complex projects with warranties will allow for a larger number of contractors to bid, while larger, complex projects will most likely have a smaller number of bidders.

Conceptual Planning Phase

The first three steps in the warranty contracting process model describe the Conceptual Planning phase of the program, shown in Figure 2. These are the first steps a SHA should take to begin implementation of a warranty contracting program.

1) What Is SHA's Current Level of Experience with Warranty Contracting?

Although all SHAs are encouraged to follow the entire process described here, SHAs with different levels of experience using warranty contracting will want to enter this flowchart at different points, as shown in Figure 2.

➢ No Experience
- First-time warranty users should begin with Step 2 (Determine Motivation for Implementing Warranties) and move directly through the numbered sequence of steps.

➢ Low-to-Moderate Level of Experience
- Low-to-moderate level of experience users would be those with limited experience using warranty contracting on anywhere from one to five different projects. This could also apply to agencies who have experience with a particular end product and who wish to expand their warranty program to include one or more new end products.
- These users are encouraged to look at the entire process to formalize their program. However, SHAs may wish

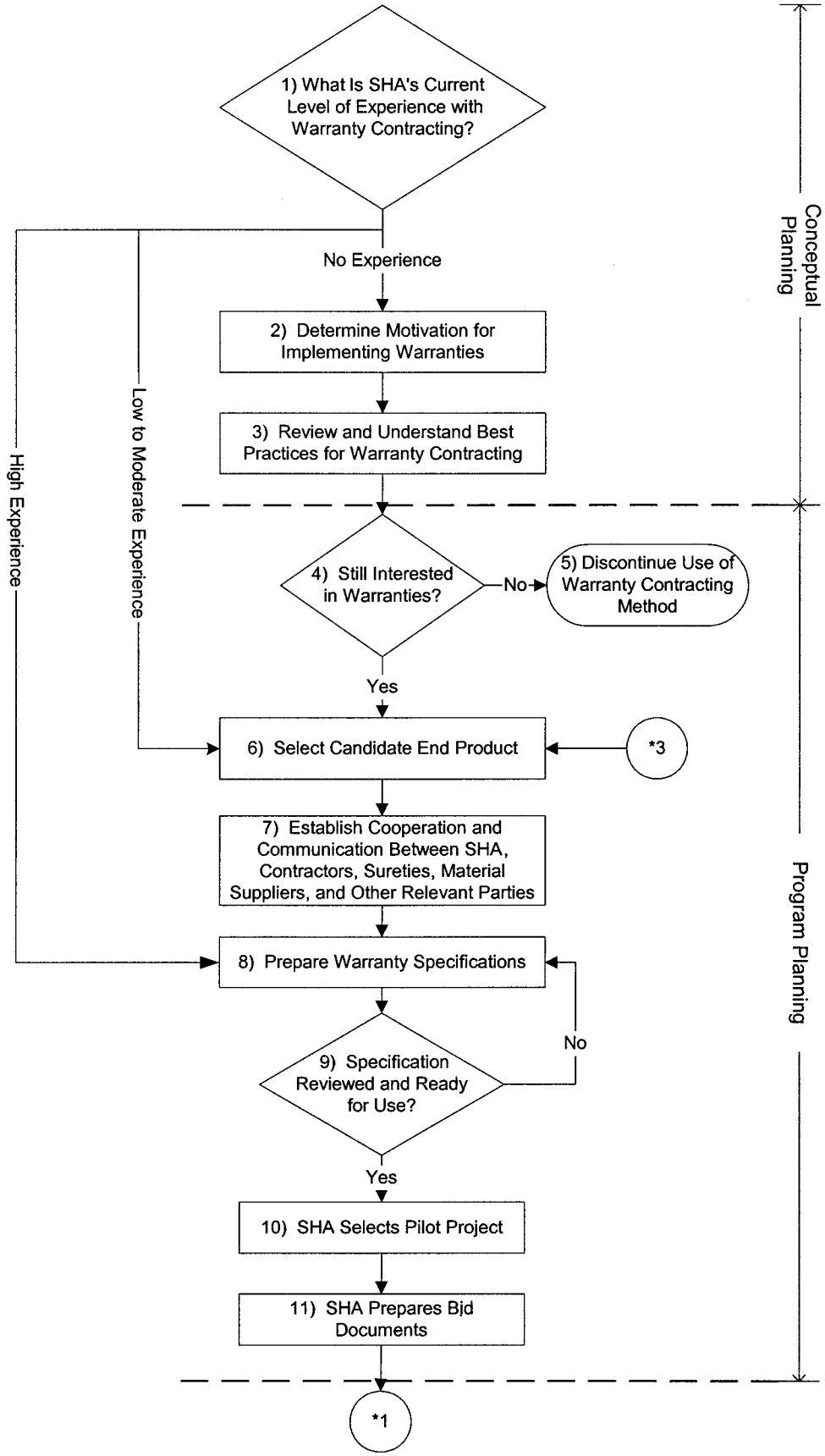

Figure 1. Flowchart process model for warranty contracting (continued on next page).

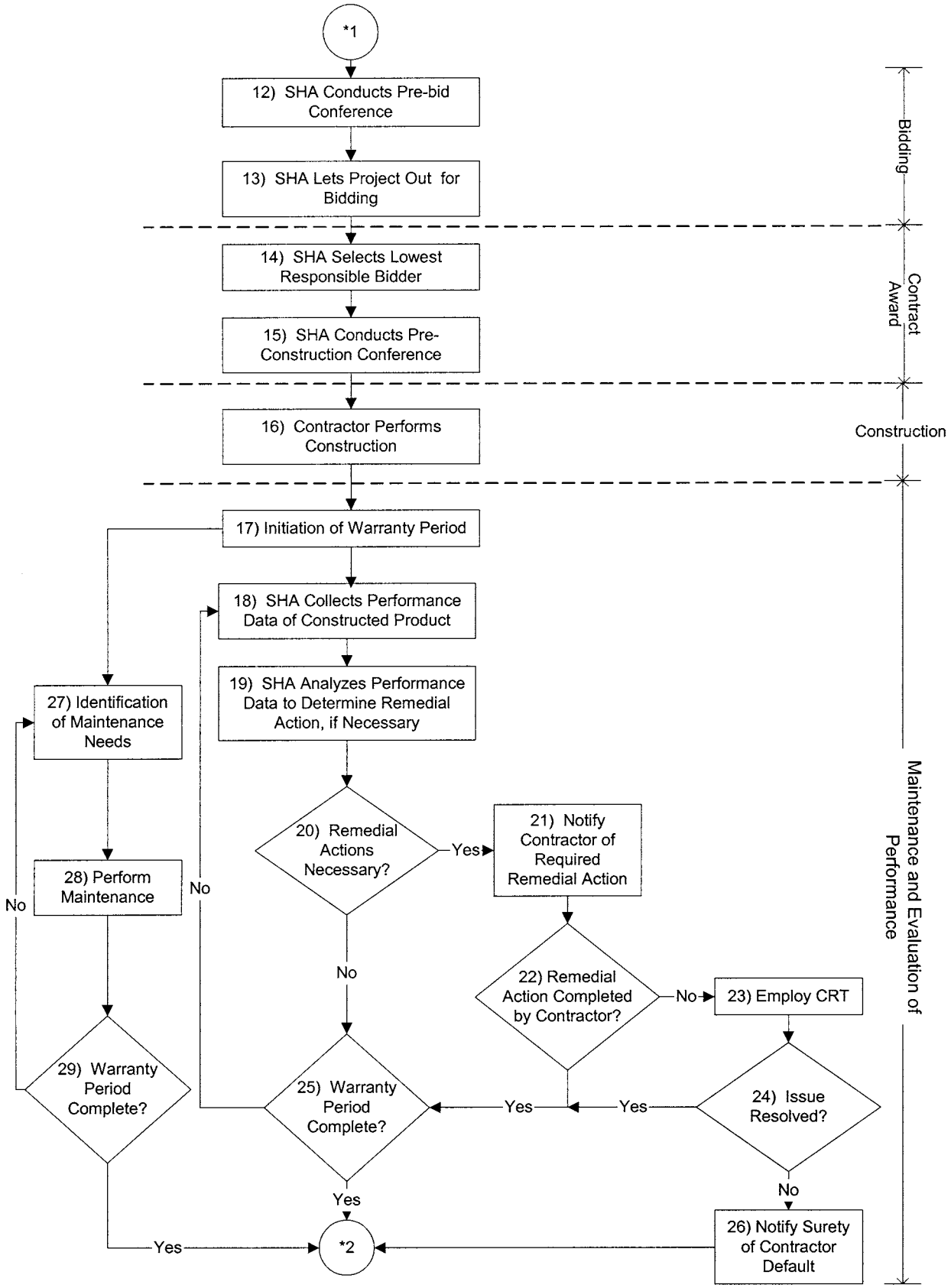

Figure 1. (Continued).

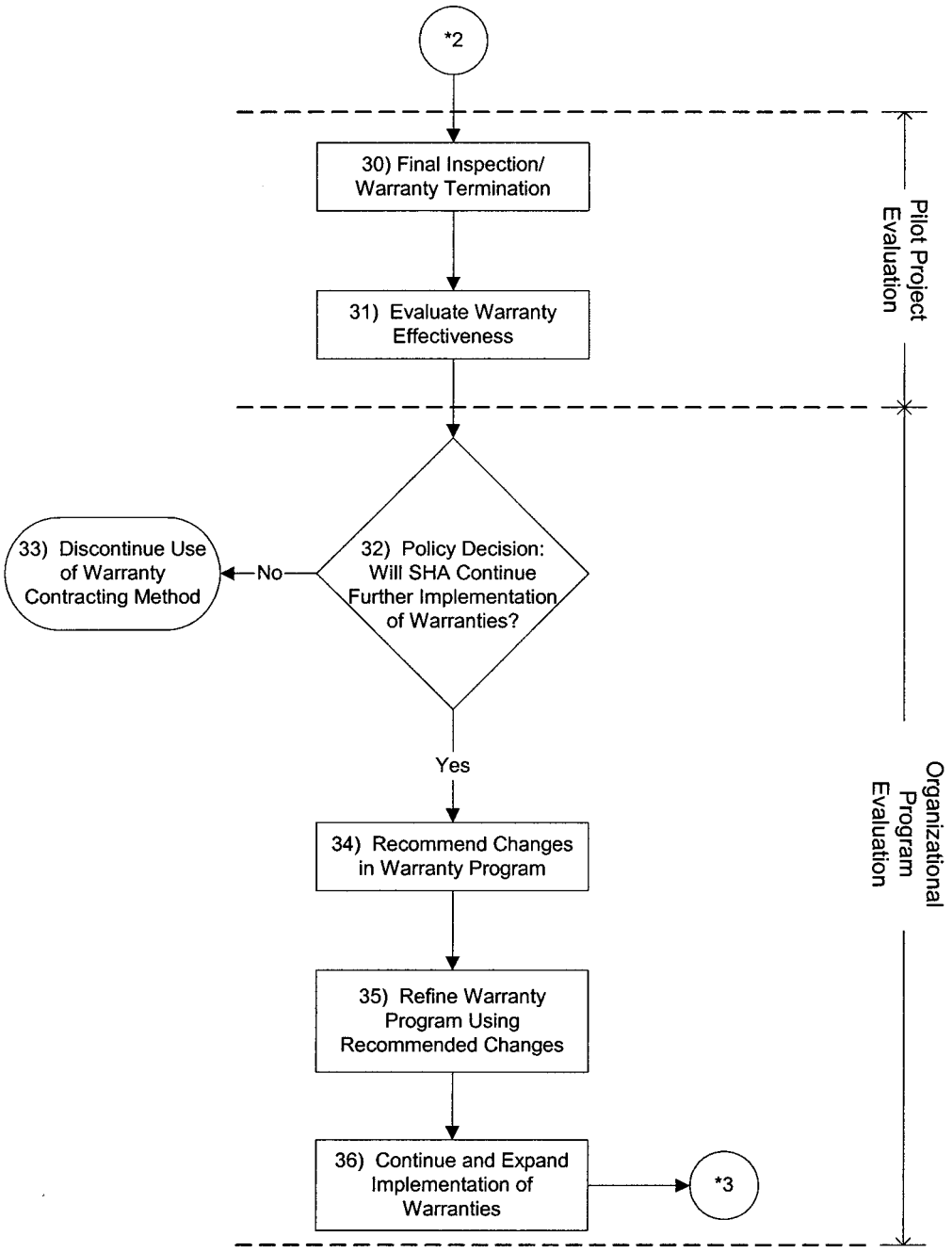

Figure 1. (Continued).

to begin with Step 6 (Select Candidate End Product). It would be important, however, for these users to examine Step 3 (Review and Understand Best Practices for Warranty Contracting), as well.

➢ High Level of Experience

- Users with a high level of experience are those who have completed more than five warranty projects and are comfortable with their process. They may begin with Step 8 (Prepare Warranty Specifications). Once again, Step 3 (Review and Understand Best Practices for Warranty Contracting) may be of use.

2) Determine Motivation for Implementing Warranties

➢ The first step for the SHA is to determine the reasons for interest in warranty contracting. The agency must articulate the objectives they hope to accomplish through im-

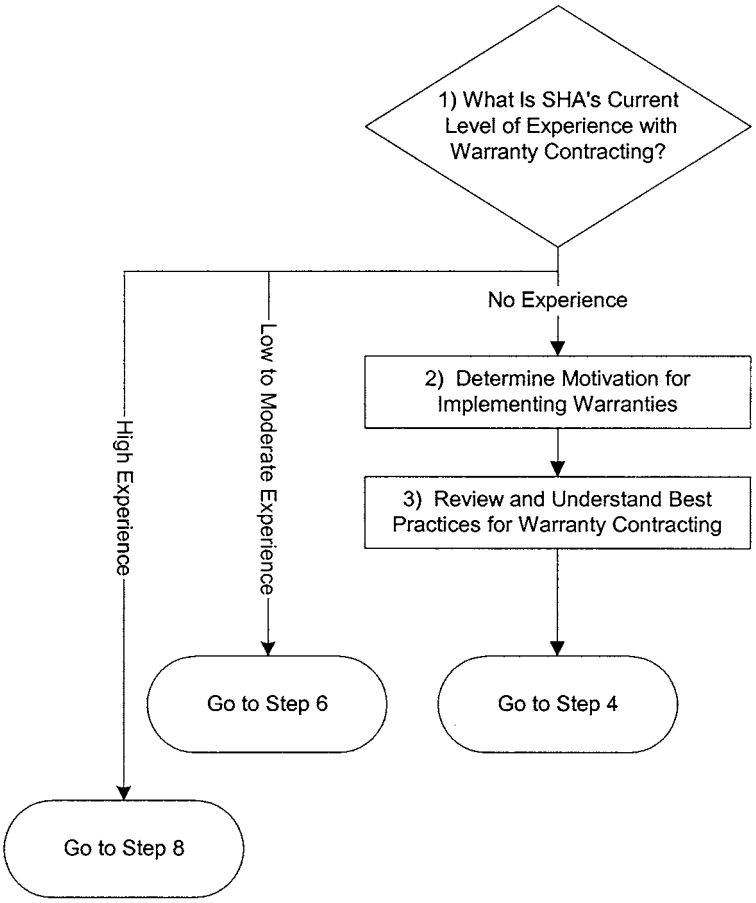

Figure 2. Conceptual planning phase process model.

plementation of the warranty program. The objectives may include

- Improved performance,
- Redistribution of product performance risk to the party that can most effectively control it, and
- Reduction of the number of agency design, testing, and inspection personnel.

The agency must review its available personnel and determine how warranty contracting will affect the personnel requirements of a project.

3) Review and Understand "Best Practices" for Warranty Contracting

One of the most important steps in moving toward a warranty contracting program is to understand industry best practices for warranty contracting. A best practice is defined as a way or method of accomplishing a function or process that is considered to be superior to all other known methods. An agency must gather information in order to understand the industry's best practices. In this step, the key is to understand and perhaps integrate best practices from SHAs currently implementing warranty contracting.

Information Sources

➢ This guideline will provide a solid foundation in the basics of warranty contracting.

➢ A search of the existing literature may be conducted. Some specific publications to include are

- The unpublished final report for NCHRP Project 10-49, *Improved Contracting Methods for Highway Construction Projects*.
- *NCHRP Synthesis of Highway Practice 195*: *Use of Warranties in Road Construction.*
- The FHWA report on "Contract Administration Techniques for Quality Enhancement Study Tour" (CATQUEST), which details the results of a fact-finding tour regarding the use of warranties in highway construction in Europe.
- Wisconsin's Draft Asphaltic Pavement Warranties Three-Year Progress Report.
- The Associated General Contractors (AGC) "White Paper on Innovative Contracting Practices in Federal-Aid Highway Construction."

See References for complete citations of these and additional references. Additional review of recent literature and Internet sources is also recommended.

- The FHWA.
- Other industries in which warranty contracts are more common (e.g., the automobile and home electronics industries).
- For more specific information, identify and evaluate warranty programs currently in use by SHAs. Some of the leaders and their various end products are listed in Table 3.
- See the Utah State University Innovative Contracting Best Practices web site: http:\\www.uthaht2.usu.edu\projects\innovativecontracting\ichomepage.html.
- Some states may have available in-house reports evaluating their use of warranties, whereas others may be able to offer a subjective or qualitative evaluation from personnel involved with the warranted projects.
- Other agencies' successes are also an effective means to initiate change and build support for warranties within an interested SHA.
- Collect "lessons learned" from other SHAs that have implemented warranties.
  - Illustrate possible improvements in existing systems,
  - Offer solutions to potential problems that may be encountered in the future implementation of the agency's own program, and
  - Indicate what issues remain unresolved and which problems still require additional attention to solve.
- Gather information on the criteria to be used to evaluate project effectiveness based, in part, on the goals set in Step 2.
  - The most common criteria to evaluate effectiveness include
    - Cost savings,
    - Reductions in SHA personnel requirements, and
    - Improved quality of the constructed product.
  - Determine appropriate means of measuring each of these criteria.

Program Planning Phase

Steps 7 through 11 describe the Program Planning phase of the warranty program development. These steps, shown in Figure 3, include development of the specific characteristics of the SHA's warranty contracting program.

4) Still Interested in Warranties?

At this point, a comparison must be made between the information gathered in Step 3 and the objectives set in Step 2. If the information gathered makes it evident that the objectives set are attainable using warranties, the SHA should continue to pursue its warranty program. If the objectives now appear unattainable, or could be better met by some other contract method, the SHA should discontinue its investigation of a warranty program. One critical issue that must be considered at this point is obtaining senior management support within the SHA central and district offices.

TABLE 3 Warranty programs to examine

State	Significant Warranted End Product
Indiana	Asphalt pavement
Maryland	Bridge painting
Michigan	Asphalt pavement, bridge painting, chip sealing, microsurfacing, crack treatment
North Carolina	Intelligent transportation system components
Pennsylvania	Pavement marking
Wisconsin	Asphalt pavement, portland cement concrete pavement

- If the SHA is not interested in warranty contracting at this time, go to Step 5 (Discontinue Use of Warranty Contracting Method).
- If the SHA is still interested in warranty contracting, go to Step 6 (Select Candidate End Product).

5) Discontinue Use of Warranty Contracting Method

If the decision is made that the SHA is not interested in implementing warranty contracting, the SHA should discontinue its investigation of a warranty program.

6) Select Candidate End Product

- The end product selected should be chosen to achieve the objectives established in Step 2.
- The SHA must decide whether it has the necessary resources available to implement the warranty program.
- The following end products are currently being warranted by SHAs:
  - Asphalt pavement,
  - Concrete pavement,
  - Pavement marking,
  - Bridge deck waterproofing membrane,
  - Crack treatment,
  - Microsurfacing,
  - Bridge painting,
  - Bridge deck joints,
  - Chip sealing,
  - Roofs,
  - Intelligent transportation system components,
  - Landscaping,
  - Irrigation systems,
  - Bridge components, and
  - Reflective sheeting for signs.
- For states initiating warranty contracting, it is recommended that only one end product be selected to pilot the process. This will allow the SHA to gain valuable experience with implementing this contracting alternative.

7) Establish Cooperation and Communication Between SHA (Owner), Contractors, Sureties, Material Suppliers, and Other Relevant Parties

It is important to bring all affected parties into the warranty development process early. Cooperation and communication

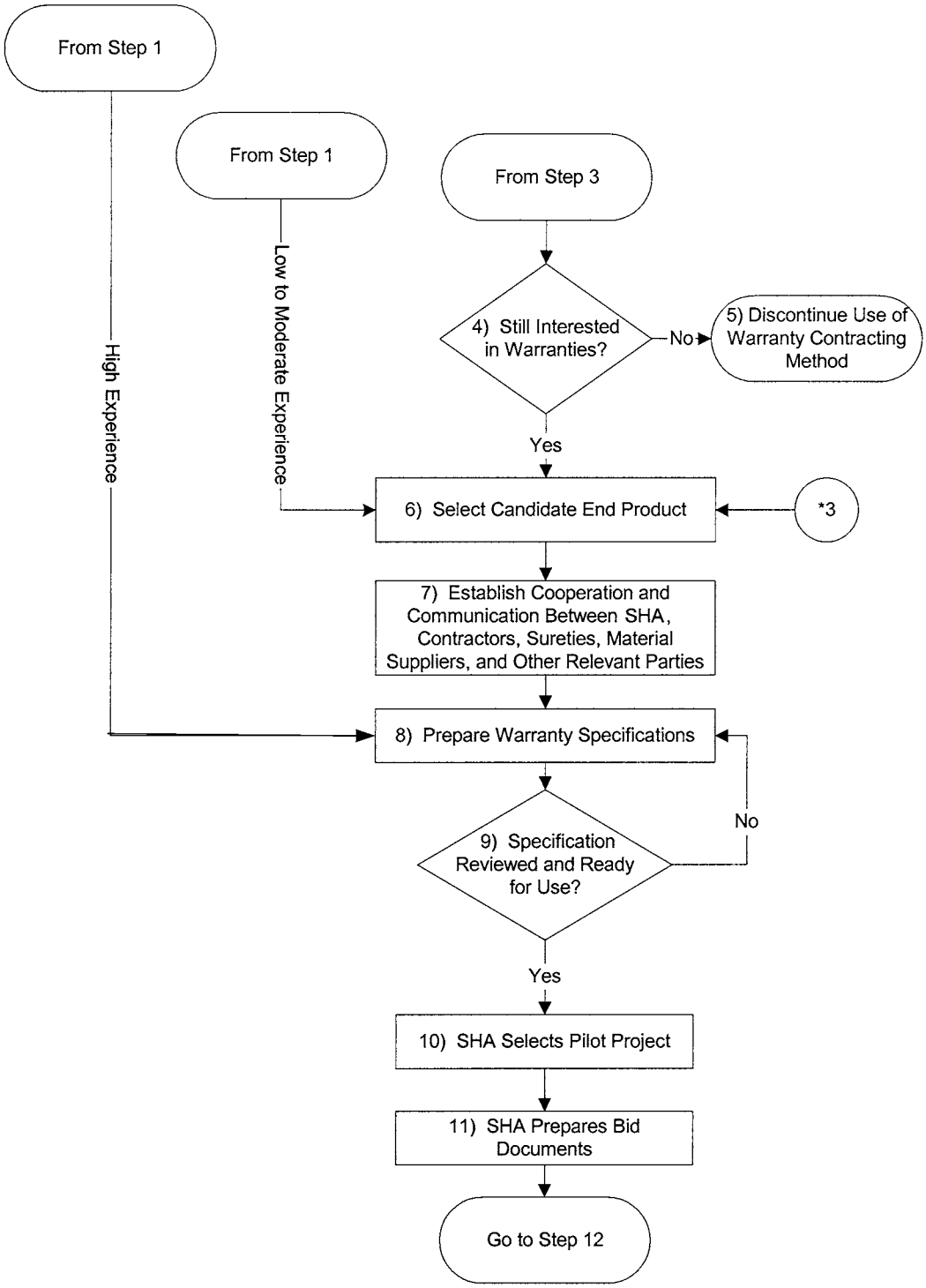

Figure 3. Program planning phase process model.

between the SHA and the local contracting community are particularly essential.

Identify and Contact Involved Parties

- ➢ Some of the major participants in the warranty process include
  - Contracting community,
  - Surety community, and
  - Material suppliers.
- ➢ It is important to have early contractor input when developing the warranty program. Contractor input is essential when choosing
  - The end product to warrant,
  - Performance indicators, and
  - Threshold values upon which performance will be evaluated.
- ➢ Surety companies are very important to the process. They must be willing to underwrite warranty bonds for warranty projects.

Educate Involved Parties

- ➢ Education of all involved parties is an important aspect of the warranty program.
  - SHA personnel
    - –Less responsibility for SHA personnel and more for contractor personnel during construction.
    - –Must allow contractor latitude to perform work.
  - Contracting community
    - –New contractor roles, responsibilities, and risks.
    - –Historic ability of product to meet the threshold levels set.
    - –Understand how production and construction methods and techniques can affect the performance of the product.
  - Surety community
    - –Documentation that the threshold levels are achievable.

Form Partnership to Implement Warranty Process

- ➢ Early discussions with contractors and sureties offering input into the process will help to facilitate communication and reassure both parties that the requirements of the warranty program are fair, reasonable, and equitable.
- ➢ Early input will enable any potential problems to be identified and addressed.
- ➢ A relationship among these parties must be established early to allow ongoing input from each involved party throughout the process.

8) Prepare Warranty Specifications

These guidelines use the AASHTO *Guide Specifications for Highway Construction* (1998 Edition) as a basis for the development of the model warranty specification. This guideline assumes that SHAs have a standard specification based on the AASHTO guide or are familiar enough with the AASHTO guide that specific sections in the state Standard Specifications can be identified and correctly referenced.

Compatibility

- ➢ Warranty specifications may take two basic forms:
  - Supplemental Specifications—Approved additions and revisions to the Standard Specifications.
  - Special Provisions—Revisions to the Standard and Supplemental Specifications applicable to an individual project.
- ➢ An important issue to keep in mind when preparing warranty specifications is that they must be integrated into the state's existing Standard Specifications.
  - Section 105.04 of the AASHTO *Guide Specifications for Highway Construction* gives an order of precedence for the standard specifications, supplemental specifications, and special provision when these documents conflict. The goal of the precedence is to provide clear direction to the contractor and form a basis to rely on when unexpected and unplanned conflicts occur.

Elements of Warranty Specifications

When determining what items need to be included in an agency's warranty specifications, a review of what other agencies include in their warranty specifications may be useful. The key items that should be addressed when preparing a warranty specification are identified in Table 4.

Performance Indicators

- ➢ Performance indicators and threshold values will be used to evaluate the final product.
  - Must be clearly stated in the specifications.
  - Will minimize uncertainty regarding warranty risks for both contractors and sureties.
- ➢ Tables for each end product currently warranted may be found in Appendix B. The tables, organized by state, include the performance indicators, threshold values, and remedial actions currently specified for each end product.
  - These tables may be used to aid in the development of specifications for end products other than HMAC pavements.
- ➢ Performance indicators should be chosen that directly affect the road user. They should also be chosen such that they allow contractors to determine how best to technically produce the results desired by the road user.
- ➢ For an example of a process to determine performance indicators and threshold values see Appendix A.

TABLE 4 Issues to consider when drafting a warranty specification

Item	Explanation
Description	• Describe work required and what the specification covers
Length of Warranty	• Establish length of the warranty. Can be fixed or varying using "A minus B" system described in the model specifications below
Bonding Requirements	• Establish the penal value of warranty bonds or retainage system. The penal value should be enough to cover the cost of remediating a worst-case failure scenario • Establish acceptable bond rating using A.M. Best rating system • Determine combinations of acceptable bonds (e.g., one full-length bond or a combination of bonds) • Determine steps to be taken if surety company falls below acceptable rating • Determine penalties if contractor fails to renew warranty bond
Maintenance	• Establish who is responsible for maintenance activities • Establish how contractor-performed maintenance activities will be approved
Conflict Resolution	• Establish conflict resolution team (CRT) • Determine composition of the CRT • Determine when CRT will be used • Determine length of conflict resolution process
Contractor Responsibilities	• Securing of a warranty bond for the entire period of the warranty • Guarantee of the end product for the entire period of the warranty • Selection of materials and construction methods • Remedial action if any threshold levels are met or exceeded • Establishment and submission of a Quality Control Plan and data • Elective/preventative actions deemed necessary by the contractor • Maintenance of third party liability insurance
Department Responsibilities	• Approve liability insurance and bond providers • Determination of end product inspection method • Annual inspection of end product • Compilation and timely submission of an annual written report to contractor documenting performance of end product • Notification of contractor regarding any required remedial actions • Approval of materials and construction methods and techniques used to perform remedial actions • Approval of any elective/preventative action performed by the contractor • Specification of special requirements such as Quality Control Plans • Definition of what constitutes an emergency condition • Determination of responsibilities and time frames for responses to emergency conditions • Determination of the existence of emergency conditions and remedy if necessary • Establishment of acceptable contractor response time in an emergency situation • Definition and performance of routine maintenance (e.g., snow removal, sign maintenance, mowing grass) during the warranty period
Performance Indicators	• Establishment of performance indicators and threshold levels • Definition of conditions under which specified threshold values are not valid
Requirements for Corrective Action	• Approval of remedial action • Establishment of remedy period • Establishment of activity types that void requirements for remedial action by the contractor (e.g., destructive testing procedures by the SHA or utility relocation)
Basis of Payment	• Establishment of measurement method for warranted end product (i.e., by the foot, meter, ton, square foot)

➢ SHAs should evaluate any available performance data (e.g., the Pavement Management System) to determine appropriate performance indicators and threshold values.

➢ There are several examples for setting threshold values for warranty specifications.

- Wisconsin set threshold values such that 90 percent of the pavements in their Pavement Management System would satisfy the warranty requirements.
- Indiana set the threshold levels at two standard deviations from the mean value for their warranty specification. In this case, 95 percent of the pavements in the Pavement Management System would, theoretically, satisfy the threshold values chosen.
- In both cases, the SHA determined a statistical method for defining the threshold values for their warranty contracting programs.

Quality Control

- ➢ It may be desirable to specify the minimum requirements of the QC program to be submitted by the contractor.
- ➢ Indiana requires the contractor to "provide, maintain and follow a Quality Control Plan that will assure all materials submitted for acceptance will conform to the contract requirements . . . The Plan shall contain, but not be limited to, the mix design methodology, proposed methods of sampling, testing, calibration, construction control, monitoring, and anticipated test frequencies." Indiana also requires the Quality Control Plan to meet requirements outlined by the SHA.
- ➢ For the initial pilot projects, the SHA may wish to obtain the contractor's QC test results for comparison with traditional projects.

Insurance

- ➢ The SHA must examine the general provisions contained in their own state statutes to determine coverage for all project participants.
- ➢ The SHA should have the contractor name the SHA as an additional insured party in their third-party general liability and automotive liability insurance policies.

Model Specifications

In addition to the flowchart, a model specification was drafted for warranty contracts, which was developed by collecting, reviewing, and evaluating warranty specifications from SHAs currently using warranty contracts for selected end products.

The Model Warranty Specification presented at the end of this chapter has been developed as a supplemental specification compatible with the AASHTO *Guide Specifications for Highway Construction* (AASHTO 1998).

The specific product used to illustrate a model warranty specification is an asphalt pavement. This model specification cannot be used directly as a supplemental specification as presented herein; it must be modified to fit each individual SHA's standard specification system. This model asphalt specification provides commentary on critical sections, identified as *considerations*, to aid the user in tailoring a warranty specification for their own use. The Model Warranty Specification was developed to permit the contractor to bid extended warranty periods. The contractor's bid is reduced by a specified amount corresponding to the extended warranty period bid.

9) Specification Reviewed and Ready for Use?

Draft specifications should go through a rigorous, iterative revision process to resolve any inconsistencies or shortcomings that may present problems in the future.

- ➢ SHA personnel should thoroughly review the draft of the specifications, especially the personnel who will actually implement the warranty specification, both at the district and field levels.
- ➢ Interested parties, such as contractors and sureties, should review the specifications.
- ➢ SHA personnel should revise and refine the draft specifications until all concerns have been addressed.
  - If the specification has not yet been satisfactorily revised, return to Step 8 (Prepare Warranty Specifications).
  - If the specification is ready for implementation, go to Step 10 (SHA Selects Pilot Project).

10) SHA Selects Pilot Project

A SHA should not implement warranties on all construction projects. Rather, the SHA should target projects on which to pilot the warranty process to fine tune and understand the process.

- ➢ Some agencies use a single pilot project for an end product.
- ➢ Other agencies have selected as many as three pilot projects for a given product in a single construction season.
- ➢ Piloting may be repeated in successive years for purposes of obtaining additional experience and performance data.

Selecting a Pilot Project

- ➢ Projects that have a high probability of performing well (i.e., low risk, low complexity) are the best candidates for an initial pilot project. A pilot project should be selected such that factors not covered under the warranty will not impact the performance of the warranted items.
  - For pavement projects, it is appropriate to have access to relevant traffic data, such as the Average Annual Daily Traffic (AADT), so that loading conditions can be properly calculated, and performance can be measured against a set parameter. It may be inappropriate to measure a pavement with a high AADT against the same performance standards as a low AADT pavement.
- ➢ If pilot projects are selected based on the high probability of performing well, the SHA must realize that the results of these projects may be difficult to compare to average, traditional projects. This must be taken into account when evaluating the warranty program.

11) SHA Prepares Bid Documents

- ➢ The warranty portion of a state's specifications may be included as a supplemental specification or as special provisions to the state standards.

- In either case, these documents must be included with the bid documents.

➢ In the case of a pilot project, some explanation of the warranty program should be included, particularly if the bid adjustment system shown in the model specification is to be used.
- In this system, a contractor's bid is adjusted by some predetermined amount to reflect each additional year beyond the minimum number of years of warranty the contractor bids. For example, the minimum warranty period may be 5 years, and for every year beyond 5 the contractor receives a bid reduction of $20,000. If the contractor bids a 7-year warranty, then the contractor's bid is reduced by $40,000 (i.e., $[7 - 5] \times \$20{,}000$).

➢ A SHA may take quality measurements similar to a traditional project during the pilot phase of a warranty contracting program. These measurements would be for comparison and informational purposes only.

➢ The primary differences between traditional and warranty specifications are summarized in Table 5.

Bidding, Contract Award, and Construction Phases

Steps 12 through 16 of the warranty process model describe the Bidding, Contract Award, and Construction phases of the program. These phases are shown in Figure 4.

12) SHA Conducts Pre-Bid Conference

➢ A pre-bid conference is strongly suggested for those SHAs with little or no warranty contracting experience to ensure that all parties understand the warranty process.

➢ Not all states conduct pre-bid conferences for their warranty projects.

➢ Because warranty contracting is still an alternate contracting practice, it is recommended that pre-bid conferences be held, particularly on pilot projects.

➢ A pre-bid conference for a warranty project should include all the items that a traditional project's pre-bid conference includes, as well as items specifically related

TABLE 5 Differences between traditional and warranty specifications

Attribute	Traditional Specification	Warranty Specification
Award of Contract	Lowest responsible and responsive bidder	Same as traditional specifications, unless adjusted by means of the A--B system
Bonds	Payment and performance bonds at specified penal values must be executed and delivered to the owner prior to the start of construction	An additional warranty bond at a specified value (usually less than the full contract amount) must be obtained from an approved surety company
Maintenance	Contractor is responsible for and maintains the work during construction until final or partial acceptance of the work by the owner	Contractor is responsible for maintaining the end product for the warranty period, including any necessary routine or emergency maintenance, as well as any required remedial actions
Conflict Resolution Team (CRT)	No CRT	CRT established for each project prior to start of construction. CRT consists of two contractor representatives, two SHA representatives, and one mutually agreed upon third party representative, whose cost is shared equally by the SHA and the contractor
Contractor Duties	• Maintain a quality control (QC) program • Provide a copy of all QC data to the SHA	• Submit a QC plan to the SHA • Provide a copy of all QC data to the SHA • Any required remedial actions, preventive maintenance, and emergency maintenance necessary for the length of the warranty period
Owner Duties	• Quality assurance testing • Observing and sampling contractor-performed tests • Monitoring control charts • Directing contractor to take additional samples when necessary	• Survey end product annually to measure product performance throughout the warranty period • Notify contractor of evaluation results and any remedial actions required within the prescribed time frame
Quality Measures	As stated in existing standard specifications. Performance-based or performance-related indicators vary by end product and by state	QC plans may be described and specified, and data gathered from contractors' QC tests
Performance Indicators	None	As listed in the warranty specification. Performance indicators will vary by end product and by state, according to their own needs and experience

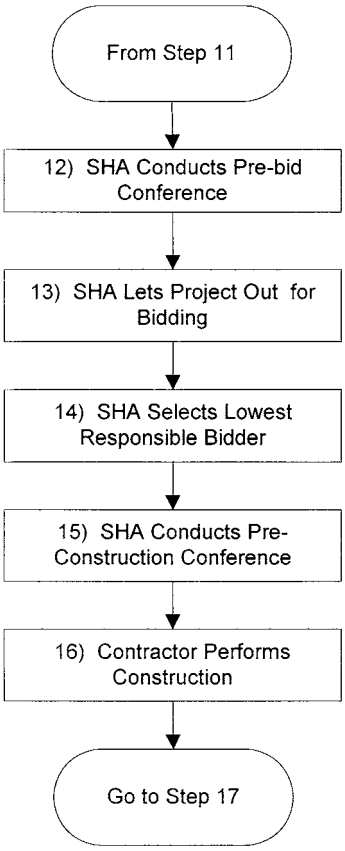

Figure 4. Bidding, contract award, and construction phases process model.

to the special provisions or supplemental specifications. A sampling of items that should be covered is shown in Figure 5.

➢ As an example, the following list of discussion issues has been generalized from a California Department of Transportation (Caltrans) warranty project pre-bid conference:
  - A description of the project, the warranty requirements, and the length of the warranty period.
  - The reason for using the warranty method (in this case the reason was to achieve a higher quality product).

- ✓ List of any special site conditions
- ✓ Review of any special provisions included in the contract (in particular, warranty special provisions)
- ✓ Site visit
- ✓ Answers to any questions relating to right-of-way, utilities, design, and construction issues

Figure 5. Items to be covered at a warranty project pre-bid conference.

  - A description of the contractor's responsibilities, especially those that are different from a traditional project. In the Caltrans case, the SHA stressed that the QC plan was now the contractor's responsibility, described the guidelines for developing the mix design, listed minimum requirements for some materials, and described two tests that need to be performed and submitted to Caltrans.
  - An explanation of why and how the warranty period was selected. In the Caltrans case, the 5-year warranty period was chosen because, historically, pavement failures had occurred in the first 4 years of pavement life.
  - A reiteration that the thickness of the pavement was to be designated by the SHA, and that the SHA would not pay for additional thickness.
  - A reminder to the contractor that SHA personnel and testing equipment would not be available to the contractor, and that the contractor was responsible for providing QC testing equipment and personnel.
  - An explanation as to how the retained funds (or bonds) may be invoked, or the contractor billed, if the SHA was forced to perform repairs for which the contractor was responsible under the warranty provisions, but failed to complete. A clarification of the emergency repairs policy explaining the process that goes into effect when an emergency repair situation arises should be offered, as well.
  - A description of any special considerations regarding measurement or evaluation information (at the Caltrans conference it was explained that cracks would be measured in the winter when the temperature is cooler and the cracks are more likely to be wider).

13) SHA Lets Project Out for Bidding

➢ A warranty project is bid and awarded in a manner similar to that of a traditional project. Figure 6 graphically depicts the milestone events in the warranty program.

14) SHA Selects Lowest Responsible Bidder

➢ This process may be the same as for a traditionally bid project.

➢ The bid reduction system illustrated in the accompanying model specifications for warranty projects and discussed briefly in Step 11 would modify the selection of the lowest responsible bidder.
  - The bid would be modified downward by a predetermined and predisclosed amount for each year over the minimum required warranty that a contractor bid.
  - These modifications would be for bid comparison purposes only and would not directly affect the final contract price.

➢ The SHA should keep track of the unit costs bid by the selected contractor to make a cost comparison with projects bid in the traditional manner.

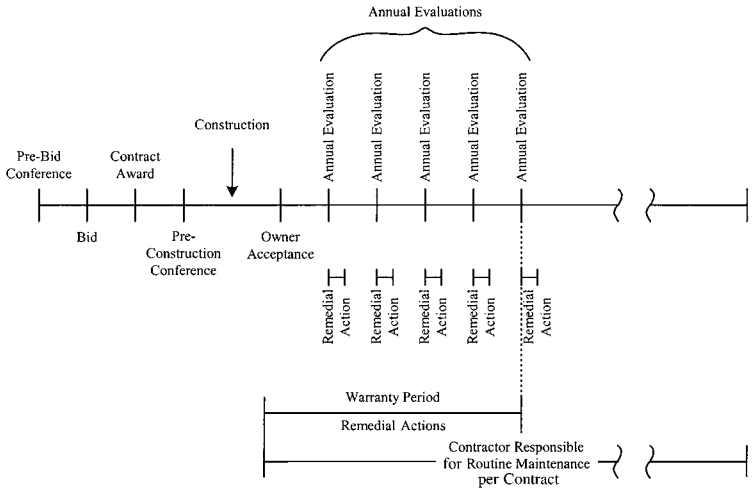

Figure 6. Milestone events related to implementing and monitoring warranties for highway construction.

15) SHA Conducts Preconstruction Conference

- ➢ The preconstruction conference is a forum to address any questions or ambiguities relating to the plans, specifications, and/or contract.
- ➢ The warranty requirements should be discussed again.
- ➢ The contractor should be encouraged to disseminate the information regarding warranty requirements to field construction personnel. By providing a clear understanding of the warranty concept to field personnel, a contractor will ensure that everyone understands the consequences of poor quality work.
- ➢ At or near the time of the preconstruction conference, the conflict resolution team should be formed and should meet to establish their responsibilities.

16) Contractor Performs Construction

- ➢ The contractor has more latitude to select materials, methods, and techniques than on a traditional project.
- ➢ The contractor performs both QC and testing for the project.
- ➢ The SHA may reserve the right to collect split samples of materials for informational purposes, but does not need to run a formal QA program.
- ➢ The SHA should document other costs associated with project management and construction. This will be useful later in comparing the cost of warranty projects with traditional projects.

Under the traditional system of specifications the SHA prescribes the mix design, construction methods and techniques, QA testing, method of payment, and the incentives/disincentives (I/D) to be used on a project. The QC tests to be run may also be specified by the SHA (often including asphalt cement content, air voids density, and voids in the mineral aggregate [VMA] tests). Under a warranty specification, the contractor has the freedom to determine the job mix formula, the construction methods and techniques, and the QC performed on the project. The only criterion that determines compliance with the warranty specification is the performance of the product relative to the established performance criteria.

Maintenance and Evaluation of Performance Phase

Steps 17 through 29 illustrate the Maintenance and Evaluation of Performance phase of the warranty program. Figure 7 shows this portion of the warranty process model. These are the steps that differ the most from those used in a traditionally contracted project.

17) Initiation of Warranty Period

- ➢ The initiation of the warranty period may occur at any of the following points in the project.
  - The point of substantial completion,
  - The point of final acceptance, or
  - The opening of the project to traffic.
- ➢ Additionally, the warranty may be initiated at completion, acceptance, or opening to traffic of either the entire project or a significant section of the project.
  - For example, if one segment of a project is a bridge, and the bridge has been completed, although the contractor continues to work on other segments of the project, it may be appropriate to initiate the warranty period on the bridge at the point in time when the bridge is opened to traffic.

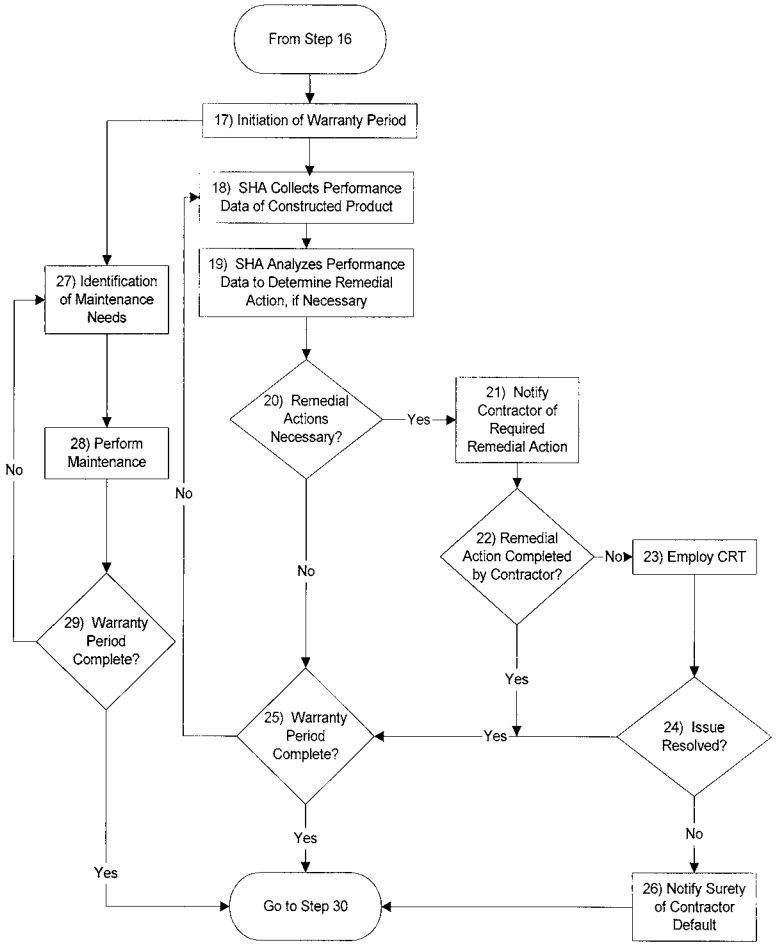

Figure 7. Maintenance and evaluation of performance phases process model.

After Step 17, the process splits into two separate paths, Steps 18–26 and Steps 27–29, which are cycled through concurrently until the end of the warranty period. The two separate paths represent the simultaneous occurrence of routine maintenance with the distress survey and remedial action process.

18) SHA Collects Performance Data of Constructed Product

Performance Data

- The decision as to what performance data to collect is based on the performance indicators and measurements selected in Step 8 (Prepare Warranty Specifications).
- The SHA must collect the performance data on the indicators listed in the specifications to evaluate the warranted end product. If the performance does not meet the established threshold values, specific remedial actions will be required.

Annual Surveys

- Generally, the SHA performs annual surveys of the end product, as illustrated in Figure 6.
- Surveys are done within 1 month of the anniversary date of the initiation of the warranty period.
- For pavement, the warranted project is split into segments, and each segment is split into sections. One predetermined section in each segment is evaluated, along with a random section in each segment. An illustration of this approach is shown in Figure 8. Further surveys may be performed, either on additional segments or at additional times throughout the warranty period, if the SHA has reason to suspect that threshold levels are being exceeded.
- For non-pavement products, the end product may be thoroughly inspected, if practical. Alternatively, a random inspection of representative portions of the product may be made.

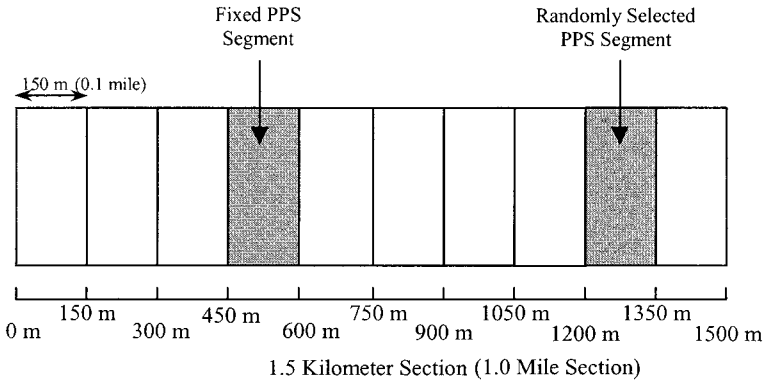

Figure 8. Annual pavement performance survey (PPS).

Other Data to Collect

- ➢ The SHA must continue to monitor costs both for distress surveys and remedial actions throughout the period of the warranty.
- ➢ All costs and efforts expended by the SHA on warranty projects should be documented.

19) SHA Analyzes Performance Data to Determine Remedial Action, if Necessary

- ➢ Compare the results of the annual survey (or additional surveys, if applicable) to the threshold values established for selected performance indicators.

Remedial Actions

- ➢ Remedial actions consist of major repair or rehabilitation actions that are required when threshold levels of performance indicators are exceeded.
- ➢ Remedial actions may arise only out of annual and/or additional survey evaluations, and the contractor is responsible for remedying them under the warranty contract.
- ➢ Recommended remedial actions for each distress type are generally included in warranty specifications. A list of those currently in use by SHAs is included in Tables B1–B10 in Appendix B.
- ➢ Remedial actions are distinct from both routine and emergency maintenance.

20) Remedial Actions Necessary?

- ➢ Based on Step 19, the SHA determines which distresses, if any, meet or exceed the established threshold levels.
- ➢ Any distresses that do meet or exceed the established threshold levels require remedial actions.
  - If no remedial actions are required, go to Step 25 (Warranty Period Complete?).
  - If remedial actions are required, go to Step 21 (Notify Contractor of Required Remedial Action).

21) Notify Contractor of Required Remedial Action

- ➢ Establish some maximum allowable time after a survey evaluation is completed for the SHA to notify the contractor of remedial action requirements.
  - This could be a time period of 2 weeks to 30 days.
- ➢ Notify the contractor in writing of any deficiencies requiring remedial action.

22) Remedial Action Completed by Contractor?

- ➢ Within 30 days of notification, the contractor should submit to the SHA a proposed plan for completing the remedial work.
- ➢ The plan should be approved by the SHA in a timely manner before the contractor starts work.
- ➢ A maximum allowable period of time in which the contractor may complete the work should be established.
- ➢ If the required remedial actions are completed by the contractor, go to Step 25 (Warranty Period Complete?).
- ➢ If the contractor refuses or fails to complete the required remedial actions, go to Step 23 (Employ Conflict Resolution Team).

23) Employ Conflict Resolution Team (CRT)

- ➢ If the contractor refuses to accept responsibility for the distress, or disputes the cause of the distress, the process for employing the CRT must be invoked.
- ➢ Generally, there is a 30-day period during which the contractor may appeal a SHA decision to the CRT, and another 30 days during which the conflict must be resolved.
- ➢ If the CRT fails to resolve the issue within a specified amount of time, and the contractor fails or refuses to perform the required remedial work, the SHA may have the

work performed or perform the work itself, and bill the contractor for the cost.
  - If the contractor refuses or fails to compensate the SHA for the cost of these performed remedial actions, the SHA should notify the surety that the contractor is in default of obligations under the warranty bond.
- ➢ Finally, if the CRT is unable to resolve the conflict, the SHA may resort to its existing legal claims policy.
- ➢ The conflict resolution process is presented in Figure 9.

24) Issue Resolved?

- ➢ If the CRT has successfully resolved the conflict, go to Step 25 (Warranty Period Complete?).
- ➢ If an agreement has not been reached, go to Step 26 (Notify Surety of Contractor Default).

25) Warranty Period Complete?

- ➢ If there is still time remaining in the warranty period once the remedial actions have been completed, the SHA must return to Step 18 to collect performance data for the next year of the warranty. Repeat Steps 18 to 26 until the warranty period is complete.
- ➢ If the warranty period is complete, the SHA should go to Step 30 (Final Inspection/Warranty Termination).

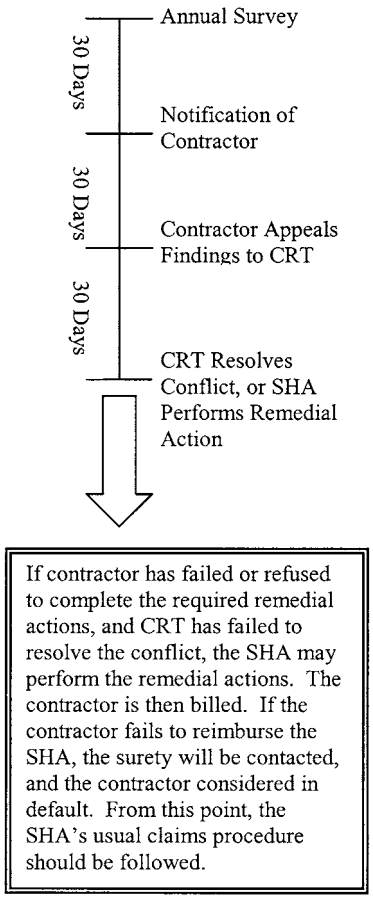

Figure 9. Conflict resolution process.

26) Notify Surety of Contractor Default

If the contractor refuses or fails to meet the obligations stated in the contract, and the conflict cannot be resolved by the CRT, the SHA must notify the surety that the contractor is in default of obligations under the warranty bond.

27) Identification of Maintenance Needs

- ➢ Both the SHA and/or the contractor may identify maintenance needs for the end product.
- ➢ Both the SHA and the contractor may perform some types of maintenance throughout the warranty period.
- ➢ Maintenance is distinct from remedial action. The different types of maintenance and the party responsible for each are listed in Table 6.
- ➢ Different agencies have different terms for the types of maintenance described. A maintenance continuum is presented in Figure 10. Certain types of maintenance can be classified as remedial actions and some can be classified as routine maintenance. However, as actions approach the middle area of the continuum, these two major types of maintenance begin to overlap, and judgment must be used to determine which are which.
- ➢ The warranty specification must clearly describe what remedial actions consist of so that a distinction can be made between routine maintenance and remedial actions.

28) Perform Maintenance

- ➢ Routine maintenance.
  - The types of maintenance that agencies frequently perform include, in cold climates, snow removal and salting/sanding. General types of maintenance include mowing, and lighting, sign, and guardrail upkeep.
- ➢ Preventative maintenance.
  - Maintenance performed on the end product itself before a distress has exceeded a threshold level.
  - Maintenance performed to prevent distress from reaching the threshold level, at which point a remedial action would be required. Examples include minor crack sealing, microsurfacing, crack filling, patching of potholes, and thin overlays.
- ➢ Emergency maintenance.
  - When some form of distress or product failure presents an immediate safety hazard to the traveling public and/or a threat to the integrity of the infrastructure. Examples include excessively large potholes, roadway collapse or undermining, severe loss of roadway friction, and concrete blow-ups.

TABLE 6 Types of maintenance under a warranty specification

Type of Maintenance	Description	Responsibility
Routine	Such items as signage removal and repair, snow removal, salting/sanding, mowing, and guardrail improvements or repairs	SHA
Preventative	Smaller, less serious forms of remedial action performed to prevent a distress from reaching a threshold level	Contractor
Remedial Action	Repair or replacement of deficient areas, as defined in warranty specifications	Contractor
Emergency	Any distress or product failure that presents an immediate safety hazard to the traveling public	Contractor (However, SHA may perform or have performed if Contractor is not able to perform in a timely manner)

- The SHA may or may not have time to contact the contractor.
- If the contractor is unable to perform the work in a timely fashion, or time does not permit notification of the contractor, the SHA may elect to perform the maintenance on its own or through other means.
  - –The SHA must determine what constitutes a timely fashion.
- If the contractor does not perform the emergency maintenance, the SHA may bill the contractor for the work completed.
  - –If the contractor refuses or fails to compensate the SHA for work performed, the SHA may file a claim with the surety against the contractor's warranty bond.
  - –If the distress necessitating emergency maintenance can be determined to be the result of something other than the contractor's work, the contractor must not be held responsible.

29) Warranty Period Complete?

➢ If the warranty period is not complete, return to Step 27 (Identification of Maintenance Needs) and continue to identify maintenance needs and perform maintenance.
➢ When the warranty period has ended, go to Step 30 (Final Inspection/Warranty Termination).

At the end of the warranty period, beginning with Step 30, the two concurrent cycles rejoin.

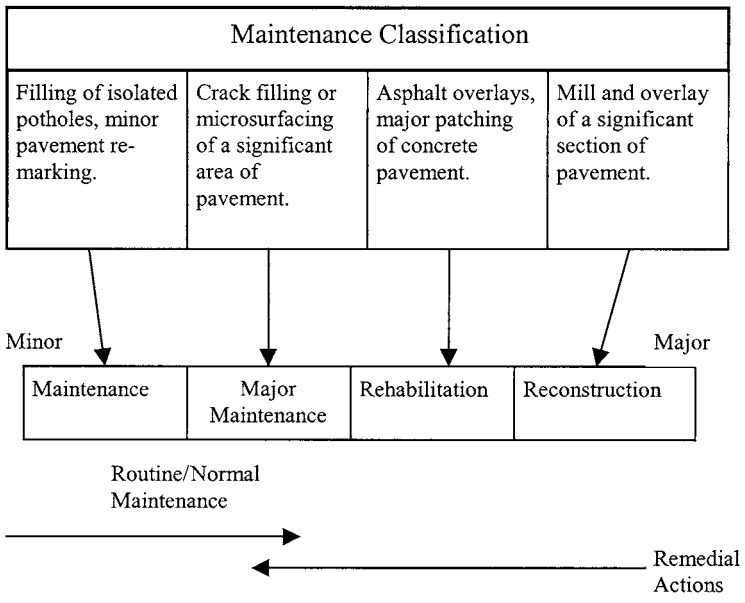

Figure 10. Range of pavement maintenance activities.

Pilot Project and Organizational Program Evaluations Phases

The Pilot Project and Organizational Program Evaluation phases of the warranty program are essential for success. These two phases are illustrated in Figure 11.

30) Final Inspection/Warranty Termination

➢ The SHA must perform a final inspection at the end of the warranty period to ensure that the product meets the specified threshold levels.
- The final annual survey should be completed within 1 month of the end date of the warranty period.
- The contractor should then perform the necessary remedial actions within 1 year of the final pavement distress survey (see Figure 6).
- Once all final remedial actions are completed, the SHA should conduct a final acceptance evaluation to determine whether the remedial actions have been satisfactorily completed.
- If the work has been satisfactorily completed, and the product meets all performance criteria, the warranty will be terminated at that point.

31) Evaluate Warranty Effectiveness

Once the warranty period has been completed, the entire project should be evaluated. This is an important step in evaluating the effectiveness of warranties within a SHA.

➢ Some important items to evaluate in relation to the original objectives set in Step 2 include

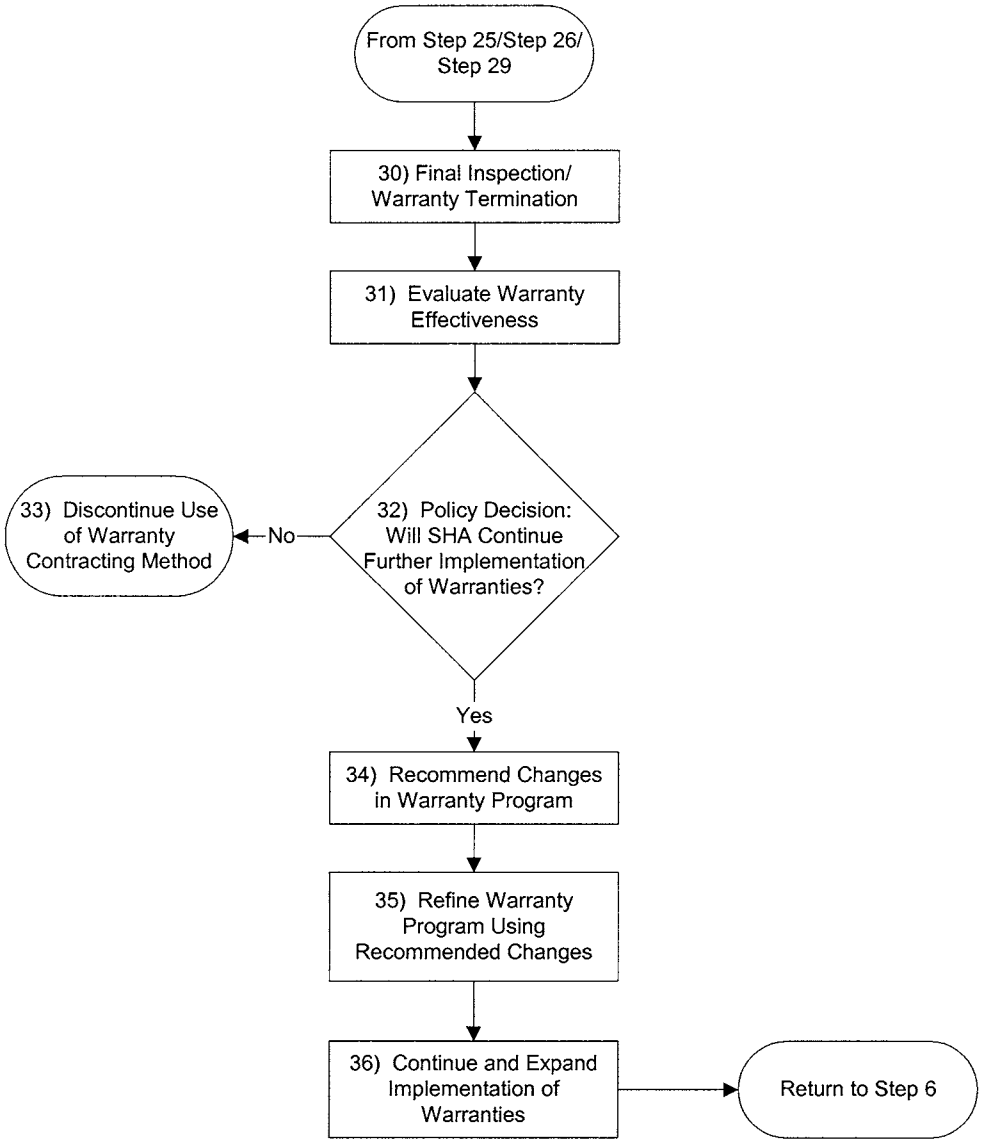

Figure 11. Pilot project and organizational program evaluation phases process model.

  - The long-term performance of the final constructed project;
  - The design and testing/inspection personnel required for the project;
  - The use of SHA and outside expertise;
  - Risk distribution factors;
  - The amount of claims and litigation, if any; and
  - Total cost (construction plus SHA management).
- ➢ Costs must be compiled to evaluate the LCC of the warranted product.
- ➢ These costs can then be compared with those of traditional contract methods to evaluate warranty effectiveness.
- ➢ Feedback on the program should be solicited from contractors, sureties, and other interested parties, as well as from district personnel.
- ➢ Lessons learned should be captured and communicated to all parties.
- ➢ SHAs must take into account that pilot projects may present a biased view of the warranty program's effectiveness. If pilot projects are intentionally chosen as projects with a high probability of success, this information must be considered when evaluating the project's results.

32) Policy Decision: Will SHA Continue Further Implementation of Warranties?

- ➢ Has the pilot project (or projects) met the objectives?
  - The results of the pilot project(s) must be compared with the objectives established in Step 2.
  - Using the information gathered in Step 31, the SHA must determine whether the warranty pilot project(s) was cost effective.
- ➢ Once the process is established and accepted, the SHA should repeat the process for other planned end products.
  - If the SHA does not wish to continue implementing warranties, go to Step 33 (Discontinue Use of Warranty Contracting Method).
  - If the SHA wishes to continue the implementation of warranties, go to Step 34 (Recommend Changes in Warranty Program).

33) Discontinue Use of Warranty Contracting Method

If the policy decision is made not to continue further implementation of warranties, the SHA should discontinue the use of warranties as an alternate contract method.

34) Recommend Changes in Warranty Program

- ➢ To continue implementation of the warranty program, it must be evaluated and, where appropriate, modified to include additional best practices and lessons learned, as they become available.
- ➢ Feedback is essential in improving the process.
- ➢ Any problems that were encountered on the pilot project(s) must be identified and appropriate corrective action taken.
- ➢ Changes should be recommended for the subsequent warranty specifications.
- ➢ As more experience is gained with warranty contracting, the specifications can be refined to more effectively accomplish the SHA's program goals.
  - Specifically, the threshold values established for each performance indicator must be carefully evaluated.
  - It is important that the threshold values be stringent enough to keep project quality at the desired level, but at the same time reasonable and achievable.

35) Refine Warranty Program Using Recommended Changes

Establish a feedback loop to improve the efficiency and effectiveness of the warranty method.

- ➢ Incorporate the changes recommended in Step 34 into the warranty program through revision of the supplemental specifications or provisions prepared in Step 8.
- ➢ Continue this iterative process of improvement throughout the life of the warranty program.
  - Iterations are especially important for the pilot phase.
- ➢ Special attention should be paid to determining the types of projects for which warranties are deemed appropriate.

36) Continue and Expand Implementation of Warranties

Once the warranty program has been modified and the specifications have been revised, the SHA may consider implementing warranties on additional projects.

- ➢ Implement the warranty program using the revised supplemental specifications or provisions on a second project.
- ➢ Apply warranties to more projects as the SHA becomes more comfortable with the method.
- ➢ Expand the process to warrant additional end products.
  - The pilot process should be followed for each new end product by returning to Step 6 (Select Candidate End Product) and repeating the pilot development and implementation process for the newly selected end product.
- ➢ The SHA must continue to gather cost and performance data on warranty projects and on the process in general.
- ➢ Collect and update information on LCCs, and continually improve the effectiveness of the warranty program.

Warranties are not the appropriate contract administration method for every project; however, the warranty program can be effective if applied correctly under the appropriate conditions.

CRITICAL SUCCESS FACTORS

All steps listed and described previously are considered important for the implementation of the warranty program. However, the following factors are some of the most critical

affecting the degree of success achieved through the implementation of warranties.

Training

- ➢ All parties involved must be made aware of and understand their roles and responsibilities under the warranty specification system.
- ➢ SHA responsibilities will be changed, as well as contractor responsibilities.
  - SHA no longer performs QA inspection and testing.
  - SHA no longer specifies methods and materials.
  - Contractor must formulate, submit, and perform a QC program.
- ➢ The SHA must employ personnel with the appropriate expertise to implement a warranty program.

Appropriateness of Method for Projects

- ➢ Both the SHA and the contractor must possess appropriate levels of resources to execute the roles defined in the training process.
- ➢ Criteria must be defined to determine what projects are candidates for a warranty contract.
- ➢ Projects chosen for a warranty contract must match the objectives of the SHA for implementing warranty contracting.

Communication

- ➢ Communication among the major parties involved is crucial throughout program development, as well as throughout the project duration.
  - SHA personnel, contractors, sureties, and other involved parties must clearly communicate concerns and feedback to each other to improve the warranty process.
- ➢ Attention must be paid to a means for resolving conflicts quickly during the project.

Initial Agreement

- ➢ All involved parties must bring their expectations into agreement early in the process.
- ➢ All involved parties must understand and buy into the warranty program early in the process.

Post-Award Agreement

- ➢ A working relationship among all involved parties must evolve and continue throughout the project duration. Partnering is a practice that may help achieve this relationship.

Integration of Design, Construction Methods and Techniques, and Sequences of Work

- ➢ The warranty process must be identified as the chosen contract method early in the life of the project.
  - The design, scope of work, and preparation of specifications and contract documents are examples of the elements of the project that may be affected by the choice of warranties as the contracting method.
  - It is highly desirable for a warranty to be designed into a project when these elements are prepared.
- ➢ Design should incorporate construction methods, techniques, and sequences of work because they are all interrelated and will be impacted by the warranty contracting process.

More Up-Front Investment by SHA

- ➢ The SHA must be willing to invest more resources initially in the development process.
  - Program planning,
  - Specification development,
  - Data collection for establishment of performance indicators/threshold values,
  - Training of SHA personnel to implement the program, and
  - Education of involved parties (e.g., contractors, sureties, suppliers).
- ➢ As the warranty process matures, these costs will be recouped as LCCs of individual projects are reduced.

Support of SHA Upper Management and Industry Buy-In

- ➢ Without the approval and support of senior level management within the SHA, the warranty contracting program cannot be implemented successfully.
- ➢ Without buy-in of local industry personnel, the warranty contracting program will fail.

MODEL ASPHALT WARRANTY SPECIFICATION SECTION 4XX

Note: This model specification represents a framework for the development of specifications compatible with a SHA's standard specifications and methods of presenting supplemental specifications and special provisions. It is a compilation of practices employed in several states. Because the experience is limited, and none of the warranted projects studied have lives exceeding the warranted periods, this should not be considered as best and proven practices.

Specifications included in this model specification refer to the AASHTO *Guide Specifications for Highway Construction* (1998 Edition).

Under several of the specification sections, *"Considerations"* are italicized to list options and alternate approaches.

4XX.01 Description/Summary. Construct a plant-mix asphalt pavement consisting of one or more courses of asphalt mixture constructed on a prepared foundation. Perform any required remedial work to correct deficiencies identified in annual pavement evaluations, as described in Section 4XX.04. Maintain the pavement during the warranty period.

Warrant the specified pavement for a minimum period of 5 years. The Bidder may bid alternatives providing for 6-, 7-, or 8-year warranty periods. If the Bidder bids the 6-, 7-, or 8-year warranty period, the bid submitted will be adjusted by a specified amount only for bid comparison purposes and the selection of the low bidder. Payment for the work performed will be at the unit prices bid (refer to Section 4XX.04 Warranty, Paragraph A; and Section 4XX.10 Award of Contract).

Provide acceptable warranty bonds for the warranty period (refer to Section 4XX.09 Warranty Bond).

Develop remedial action(s) for those sections of pavement that do not meet specified standards of performance as determined by periodic evaluations conducted by the Agency. This remedial action will be subject to the approval of the Agency. Complete the approved remedial work at no additional cost to the Agency (refer to Section 4XX.04 Warranty, Paragraphs D through K).

Maintain the pavement surface during the warranty period at no additional cost to the Agency (Refer to Section 4XX.04 Warranty, Paragraph C).

A Conflict Resolution Team (CRT) will be formed to resolve any disagreements associated with the warranty work (refer to Section 4XX.08 Conflict Resolution Team).

4XX.02 Materials.

A. *Construction.* Establish the mix formula and select all materials. All materials used for the construction of plant-mix pavements will conform to the requirements of **Section 401.02 Material**.

B. *Maintenance and Remedial Work.* Use materials which conform to the specification requirements included in the AASHTO *Guide Specifications for Highway Construction* (1998 Edition) and which correspond to the maintenance and/or remedial action employed. Where no corresponding specification exists, submit appropriate specifications to the Agency for approval.

4XX.03 Construction.

A. *General.* Construct all plant-mix pavements in conformance with the requirements of **Section 401.03 Construction**.

B. *Quality Control/Quality Assurance.* Develop a Quality Control Plan that meets the requirements of _____. Submit this plan to the Agency for approval prior to beginning of plant-mix pavement construction. Provide periodic reports to the Agency that demonstrate compliance with the approved plan, including test results.

Considerations: The required QC/QA program could be AASHTO R-9, an Agency's program, or some other acceptable program. The provisions of end result specifications with incentives and disincentives associated with the achieved quality parameters could also be included in the specifications to provide increased emphasis on quality during the construction phase.

C. *Maintenance and Remedial Work.* Use construction methods which conform to the specification requirements included in the *Guide Specifications for Highway Construction* (1998 Edition) and which correspond to the maintenance and/or remedial action employed. Where no corresponding specification exists, submit appropriate specifications to the Agency for approval.

Considerations: The Contractor's responsibility includes the construction of the pavement as would normally be required. During the warranty period, the Contractor is also responsible for maintaining the pavement (e.g., repairing pavement failures, crack sealing,

pothole repairs, and treating flushed pavement areas). These maintenance responsibilities are further defined in Section 4XX.04.C. For pavement deficiencies identified by annual or special evaluations, the Contractor is responsible for developing and performing remedial actions to correct the deficiency. Essentially, the Contractor is responsible for all pavement-related construction, maintenance, and remedial action during the construction and warranty periods of the contract.

4XX.04 Warranty.

A. *General*. Designate as provided in the bid proposal the warranty period as a 5-, 6-, 7-, or 8-year period for all pavements constructed on this project. The minimum warranty period will be 5 years, while alternate bids can be for warranty periods of 6, 7, or 8 years.

Considerations: The Agency may be more specific in the work that is to be warranted; e.g., all pavements constructed on the main lanes, or the main lanes and adjacent shoulders, etc.

B. *Term.* The warranty period begins on the date of final acceptance by the Agency of the construction phase of the project and extends for the number of years bid by the Bidder.

Considerations: The beginning of the warranty period may alternately be established as the date when all warranted pavements have been completed on all or portions of the project. For example, if a project involves completion of a main lane early in the project, it may be considered appropriate for the warranty period for that pavement to begin at that early date.

C. *Maintenance Requirements*

1. *Contractor Responsibility.* During the warranty period, perform all required pavement-related maintenance except that listed in paragraph C.2. of this section. Pavement-related maintenance includes, but is not limited to, crack sealing, pothole repair, correction of bleeding areas, and isolated level-ups. The contractor may initiate pavement-related maintenance activities.
2. *Agency Maintenance Responsibility*. The Agency will perform routine maintenance during the warranty period, such as snow and ice removal, including application of de-icing chemicals; repairs to safety appurtenances; pavement markings; mowing; and sign maintenance. The Agency will not perform any routine pavement surface maintenance activities, such as crack sealing, pothole repair, correction of bleeding areas, and isolated level-ups during the warranty period, except for emergency conditions as stated in Section 4XX.05. The Agency will advise the Contractor when pavement-related maintenance work is required.

Consideration: Because of the interrelationship of routine maintenance and potential remedial requirements, it appears desirable to assign pavement-related maintenance responsibilities to the Contractor for the warranty period. Few contractors are familiar with maintenance activities and many may be geographically located so as to necessitate their subcontracting with a local contractor to address the maintenance requirements.

D. *Performance Requirements.* The parameters used to measure pavement performance will be ride quality, surface distress features, and surface friction. Each parameter will be measured at least annually. More frequent measurements may be made when considered necessary by the Agency. If any of the measured values are found to be deficient, develop and submit the appropriate remedial action to the Agency for approval.

E. *Pavement Evaluations.* An annual pavement evaluation of the warranted pavement will be conducted within 2 months of the anniversary date of the initiation of the warranty period or on a date mutually agreed upon by the Contractor and the Agency. The Agency may also conduct special evaluations on a more frequent basis. The Agency will conduct these evaluations at no cost to the Contractor. The Agency will notify the Contractor of the evaluation date. The Contractor may have a representative present during the evaluation.

F. *Evaluation Parameters and Methods.* The Agency will conduct the pavement evaluation in accordance with the standard methods adopted by the Agency and described in the Agency's publication that includes the pavement evaluation methods.

The pavement evaluation surveys will be conducted by dividing the warranted pavement into nominal 1.5-km (1.0-mile) sections. Two 150-m (0.1-mile) segments in each section will be evaluated for pavement distress. One segment will be from 450 m (0.3 mile) to 600 m (0.4 mile) from the start of the section. The second segment will be randomly selected from the nine remaining segments. The second segment to be evaluated will be reselected each year.

If areas outside the surveyed segments are suspected of exceeding a threshold level, the Agency will conduct the evaluation survey in any, or all, segments to determine if a threshold level is exceeded.

The results of the pavement evaluation survey and the identification of segments where threshold levels have been exceeded, together with the identification of the deficiencies will be reported to the Contractor within 14 days of completing the survey.

If the pavement evaluation results are disputed, provide written notification to the Agency within 30 days following the receipt of the evaluation results. If the Contractor and Agency cannot resolve the dispute within the following 30 days, the dispute will be presented to the CRT.

Considerations: It is suggested that the evaluation be conducted using the same parameters, equipment, methods, procedures, and staff (to the extent possible) employed as part of the Agency's pavement management system.

G. *Pavement Performance Indicators, Threshold Values, and Guide to Remedial Actions.*

Performance Indicator	Threshold Levels	Guide to Remedial Action
Ride Quality	International Roughness Index—2.1 m/km	Level-up, overlay, milling, or combinations thereof to correct inadequacies.
Surface Friction	Skid number must average 35 with no individual value less than 25	Milling, surface treatment, or overlay to correct inadequacy.
Alligator Cracking	10% of area in a segment	Remove and replace distressed layer(s). The removal area will be equal to 150% of the distressed surface to a depth not to exceed the warranted pavement.
Block Cracking	10% of area in a segment	Remove and replace distressed layer(s). The removal area will be equal to 110% of the distressed surface to a depth not to exceed the warranted pavement.
Edge Raveling	10% of segment length	Remove and replace distressed layer(s). The removal area will be equal to 110% of the distressed surface.
Flushing	20% of segment length	Remove and replace distressed surface mixture full depth.
Longitudinal Cracking	300 m for cracks that average 12 mm or less in width	Rout and seal all cracks with rubber crack filling material or agreed upon equal.
	150 m for cracks which average greater than 12 mm in width.	Rout and seal all cracks with rubber crack filling material or agreed upon equal.
	Either of the above plus 25% of linear meters having bank cracking or dislodgment	If over 300 m, remove pavement and replace for the affected depth. If less than 300 m, a patch 0.6 m in width and 0.6 m longer than the crack length will be placed for the affected depth or agreed upon equal.
Rutting	6 mm in depth	Mill surface with fine-toothed mill to remove ruts, overlay or microsurface.
	12 mm in depth	Remove and replace surface layer.
Surface Raveling	Slight (for segregation, a slight rating is three or more segregated areas per segment. A segregated area is 2.8 m^2 or more in size)	Apply a chip seal coat.
Transverse Cracking	25 cracks per segment	Rout and seal all cracks with a rubberized crack filler or approved equal.
	25 cracks per segment with 25% of the linear meters of cracking having band cracking or dislodgment	Remove and replace distressed layer(s) to a depth not to exceed the warranted pavement.
Patching	45 m of patching per segment (excluding longitudinal cracking remedial action)	Remove and replace surface layer or place a 32-mm overlay.
Potholes, slippage areas, other disintegrated areas	Existence	Remove and replace distressed area(s). The removal area will be equal to 150% of the distressed area to a depth not to exceed the warranted pavement.

Considerations: The preceding table is adapted from the Wisconsin DOT and the Indiana DOT warranty specifications. It provides a format for presenting the specific specification requirements.

It is recommended that the Agency review information in their pavement management system and consult with industry prior to establishing the specification requirements.

It is suggested that the Agency's pavement performance data on similar type highways be researched to select significant performance parameters and to establish realistic threshold values that parallel performance of high-quality pavements in the area.

Some states have set threshold values that change during the warranty period in recognition of the normal pavement deterioration with age and traffic.

Some states also provide a varying threshold for some traffic-related parameters (e.g., rutting) based on traffic volumes (or truck volumes), which grossly exceed the design traffic.

It would be desirable to list both severity and extent of all performance indicators, where applicable. For example, in several cases only the presence of an unsatisfactory condition would be sufficient to trigger remedial work (e.g., a pothole or a slippage area). In other cases only the extent of the defect is appropriately cited (e.g., the extent rather than the severity of the flushing is the criteria.). The emphasis should be on linking the performance indicators and the threshold values to the Agency's pavement performance data. If severity and/or extent are measured for a performance indicator, it would be appropriate to similarly cite these factors in the warranty specs.

The definition of segment width should also be consistent with the Agency's definition in their pavement management system. In some cases the segment may be only one lane, whereas in other cases it may include the entire roadway width.

H. *Remedial Work*. If the annual evaluation results exceed the established threshold levels, develop a remedial action that will correct the inadequate condition. This remedial action will be applied to the entire segment(s) in which the threshold level is exceeded unless otherwise noted in paragraph G, "Pavement Performance Indicators, Threshold Values, and Guide to Remedial Actions." Within 1 month of the receipt of the evaluation results, submit the proposed remedial action for the Agency's approval. If the Agency does not approve the proposed action or negotiate a mutually agreeable remedial action with the Contractor within 30 days, the issue will be presented to the CRT for resolution.

I. *Remedial Work Requirements*. Use materials and construction methods that conform to the specification requirements included in the *Guide Specifications for Highway Construction* (AASHTO 1998) and which correspond to the remedial action employed. Where no corresponding specification exists, submit appropriate specifications to the Agency for approval.

J. *Schedule for Remedial Work.* Begin the remedial work within 1 month following approval of the remedial action.

K. *Warranty on Remedial Work*. Warranty for all remedial work will be limited to period of original contract warranty.

4XX.05 Emergency Work. If, in the opinion of the Agency, a pavement condition covered by the warranty requires immediate attention for the safety of the traveling public, the Contractor shall be notified immediately. If the Contractor cannot be contacted or cannot perform the required work in a timely fashion, the Agency may have the work performed, at the Contractor's expense, by Agency personnel or through an Agency procurement. Any work thus performed will not alter the requirements, responsibilities, or obligations of the warranty.

4XX.06 Pavement Markings. Restripe and/or reinstall raised pavement markers damaged or obliterated due to maintenance and/or remedial work.

4XX.07 Exceptions. The Agency will be responsible for repairing pavement conditions that are caused by factors beyond the control of the Contractor. Included are conditions resulting from major accidents and major flooding.

4XX.08 Conflict Resolution Team. A CRT for Warranty Work will be established prior to the initiation of the warranty period to resolve any conflicts regarding the warranty requirements. This team will be composed of two representatives appointed by the Contractor, two representatives appointed by the Agency, and an independent party mutually agreed upon by the Contractor and the Agency. Decisions of the CRT will be based on a simple majority vote. The expenses of the independent party will be shared by the Contractor and the Agency. Any disputes involving the warranty provisions of plant-mix pavement will be initially processed through the CRT for Warranty Work. If resolution is not achieved, the Agency's claims procedure as specified in **Section 105.18, Claims for Adjustment**, shall be invoked.

Considerations: Some warranty specifications state that the decision of the CRT is final. However, some states do not permit binding arbitration, in which case the decision of the CRT could not be considered as final.

It is recommended that the two members appointed by the Agency should be representatives of the central office and the local office. This could provide a more uniform Agency interpretation of the warranty requirements.

4XX.09 Warranty Bond. The following is added to **Section 103.05. Contract Bond**.

A. Provide a warranty bond effective for the period of the warranty, to include time periods required for remedial actions that may extend beyond the end of the warranty period. These bonds are intended to ensure completion of required warranty work, including payments for all labor, equipment, and materials used for all maintenance and remedial work resulting from these warranty provisions.
B. These bonds will meet all of the requirements specified for the construction period bonds in **Section 103.05 Contract Bond** except that the penal sum for the warranty bonds will be $_____.

Considerations: It may be difficult for the Contractor to obtain warranty bonds for the relatively long warranty periods. An alternate means of securing the maintenance/remedial work is through retainage of earned funds and subsequent scheduled payments to the Contractor for satisfactory pavement performance during the warranty period. A combination of bonds and retainage could also be specified.

The bonded amount should be at least equal to the highest probable costs to fulfill the warranty conditions. One state DOT based the bonded amount on the estimated cost to remove and replace 37 mm (1.5 in.) of asphaltic concrete pavement.

4XX.10 Award of Contract. Add the following to **Section 103.01. Consideration of Proposals.**

A. Notwithstanding other provisions of the specifications the summation of the products of the quantities and the unit bid prices included in the bid proposal will be reduced, for bid comparison purposes only, by an amount based on the warranty period bid by the Bidder.
B. The adjustment will be as follows:

Warranty Period	Adjustment
5 years	$0
6 years	*
7 years	*
8 years	*

Considerations: The adjustment (*) ideally should be based on the expected benefits to the owner of the warranted work for the period provided (e.g., for a 6-year warranty, the adjustment would be the benefits for 1 year; for a 7-year warranty, the adjustment would be the benefits for 2 years; etc.). The benefits could include the Agency's normal pavement-related maintenance costs and, where applicable, probable remedial costs (e.g., seal coats or overlays). If the higher quality product anticipated in a warranty project is expected to reduce the incidence of maintenance and/or remedial actions, the Agency may elect to also include road-user benefits. For this bidding strategy to be effective these benefits must be greater than the cost of bonding and the cost of performing the potential maintenance and remedial work. The intent, of course, is to encourage higher quality materials and construction methods so that these latter costs for the Contractor are minimal.

4XX.11 Contractor's Responsibility for Work. The provisions of **Section 104.12. Contractor's Responsibility for Work** is supplemented by the following:

A. For the specified warranty period following final written acceptance of the construction phase of the project, the Contractor will remain responsible for the warranted plant-mix pavement to the extent specified herein.
B. The Contractor will be released from further warranty work or responsibility at the end of the warranty period, or when previously required warranty work has been completed, whichever occurs last.

4XX.12 General Provisions. During the period of execution of any maintenance and remedial action, and limited to the segments where the work is being performed, the provisions of **Division 100. General Provisions**, except as herein modified, shall remain in effect.

Considerations: It is essential that those applicable portions of the General Provisions (e.g., Definitions, Maintenance of Traffic, Final Cleaning Up, Environmental Protection, Inspection of Work, Load Restrictions, Legal Relations, Insurance, Indemnity, and Responsibility to Public) remain in effect for the period when the Contractor is performing warranty work. It may be desirable to specifically identify them.

4XX.13 Measurement. Warranted plant-mix asphalt pavement for each type will be measured as specified in **Section 401.04 Measurement**.

4XX.14 Payment. All work performed and measured as described previously will be paid for as provided here for each type specified. Only that work included in the construction of plant mix pavement will be paid for directly. All work and materials included in maintenance and remedial work for warranted plant-mix asphalt pavement will not be paid for directly.

Pay Items	Pay Unit
Asphalt cement (warranted)	Megagram or liter (ton or gallon)
Plant mix—Type___ (warranted)	Megagram or square meter (ton or square yard)

Considerations: This specification provides the bonds as the only means of ensuring that the Contractor will honor the warranty. A retainage, perhaps with scheduled payments to the Contractor based on compliance with the warranty provisions, may be desirable in some cases to provide additional assurance that the warranty provisions will be fulfilled.

If the original contract remains in effect for the period of the warranty, special provisions must be included to administer the retainage.

CHAPTER **3**

GUIDELINES FOR MULTI-PARAMETER BIDDING AND CONTRACTING

METHOD DESCRIPTION

Multi-parameter bidding is defined for these guidelines as cost-plus-time bidding with I/D or A+B with I/D. Contractors are required to bid a contract amount, which is defined as the sum bid for the contract's work items and the number of days specified by the contractor to complete the work. The contract amount is the "A" portion of the bid and the number of days is the "B" portion. The number of days (B) is multiplied by the road user cost (RUC) to determine the value of the time bid. The sum of the cost and time bids is only used to determine the successful bidder. The contract is awarded to the qualified contractor who bids the lowest combination of cost and time. An incentive provision (to assess RUC) is usually included to reward the contractor if the work is completed earlier than the time bid. A disincentive provision is also incorporated into the contract to discourage the contractor from overrunning the time bid. The value of the RUC is predetermined by the contracting agency and specified in the proposal. An A+B with I/D contract is likely to reduce project durations by accelerating construction schedules.

In addition to cost and time, other parameters can be used in multi-parameter bidding. One of these parameters is quality. A process that includes a theoretically biddable quality parameter has been developed and included in the second half of this chapter. The proposed process has not been tested by any agency.

The next four sections of this chapter are related to A+B with I/D only (i.e., without additional parameters). The last four sections are devoted to the proposed biddable quality parameter that could be added to cost and time in multi-parameter bidding.

ADVANTAGES AND DISADVANTAGES

The advantages and disadvantages for A+B with I/D were developed from survey questionnaires and interviews with state agencies and contractors using this method. Data from these sources were synthesized into Table 7. This table lists 10 critical issues related to innovative contracting (column 1). Columns 2 and 3 indicate whether an advantage and/or a disadvantage are associated with this critical issue under the A+B with I/D method. Column 4 offers a brief explanation of the associated advantage or disadvantage. Finally, column 5 discusses the possible impact of the critical issue on the contracting community. It is very important for a SHA that is implementing A+B with I/D to consider and be aware of any impacts that the method has on their agency and contractors.

MULTI-PARAMETER BIDDING IMPLEMENTATION FLOWCHART

A process for implementing A+B with I/D construction contracting is presented in this section. A flowchart of this process, shown in Figure 12, outlines the steps that a SHA should take to implement A+B with I/D contracting. The Conceptual Planning; Program Planning; Bid, Award, and Construction; and Evaluation of the Project and Process phases are all covered in the context of this flowchart. Although this flowchart has been designed for the use of SHAs with little or no experience using A+B with I/D; users may enter at different points, depending on their level of experience with A+B contracting. More experienced users can use the process flowcharts to potentially refine or improve upon their existing process.

FLOWCHART DISCUSSION

To help implement the A+B with I/D process flowchart, brief explanations are provided for each step and decision point. These steps reflect a synthesis of information from SHAs that have implemented A+B with I/D for one or more projects. The steps are presented here, along with their respective explanations for each phase of the A+B with I/D flowchart.

Conceptual Planning

The first five steps of the A+B with I/D process model describe the Conceptual Planning phase of the implementation process, which is shown in Figure 13. Conceptual Planning occurs before the Program Planning phase, which begins with the selection of potential projects.

1) What Is SHA's Current Level of Experience with A+B with I/D?

Although all SHAs are encouraged to follow the entire process described here, users may have different levels of experience with A+B with I/D contracting. Thus, they may

TABLE 7 Advantages and disadvantages of A+B with I/D subcontracting

Critical Issue	Advantage	Disadvantage	Explanation	Contractor Impact
Compatibility with Low Bid System	√		The A+B+I/D method is fairly compatible with the low bid system. The contractor with the lowest combination bid of time and cost is awarded the contract. The successful contractor is not always the low cost bidder.	Contractor must bid the construction time as well as the project cost. To bid construction time, the contractor must look in depth at available resources, production rates, construction methods, and sequencing of construction phases.
Impact on Open Competition		√	The number of contractors that can bid A+B with I/D projects may be less than traditional projects. This may be due to project complexity. Reduction in open competition for projects may translate into higher project costs.	Smaller contractors may not have the resources available that are required in order to accelerate the project schedule.
Reduction of Agency Human Resources		√	A+B+I/D reduces the number of days that personnel are required on the project. Alternatively, this method often extends the work schedules (hours and days) or requires shift work to meet the construction schedule set by the contractor. Accelerated work schedules require additional personnel to accomplish the work. The work hour requirements of inspection and testing personnel increase, but for a shorter duration of time.	Many contractors must utilize extended working hours and/or shift work to accelerate the construction schedule. Typically, more management personnel and craft are required to complete the project. There may be some loss of flexibility when moving resources between projects, especially those that are not A+B with I/D projects.
Reduction in Project (Bid) Cost	–	–	The A+B+I/D contracting method has not been shown to increase total project cost significantly.	Overtime hours and night shifts cost the contractor more money.
Improvement in Quality of Constructed Project	–	–	Some SHAs report higher quality on A+B+I/D projects and other SHAs report lower quality on A+B+I/D projects. Drawings and specifications must be clear.	Contractors spend more time preparing construction schedules, estimating manpower and equipment requirements, and evaluating material availability. These actions can translate into a higher quality product. Other contractors may have a tendency to produce lower quality in the finished product because the construction process is executed faster.
Reduction of Project Completion Time	√		A+B+I/D projects are typically completed before the contractual end date and most contractors obtain the maximum incentive. The contract time is typically lower than the agency's estimated time for the construction.	To obtain the maximum incentive, contractors often increase the number of resources available to complete the project (labor and equipment). Contractors also must perform more detailed planning and scheduling of construction activities and operations when preparing bids.

(*continued on next page*)

want to enter the flowchart at different steps, depending on the extent of their experience with A+B with I/D contracting.

➢ No Experience
- First-time users of A+B with I/D should begin with Step 2 (Determine Motivation for Implementing A+B with I/D) and move directly through the numbered sequence of steps.

➢ Low-to-Moderate Level of Experience
- Users with a low-to-moderate level of experience would be those agencies with limited experience using A+B with I/D contracting; for 1 to 15 projects.
- These users are encouraged to examine the entire process with a view of refining their current program. However, some may wish to begin at Step 6 (Select Potential Projects). It would be important for users at this experience level to look closely at Step 3 (Review and Understand Best Practices for A+B with I/D.

➢ High Level of Experience
- Users with a high level of experience are those who have completed more than 15 A+B with I/D projects, and who are comfortable with their process. These users may wish to start at Step 7 (Evaluate Project by A+B with I/D Criteria). Highly experienced users may

TABLE 7 (Continued)

Critical Issue	Advantage	Disadvantage	Explanation	Contractor Impact
Shifting of Risk from Agency to Contractor	–	–	The agency shifts time risks to the contractor. However, the agency maintains certain execution risks. Any agency action that delays the contractor can produce an adversarial relationship and increase the number of time-related claims. The A+B with I/D contract has the potential to increase cost more than a traditional contract because time risk given to the contractor may result in added costs to assume any time-related risks. Other added costs may result from extended work schedules for agency personnel in the areas of testing and inspection. Frequency of inspection and testing will increase and may influence the quality of the finished product.	The contractor is responsible for meeting the time bid. Performance of the construction schedule is critical. Often the contractor works extended hours, days, or at night, increasing the likelihood of safety hazards and accident potential. The contractor must be conscious of maintaining a high standard of quality and prevent workers from taking shortcuts. Costs must be closely monitored since overtime and night work cost more.
Ease of Implementation with Respect to Resources, Data, Systems, and Expertise		√	The agency must be ready to work the construction schedule as determined by the contractor. Additional effort must be expended in constructibility reviews and clearing right-of-way issues and utility conflicts. The agency must develop an A+B+I/D specification and decide critical issues such as the basis for time extensions, if allowed.	The contractor must complete a more detailed schedule to estimate the time bid. Additional resources will be required and must be available over a shorter period of time because of the accelerated schedule. The contractor must also know what levels of production can be realistically achieved as well as the typical weather events that will impact construction progress.
Contractor Innovation	√		Innovative construction can improve quality and timely delivery of a project.	The contractor has the flexibility to propose innovative construction techniques to reduce the project duration. One area of contractor innovation is the sequencing of construction phases with traffic control plans. Another area of innovation may be construction methods that help expedite construction operations.
Project Applicability	√		A+B+I/D is applicable for reconstruction, rehabilitation, and remediation projects that are located in urban settings where high traffic volumes exist and road user costs are high. Projects that also have potential severe impacts on local business or a constrained end date are suitable candidates for this method.	No impact to contractors.

study the flowchart steps to compare their approach with the process. Once again, Step 3 may be of use, even to the experienced user.

2) Determine Motivation for Implementing A+B with I/D

The first step an agency must take in implementing an A+B with I/D process is to identify the motivation behind the program. Potential objectives the SHA may consider include:

➢ Shorten Project Duration

The number one reason to implement A+B with I/D contracting is to shorten the duration of highway construction projects when compared with traditional highway contracting. The contractor is required to bid the duration of the project for competition; therefore, the successful bidder will attempt to propose the lowest combination of cost and time.

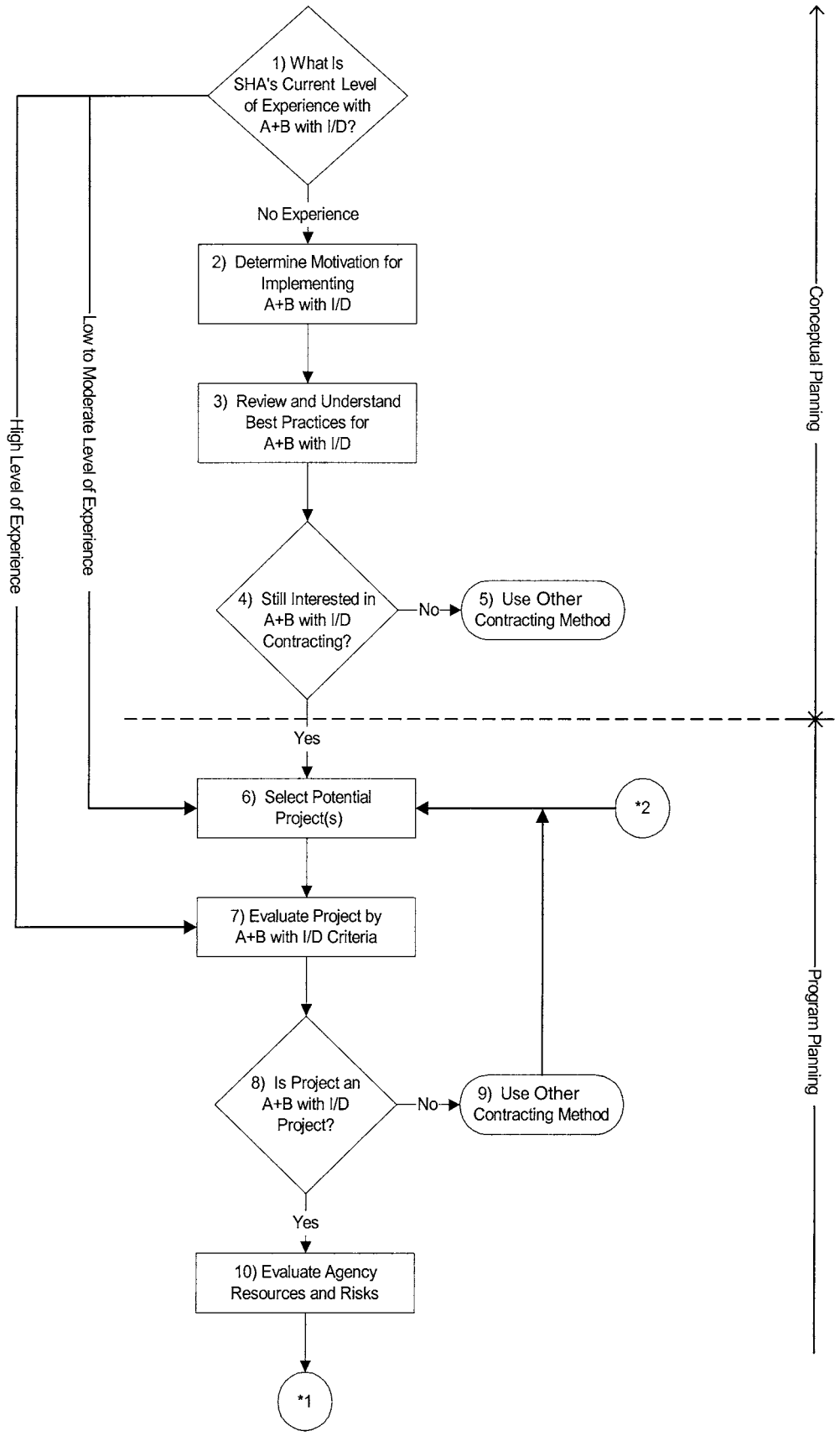

Figure 12. Flowchart process for A+B with I/D contracting (continued on next page).

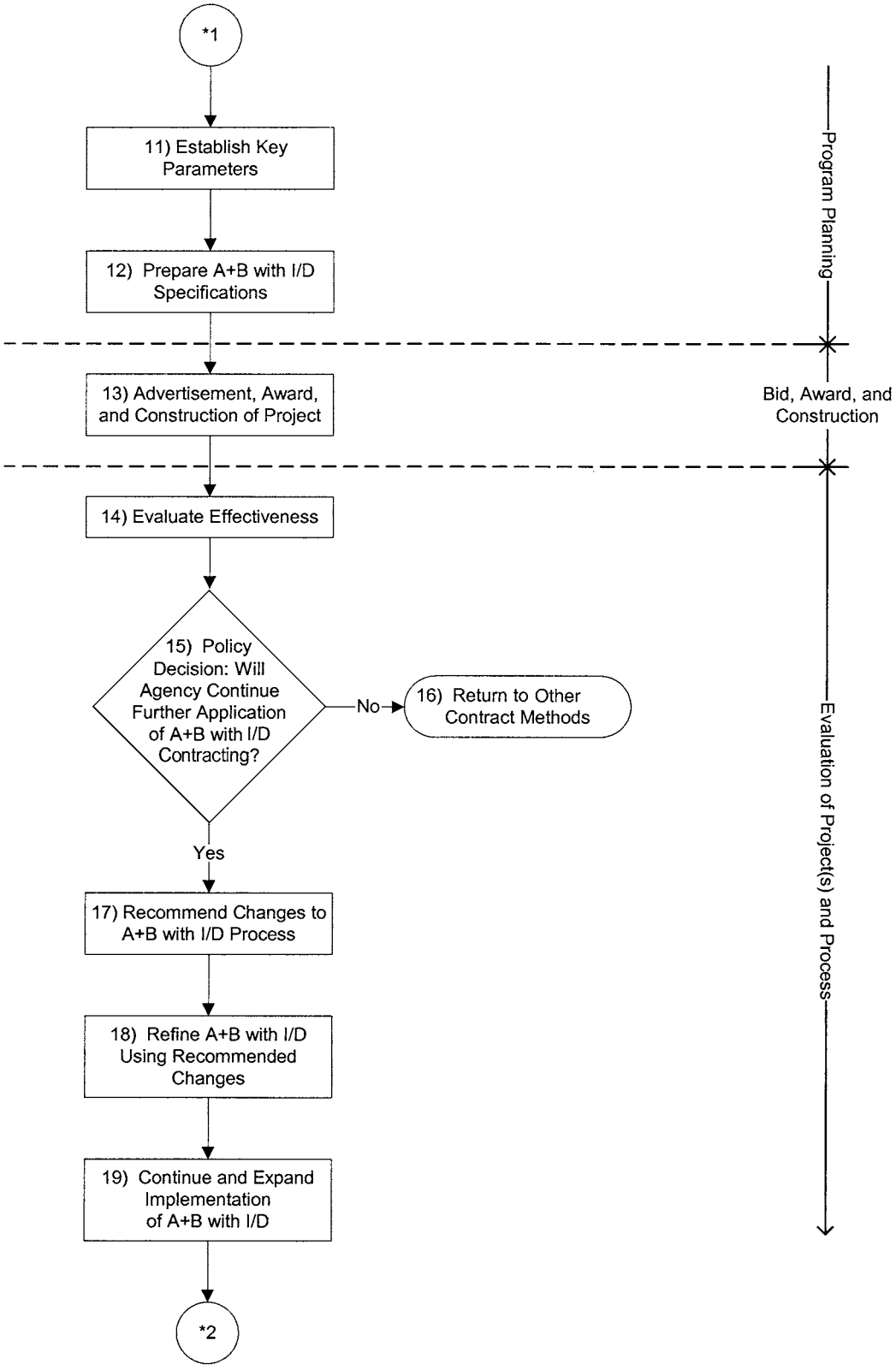

Figure 12. (Continued).

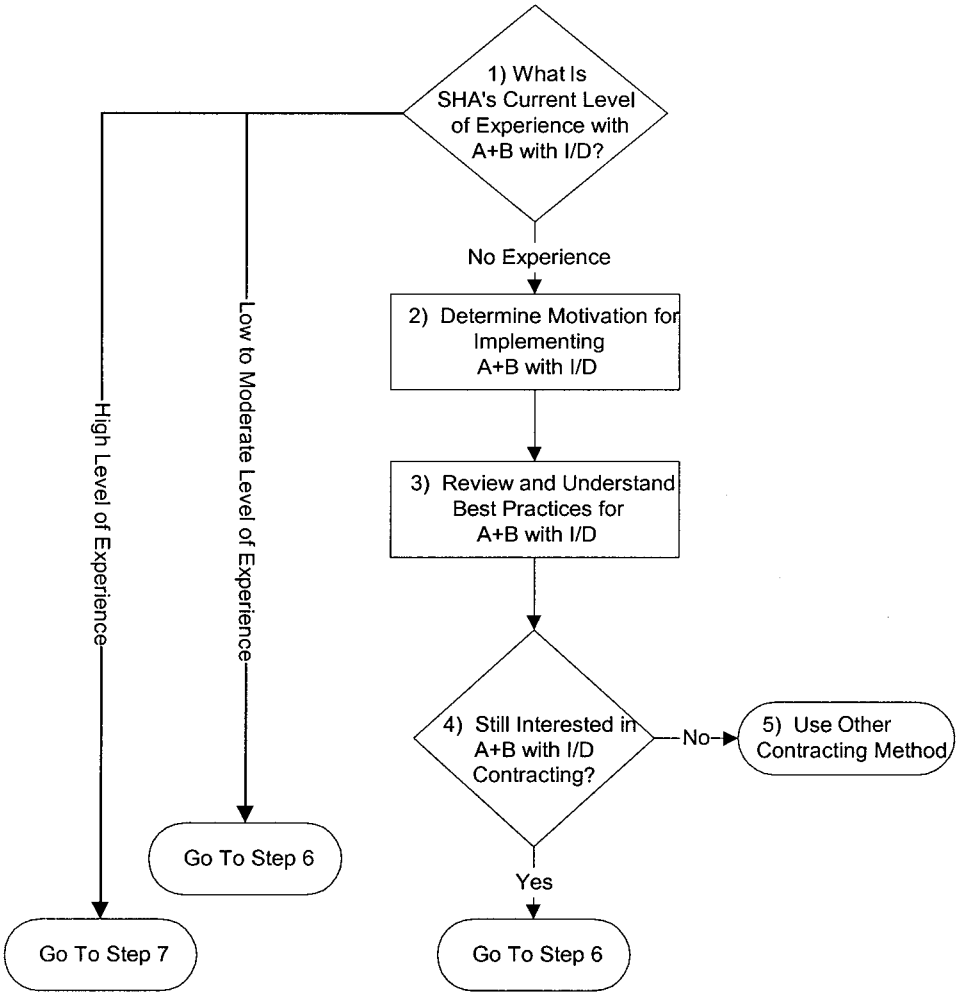

Figure 13. Conceptual planning phase process model.

➢ Reduce Inconvenience to the Traveling Public

Shortened project durations translate into reduced levels of inconvenience to road users. Congestion and rerouting of traffic occurs for shorter periods of time.

➢ Lessen Potential Impact on Local Businesses and Communities

Shortened project durations reduce the time that business access is potentially disturbed. On some A+B with I/D projects, one contract segment with a higher I/D value could consist of a roadway that restricts access to local businesses and neighborhoods.

➢ Encourage Innovative Construction Processes

Allowing the contractor to determine the project duration opens the door for innovative construction processes and methods required to accelerate the project. The contractor could also be innovative with the sequencing of construction in relation to traffic throughout the duration of the project.

➢ Improved Effect of Construction on Public

The use of A+B with I/D will decrease the time required for construction. This means that the traveling public will observe that progress is made on a consistent and continuing basis. Agencies have been subjected to public criticism because of what appears to be long time periods where contractors are not seen working on the project consistently.

Identifying the objectives the agency expects to achieve through implementation of A+B with I/D contracting and translating these objectives into an evaluation framework will allow the agency to determine the effectiveness of this method. Improvements can then be made to enhance its application in practice.

3) Review and Understand Best Practices for A+B with I/D

Once the agency has determined the motivation for using the A+B with I/D contracting or what they want to achieve through the use of A+B with I/D, the next step is to review current state-of-the-art applications.

➢ This guideline document will provide a solid foundation covering the basics of A+B with I/D contracting.

- ➢ The unpublished final report for NCHRP Project 10-49 is another source of information about A+B with I/D contracting.
- ➢ For more specific information, contact other agencies using A+B with I/D contracting. These SHAs include New York, North Carolina, Florida, California, South Dakota, and Utah.
- ➢ Two states currently evaluating the effectiveness of their A+B with I/D contracting programs are New York and Florida.
- ➢ Key areas where information on current use should be collected and analyzed when implementing A+B with I/D contracting are found in Table 8.
- ➢ Other areas of information to gather include
  - Determination of RUC,
  - Amount of calculated RUC to use in contract,
  - Determination of I/D,
  - Determination of I/D caps,
  - Determination of maximum time allowed, and
  - Determination of minimum time allowed.

An understanding of both the advantages and disadvantages of A+B with I/D is important so that the agency can decide if the A+B with I/D contracting method can be effectively used on their highway construction projects. The agency should understand under what project conditions A+B with I/D is most effectively applied.

4) Still Interested in A+B with I/D Contracting?

At this point, a comparison must be made between the information gathered in Step 3 and the objectives established in Step 2. If it is evident from the information gathered that the objectives established are attainable using the A+B with I/D method, the SHA should continue pursuing A+B with I/D bidding. If the objectives appear unrealistic, or could be better met by another contracting method, the SHA should discontinue its investigation of A+B with I/D.

- ➢ If the SHA is not interested in A+B with I/D, proceed to Step 5.
- ➢ If the SHA is still interested in A+B with I/D, proceed to Step 6.

5) Use Other Contracting Method

If the agency is not interested in implementing A+B with I/D contracting or has determined that A+B with I/D will not meet their objectives, the investigation into this contracting method should be discontinued. The agency should return to the traditional or other established contracting methods.

Program Planning

The next seven steps of the A+B with I/D process model describe the Program Planning phase of the implementation process, which is shown in Figure 14. Program Planning includes the selection of potential projects, the evaluation of those projects by A+B with I/D criteria, determination of key parameters, and preparation of specifications.

6) Select Potential Project(s)

Using the knowledge gained in Steps 2 and 3, the agency should select a potential project(s) from the upcoming projects to potentially pilot the A+B with I/D contracting method. The agency's objectives and understanding of the basic key criteria and best practices should narrow the field of potential

TABLE 8 Key areas of information on current use

Key Area	Types of Information
Project Selection Criteria	• Typical projects, characteristics of projects in terms of size and complexity suitable for an A+B with I/D contract • Factors relevant to successful and unsuccessful projects
Legal Issues and Authorization	• Allowance of time extensions • Determination of criteria for time extensions
Agency Resource Impacts	• Types of personnel impacted by A+B with I/D • Special design considerations
Past Performance of A+B with I/D for Other Agencies	• Additional resources required • Risk allocation changes • Agency responsibilities • Contractor responsibilities • Reduction in project durations • Quality impact • Lessons learned • Alternate applications of A+B with I/D
Performance Evaluation Criteria for A+B with I/D	• Reduction in project durations • Quality impact • Cost impact • Agency resources impact

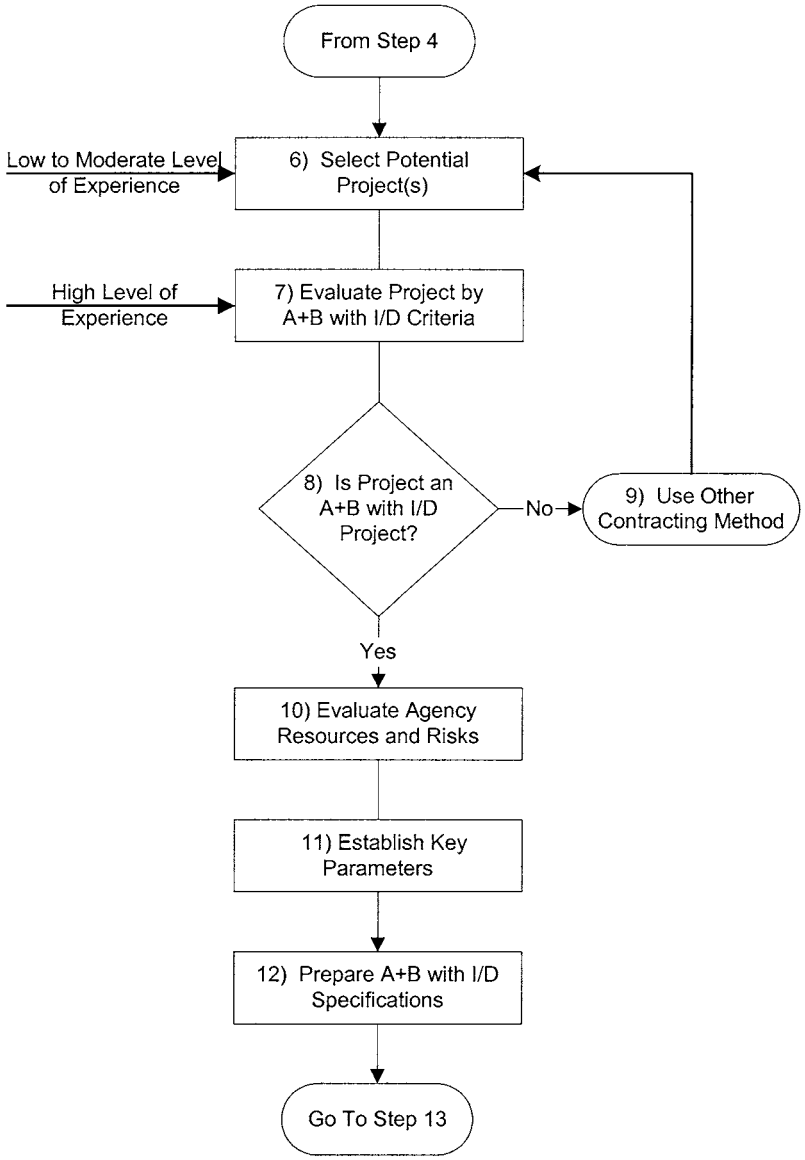

Figure 14. Program planning phase process model.

project(s). The project(s) will be evaluated by the A+B with I/D criteria found in Step 7.

7) Evaluate Project by A+B with I/D Criteria

Determine Criteria

- ➢ The agency needs a basis for matching a project with the A+B with I/D contracting method.
- ➢ The determination of criteria should be based on the best practices information for A+B with I/D projects gathered in Step 3.
- ➢ The criteria must support the agency's objectives as determined in Step 2.
- ➢ There are several criteria that can be used to identify a candidate project for A+B with I/D contracting.
  - High RUC with traffic disruption;
  - Free of third party conflicts (especially utilities and right-of-way [ROW]);
  - Emergency response;
  - Completion time constraint;
  - Major bridges out of service;
  - Disruption of emergency services;
  - Lengthy detours of high traffic volumes;
  - Major reconstruction or rehabilitation on an existing urban facility;
  - Completion of a gap in a significant highway system;
  - Interference with major public events;

- Highly sensitive project (businesses impacted, political issues);
- Significant public interest and benefit;
- Impacts to public, pedestrian, and/or worker safety; and
- Availability of contractors with sufficient resources.

Prioritize Criteria

➢ The relative importance of the criteria needs to be determined in order to make a decision.
  - The criteria could be ranked in order of importance.
  - The criteria could be weighted to reflect level of importance.

➢ Many states require that the project meet or exceed a certain RUC value to use an A+B with I/D contract.

➢ A project does not need to necessarily meet more than one of the aforementioned criteria to be considered for A+B with I/D contracting.

➢ The relative importance of these and other criteria is determined by the individual SHAs, each of which will emphasize the criteria differently.

➢ The determination of the relative importance of these and other criteria is also project specific.

Establish Decision Rules

➢ The agency must determine how to use the criteria to make a decision as to whether the project is a good candidate for A+B with I/D contracting. The following are some possible decision rules
  - Require project to meet all criteria.
  - Require project to meet the top three criteria.
  - Require project to meet a minimum RUC and three of the other criteria.
  - Require project to meet a minimum RUC, have utilities and ROW cleared, and two of the other criteria.

Example Scenarios

➢ An overlay of the road in front of city hall and the court building is required. The RUC for the project is $4,000/day. This project could be a candidate for A+B with I/D, although the project has less than the agency RUC minimum requirement of $5,000/day, because it is a highly sensitive project.

➢ A major section of the downtown highway route requires the addition of two lanes. The RUC for the project is $25,000/day and utilities and ROW are cleared. The project would have significant public interest and benefit. This project would be a candidate for A+B with I/D.

➢ The street in front of Fire Station Number 3 will be reconstructed into a four-lane divided arterial and the project would meet the minimum required RUC. ROW is cleared, but utilities are not. This may or may not be an A+B with I/D project. The agency would have to weigh the benefits of accelerating the project against the potential problems to be encountered with clearing the utilities.

8) Is Project an A+B with I/D Project?

Not every project is right for the use of an A+B with I/D contract. The agency should select projects that will maximize the chances for successful completion using A+B with I/D. Does the project meet or exceed criteria for applying A+B with I/D set by the agency?

➢ If the project does not meet the criteria for applying A+B with I/D, move to Step 9.

➢ If the project meets the criteria for applying A+B with I/D, move to Step 10.

9) Use Other Contracting Method

If the project does not meet the criteria for using A+B with I/D as determined by the agency, the investigation into this contracting method should be discontinued and the traditional or another established contracting method should be considered.

➢ If the agency wants to continue the development of the A+B with I/D contracting method, another project must be selected that meets the criteria determined by the agency. Return to Step 6.

10) Evaluate Agency Resources and Risks

Assess Impact on Agency Personnel Requirements

➢ On an A+B with I/D project the total number of agency workhours is approximately the same as would be required on a traditionally contracted project.

➢ The agency is impacted substantially when the contractor works extended hours per day and/or per week. The number of agency workhours required per day and/or per week may increase substantially because of the extended work schedules that are required to meet a reduction in project duration.

➢ The increase in agency workhours per day translates into more agency personnel required for the project. The personnel are required for a shorter length of time because of the reduced project duration.
  - One agency estimated that approximately 2½ times the traditional number of agency personnel would be required if the contractor works 7 days per week, 24 hours per day.
  - Work schedules of some agency personnel change, because they are required to work much longer hours than on a traditional project.

- ➢ The agency personnel that are typically most affected by the construction work schedule are inspectors, testing personnel, and construction engineers.
- ➢ A few agencies have reduced the extended workhours by limiting the number of hours per day and per week that the contractor can work, with the following results:
  - Longer project duration, because the contractor cannot work all day and all night, every day of the week.
  - Possible undermining of the effectiveness of the A+B with I/D contract method.
- ➢ Personnel that are assigned to an A+B with I/D project should have the required skills and expertise and be able to make appropriate decisions on a timely basis. This is especially true for engineers and inspectors.
- ➢ Supervisors must be more familiar with the status of the work, because an increased number of decisions will be made in the field instead of the office, and in a matter of hours instead of days and weeks. More coordination with design personnel, contractor, and subcontractors will be required.

Assess Impact of Risks

- ➢ Shifts time risk to contractor. The agency may pay for this risk in higher bid costs.
- ➢ Execution risks are created, especially in contract administration.
  - Agency responses to requests for information or decisions must be timely; if not, the project could incur time-related claims.
  - More planning and coordination is required by the agency. Additional attention to details is necessary to decrease the chances of problems that could lead to time claims.
  - Increased frequency of inspection and testing. If the increase in inspection and testing is not managed properly or adequate resources are not available, the quality of the constructed facility may be compromised.

11) Establish Key Parameters

Determine Application of Time

- ➢ Establish the bid time in calendar days. (For more information see the following section on the determination of maximum/minimum project durations.)
- ➢ Determine the method needed to convert the time bid into a dollar value. Use the concept of RUC or I/D.
- ➢ Determine RUC. Most agencies have a standard method for estimating RUC on traditional projects. If none exists, a method for determining RUC should be developed.
- ➢ Decide how much of the estimated RUC will be included in the contract for the time-related costs.
  - Agencies have used anywhere from 10 percent of the estimated RUC to the entire amount of RUC in previous A+B with I/D contracts.
  - Typically, this same dollar amount will be used as the I/D amount in the contract (see *Determine Incentive/Disincentive*).
  - Engineering judgment or agency policy usually determines what percentage of the estimated RUC is used.

Determine Maximum/Minimum Project Durations

- ➢ Typically, the maximum allowable duration is specified for the project.
  - Requires the use of a scheduling tool; either a critical path method (CPM) schedule or bar chart, with production rates.
  - Use historical production rates to arrive at a traditional schedule by estimating an 8-hour/5-day workweek.
  - Convert the standard production rates to reflect an accelerated schedule using engineering judgment and experience.
  - Use a CPM schedule on complex projects.
- ➢ A few agencies also specify a minimum project duration.
  - The agency can use the same scheduling tools to further adjust production rates to arrive at an estimated shortened schedule.
  - This prevents contractors from bidding a purposely low number of days to obtain the contract and then bidding a high price on the construction activities (prevents receiving unbalanced bids).
- ➢ Require contractors to submit a CPM schedule with their bid to be considered responsible.

Determine Incentive/Disincentive

- ➢ The incentive and disincentive amounts are calculated by multiplying the number of days of earlier or later contract completion than the contractor's bid time (B) by the established RUC value for the contract.
- ➢ Most often, the incentive is capped by the agency at a maximum percentage of the contract amount, a set maximum dollar amount, or a set number of days that will be paid for early completion.
- ➢ The disincentive is not usually capped by the agency, although some agencies cap both the incentive and disincentive equally.
- ➢ The FHWA recommends that an I/D provision be used with an A+B contract.
- ➢ The I/D amount must be substantial enough to motivate the contractor to achieve an earlier completion date or discourage the contractor from finishing later than the contract completion date. Without the I/D provision, the contractor has little reason to finish any earlier than the time bid to secure the contract.

➢ The allocation for the potential award of the entire incentive amount should be factored into the agency's construction budget. This allocation of construction funds could mean that fewer projects can be completed in the context of an agency's overall program.

Determine Liquidated Damages

➢ Liquidated damages can be included in A+B with I/D contracts.
➢ Liquidated damages can include contract administration costs only or both contract administration costs and RUC.
  • If liquidated damages include only contract administration costs, assessment typically begins when the maximum allowable time (the contract time bid, B) is reached and accrues until the project is accepted by the agency. Both the disincentive and liquidated damages can be assessed on the project.
  • If liquidated damages include both contract administration costs and RUC, assessment typically begins at the end of a capped disincentive or at substantial completion and accrues until final project acceptance by the agency.
  • Some agencies do not assess liquidated damages on A+B with I/D projects, but assess only the disincentives.

12) Prepare A+B with I/D Specifications

➢ A model specification for A+B with I/D has been developed from a sampling of state specifications and a determination of best practices for A+B with I/D, and is presented at the end of this chapter.
➢ The specification is based on the AASHTO *Guide Specifications for Highway Construction* (1998 Edition).
➢ The specification is a series of special provisions to the 1998 AASHTO *Guide Specifications*.
➢ The model specification cannot be used directly as a special provision to an agency's standard specifications.
➢ The model specification must be modified to meet the requirements of agency procurement policies and then integrated into an agency's standard specifications.
➢ A checklist of specification elements to include when preparing an A+B with I/D specification is provided in Table 9. These elements are critical to the definition of the A+B with I/D method and are located within the designated sections of the model specification.
➢ A model A+B with I/D specification is described on the following pages.

Bid, Award, and Construction

The next step of the A+B with I/D process model describes the Bid, Award, and Construction phase of the implementation process, which is shown in Figure 15. This phase is made of several distinct steps, which differ somewhat from the traditional contracting process.

13) Advertisement, Award, and Construction of Project

Advertisement for Bids

The advertisement of bids for an A+B with I/D project is the same process as used for traditional contracts, with the exception of noting the project as an A+B with I/D project.

Owner Conducts Pre-Bid Conference

➢ A pre-bid conference may be held when beginning the implementation of A+B with I/D contracts.
➢ Typically, agencies that have used A+B with I/D on several projects and have developed the method do not hold a pre-bid conference for all A+B with I/D projects.

TABLE 9 Checklist of specification elements

Specification Element	Location in Model Specification
General Description of A+B	XXX.01
Definition of A	XXX.05
Definition of B	XXX.05
Definition of RUC	XXX.03
Equation for Determining Total Bid Value	XXX.05
Definition of Contract Segments	XXX.02B
Definition of Work Included in Contract Segments	XXX.03
Maximum Time Length	XXX.02D, XXX.03
Minimum Time Length	XXX.02E, XXX.03
Incentive/Disincentive	XXX.02C, XXX.03, XXX.07
Incentive and/or Disincentive Caps	XXX.07
Liquidated Damages	XXX.07
Working Days or Calendar Days	XXX.02A, XXX.07
Substantial Completion	XXX.02F, XXX.07
Progress Schedule Submission	XXX.06
When Time Charges Begin	XXX.07
Provisions for Time Extensions	XXX.07

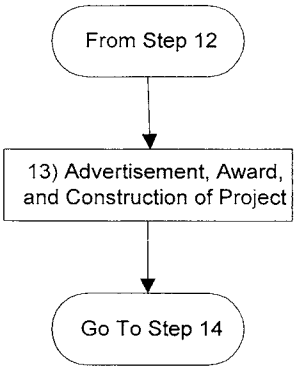

Figure 15. Bid, award, and construction phases process model.

- ➢ Holding pre-bid conferences is directly related to the complexity of the project, instead of the application of the A+B with I/D contract.
- ➢ Figure 16 is a checklist of additional items to be discussed at the pre-bid conference.

Owner Selects Lowest Responsible Bidder (Contract Award)

- ➢ The contract is awarded at a public bid opening.
- ➢ A public bid opening is the same as a traditional bid opening, except that both the cost A and time B bids, as well as the total value, of each contractor are announced.
- ➢ Other agencies choose only to announce the total bid amounts for each contractor at the public bid opening and then publish the cost A and time B values of the successful contractor only.

Owner Conducts Preconstruction Conference

The preconstruction conference for an A+B with I/D project would be similar to a traditional preconstruction conference. Additional items that would be covered include

- ➢ Awarding of additional contract time, if the contract provisions allow for time extensions;

- ✓ A+B with I/D description
- ✓ Contract award process
- ✓ Contract segments, if necessary
- ✓ Time charges
- ✓ Additional time allowed
- ✓ Any necessary clarifications

Figure 16. Checklist of additional items to be discussed at an A+B with I/D pre-bid conference.

- ➢ When time charges begin;
- ➢ When time charges end; and
- ➢ Utility interfaces, if not cleared.

Contractor Performs Construction

Construction is performed in the same manner as in traditional competitively bid contracts.

- ➢ Many A+B with I/D projects use extended working hours, either with overtime or multiple shifts, so that the contractor can obtain the maximum incentive possible.
- ➢ The agency must be ready to adapt their work schedule to the contractor's work schedule.
  - This often involves additional inspectors to verify the contractor's work and faster turnaround times on testing.
- ➢ Agency personnel must make sure that they do not delay the contractor and emphasize timely decision making.

Evaluation of Project(s) and Process

The final six steps of the A+B with I/D process model describe the Evaluation of Project(s) and Process phase of the implementation process, which is shown in Figure 17. The Evaluation of Project(s) and Process includes an evaluation of the effectiveness of the A+B with I/D method on the project, an agency policy decision to continue to develop A+B with I/D, and recommending changes and refining the A+B with I/D process.

14) Evaluate Effectiveness

Once construction of the project has been completed, the effectiveness of the A+B with I/D contracting method should be evaluated.

- ➢ Several important items that should be included in the evaluation are listed here.
  - Amount of project duration reduction: compare engineer's time estimate, time bid, and actual project duration.
  - Effects on department personnel resource requirements: track overtime hours, total hours, number of personnel required, and any resulting problem areas. Typical personnel involved are
    - –Design personnel,
    - –Testing personnel,
    - –Inspection personnel,
    - –Project management personnel, and
    - –Other agency personnel.
  - Impact on design process: track number of requests for information (RFIs), change orders, design hours, special reviews (constructibility reviews, etc.).

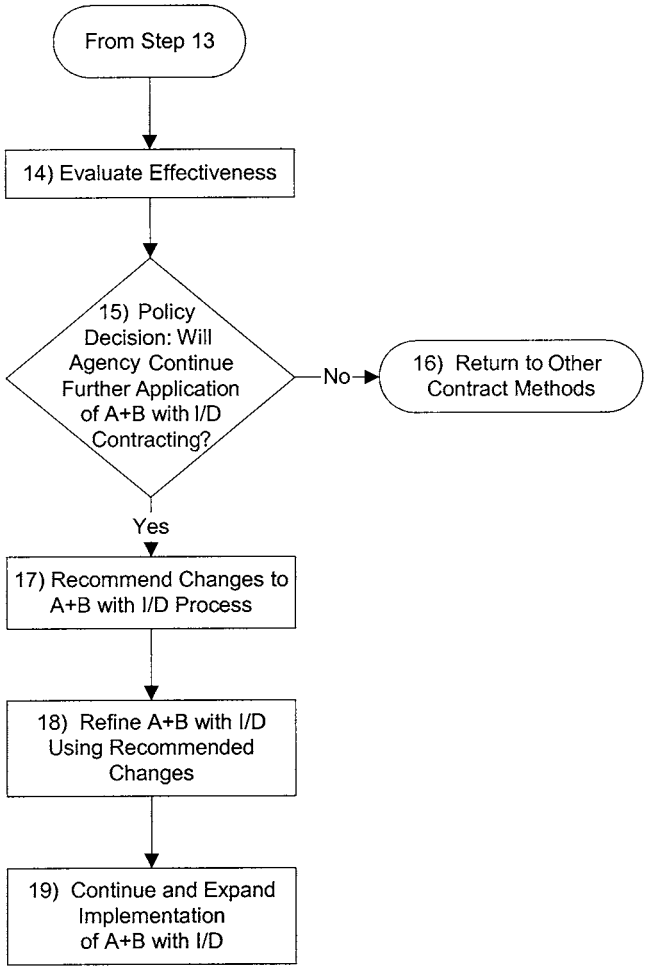

Figure 17. Evaluation of project(s) and process phases process model.

- Impact on quality of the finished project: track performance of the project product over future life.
- Amount of claims and litigation: number and value of time-related project claims, value of litigation, if any.
- Project costs: compare engineer's cost estimate, price bid, and actual project cost.
- I/D earned.
- Innovative construction processes used: note any innovative construction processes used by the contractor and/or subcontractors.
- Innovative sequencing used: note any innovative traffic or construction sequencing used by designer or contractor.
- Impacts of third party conflicts (if any): measure delays and their cost to agency and contractor.
- Overall effectiveness of the project.

➢ Feedback should be solicited from contractors and other interested parties, as well as involved state and FHWA personnel. This feedback could be in the form of lessons learned.

15) Policy Decision: Will Agency Continue Further Application of A+B with I/D Contracting?

➢ Evaluate the results of the pilot project according to the objectives determined in Step 2 for using A+B with I/D. Use the information gathered in Step 14.
- Did the A+B with I/D project save time (accelerate the project duration)?
- Did the A+B with I/D project maintain acceptable quality standards?
- Did the A+B with I/D project maintain acceptable safety standards?
- Was the A+B with I/D project cost-effective?
- Did the agency accomplish the objectives it wanted to achieve by implementing A+B with I/D?

As this policy decision is made, it must be kept in mind that A+B with I/D contracts are not appropriate for every project. The A+B with I/D contracting method is not being proposed as a replacement for the low bid system, but as an additional option for SHA's contract administration.

➢ If the SHA does not wish to continue implementation of the A+B with I/D method, go to Step 16.
➢ If the SHA wishes to continue implementation, go to Step 17.

16) Return to Other Contract Methods

If the policy decision is made not to continue further implementation of A+B with I/D, the SHA should discontinue the use of A+B with I/D as a contracting method option.

17) Recommend Changes to A+B with I/D Process

If the agency makes the decision to continue implementation of the A+B with I/D program, it must be evaluated for possible improvements. Feedback is essential to improve on any shortcomings identified in the first project application of the method.

➢ Identify any problems that were encountered during the pilot project.
➢ Determine solutions to those problems.
➢ Recommend changes to the specifications, if necessary.
➢ Determine changes in the design process to enhance the use of A+B with I/D.

This step assumes that future projects will be procured through the use of the A+B with I/D contracting method after the initial pilot project(s) is completed.

18) Refine A+B with I/D Using Recommended Changes

The efficiency and effectiveness of the A+B with I/D contracting method can (and should) be improved through the establishment of a feedback loop.

- ➢ Incorporate the changes recommended in Step 17 into the A+B with I/D program through
  - Revision of the project selection criteria determined in Step 7,
  - Revision of the evaluation of agency resources and risks in Step 10,
  - Revision of the maximum and minimum time parameters in Step 11,
  - Revision of the I/D parameters in Step 11, and
  - Revision of the specifications drafted in Step 12.
- ➢ The A+B with I/D process should be periodically refined based on experience gained from each A+B with I/D project constructed.

19) Continue and Expand Implementation of A+B with I/D

Once the process has been refined and revised the agency may consider the use of A+B with I/D contracting.

- ➢ Additional projects should be conducted using the revised process (criteria, specification, etc.).
- ➢ As the SHA becomes more comfortable with the practice of A+B with I/D contracting, it can be applied to additional projects when appropriate.
- ➢ One of the greatest challenges involved with the implementation of an A+B with I/D process is determining which projects are most effectively administered with an A+B with I/D contract.
- ➢ Finally, the SHA must continue to gather information on its A+B with I/D projects and on the process in general to continue monitoring LCCs and improving the effectiveness of the A+B with I/D program.

CRITICAL SUCCESS FACTORS

The general implementation of A+B with I/D is described by the steps and decisions found in the flowchart of the A+B with I/D process (Figure 12). The successful implementation of A+B with I/D contracting is also affected by the following critical success factors.

Training

- ➢ Contractors will need to bid reasonable estimates of project time to win the contract award.
- ➢ Implementation of A+B with I/D will require agency personnel with appropriate levels of skill and expertise.
  - Agency personnel must be trained to respond quickly to contractor RFIs and potential change orders to eliminate contractor delay.

Appropriateness of Method for Projects

- ➢ Appropriate levels of resources, including personnel, equipment, and materials, must be available to both the SHA and the contractor to accomplish an A+B with I/D project.
- ➢ Criteria must be prioritized to make clear what projects are candidates for an A+B with I/D contract.

Communication

- ➢ Communication among major involved parties is crucial throughout the duration of the project. Coordination between the parties may require more input from design personnel and the contracting community.
- ➢ During the project, conflicts must be resolved in a timely manner to avoid delays.

Initial Agreement

- ➢ All involved parties, including agency design personnel, consultant design personnel, and agency construction personnel, must bring their expectations into agreement early in the process.

Post-Award Agreement

- ➢ A partnering process would help agency and contractor personnel agree on project objectives, critical success factors, and other areas that might result in problems.

Integration of Design, Construction Methods and Techniques, and Sequences of Work

- ➢ The A+B with I/D process must be identified as the chosen contract method early in the project.
- ➢ The clearance of utilities and ROW is critical to avoid time delays and related contract claims.
- ➢ Design considerations, selection of construction methods and techniques, and sequences of work are all interrelated and will be impacted by the A+B with I/D process. A constructibility review process would help ensure that these interrelated areas are well planned.

More Up-Front Investment by SHA

- ➢ The SHA must be willing to invest more resources initially in both the process and an individual pilot project. As the A+B with I/D process matures, less up-front effort will be required for modification of specifications and criteria evaluation.

Support of SHA Upper Management and Industry Buy-In

- ➢ Without the buy-in of agency upper management and local industry personnel, the A+B with I/D process will not be successfully implemented.

QUALITY PARAMETER METHOD DESCRIPTION

A biddable quality parameter that could be added to the multi-parameter bidding method would offer an agency a means of awarding contracts based on the potential quality of the finished product as well as the time and price necessary to construct such a product. The quality parameter would allow an agency to improve the quality delivered on future projects. By implementing a multi-parameter plus quality contract, the successful bidder would be awarded the contract based on the lowest combined cost of all factors bid (price, time, and quality), and not on price alone. The following proposed process for a biddable quality parameter has not been tested by any agency.

Many different end products are associated with the highway construction industry. The measurement of quality in the different types of products varies from laboratory testing to visual inspection or on-site measurements. Three challenges exist for developing this biddable parameter.

1. Selection of the best measure of quality.
2. Determination of how the quality parameter is used in the A+B+Quality formula or how a level of quality is translated into a dollar value.
3. Determination of how the contractor's payment will be impacted due to performance on the contract and the quality bid.

The ideal quality parameter would be derived from a performance-related model such as a LCC.

An example of the preliminary development of a biddable quality parameter for use with asphalt pavement has been included in Appendix C. A full discussion of the development of the quality parameter is included in the unpublished final report for NCHRP Project 10-49.

QUALITY PARAMETER FLOWCHART

A process for developing and implementing a biddable quality parameter is presented in this section. A flowchart of this process is shown in Figure 18 and details the steps an agency should take to develop and implement a biddable quality parameter.

QUALITY PARAMETER FLOWCHART DISCUSSION

To help develop and implement the biddable quality parameter process, brief explanations are provided here for each step and decision point of the biddable quality parameter flowchart.

1) Is the Agency Interested in Developing a Biddable Quality Parameter?

A quality parameter that could be added to the multi-parameter bidding method would offer an agency a method of awarding contracts based on the potential quality of the finished product, as well as the time needed to construct such a product. The quality parameter could assist an agency to improve quality delivered on future projects.

By implementing a cost-plus-time-plus-quality contract (A+B+Q), the successful bidder would be awarded the contract with the lowest cost combination of price, time, and quality and would not necessarily be the lowest price bidder. One goal of A+B+Q is to increase the quality of the constructed product while decreasing the construction time over what would have been obtained by awarding the project to the lowest price bidder.

2) Use Other Contracting Methods

If an agency is not interested in implementing a biddable quality parameter, the investigation should be discontinued and the agency should return to traditional contracting methods.

3) Establish Cooperation and Communication Between Agency, Contractor, Sureties, and Other Relevant Parties

- ➢ The agency should enlist the support of top management for the development of a quality parameter. Without this support, the implementation of a quality parameter will not be successful.
- ➢ The agency should determine the objectives for the implementation of a biddable quality parameter.
- ➢ After obtaining the support of agency top management, a task force should be formed to oversee the development and implementation of the procedure.
  - The task force should include both agency personnel and contracting representatives.
  - The task force could also include academic researchers, material suppliers, and/or expert consultants in the field.
  - The task force should review (and modify if necessary) the agency's objectives of implementing a biddable quality parameter.
  - The task force should establish both short- and long-term goals and must determine the time frame for the development and implementation of procedure.
  - Several items should be included in the preparation of the quality parameter.
    - An agreement of the expectations of the different parties (stakeholders);
    - An initial choice of end products to be evaluated by a quality parameter;
    - Education of agency and contracting personnel, especially those in the field who will be directly affected; and
    - A tentative schedule for task force meetings and milestones.
- ➢ It is very important to foster a partnership between an agency and the contracting community.
- ➢ Other parties that might need to be involved in the process are the FHWA, surety companies, and the subcontracting

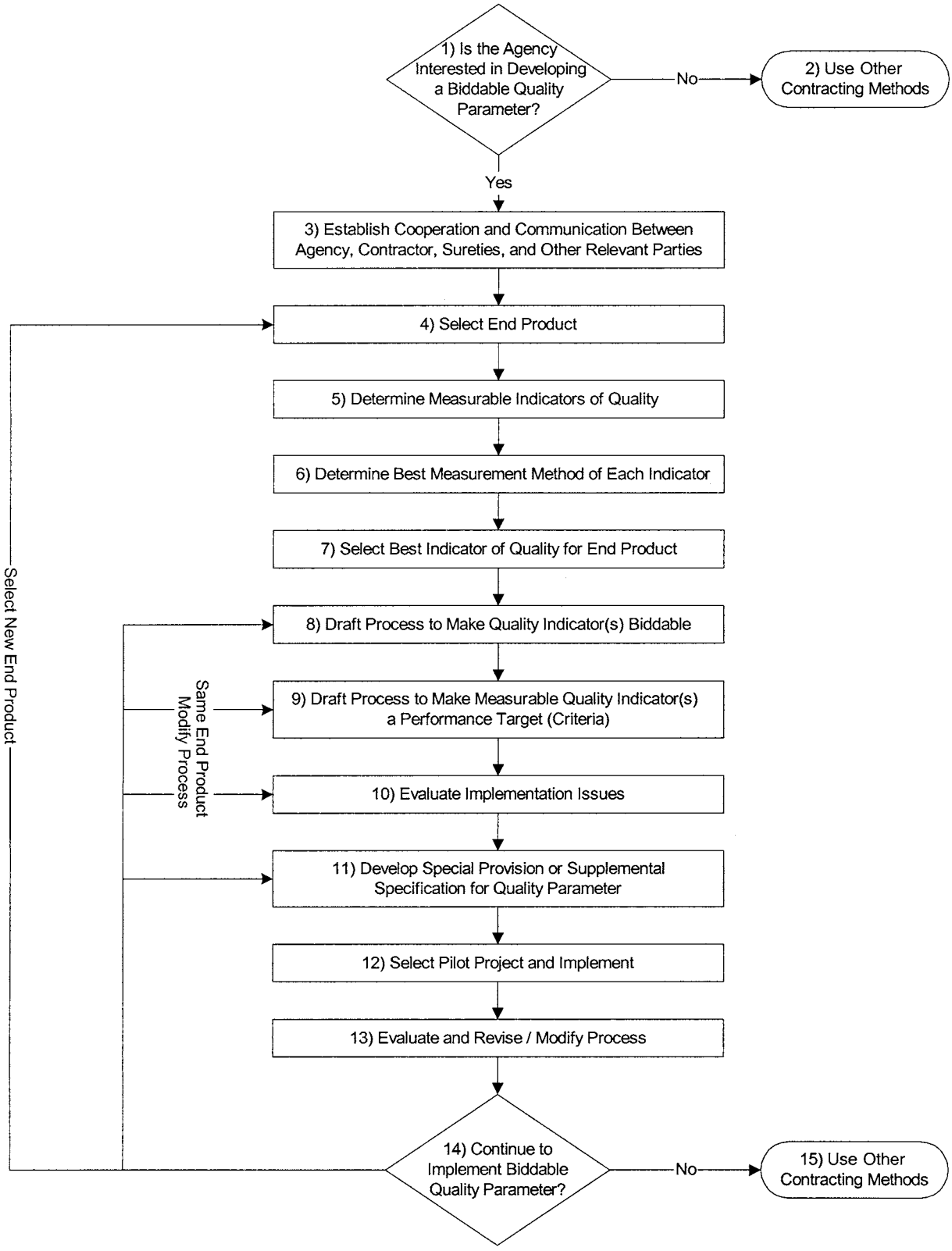

Figure 18. Quality parameter implementation process.

community. FHWA headquarters approval is necessary for any nontraditional construction contracting technique that deviates from the competitive bidding provisions in 23 USC 112. Any contract that uses a method of award other than the lowest responsive bid (or force account as defined in 23 CFR 635B) should be evaluated under the FHWA's SEP-14. These nontraditional contracting techniques may include best value, LCC, qualifications-based bidding, and other methods where cost and other factors are considered in the award process.

- ➢ The goal of implementing a quality parameter is to increase the quality of finished projects, not to exclude certain "undesirable" contractors.

4) Select End Product

- ➢ Select an end product for application of a biddable quality parameter.
  - An end product that needs improvement to meet the current standards.
  - An end product where an agency is interested in improving the quality over the current standards.
- ➢ The selection of the end product should include input from the contracting community and other stakeholders.
- ➢ The agency should consider only one end product as a starting point.
- ➢ After using the quality parameter several times, an agency could proceed to use several end products. These end products could possibly be integrated together in the quality parameter if they are material related, construction related, or both material and construction related.

Examples of Possible End Products

- ➢ HMAC pavement
- ➢ Portland cement concrete (PCC) pavement
- ➢ Pavement marking
- ➢ Bridge painting.

5) Determine Measurable Indicators of Quality

- ➢ These indicators should be selected in consultation with the contracting community and other stakeholders.
- ➢ Other sources to consult include research in the end product area and expert opinion.

Examples of Possible Measurable Indicators for End Products

- ➢ HMAC Pavement
  - Asphalt content
  - Laboratory compacted air voids
  - Voids in mineral aggregate
  - Ride quality
  - In-place air voids.
- ➢ PCC Pavement
  - Compressive strength (7-day, 28-day)
  - Flexural strength
  - Ride quality
  - Thickness.
- ➢ Pavement Marking
  - Color
  - Retroreflectivity
  - Reflectivity.
- ➢ Bridge Painting
  - Coating thickness
  - Visible rust
  - Peeling.

6) Determine Best Measurement Method of Each Indicator

- ➢ Evaluate the methods commonly used to measure the quality indicators if methods exist for the measurement of the indicator.
- ➢ Develop a method of measuring the quality indicator based on best engineering expertise to choose properties most likely related to quality if methods to measure the indicator do not exist.
- ➢ For the selected indicators, consider the following
  - Appropriate statistical procedures applicable for measuring quality.
  - Appropriate specification limits or tolerances compatible with an acceptable quality level (AQL) for the indicator.
  - A method for combining individual properties when necessary.

Examples of Possible Measurement Methods of Indicators for End Products

- ➢ HMAC Pavement
  - Asphalt content—Measure through use of ignition oven.
  - Laboratory compacted air voids—Measure by Superpave gyratory compactor.
  - Voids in Mineral Aggregate—Measure by Superpave gyratory compactor.
  - Ride quality—Measure by Profilometer.
  - In-place air voids—Measure through use of cores or sawed plugs.
- ➢ PCC Pavement
  - Compressive strength—Measure strength by compression test.
  - Flexural strength—Measure strength by flexural or split cylinder test.
  - Ride quality—Measure by Profilometer.
  - Thickness—Measure through use of cores or sawed plugs.

- ➢ Pavement Marking
  - Retroreflectivity—Measurement of millicandelas.
  - Reflectivity—Measurement of millicandelas.
  - Color—Measurement of match to federal standard color chips or measurement of yellow index.
- ➢ Bridge Painting
  - Coating thickness—Measurement versus specifications.
  - Visible rust—Occurrence.
  - Peeling—Occurrence.

7) Select Best Indicator of Quality for End Product

- ➢ Select the best indicator with the best measurement method for use in the biddable quality parameter.
- ➢ Consider the availability of information on both the indicator and the measurement method.

8) Draft Process to Make Quality Indicator(s) Biddable

- ➢ Select quality levels for AQL and rejectable quality level.
- ➢ Develop an appropriate pay factor equation that awards 100 percent pay at AQL.

Bidding Process

- ➢ Develop a bidding approach using the quality indicator. Possible approaches include
  - Approach 1: The agency would establish a minimum quality level for a contractor to bid on a project (prequalification).
  - Approach 2: The agency would track the contractors' quality history for use in adjusting and evaluating the bid.
  - Approach 3: The agency would allow the contractor to estimate a quality level to be achieved on the project for use in adjusting and evaluating the bid.

9) Draft Process to Make Measurable Quality Indicator(s) a Performance Target (Criteria)

- ➢ Determine a method for a quality level bid to impact the contractor's actual performance.

Approach 1

- ➢ Contractor is held to achieving the AQL to receive 100 percent pay.
- ➢ Contractor may strive to produce higher than the AQL on the project(s) to be able to prequalify on future projects.

Approach 2

- ➢ Contractor is held to achieving the AQL to receive 100 percent pay.
- ➢ Contractor may strive to produce higher than the AQL on the project so that the quality history tracked by an agency will increase in value.

Approach 3

- ➢ Contractor is held to achieving the quality level bid on the contract to receive 100 percent pay.
- ➢ Contractor may bid a higher quality level to capture the project award.
- ➢ Contractor could achieve the AQL on the project and receive less than 100 percent pay because the quality bid was higher than the AQL to capture the contract.

10) Evaluate Implementation Issues

- ➢ For a discussion of implementation issues as they relate to the development of a biddable quality parameter, see the section on implementation issues later in this chapter. For issues specific to HMAC, see Appendix C.
- ➢ The implementation issues are divided into project selection criteria, risk allocation, agency resources, bidding system, bonding requirements, and quality aspects.

Implementation Issues

- ➢ How will the biddable quality parameter impact the low bid system?
- ➢ Who is responsible for generating quality history?
- ➢ How will firms with no quality history be treated (to account for out-of-state contractors and new contractors in the business)?
- ➢ If a minimum quality history is specified, how to assure it is reached or exceeded? What happens if a contractor's quality history rating falls below stated minimums?
- ➢ Establish training and education for all industry personnel (agency, contractors, material suppliers).

11) Develop Special Provision or Supplemental Specification for Quality Parameter

The Special Provision or Supplemental Specification for the quality parameter should include all of the different aspects of the procedure. Items to be included are listed in Figure 19.

12) Select Pilot Project and Implement

The agency should select pilot projects to implement the new quality parameter process and specifications to test the viability of the process, the application of the indicators, measurement options for the selected end product, and the bid adjustment process.

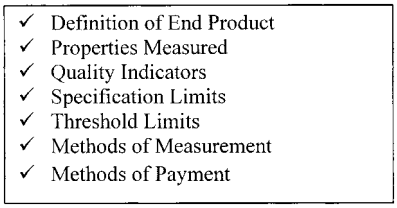

Figure 19. Items to include in the special provision or supplemental specification.

13) Evaluate and Revise/Modify Process

➢ At the conclusion of the project, an agency should evaluate the effectiveness of the process. Items evaluated should include
  - Quality of the end product (measured at project completion and supplemental evaluations to determine long-term quality performance),
  - Impacts on agency personnel,
  - Amount of claims and/or litigation,
  - Schedule performance, and
  - Cost performance.

➢ The final goal of the evaluation should be a determination of the LCC of the end product.

➢ Feedback should be obtained from the selected contractor, material supplier, and surety, as well as agency personnel.

➢ Continued implementation of the quality parameter will require revisions and modifications. Areas of the process to modify include
  - Bidding process,
  - Selection of end products,
  - Determination of quality indicators,
  - Determination of measurement methods,
  - Selection of quality indicator and measurement method,
  - Special provisions or supplemental specifications, and
  - Selection of applicable projects.

14) Continue to Implement Biddable Quality Parameter?

➢ The results of the pilot projects must be evaluated against the agency objectives determined in Step 3.

➢ Using the information gathered in Step 13, the agency must determine whether the biddable quality parameter project was cost-effective and whether it met the agency objectives.

As this policy decision is made, it must be kept in mind that A+B+Q contracts would not be appropriate for every project undertaken by the SHA. This method is being proposed as an additional option for the agency's contract administration.

➢ If the SHA does not wish to continue implementation of the A+B+Q method, go to Step 15.

➢ If the SHA wishes to continue implementation with the same end product, modify Steps 8, 9, 10, and 11, and continue implementation.

➢ If the SHA wishes to continue implementation with a different end product, go to Step 7.

15) Use Other Contracting Methods

If the policy decision is made not to continue further implementation of A+B+Q, the SHA should discontinue the use of A+B+Q as a contracting method option.

IMPLEMENTATION ISSUES FOR QUALITY PARAMETER

The following issues should be considered from the standpoint of implementing this framework.

Project Selection Criteria

The size of the project may have an impact on whether or not this method should be used. Because the concepts are somewhat complex, it may not be desirable to use the method on very small projects. On the other hand, if it is desirable to quantify the quality of construction in the bid process, the use of this method should be attempted irrespective of the project size.

Risk Allocation

In the statistical sense, one paramount reason for using QA specifications is to balance risk between the buyer (agency) and seller (contractor) from an acceptance standpoint. This, by extension of the concept, would apply to the use of a quality parameter in multi-parameter bidding. Risk allocation from a cost standpoint would definitely shift to the contractor.

Agency Resources

The need for additional agency resources depends on where an agency is using QA specifications. If an agency has used Quality Acceptance procedures that incorporate the quality level analysis (QLA) concept, very little additional resources would be needed beyond developing a computer program to calculate the daily and overall project quality parameter (see Appendix C). However, if an agency has little or no experience with the QLA concept, substantial training would be necessary. As for additional staffing, several agencies have adopted QA specifications as a means of turning more testing responsibility over to the contractor and, thus, reducing agency testing and inspection

personnel. It should be emphasized that downsizing is not recommended as a goal of either QA or the use of a quality parameter.

Bidding System

The bidding system would definitely be affected. However, the low bid system would still apply, taking into consideration that a short time period and high quality level would enhance the low bid. The concern about how the quality parameter is used by the contractor or by an agency needs to be addressed as an issue.

Bonding Requirements

Bonding requirements would likely be minimally impacted, with the possible exception that contractors with a history of lower quality work might have higher bonding requirements than contractors with a history of higher quality work.

Quality Aspects

The primary focus of this method is to incorporate the value of quality, in a quantitative manner, in the bidding and contractor selection process.

MODEL A+B WITH I/D SPECIFICATION

Note: *This model specification represents a framework for the development of specifications compatible with an agency's standard specifications and methods of presenting supplemental specifications and special provisions. It is a compilation of practices employed in several states. This should not be considered as best and proven practices. To integrate these specifications into a proposal, special care must be exercised to ensure complete compatibility with the agency's standard specifications, especially the General Provisions.*

Specifications included in this model specification refer to the AASHTO Guide Specifications for Highway Construction (1998 Edition).

Under several of the specification sections, "Considerations" are italicized to list options and alternate approaches.

XXX.01 Description/Summary.

A. Bid the time in calendar days that the Bidder proposes to use to substantially complete a specified segment(s) of the project, subject to any minimum and/or maximum number of days that may be specified for each segment.
B. Incentive/disincentive (I/D) values are listed for each specified segment of the project.
C. The bids will be adjusted, for bid comparison purposes only, to include consideration of the days bid and the I/D value for each specified contract segment.

XXX.02 Definitions. The following definitions are added to **Section 101.03 Definitions**:

A. *Calendar Day*—Every day, beginning and ending at midnight, shown on the calendar.
B. *Contract Segment*—A specifically identified portion of a project. Examples are a bridge, a roadway segment, or an interchange.
C. *Incentive/Disincentive Provisions*—Predetermined adjustment to the contract price for each day work is completed ahead or behind specific milestone, phase, or contract completion dates.
D. *Maximum Days*—The maximum number of calendar days specified for a specific contract segment. It is the maximum number of days that the Bidder may bid for the subject contract segment.
E. *Minimum Days*—The minimum number of calendar days that the Bidder may bid for the subject contract segment.
F. *Substantial Completion*—The point at which the project or a segment is complete such that it can be safely and effectively used by the public without further delays, disruptions, or impediments. For the conventional bridge and highway work, the point at which all bridge deck, parapet, pavement structure, shoulder, signing and markings, traffic barrier, and safety appurtenance work are complete.

Considerations: The following are some alternate definitions of substantial completion.

- *The current Section 108.07 uses the term "Unrestricted continuous traffic" as the condition of completion. Unrestricted continuous traffic means that the affected lanes are open to unrestricted traffic flow with the specified striping and safety features in place.*
- *The project is substantially complete when all of the following have occurred:*
  1. *All lanes of traffic are accepted and traffic can move unimpeded through the project at the posted speed.*
  2. *All signage is in place and accepted.*
  3. *All guardrails, drainage devices, ditches, excavations, and embankments have been accepted.*
  4. *The only work left for completion is incidental, away from the paved portion of the highway, and does not affect the safety or convenience of the traveling public.*
- *The decision whether the project is substantially complete is solely within the discretion of the Engineer.*
- *Each individual phase or stage of work subject to A+B Bidding shall be considered to be substantially complete when: (1) all work requiring lane or shoulder closures or obstruction to normal flow of traffic is completed; (2) traffic is following the lane arrangement as shown on the plans for the finished roadway (or the specified phase[s] of work); and (3) all pavement construction, resurfacing, and traffic control devices shall be in their final position or as called for in the plans for the specified phase(s) of work.*

XXX.03 Contract Segments, Incentives/Disincentives. The contract segments for this project, the maximum and minimum number of days that may be bid for each segment, and the corresponding I/D amounts are as follows:

Segment No.	Description	Maximum Days	Minimum Days	Incentive/ Disincentive (I/D)
1	(Note: A segment could be the entire project.)	(Optional)	(Optional)	$
2				
Etc.				

Considerations: If the agency elects to establish the maximum and/or minimum days for a contract segment(s), it must analyze the proposed construction duration sufficiently to ensure the practicality and reasonableness of the limit.

The I/D value is ideally established by evaluating the costs to the traveling public resulting from traffic congestion (and possibly other costs such as lost tolls) during construction operations on the contract segment. If the I/D is not significantly high in relationship to the contract amount, the I/D provisions may be a less than meaningful incentive for early completion.

Some agencies have included a statement that the I/D is substantially less than the estimated road user costs. It is assumed that this strategy was to improve the agency's posture in the event of litigation.

XXX.04 Irregular Proposals. The following is added to the conditions listed in **Section 102.07 Irregular Proposals,** under which proposals are considered irregular and may be rejected.

G. When A+B with I/D bidding is specified, the proposal does not contain the number of days bid to complete each of the listed contract segments or the number of days bid is outside the range specified for the contract segment.

XXX.05 Consideration of Proposals. The following replaces **Section 103.01 Consideration of Proposals**.

After proposals are opened and read, they will be compared based on the adjusted bid, which is determined as follows:

$$\text{Adjusted bid} = A + \left[B_1 \times (I/D)_1\right] + \left[B_2 \times (I/D)_2\right] + \ldots + \left[B_n \times (I/D)_n\right]$$

where A = sum of the estimated unit quantities times the respective unit prices bid,
B_1 = number of calendar days bid to complete contract segment No. 1,
$(I/D)_1$ = the listed I/D value for segment No. 1,
B_2 = number of calendar days bid to complete contract segment No. 2,
$(I/D)_2$ = the listed I/D value for segment No. 2,
n = total number of contract segments.

Example:

Item	Unit	Estimated Quantity	Unit Bid Price	Extension
Asphalt Cement	Megagram	1,000	$125.00	$ 125,000
Plant Mix—Type	Megagram	20,000	75.00	$ 1,500,000
Base Bid (A)				**$1,625,000**

Segment	Days Bid (B)	I/D	B × I/D
1	125	$2,000	$250,000
2	60	1,500	90,000
3	75	3,000	225,000
Total Bid Adjustment			**$565,000**

$$\textbf{Adjusted bid} = \mathbf{A + \left\{\left[B_1 \times (I/D)_1\right] + \left[B_2 \times (I/D)_2\right] + \left[B_3 \times (I/D)_3\right]\right\}}$$

$$= \$1{,}625{,}000 + \$565{,}000$$

$$= \mathbf{\$2{,}190{,}000}$$

The adjusted bids will be used only for the comparison of proposals and to determine the low bidder. Payment for work accomplished will be in accordance with the pay provisions of the specified items of work. Payment for incentives and disincentives will be as specified in **Section XXX.07** of this specification.

Bid results are public information.

Unit prices govern if discrepancies exist between unit bid prices and extensions. The number of days bid govern if discrepancies exist between the number of days bid and the extensions for the A+B bid comparisons. The agency can reject proposals, waive technicalities, or advertise for new proposals.

XXX.06 Progress Schedule. The following is added to **Section 108.02 Progress Schedules.**

Prepare a CPM schedule as defined in **Section 108.02.B.** Clearly indicate the plans to complete the work described in each of the specified Contract Segments within the time bid for the segment.

XXX.07 Incentive/Disincentive for Early Completion. The following replaces **Section 108.07 Incentive/Disincentive for Early Completion.**

It is in the public's interest that the specified contract segments be substantially completed at the earliest possible date. An I/D is provided to encourage the early completion of the contract segments described in **Section XXX.03.**

The beginning date for charging calendar days to a contract segment will be the day when traffic on the contract segment, or traffic affected by work on the contract segment, is first negatively impacted by the construction, unless the beginning date is otherwise stated in the plan notes or specifications. Calendar days will continue to be charged until the segment is determined to be substantially complete. The Engineer will determine the beginning date and the date of substantial completion.

For each of the contract segments that are substantially completed in fewer days than bid by the Contractor, the Contractor will earn an incentive. This incentive payment will be calculated by multiplying the listed I/D value for the subject segment by the difference in the number of days used by the Contractor to substantially complete the segment and the number of days bid for the segment.

Correspondingly, for each of the contract segments that are not substantially completed within the days bid by the Contractor, the Contractor will be charged a disincentive. This disincentive will be calculated by multiplying the listed I/D value for the subject segment by the difference in the number of days used by the Contractor to substantially complete the segment and the number of days bid for the segment.

Incentives or disincentives will be paid or deducted, as appropriate, in the current progress payment and in the final payment.

Liquidated damages under **Section 108.08** may be assessed concurrently with disincentives if they are not based on duplicate costs.

Considerations: Some agencies have elected to eliminate liquidated damages when the I/D provisions would result in additional charges for the same time overruns.

If a progress or final estimate, including incentives and disincentives, indicates that the agency has overpaid the Contractor an amount exceeding the retainage, submit a certified check to the agency for the difference between retainage and the amount of the overpayment. Submit check within _____ days [suggest 30 days] of payment notice.

Request time extensions only for documented industry-wide labor disputes or industry-wide material delivery delays.

Considerations: For design modifications or changes in quantities requiring a contract modification and/or a change order, appropriate modifications to the time bid for affected contract segments could be included in the negotiations. The impact of the modifications on the project critical path should be considered in the negotiations.

Some agencies have included provisions for time extensions or suspensions for acts of God, inordinate periods of inclement weather, or for winter shutdown.

CHAPTER **4**

GUIDELINES FOR BEST VALUE CONTRACTING

METHOD DESCRIPTION

Best value contracting is a method of awarding a contract based on price and other factors, such as technical excellence, management capability, past performance, and personnel qualifications. Selection of a proposal that is comparatively more costly may be justifiable if the proposal provides a more advantageous technical and management plan for project execution. Because the best value method is aimed at selecting a contractor based on technical and management merit as well as price, this approach reduces risk to the owner. Best value contracting ensures early development of detailed project and procurement plans, which can yield significant benefits in construction timeliness, cost containment, and customer satisfaction.

A case study from the Oregon DOT has been developed to illustrate the best value contracting process (see Appendix D1). A second case study has been developed to show the best value prequalification evaluation process (see Appendix D2).

ADVANTAGES AND DISADVANTAGES

A table of advantages and disadvantages regarding the best value contracting method was developed from data derived from survey questionnaires and interviews with state and federal agencies using this method (Table 10). This table lists 10 critical issues related to innovative contracting. Columns 2 and 3 indicate whether using the best value method has an advantage or disadvantage with respect to each critical issue. Column 4 offers a brief explanation of this associated advantage or disadvantage, and column 5 discusses the possible impact on the contracting community associated with the critical issue. It is very important for a SHA contemplating implementation of the best value process to consider and be aware of any impacts this method may have on contractors.

BEST VALUE IMPLEMENTATION FLOWCHART

A process for implementing best value contracting for the construction of highway projects is presented in this section. A flowchart of this process, shown in Figure 20, details the steps a SHA should follow to implement a best value contracting program. These steps relate to Conceptual Planning; Program Planning; Bid, Contract Award, and Construction; Evaluation of the Pilot Project; and Evaluation of the Program phases of the project. Although the flowchart was designed for use by SHAs with little or no experience using best value, users may enter at different points, depending on their experience with best value contracting.

The process splits into two distinct paths at Step 8. Path one, Steps 9–14, provides an approach that allows implementation of best value contracting within existing low bid laws. This form of the best value method will be feasible for implementation in states where low bid laws remain the final word on contracting legality (see Appendix D2). Enabling legislation is not required to implement this approach.

In states with flexible procurement laws or exemptions from the low bid system for various project types, an alternate path, Steps 15–23, can be implemented. This approach is similar to one applied by the Oregon DOT and is designed to be implemented in an environment in which the low bid is not the only method of procurement. A case study documenting the best value approach taken by the Oregon DOT on their I-5 Trunnion Replacement Project is included in Appendix D1. This case study provides a specific example of the process described in Steps 1–8, 15–24, and 25–32 of the flowchart. Enabling legislation would likely be required to implement this application of best value.

FLOWCHART DISCUSSION

To help implement the best value process, brief explanations are provided for each step in the flowchart. These explanations reflect a synthesis of information obtained from federal agencies using best value, as well as from SHAs that have used best value for one or more projects. These steps are presented here, along with their respective explanations for each phase of program implementation.

Planning Phase

The first eight steps of the best value process model describe the Planning phase of the implementation process, as shown in Figure 21. This phase includes both the Conceptual Planning and Program Planning phases and occurs before a SHA begins drafting the best value contract documents.

TABLE 10 Advantages and disadvantages of best value contracting

Critical Issue	Advantage	Disadvantage	Explanation	Impact
Compatibility with Low Bid System		√	Best value contracting, in general, is not compatible with the low bid system. It can be altered to fit within the low bid system, but for a true application of best value, enabling legislation must be enacted.	Under some forms of best value, it is possible that the low bidder may not receive the contract award.
Impact on Open Competition		√	The number of contractors in a position to bid on a best value project may be smaller than a traditional project. This may be due to the complexity of the required proposal, to a stringent prequalification process, or to the complexity of the project itself.	Since best value is often applied on very complex projects, only a small number of contractors may have the capabilities to perform the work. If a proposal requires an extensive amount of effort, a smaller contractor may not have the resources to produce one competitively.
Reduction of Agency Human Resources		√	The SHA resources required on a best value project increase during the writing of the Request for Proposals/Qualifications (RFP/RFQ) and during the evaluation of proposals. The personnel requirements for the SHA remain essentially the same throughout the construction process. Some agencies argue that personnel requirements are often reduced during construction, because a best value project is better planned and executed than a traditional project.	Preparation of proposals requires a greater effort than a traditional bid. Once the proposal is awarded, the resources required of the contractor will be similar to those required on a traditional project.
Reduction in Project (Construction) Cost		√	The best value method has no mechanism to reduce bid prices. It is more likely that it will actually increase bid prices. However, life cycle costs may be reduced through decreases in maintenance costs and increases in the life span of the project due to the higher quality achieved with best value.	Under some forms of best value, it is possible that the low bidder may not receive the contract award.
Improvement in Quality of Constructed Project	√		Best value is designed to improve the level of quality of the constructed product by making the quality of the product a competitive item. Best value allows for contractor innovation to improve quality, encourages effective quality control measures, and assures the agency of selecting a capable, qualified contractor.	Under some best value systems, only contractors attaining a minimum level of quality are allowed to bid on a project. Under another variation of the system, the successful contractor will be the one who most effectively balances quality, experience, and price.
Reduction of Project Completion Time	√		Schedule is often evaluated in best value proposals. This results in more efficient, well-planned construction schedules, and also makes the schedule a competitive item.	The contractor is often required to plan the entire project and carefully develop the schedule to be competitive in the evaluation process.

(*continued on next page*)

1) What Is SHA's Current Level of Experience with Best Value?

Although all SHAs are encouraged to follow the entire process described here, users may have different levels of experience with the best value contracting method. Thus, depending on the extent of their experience, they may want to enter this flowchart at different points.

➢ No Experience
- First-time best value users should begin Step 2 (Determine Motivation for Implementing Best Value) and move directly through the sequential steps.

➢ Low-to-Moderate Level of Experience
- Users with a low-to-moderate level of experience would be those agencies with some experience using best value contracting (between one and five projects).
- These users are encouraged to examine the entire process to formalize their program. However, some may wish to begin at Step 7 (Select Pilot Project). It would be important for these users, as well, to examine Step 3 (Review and Understand Best Practices for Best Value Contracting).

➢ High Level of Experience

TABLE 10 (Continued)

Critical Issue	Advantage	Disadvantage	Explanation	Impact
Shifting of Risk from Agency to Contractor	√	√	The SHA runs the risk of paying a higher initial price, but this risk is countered by reduction of the risk of poor quality. The time risk associated with the project, as well as the risk of selecting an unqualified contractor may also be reduced for the SHA.	The main change in risk for the contractor involves the increased effort required to formulate proposals. The contractor runs the risk of committing a greater amount of resources to writing a proposal, but still may not receive the project.
Ease of Implementation with Respect to Resources, Data, Systems, and Expertise		√	The SHA will require an increase in personnel requirements for the process of training SHA personnel, writing the RFP, and evaluating proposals. Determining all of the requirements and evaluation techniques at the beginning of the project requires an increase in agency efforts, and some increase in agency expertise, probably through research or contacting other agencies that have experience with best value. The best value method may also require the added effort of enacting enabling legislation.	The contractor will need to plan projects more carefully to prepare the detailed proposals often required for best value projects. Once awarded the contract, some training or education may be appropriate for employees who have no prior experience with best value. Some additional effort may be required to meet the quality proposed by the contractor, if it exceeds the minimum traditionally required by the SHA.
Contractor Innovation	√		Best value encourages contractor innovation in planning the project and in the use of innovation with respect to contracting methods and sequencing. Some best value RFPs even require innovative ideas as part of the proposal.	Best value allows contractors to use methods and techniques that will lead to successful project execution. Costs may not be as important a factor in contractor innovation when compared to the traditional approach.
Project Applicability	–	–	Best value offers an effective means to deliver highly complex or unique projects. It is also useful for fast-tracked projects and any project where high precision or quality is extraordinarily important due to the technical complexity of the project. It is probably not very useful for normal, everyday projects of average size.	This will generally only impact contractors that would bid on extremely large, complex, or unique projects under the traditional low-bid system. Smaller specialty contractors may have a better chance to perform projects that are small but highly complex or specialized.

- Users with a high level of experience are those users who have completed more than five best value projects, and who are comfortable with their process. These users may wish to start at Step 8 (Required to Satisfy Low-Bid System?). Once again, Step 3 may be of use, even for the experienced user.

2) Determine Motivation for Implementing Best Value

The first step an agency must take in implementing the best value process is to identify the motivation behind implementing the program. Potential objectives the SHA may consider include

➢ Improve Quality

By using the best value selection procedure the agency attempts to receive the highest quality possible for the cost. This may result in an offeror other than the low bidder being awarded the contract. However, should this occur, the quality of the constructed product is expected to improve over what would be obtained by awarding the project to the low bidder.

➢ Reduce Change Orders

The best value method often requires the contractor to provide a schedule at the beginning of the project, and the agency must clearly define the scope of the project when writing the request for proposals (RFP) or request for qualifications (RFQ). This leads to fewer unexpected and costly change orders on the project.

➢ Compress Project Schedule

Writing best value RFPs/RFQs requires the agency to clearly define the scope and requirements of a project from the very beginning. The offerors are generally required to submit construction and management plans, as well as schedules. By

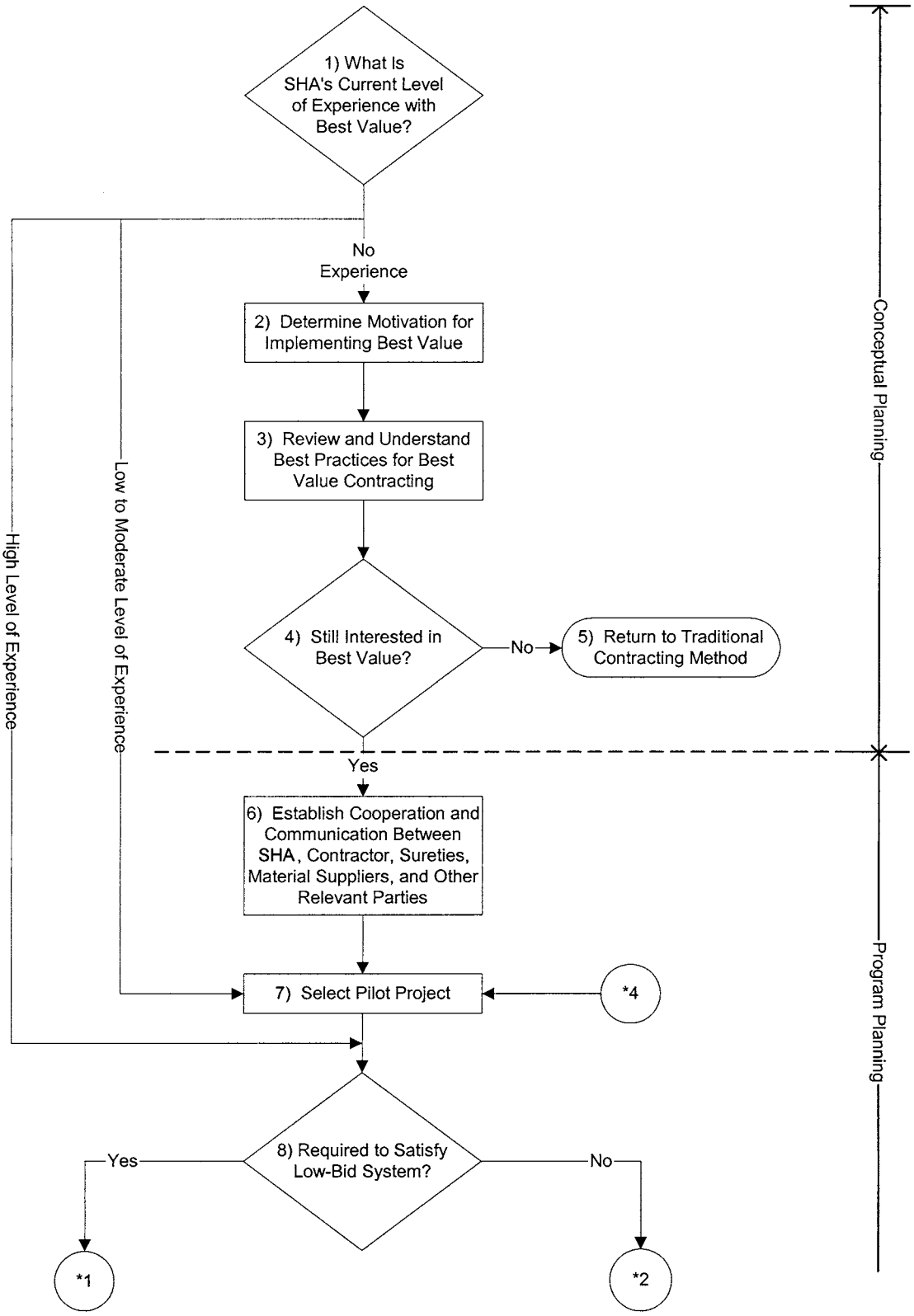

Figure 20. Flowchart process for best value contracting (continued on next page).

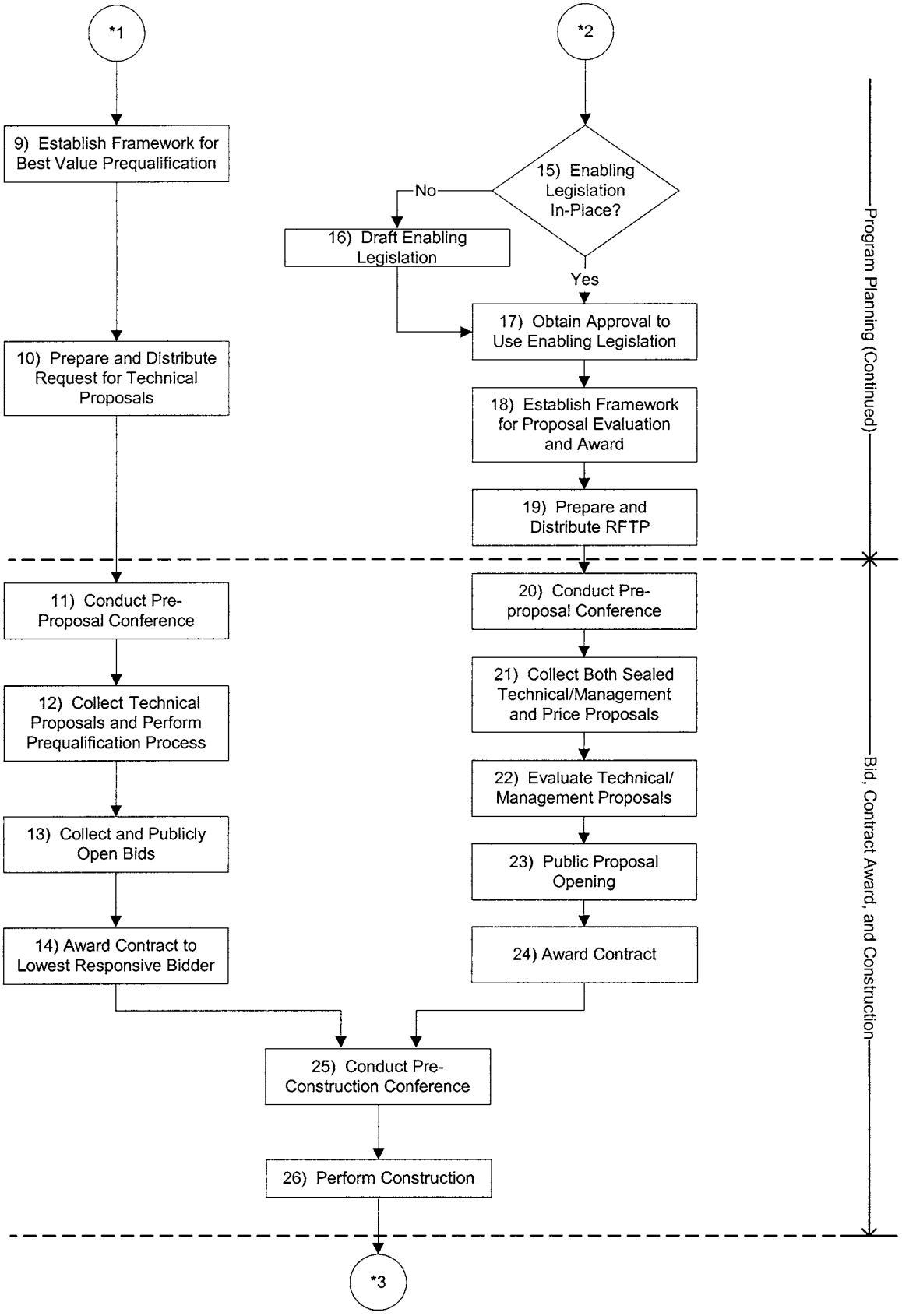

Figure 20. (Continued).

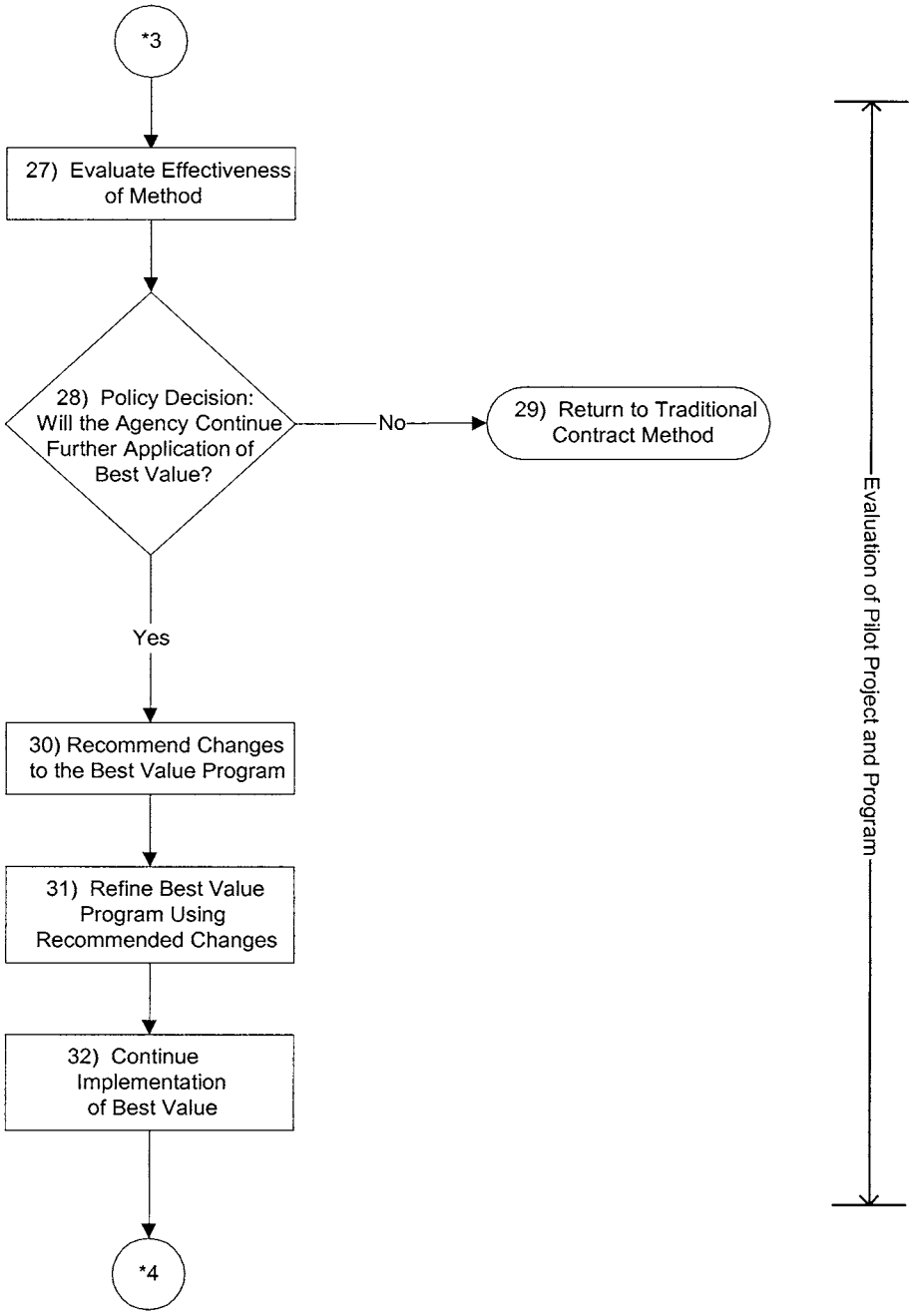

Figure 20. (Continued).

developing a detailed project plan in advance, even before the project is awarded, the contractor can integrate and streamline many aspects of the project by giving more attention to constructability issues or to value engineering. This can lead to better planning and more accurate scheduling. In addition, the above-mentioned reduction in change orders will tend to contribute to the reduction of project schedules, as well as total project costs. Finally, if the schedule is a technical feature for proposal evaluation, it will likely be developed by each individual proposer from an innovative perspective, because of the competitive nature of the proposal.

➢ Decrease Life-Cycle Costs

The project may be awarded to an offeror other than the low bidder under some versions of the best value system. This may result in a higher initial cost for the project, but the goal of the best value contracting method is to achieve a higher level

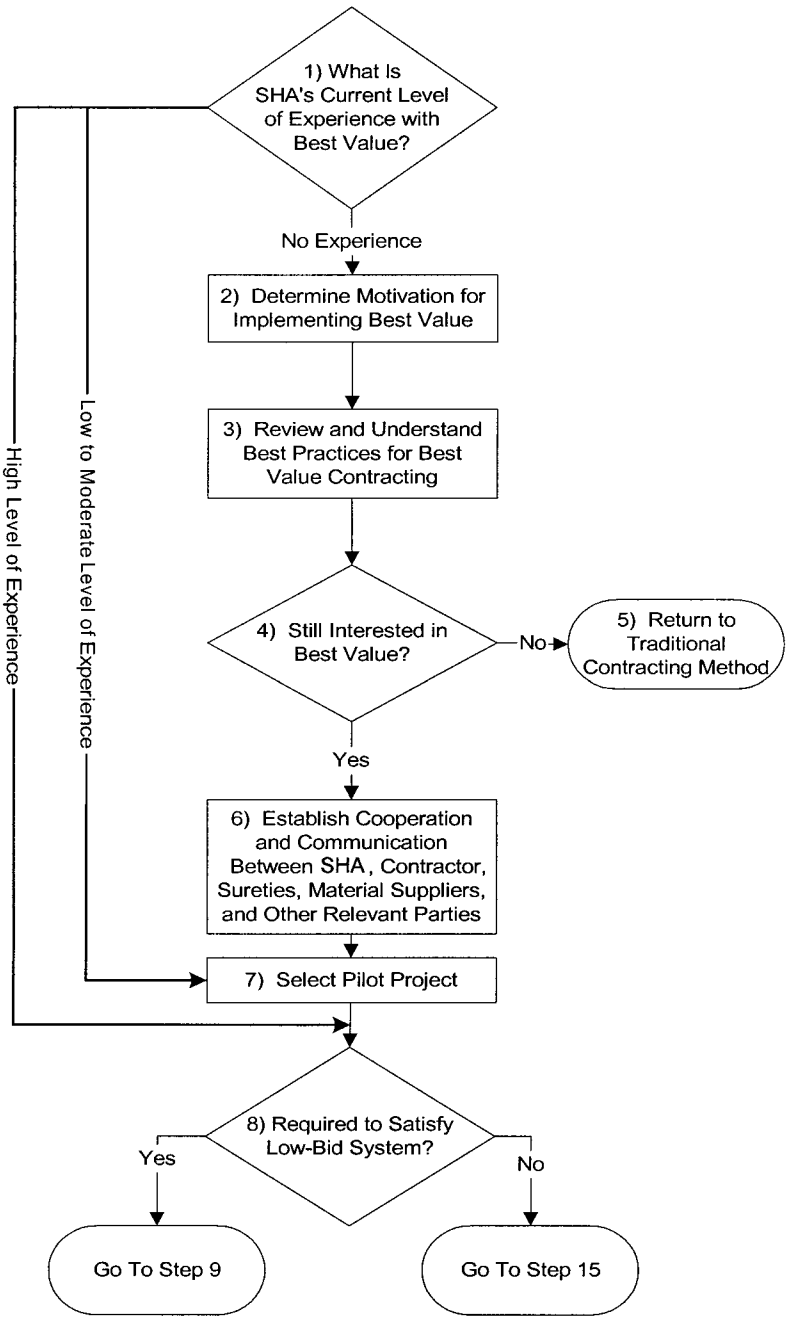

Figure 21. Planning phase process model.

of value, or quality per price, in the final product. This may include a longer project life span and lower maintenance and operation costs. Ideally, this combination will lead to lower project LCC.

➢ Encourage Innovation

Each firm can propose unique technical solutions based on the techniques and technologies most familiar to them. Innovation is encouraged because price is not the only factor considered in making the contract award. Therefore, an innovative method that may enhance quality or shorten the schedule may be employed, whereas under the competitive bidding process these innovations may not be attempted.

Identifying up-front what objectives an agency expects to achieve through the implementation of this method and translating these objectives into an evaluation framework will allow the agency to evaluate the effectiveness of best value contracting.

3) Review and Understand Best Practices for Best Value Contracting

Once the agency has determined the motivation for implementing a best value program or what objectives they want to achieve through the use of this contracting method, the next step is to determine how to proceed.

- ➢ This document will provide an introduction to the basics of best value contracting.
- ➢ For more specific information, evaluate best value methods being applied by other agencies.
  - Some federal agencies, including the U.S. Army Corps of Engineers and the Department of the Navy, have well-developed best value programs.
  - This method has also been used by a small number of SHAs on the following projects:
    - Reconstruction of I-15 in Salt Lake City, Utah;
    - Whittier Access Tunnel project in Alaska; and
    - I-5 Trunnion Replacement project in Oregon.
  - The unpublished final report on NCHRP Project 10-49 provides further insights into the recent use of best value contracting.
- ➢ An important document to review when implementing a best value program is the Federal Acquisition Regulation (FAR). This document outlines the best value contracting practices followed by federal agencies (see FAR, Part 15.1 Source Selection Process and Techniques).
- ➢ Key areas where information relating to best practices should be collected when implementing a best value program are described in Table 11.

It is important to understand the strengths and weaknesses of the best value method before determining if the agency is interested in implementation. The agency should also understand under what project conditions the best value method is most effective.

4) Still Interested in Best Value?

At this point, a comparison must be made between the information gathered in Step 3 and the objectives established in Step 2. If the information acquired makes it evident that the objectives established are attainable using the best value method, the SHA should continue pursuing a best value program. If the objectives appear unrealistic, or could be better met by another contract method, the SHA should discontinue its investigation of a best value program.

Best value needs support within the SHA central office and district offices, an upper-level management advocate in the agency, and possibly a champion in the state legislature for

TABLE 11 Best practices information

Information to Collect	Explanation
Project Selection Criteria	• Types of projects to which best value has been applied—size, complexity • Successes and failures
Legal Issues and Authorization (Low Bid Compliance)	• Prequalification or RFP process • Is legislation in place to allow best value contracting?
Enabling Legislation	• Innovative contracting bills • Special project exemptions of low bid procurement laws • Federal Acquisition Regulations
Personnel and Expertise Needs	• Types of expertise needed to prepare an RFQ/RFP • Personnel requirements for evaluation of RFQ/RFP
Example RFQ/RFP	• Collect RFQs from other agencies • Examine the agency's own existing prequalification process • Collect sample RFPs from implementing agencies
Evaluation Method for Qualifications/Proposals (Contract Award Process)	• Collect and review examples of evaluation methods for both qualifications and proposals from implementing agencies
Criteria for Proposals	• Examples of criteria on which to evaluate proposals can be found in the RFPs of implementing agencies
Performance of Best Value Method for Other Agencies	• Quality improvements • Additional effort for the agency • Risk allocation changes • Contractor responsibilities • Agency responsibilities
Criteria to Evaluate the Performance of the Best Value Method	• Improved quality • Reduction of change orders • Life cycle cost savings • More timely completion • Increased innovation

changes in legislation or approval of the pilot project. Most states' procurement laws must be modified to permit best value contracting in its complete and fullest form.

➢ If the SHA is not interested in Best Value at this time, go to Step 5.
➢ If the SHA is still interested in Best Value, go to Step 6.

5) Return to Traditional Contracting Method

If the program objectives established in Step 2 appear unrealistic, or could be better achieved by some other contract method, the SHA should discontinue its investigation of a best value program and continue to use their traditional design-bid-build or other approved contracting method.

6) Establish Cooperation and Communication Between SHA, Contractor, Sureties, Material Suppliers, and Other Relevant Parties

"Buy-in" from all project participants is easier to achieve if the participants have input into the development of the process. Solicitation of input early in the process will also identify potential problems when the opportunities to improve the program are greatest.

Identify and Contact Involved Parties

➢ Contractor input is essential when developing the best value program.
➢ Some project participants who should be contacted include
  • Construction contracting community,
  • Surety community,
  • Legal advisors, and
  • Material suppliers.

Educate Involved Parties

➢ Convey to involved parties, including agency personnel, the objectives set in Step 2 and some background on best practices gathered in Step 3.
➢ Education should cover
  • Solicitation process,
  • Proposal process,
  • Contents of proposals,
  • Expectations for a successful proposal, and
  • Award process.

Form Partnership to Implement Best Value Process

➢ Participation of all interested parties will assist in understanding the solicitation and award process.
➢ A relationship among these parties must be established to allow input from each involved party throughout the process.
➢ The process must be as fair, objective, and as impartial as possible to remain competitive for all contractors who propose bids on best value projects.
➢ Expectations of involved parties must agree with the program objectives set by the SHA.

7) Select Pilot Project

The best value method, as is the case with any contracting method, must be used only when it is the most appropriate contract administration method for a given project.

Identify Project Selection Criteria

Best value is not the appropriate method for all projects. Project selection criteria must be developed that are specific to each SHA.

➢ The best value method is most applicable to projects where
  • A high quality product is especially critical. For example, a high-profile or high-cost project that will be under public scrutiny;
  • The project is time sensitive. For example, Utah's I-15 reconstruction project, where the DOT is under extreme pressure to complete the project in time for the 2002 Olympic Games in Salt Lake City; or
  • The project is unique or specialized. For example, the Oregon DOT's I-5 Trunnion Replacement Project (described as a case study in Appendix D1).

Determine Standards to Evaluate Effectiveness of Pilot Project

When choosing a pilot project for the best value method, the SHA must also determine the standards to be used to evaluate the effectiveness of the method at the end of the pilot project. These standards should match the objectives set in Step 2, such as:

  • Improvement in quality,
  • Reduction of change orders,
  • Compression of project schedule,
  • Decrease in LCCs, and
  • Increase in contractor innovation.

Although improvements in quality may be difficult to quantify directly, others, such as the reduction in change orders, compression of project schedules, and increased contractor innovation may be documented and compared with similar projects bid in the traditional manner. Decreases in LCCs may be measured over time as compared with the cost of similar facilities built under traditional contract methods.

8) Required to Satisfy Low Bid System?

Most SHAs are still legally obligated to award contracts based on the traditional low bid system.

- ➢ If the SHA has no plans to pursue changes in legislation, they may use best value as an enhanced prequalification process to fit within existing low bid laws. The best value process can essentially be used to determine which bidders are responsive and have established an acceptable level of quality based on past performance; proceed to Step 9.
- ➢ If the SHA decides to use a best value process that is more than the enhanced prequalification process, go to Step 15.

Best Value Prequalification Phase

The Prequalification phase comprises the left-side branch of the flowchart in Figure 20. Steps 9 through 14, shown in Figure 22, describe a process intended to integrate the ideas behind best value contracting into a method compatible with the existing low bid system. Implementation of this process does not require enabling legislation.

9) Establish Framework for Best Value Prequalification

To satisfy low bid criteria, the best value method may be modified to an enhanced prequalification process. All participants identified in Step 6 must be involved throughout the development of the framework for the best value prequalification process.

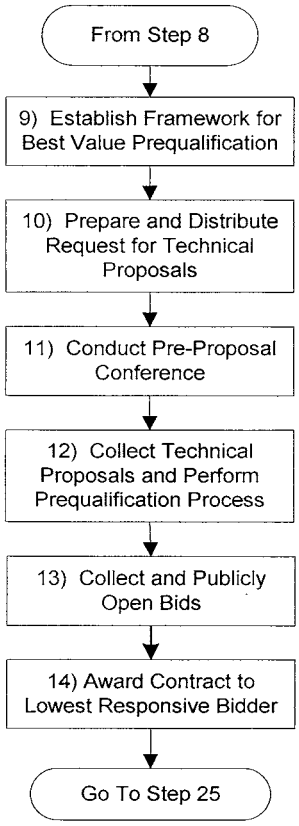

Figure 22. Best value prequalification phase process model.

Form Selection Committee to Evaluate Proposals

- ➢ The selection committee should be composed of competent professionals of strong moral and ethical character, with no direct personal interest in the outcome of the proposal evaluation process. Some professionals who may be placed on the committee include
  - A member from the project design team,
  - A member from the contract administration department,
  - A member from the project management department, and
  - A nonproposing construction contracting member of the local Association of General Contractors (AGC).
- ➢ Committee should have access to technical advisors, as necessary.
- ➢ An independent selection authority should be established as a point of responsibility for the final decision and/or mediator for the committee. This authority could be any of the following people
  - Head of the SHA,
  - District engineer,
  - Contracts engineer, or
  - Construction engineer.

Determine Factors for Evaluation

Evaluation criteria and the weighting of these criteria are project-specific. The evaluation criteria may be divided into three areas: (1) management solutions, (2) technical solutions, and (3) past performance.

- ➢ The technical solutions are very project-specific. These may include anything relevant to the project, but should be focused around achieving the following objectives set in Step 2:
  - Improved quality,
  - Increased contractor innovation, and
  - Decreased LCCs.
- ➢ Management criteria are more consistent among current users of best value. The most common examples are described in Table 12.
- ➢ Management criteria should focus on the following goals set in Step 2:
  - Reduced change orders,
  - Compressed project schedule, and
  - Increased contractor innovation.
- ➢ Some examples of the types of technical and management factors to evaluate include
  - Technical expertise—may include anything relevant to the individual project and the agency's objectives including the following:
    - –Construction methods related to the project,
    - –Expertise with using relevant materials,
    - –QC approaches, and
    - –Past project examples.
  - Personnel qualifications and availability.

TABLE 12 Common management-related evaluation criteria

Criteria	Contents
Organization/Management Plan	• Proposed project organization • Responsibilities and expertise of key personnel
Relevant Experience/Past Performance	• Examples of past projects that the proposer has completed of similar size, scope, and complexity
Proposed Schedule/Work Plan	• Proposed plan for project completion • Proposed schedule for project completion

  - Compatibility of the construction contractor with the SHA.
- ➢ Past performance may include the following subcriteria:
  - History of customer satisfaction,
  - History of timely delivery,
  - History of conforming to specifications,
  - Standards of workmanship,
  - History of adherence to schedule,
  - Safety record, and
  - Past management of subcontractors.
- ➢ The final criterion for evaluation is the price. The prices of the proposals should be collected separately from the technical proposals.

Determine Weighting of Factors

The weighting of factors will be different for each best value project. There is no set, uniform scheme applicable to all projects. One method of setting factor weights is described here.

- ➢ Break technical/management factors down into percentages based on the objectives established in Step 2.
  - The technical factors tend to carry more weight than the management factors.
  - The order of importance of the various technical subfactors is also project-specific.
  - Some factors may be evaluated on a pass/fail basis. If one or more factors are found to be unacceptable, the proposal may be rejected.

Determine Prequalification Process

The first step in the evaluation process is a screening step.

- ➢ Advertise the project in appropriate publications and distribute requests for technical proposals (RFTP) to any interested contractors. The qualifications of these technical proposals may include traditional prequalification issues that the SHA may already employ, such as those listed in Table 13.
- ➢ Ensure that returned qualification statements comply with the RFTP.

Determine Best Value Evaluation Portion of Process

In addition to the traditional prequalification process, the SHA must prepare a RFTP describing the technical and management factors to be evaluated. Before drafting the RFTP, the evaluation framework must be determined. In the technical/management evaluation, the evaluation committee will rate proposals based on the criteria determined previously.

- ➢ There are three basic alternatives as to how the factors will be rated:
  - May be rated by each member individually and the scores averaged,
  - Proposals may be ranked by the group, or
  - May be rated using an adjectival system as illustrated in Table 14. This is only an example and is meant to be used as a means of quantifying the decision-making process.
- ➢ Determine the minimum score for prequalification based on the total number of points available. This process must be clearly spelled out in the RFTP.
- ➢ The process must be objective and fair.

10) Prepare and Distribute Request for Technical Proposals

- ➢ Beyond merely publishing an advertisement for proposals, a SHA must also prepare a RFTP for a best value project.
- ➢ Drafting the RFTP will require more intensive use of resources than a traditional methods and materials specification project.
- ➢ The RFTP must describe the evaluation criteria, how the criteria will be evaluated, and how the final selection decision will be made.
- ➢ Prequalification forms must be prepared, advertised, and distributed to any interested parties.
- ➢ The method established previously in Step 9 must be used to make the selection decision.

TABLE 13 Common prequalification criteria

Prequalification Criteria	Contents
Financial Stability	• Contractor's management of operations at the organization level • Ownership structure of the contractor • Outstanding loans
Experience	• Number of years a contractor has been in business • Types of projects the contractor has performed • Contractor's experience with relevant projects similar to the project under proposal • Contractor's quality control history • Personnel available
Current Capacity	• Contractor's assets • Contractor's liabilities • Contractor's equity and bonding capacity • Concurrent projects or work backlog that may overtax the contractor or overextend bonding capacity
Available Capital	• The type of equipment the contractor has available to complete the job
References	• Banking references • Previous clients • Trade suppliers • Surety agents
Safety Record	• Experience Modification Rating • OSHA (Occupational Safety and Health Administration) incidence rates • Management Safety Accountability Index

➢ The RFTP must state the minimum numerical aggregate rating of the technical/management proposal in order to be considered for the next step of the evaluation process.
➢ RFTPs are generally advertised in the same way as for a traditional project.

The most important issue in the drafting of the RFTP is to be as clear as possible in describing the project requirements, evaluation criteria, and award decision process.

11) Conduct Preproposal Conference

Figure 23 presents a checklist of topics to be covered at the preproposal conference for a best value project. This checklist is not exhaustive, and other topics may need to be addressed.

12) Collect Technical Proposals and Perform Prequalification Process

The SHA may begin the best value prequalification process by performing a more traditional prequalification process as described in Step 9. Many SHAs may already have this portion of the process in place.

TABLE 14 Example of adjectival scoring system

Adjectival Rating	Value (points)
Exceptional	5
Acceptable	3
Marginal	1
Unacceptable	0

➢ The prequalification criteria are evaluated individually on a pass/fail basis. If a proposal bid fails to meet any of the prequalification criteria, that contractor will be disqualified from pursuing the project further.
➢ Once this portion of the process is complete, the SHA moves on to the best value prequalification process.
➢ The technical/management proposals should be collected and evaluated as described in Step 9 prior to collecting the price proposals.
➢ All proposal bids achieving the minimum aggregate rating will be qualified to move to the opening of bids.
➢ Prepare a written narrative justifying the ranking for each criterion with a subjective rating. These narratives must be sufficiently detailed so that the committee is able to formalize their decision as to the most advantageous

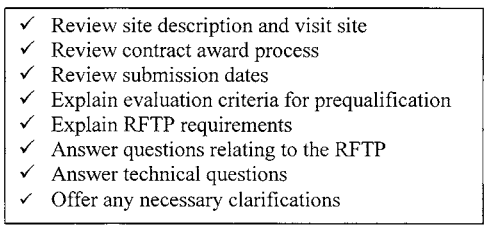

Figure 23. Checklist of items for best value preproposal conference.

offeror (highest technical proposal score) to unsuccessful offerors (proposals with lower scores) and, if necessary, in a legal dispute.
- ➢ An example best value evaluation is presented in Appendix D2.

13) Collect and Publicly Open Bids

- ➢ Those offerors who have advanced beyond the prequalification stage described in Step 9 will have their sealed bids opened. The bid with the lowest total cost that has met the technical/management prequalification criteria described in the RFTP is selected as the successful offeror.
- ➢ The bids would include a schedule of materials, estimated quantities, fixed-unit prices, and the other items normally required in a traditional bid.

14) Award Contract to Lowest Responsive Bidder

The contract would be awarded to the qualified, responsive offeror with the lowest total bid. Go to Step 25.

Best Value Evaluation

The alternative to an enhanced prequalification process is a best value evaluation process, where the contract award does not necessarily go to the lowest responsible bidder. Steps 15 through 24 illustrate the best value evaluation phase process, which differs from the requirements and restrictions of the enhanced best value prequalification process found previously in Steps 9 through 14. This evaluation phase process is shown in Figure 24.

15) Enabling Legislation In Place?

- ➢ If the necessary enabling legislation is not in place, but the SHA needs to develop a best value process that awards the project on more than cost, enabling legislation must be developed. Go to Step 16.
- ➢ If enabling legislation is in place to allow the SHA to experiment with or use best value, go to Step 17. By obtaining approval, this legislation would permit the SHA to implement the best value method to its fullest extent possible.

16) Draft Enabling Legislation

An agency could be authorized to use best value through enabling legislation in two different forms.

- ➢ A best value-friendly bill could be approved by the state legislature.
  - The FAR language found in Subpart 15.1 could be an example for a general, permanent type of change.
- ➢ An exemption to the low bid laws could be authorization by the state legislature that would allow the agency to use best value on an experimental basis for a select number of pilot projects.
  - An example of enabling legislation for an exemption to the low bid procurement laws is demonstrated in Figures 25 and 26 from the state of Oregon.
  - The exemption guidelines and exemption request approval from the Oregon DOT is included in the Oregon Best Value Case Study in Appendix D1 (Figures D1.6 and D1.7).
- ➢ After the program has been piloted and evaluated, it may then be appropriate for the agency to recommend to the legislature that the procurement laws be changed.

17) Obtain Approval to Use Enabling Legislation

The enabling legislation may require approval by a governing body in order for the agency to use the best value contracting method. The approval could require that the agency evaluate the contract method for the conditions of insubstantial harm to competition, nonfavoritism, and substantial (or neutral) cost savings. Only if the conditions of the approval are met will the agency be allowed to proceed with the implementation of best value contracting. The request for approval should contain input from the contracting community and other involved parties.

18) Establish Framework for Proposal Evaluation and Award

Evaluation criteria and the weighting of these criteria are project-specific. The evaluation criteria are separated into management, technical, and price categories. The determination of the criteria in each category should be developed in consultation with other participants, especially the AGC.

Management Criteria

- ➢ The management criteria should focus on the objectives set in Step 2:
  - Increased innovation,
  - Reduced change orders, and
  - Compressed project schedule.
- ➢ Common types of management-related evaluation criteria are included in Table 15.

Technical Criteria

- ➢ Similarly, the technical requirements are also project-specific. These requirements deal with unique technical circumstances surrounding the project and unusual technical conditions essential to be understood and addressed in order to achieve project success.

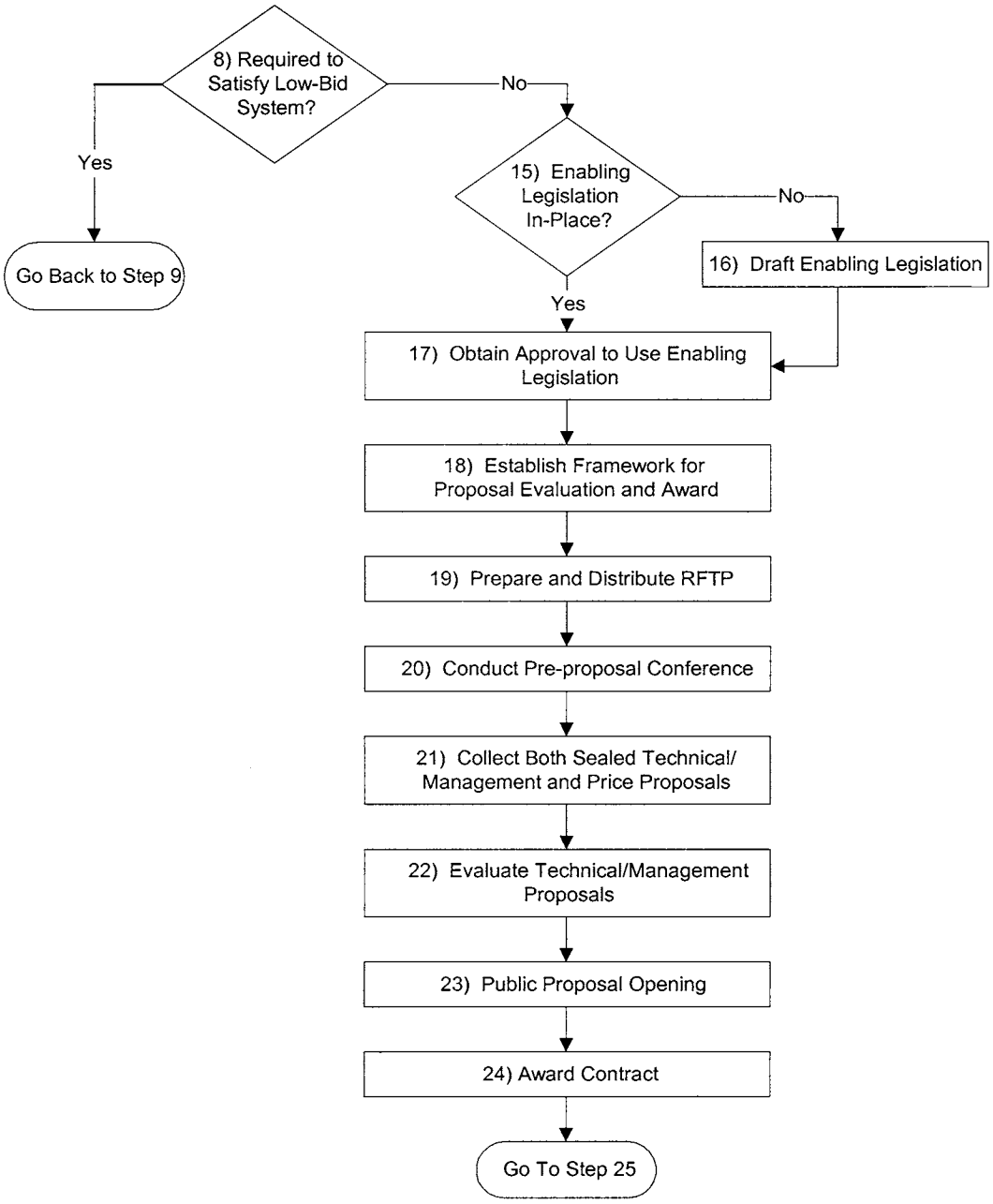

Figure 24. Best value evaluation phase process model.

➢ These criteria should be chosen based on achieving the objectives set in Step 2:
  - Improved quality,
  - Increased innovation, and
  - Decreased LCCs.

➢ Example potential criteria related to construction include
  - Construction methods related to the project,
  - Construction materials related to the project,
  - Expertise when installing materials,
  - QA/QC approaches,
  - Past project examples, and
  - Ability of the contractor to obtain materials/equipment/ personnel.

Technical/Management Evaluation Committee

➢ The Technical/ Management Evaluation Committee evaluates the technical/management proposals.

➢ This committee should be composed of competent professionals of strong moral and ethical character, with no direct personal interest in the outcome of the pro-

Oregon Revised Statutes 279 – Public Contracts and Purchasing
279.015 Competitive bidding; exceptions; exemptions.
(1) Subject to the policies and provisions of ORS 279.005 and 279.007, all public contracts shall be based upon competitive bids or proposals except:
(c) A public contract exempt under subsection (2) of this section;
(2) Subject to subsection (6)(b) of this section, the Director of the Oregon Department of Administrative Services or a local contract review board may exempt certain public contracts or classes of public contracts from the competitive bidding requirements of subsection (1) of this section upon approval of the following findings submitted by the public contracting agency seeking the exemption:
(a) It is unlikely that such exemption will encourage favoritism in the awarding of public contracts or substantially diminish competition for public contracts; and
(b) The awarding of public contracts pursuant to the exemption will result in substantial cost savings to the public contracting agency. In making such finding, the director or board may consider the type, cost, amount of the contract, number of persons available to bid and such other factors as may be deemed appropriate.
(6) In granting exemptions pursuant to subsection (2)(a) and (b) of this section, the director or board shall:
(b) Require and approve or disapprove written findings by the public contracting agency that support the awarding of a particular public contract or a class of public contracts, without the competitive requirements of subsection (1) of this section. The findings must show that the exemption of a contract or class of contracts complies with the requirements of subsection (2)(a) and (b) of this section.

Figure 25. Oregon Revised Statutes 279.015 Excerpt.

Oregon Administrative Regulations (OAR)
125-300-0050 Exemptions Requests
(1) An agency may request an order from the Department exempting a particular contract or contracts from competitive bidding where such contract or contracts are not otherwise exempted under these rules. The request shall contain the following:
(a) The nature of the project;
(b) Estimated cost of the project;
(c) A narrative description of the cost savings anticipated by the exemption from competitive bidding and the reasons competitive bidding would be inappropriate;
(d) Proposed alternative contracting and purchasing practices to be employed; and
(e) The estimated date by which it would be necessary to let the contract.
(2) The Department may require any additional information deemed necessary to determine whether a particular contract or contracts is (are) to be exempt from competitive bidding.
Statutes Implemented: ORS 279.015 & 279.019

Figure 26. Excerpt of Oregon Administration Regulations.

TABLE 15 Common management-related evaluation criteria

Criteria	Contents
Organization/Management Plan	How the proposer's firm will organize the project
Key Personnel Plan	Resumes of the key personnel who will be filling the various positions (to demonstrate expertise)
Relevant Experience/Past Performance	Examples of similar past projects that the proposer has worked on
Proposed Schedule/Work Plan	The proposer's plan for completing the project

posal evaluation process. Some suggested professionals who may be appropriate for the evaluation committee include
  - A member from the project design team,
  - A member from the contract administration department,
  - A member from the project management department, and
  - A nonproposing construction contracting member of the local AGC.
- The committee should have access to technical advisors as necessary, particularly if a portion or the entire project falls outside the range of experience of the committee members.

Price Criteria

- Cost proposals should be evaluated separately from technical proposals.
- The Technical/Management Evaluation Committee should not have any access to the price proposals.
- Predetermine how to evaluate the price proposals.
  - Rate price proposals in comparison with the average price of all proposals received at the public proposal opening.
  - Rate price proposals in comparison with the engineering estimate for the project.
  - Rank order—low to high; assign the highest number of points to the low bid.

Weighting of Criteria

One method of ranking the criteria is to make the price criteria equal to the nonpriced factors.

- The nonpriced criteria are then separated into percentages, according to the significance placed on the different technical and management factors.
- The significance of each of these criteria may be determined by considering the objectives established in Step 2.
- The technical criteria in most cases are more significant and thus weighted more than the management factors.
- Within the technical criteria grouping, specific project characteristics determine the order of significance of the subcriteria.
- Some criteria may be evaluated on a pass/fail basis.

Contract Award Determination Process

The method of selecting the successful offeror must also be determined. The contract award selection process should include the following items:

- Selection of Technical/Management Evaluation Committee members.
- Collection of sealed technical/management and price proposals.
- Screening of technical/management proposals.
  - Determination of compliance with the RFTP requirements: all required forms and certificates must be included.
- Evaluation of the technical/management proposals (performed by the Technical/Management Evaluation Committee).
  - A predetermined schedule of values can be developed to decrease the subjectivity of rating.
- Determination of format and order of public proposal opening.
  - Announcement of technical scores,
  - Announcement of price proposals,
  - Scoring and announcement of price proposals, and
  - Calculation and announcement of total score.

19) Prepare and Distribute RFTP

- RFTP are generally advertised for in the same way as a traditional project.
- The RFTP drafting process will require more intensive efforts than a traditional methods and materials specification project. Items to be included in the RFTP are
  - Technical criteria,
  - Management criteria,
  - Weighting of criteria,
  - Schedule of deductions for each criterion,
  - Price proposal scoring process,
  - Submission date(s) of proposals, and
  - Composition of Technical/Management Evaluation Committee.
- The most important issue in the drafting of the RFTP is to be as clear as possible when describing the project requirements, evaluation criteria, and award decision.
- A final test of objectivity for this process would be for the proposers to score their own technical/management proposals for each of the criterion using the schedule of deductions included in the RFTP. A proposer could submit a proposal having a good idea of the technical/management score.

20) Conduct Preproposal Conference

Figure 27 presents a checklist of topics to be covered at the preproposal conference for a best value project. This checklist is not exhaustive, and other topics may need to be addressed for each individual project.

21) Collect Both Sealed Technical/Management and Price Proposals

There are at least two different approaches to collecting the technical/management and price proposals. Two approaches are summarized here.

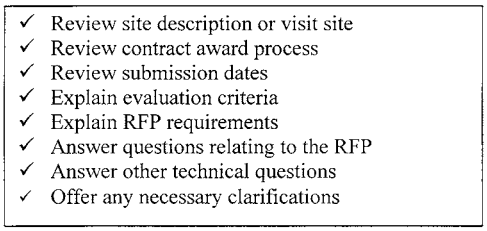

Figure 27. Checklist of items for best value preproposal conference.

Approach 1

- ➢ Collect only the technical/management proposals on the date specified in the RFTP.
- ➢ Screen the technical/management proposals to ensure that they meet the RFTP requirements, if necessary.
- ➢ Forward the technical/management proposals to the technical evaluation committee.
- ➢ Collect sealed price proposals on the day of the public proposal opening.
  - This approach would ensure that the technical evaluation committee has no means of knowing the price proposal amounts.
  - This approach would require that the price proposals be scored at the proposal opening and not by a separate committee.

Approach 2

- ➢ Collect both the sealed technical/management and price proposals on the date specified in the RFTP.
- ➢ Screen the technical/management proposals to ensure that they meet the RFTP requirements, if necessary.
- ➢ Forward the technical/management proposals to the technical evaluation committee.
- ➢ Keep the price proposals sealed and secured by someone other than the members of the technical evaluation committee until the public proposal opening.

22) Evaluate Technical/Management Proposals

Proposal Evaluation

- ➢ Evaluate each technical/management proposal according to the predetermined weighting and schedule of deductions for each of the required criteria.
  - The Technical/Management Evaluation Committee members must make certain that the identity of the proposer does not in any way affect or bias the evaluation of the proposals.
  - Each committee member should document the reason(s) for each evaluation score.

Calculate Overall Technical/Management Proposal Score

- ➢ Once every committee member has evaluated each of the proposals, an overall technical and management score should be calculated. Some possible ways of calculating this score include
  - Average the scores given to the proposal by each committee member.
  - Discard the single highest and lowest scores for each proposal and average the remaining scores. This approach would require a minimum of five committee members.
- ➢ The overall technical and management scores should be kept confidential until announced at the public proposal opening.

23) Public Proposal Opening

Proposal Opening Elements

- ➢ The public proposal opening is similar in most ways to any traditional bid opening. The main differences are the announcement of technical scores, calculation of price scores, and calculation of the final total scores. The elements to be included in the proposal opening step include
  - Announce technical scores,
  - Publicly open sealed price proposals,
  - Calculate and announce price scores,
  - Calculate and announce total scores, and
  - Announce the successful proposer.

Tips

- ➢ The announcement of technical scores can be made before or after the announcement of prices and calculation of price scores.
- ➢ All calculations should be checked and cross-checked for accuracy.
- ➢ Provide constructive feedback: An explanation of the technical score can be given to the technical and management proposal at the request of a proposer. The feedback shows the contractor what areas of the proposal need improvement for reference in future best value solicitations.

24) Award Contract

The contract would be awarded to the proposer with the highest combined score of technical/management and price factors.

Construction and Evaluation of Pilot Project and Program

Figure 28 presents the Construction phase of the best value program, as well as the two evaluation phases: Evaluation of Pilot Project and Evaluation of the Program.

25) Conduct Preconstruction Conference

- ➢ A plan must be formulated and discussed to monitor the contractor's QC program during construction.
- ➢ The contractor should also be encouraged to disseminate the information regarding the objectives of the best value method to management and other project personnel.

26) Perform Construction

Construction is performed in the same manner as with a traditional fixed-unit-price competitive bid contract.

- ➢ If the QC plan was a part of the technical proposal, then the SHA must monitor the construction process to ensure that the contractor adheres to the QC plan.
- ➢ Although the SHA still needs to monitor the contractor's QC procedures, there may actually be a decrease in the efforts expended by the SHA during the construction phase for any of the following reasons:
  - The best value method allows the SHA to select contractors who have outstanding experience and may

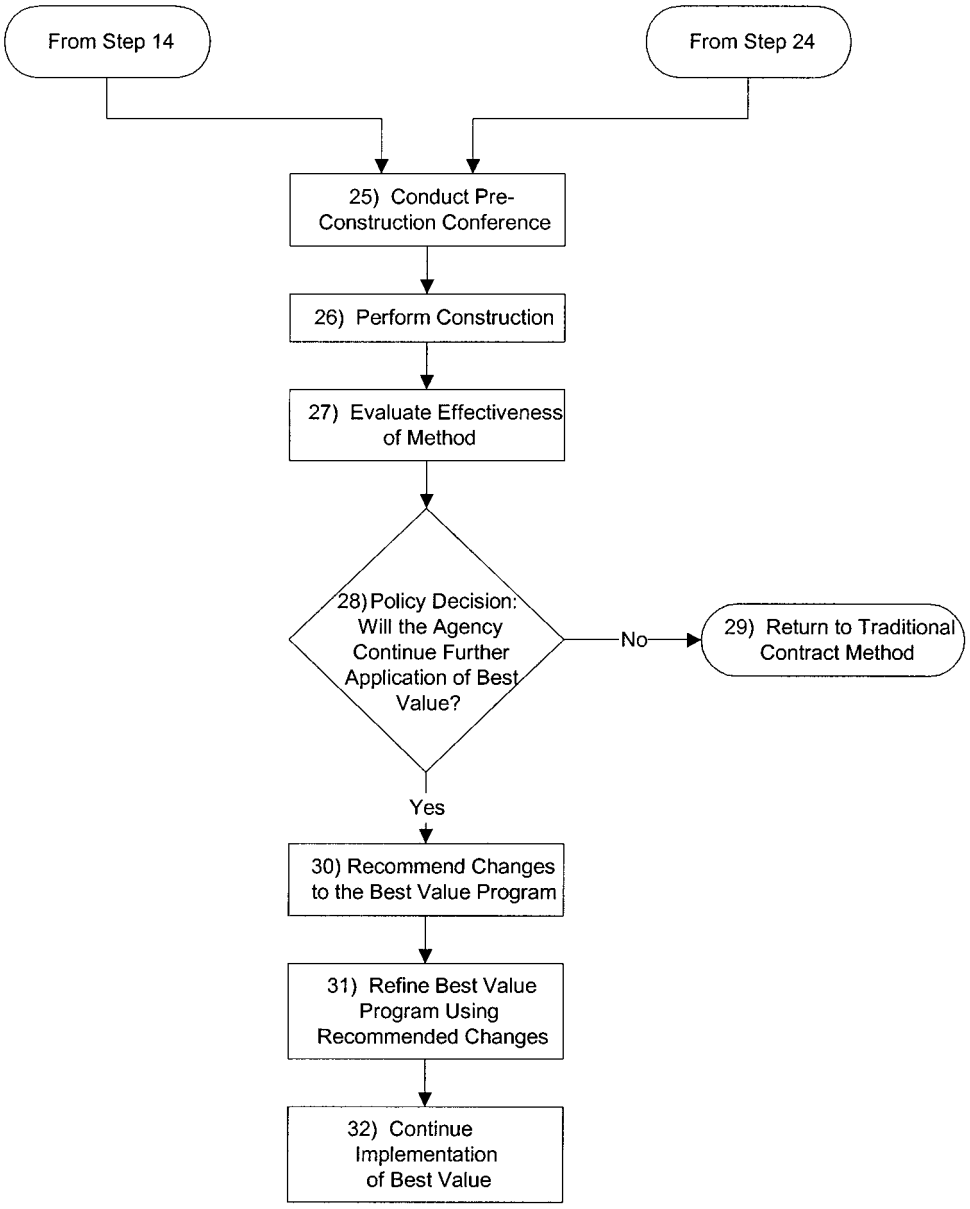

Figure 28. Process model for construction, evaluation of pilot project, and evaluation of program phases.

not require close supervision by SHA contract administrators.
- The SHA's main effort is to respond to RFIs from the contractor and to provide timely feedback on submittals required of the contractor.
- Although the agency still performs QA testing, rework may be minimized on best value projects because of the added emphasis on planning and instituting project quality.

27) Evaluate Effectiveness of Method

To determine the future course of the best value program within an agency, the effectiveness of the pilot project must be evaluated against the standards selected in Step 7.

➢ Some important factors in this evaluation include
  - Quality of the final constructed project,
  - Impact on SHA personnel resource requirements to administer the project,
  - Risk distribution, and
  - Project cost.
    – The final goal should be to evaluate the LCC of the best value project to make an accurate comparison with traditionally bid and constructed project LCCs.

➢ The project selection criteria identified in Step 7 should be evaluated and modified as appropriate.

➢ Feedback should be solicited from contractors, sureties, and other interested parties, as well as from involved state and FHWA personnel.

28) Policy Decision: Will the Agency Continue Further Application of Best Value?

➢ The results of the pilot project must be evaluated against the program objectives determined in Step 2.

➢ Using the information gathered in Step 26, the agency must determine whether the best value project was cost-effective and whether it met agency objectives when it decided to implement the best value method.

As this policy decision is made, it must be kept in mind that best value contracts are not appropriate for every SHA project. The best value contracting method is not being proposed as a replacement for the low bid system, but as an additional option for SHA's contract administration.

➢ If the SHA does not wish to continue implementation of the best value method, proceed to Step 29.

➢ If the SHA wishes to continue implementation of the best value method, go to Step 30.

29) Return to Traditional Contract Method

If the policy decision is made not to continue further implementation of best value, the SHA should discontinue the use of best value as a contracting method option.

30) Recommend Changes to the Best Value Program

If the agency makes the decision to continue implementation of the best value program, it must be evaluated for possible improvements. Feedback is essential in order to improve on any shortcomings identified in the pilot project.

➢ Identify and understand the nature of any problems encountered during the pilot project.

➢ Specify potential solutions to these problems.

➢ Recommend changes to the RFQ/RFP documents.

This step assumes that multiple future pilot projects will be procured using the best value method once the initial pilot project is completed.

31) Refine Best Value Program Using Recommended Changes

A feedback loop must be established to improve the efficiency and effectiveness of the best value method.

➢ Incorporate the changes recommended in Step 30 into the best value program through revision of the RFQ/RFP documents prepared in either Step 10 or 18.

➢ This iterative process of improvement must continue throughout the life of the best value program, but is especially important during the pilot phase.

32) Continue Implementation of Best Value

Once the program has been refined and the RFP has been revised, the SHA may consider the use of best value contracting for other projects.

➢ Additional best value pilot projects should be conducted using the revised draft of the RFQ/RFP. As the SHA becomes more comfortable with the practice of best value contracting, it can be applied to additional projects when appropriate.

➢ The process may be expanded to include both design-build and construction-only types of projects.

➢ If the SHA has decided that best value is a useful option for its contracting process, it may consider returning to Step 15 (Enabling Legislation In Place?) at this point in the development process, to establish best value as a permitted contracting practice within the state.

➢ To make the best value method acceptable, the SHA must continue to work with local contractors and other industry participants.

- ➢ The SHA must continue to develop and refine project selection criteria for best value projects.
- ➢ Finally, the SHA must continue to gather and monitor information on its best value projects and LCCs to improve the effectiveness of the best value program.

CRITICAL SUCCESS FACTORS

All steps listed and described above are considered important for implementation of the best value program. However, the following factors are some of the most critical affecting the degree of success achieved through the implementation of best value.

Training

- ➢ All parties must be made aware of and understand their roles and responsibilities under the best value system.
  - The contractor must understand the submittal requirements, which are more extensive than for a traditional project.
  - The SHA must realize that the RFQ/RFP writing and evaluation process will require more intensive efforts than required on a traditional project.
- ➢ The SHA must employ personnel with the appropriate expertise to implement the best value process.

Appropriateness of Method for Projects

- ➢ Both the SHA and the contractor must possess sufficient levels of resources to execute the roles defined in the training process.
- ➢ Criteria must be defined to make clear what projects are candidates for a best value contract.
- ➢ Projects chosen for a best value contract must be compatible with the objectives of the SHA for implementing best value contracting.

Communication

- ➢ Communication among major parties is crucial throughout the duration of the project.
  - SHA personnel, contractors, legal advisors, and other parties must clearly share their concerns in order to improve the best value process.
- ➢ Attention must be given to a means for resolving conflicts quickly during the project.

Initial Agreement

- ➢ All parties must bring their expectations into agreement early in the process.

Post-Award Agreement

- ➢ A working relationship among all involved parties must evolve and continue throughout the duration of the project.

Integration of Design, Construction Methods and Techniques, and Sequences of Work

- ➢ The best value process must be identified as the chosen contract method early in the life of the project.
  - The design, scope of work, and preparation of the contract documents are examples of the elements of the project that may be affected by the choice of best value as the contracting method.
- ➢ Design should drive construction methods and techniques and sequences of work.
- ➢ Design considerations, selection of construction methods and techniques, and sequences of work are all interrelated and will be impacted by the best value process.

More Up-Front Investment by SHA

- ➢ Initially, the SHA must be willing to invest more resources in both the process and an individual project. As the best value process matures, these costs will be recouped as LCCs of individual projects are reduced. Although an increased amount of resources will be required early in each individual project's RFQ/RFP writing phase, the projects are anticipated to perform more economically in the long run.

Support of SHA Upper Management and Industry Buy-In

- ➢ Without the support and approval of senior level management within the SHA, the best value program cannot be successfully implemented.
- ➢ Without buy-in of local industry personnel, the best value program will fail.

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APPENDIX A

CASE STUDY FOR WARRANTED ASPHALT PAVEMENT

The following case study of the Wisconsin DOT warranted asphaltic pavement program is presented to illustrate the process model for warranty contracting included in the body of these guidelines. The process model from the warranty guidelines is presented again before the case study for ease of reference (Figure A1), and the applicable steps of the flowchart are then described in the context of the Wisconsin DOT's experience with warranty contracting.

HIGHWAY WARRANTY CASE STUDY FOR WISCONSIN DOT

Step 1. What Is SHA's Current Level of Experience with Warranty Contracting?

The Wisconsin Department of Transportation (WisDOT) has traditionally been involved in highway construction from conceptual design through operation and maintenance. The WisDOT asphaltic concrete (AC) pavement specifications moved from a traditional method and materials specification to quality control/quality assurance (QC/QA) specifications in the late 1980s. This program became very comprehensive by the mid-1990s, and WisDOT felt that the next logical step in specification evolution was a move to warranty specifications. The warranty specification development process began in 1994 and has included nine asphalt paving projects and also expanded into portland cement concrete (PCC) projects. The development of WisDOT's specification methods for AC pavements is illustrated in Figure A2.

Step 2. Determine Motivation for Implementing Warranties

WisDOT identified the following four main reasons for implementing a warranty program in their *Asphaltic Pavement Warranties*: *Wisconsin Department of Transportation Three-Year Progress Report.*

- The warranty process allows WisDOT to define the final product in terms of condition and performance.
- Warranties offer the potential for improving quality and reducing state project delivery costs.
- There are shared risks: WisDOT has the risk of less-than-desired pavement performance and the contractor has the risk involved in remedial/corrective work.
- The contractor should decide how to construct the pavement.

WisDOT also felt that the warranty specifications allowed contractors to use more cost-effective and innovative construction methods for projects, and made them a "full partner in the road building process."

WisDOT also cited 10 additional purposes for implementation of warranty specification:

- To allow WisDOT to evaluate project performance based on "the final product, not on ingredients, the process, or on surrogate tests for performance";
- To enable WisDOT to use the pavement management system (PMS) to define the acceptable performance of the warranty specification;
- To evaluate the impact of pavement performance on road users;
- To build quality highways on time and at a reasonable cost;
- To allow freedom for contractor innovation and creativity, while maintaining quality standards;
- To reduce WisDOT personnel requirements in testing, supervision, and involvement with the construction process;
- To shift risk from WisDOT to the contractor by allowing the contractor to decide how best to accomplish the desired performance;
- To gain experience with warranty specifications;
- To advance the national effort to explore innovative contracting methods; and
- To improve pavement performance.

Step 3. Review and Understand Best Practices for Warranty Contracting

WisDOT's first three warranty projects in 1995 were among the first applications of the warranty concept to highway construction projects. Thus, WisDOT did not have the opportunity to review many existing best practices when implementing their warranty program. WisDOT's AC pavement warranty specification development was the result of a partnership between WisDOT and the state paving industry.

Minor modifications have been made since the inception of the WisDOT warranty specification program in 1995, and other SHAs have used existing specifications, including the WisDOT example, as the basis for the implementation of their programs.

Step 6. Select Candidate End Product

WisDOT made a conscious decision to select AC pavements as the first product to pilot the warranty process. This decision was made by the Administrator for the Division of

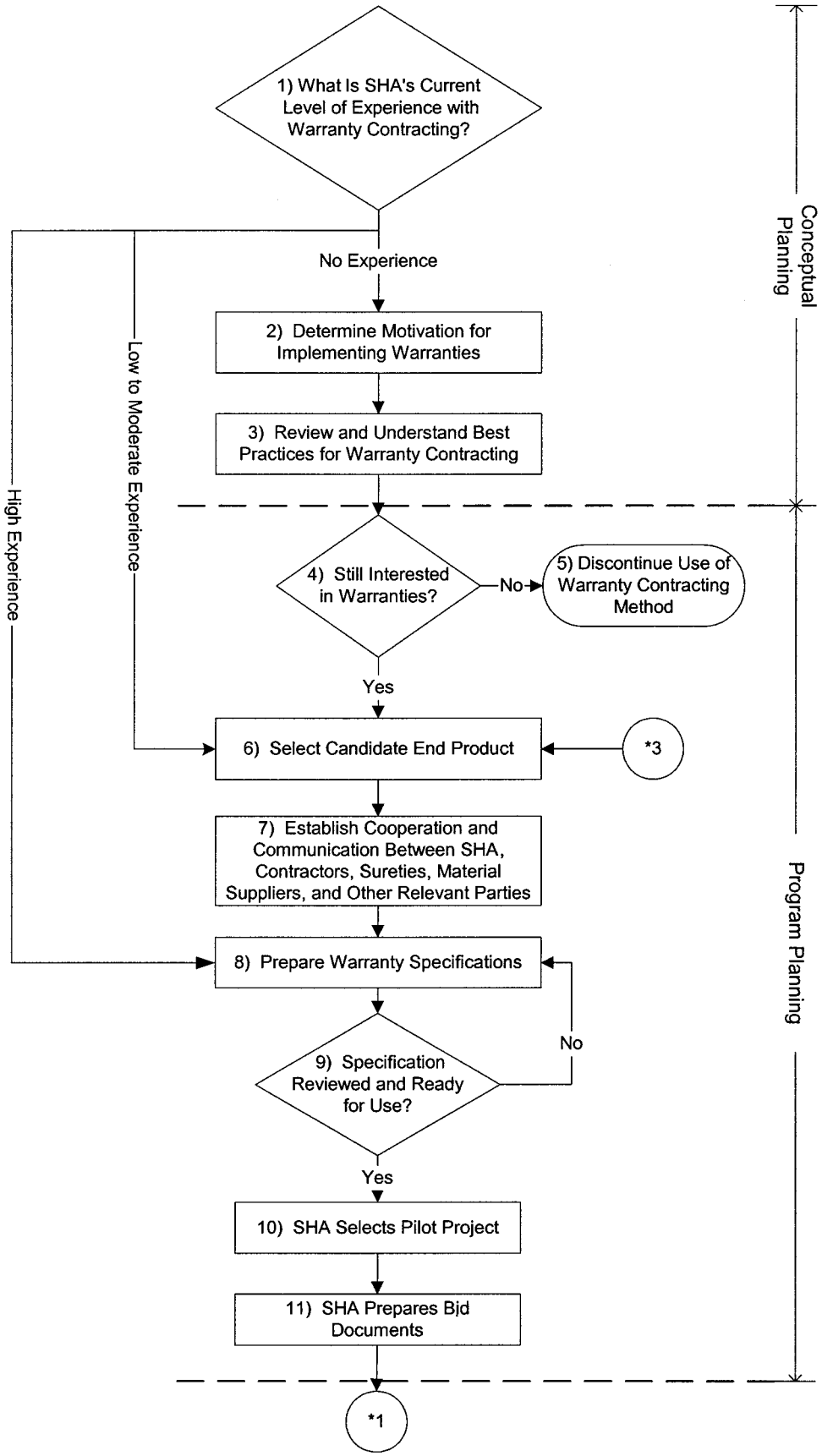

Figure A1. Warranty process model (continued on next page).

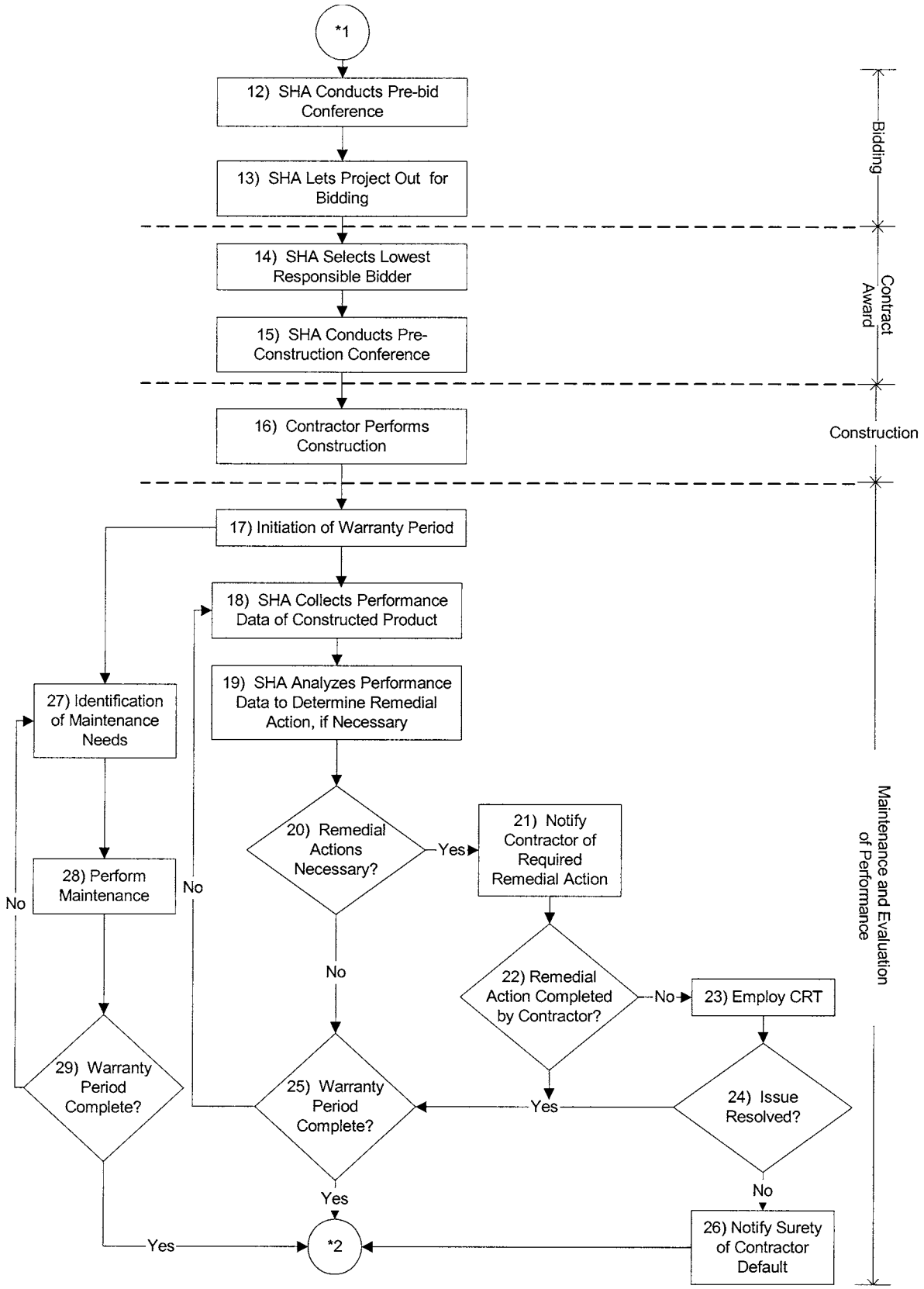

Figure A1. (Continued).

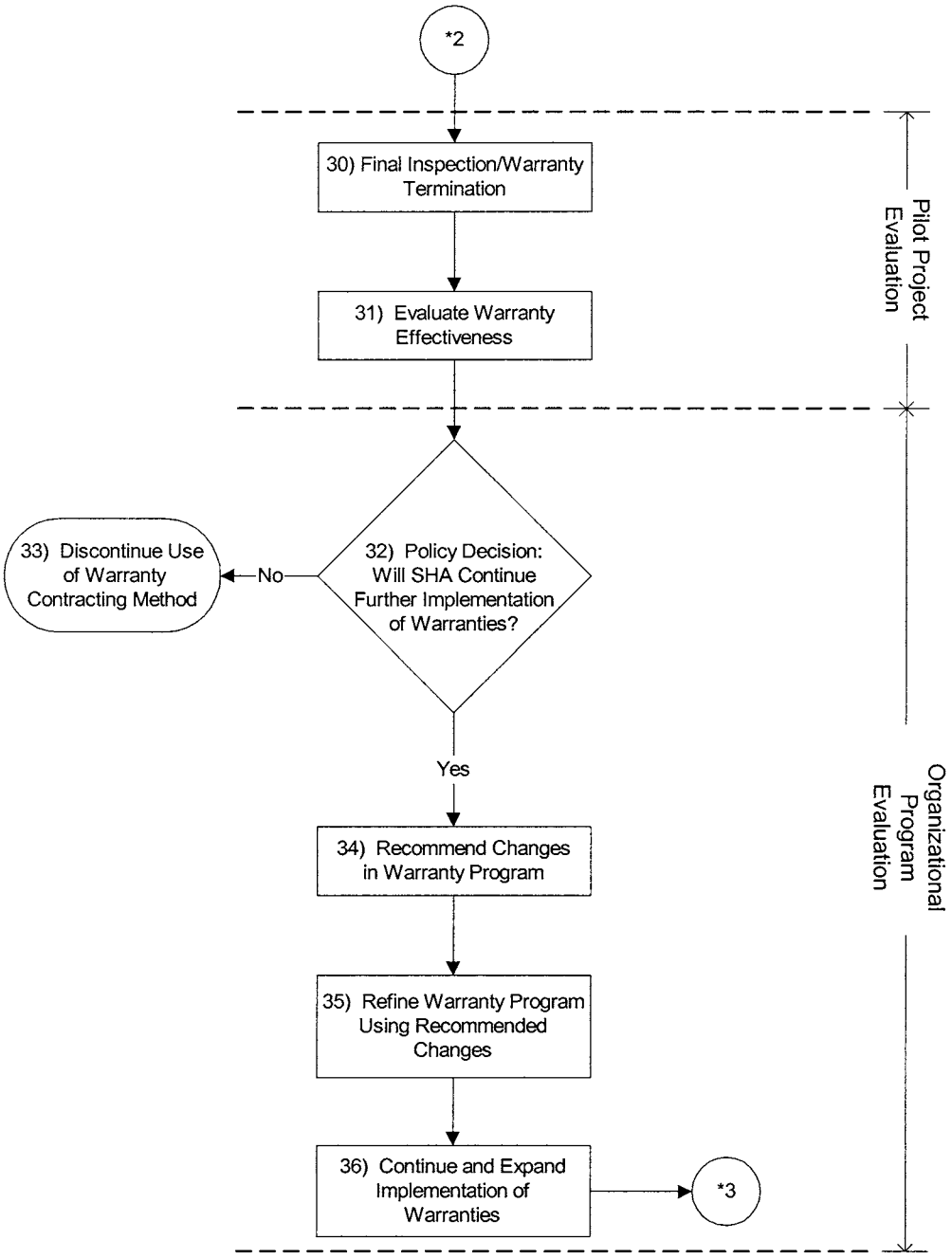

Figure A1. (Continued).

Transportation Infrastructure Development (see organization chart, Figure A3). AC pavement over granular (milled) base, PCC pavement, or AC road-mix pavement (cold-mixed asphalt) were considered for the application of warranties. However, WisDOT decided that road-mix projects were not numerous enough in Wisconsin and the performance of AC pavement over PCC pavement could vary substantially. Therefore, AC over a granular base was chosen; its performance is affected by the least number of variables external to the pavement itself.

Step 7. Establish Cooperation and Communication Between SHA, Contractors, Sureties, Material Suppliers, and Other Relevant Parties

In 1994, when the warranty program was initiated, WisDOT formed a team with the Wisconsin Asphalt Pavement Association (WAPA) and the Wisconsin Division Office of the FHWA to draft an AC pavement warranty specification. All three parties agreed from the outset to pursue a nonrestrictive approach to the warranty specification.

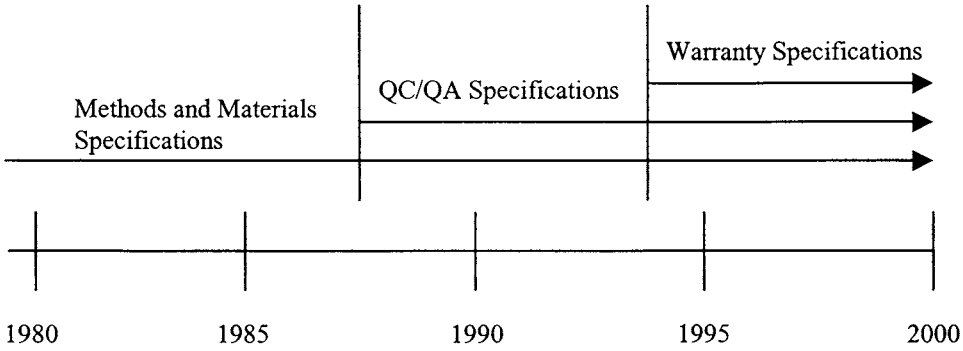

Figure A2. WisDOT specification development for AC pavements.

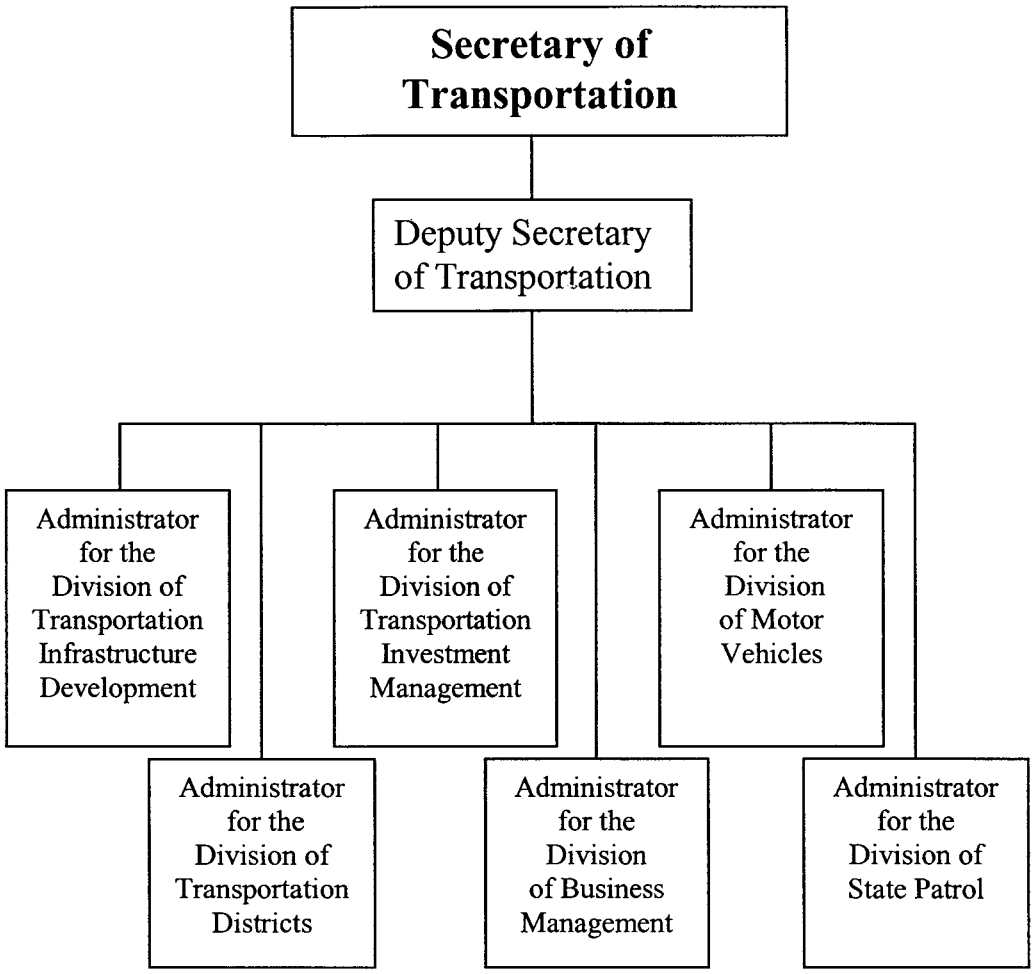

Figure A3. WisDOT organization chart.

Involving the WAPA and FHWA early in the development process allowed WisDOT to improve the process based on their input, obtain buy-in to the form and substance of the specification, and minimize the possibilities of adversarial relationships later in the process.

Step 8. Prepare Warranty Specifications

The WisDOT warranty specification is included in a special provision to the WisDOT standard specifications. WisDOT essentially views the warranty specification as a means of paying the contractor to take a specified, reasonable risk.

The warranty specification was designed to allow contractors to select materials, mix designs, construction techniques, and a QC program, while holding them responsible for pavement performance for 5 years. WisDOT's objective was to reduce its inspection and QA personnel demands. This decrease was understood to be coupled with an increase in personnel requirements for pavement evaluations. To bid warranty projects on an equal basis within the low bid environment, the pavement thickness and base type are specified for all warranty projects.

Length of Warranty

Once the end product that would be warranted was chosen, the next important issue to be addressed was that of the length of the warranty. The options considered by the WisDOT team ranged from 3 to 5 years in length. It was decided that 3 years was too short a time to determine the long-term quality of the project. The team decided that 5 years was an adequate amount of time to determine long-term quality, but was not so long as to be unreasonable from the contractors' perspective. It was apparent, based on the WisDOT's PMS, that long-term quality deficiencies tended to show up within the first 5 years of a pavement's life.

Performance Indicators

After deciding the length of the warranty to be 5 years, the warranty development team had to determine what performance indicators would be used to evaluate the performance of the warranted pavement. Eight performance factors were identified for consideration:

- Roughness,
- Appearance,
- Noise,
- Maintenance requirements,
- Rutting,
- Friction,
- Delineation, and
- Longevity (service life).

These factors were chosen because they affect the road user. WisDOT wanted to establish performance indicators that directly affected the road user and let the contractors determine how best to technically produce the desired results.

Each of these eight factors was analyzed as to its usefulness in the warranty specification. Roughness was felt to be affected by too many factors beyond the contractor's control, as the pavement ages, to be included in the warranty specification. Available historical data were insufficient to establish reasonable thresholds or measurement standards for the appearance, noise, maintenance requirement, and delineation factors. Therefore, the three factors used in the specification were rutting, friction, and longevity (service life). Longevity and rutting are assessed using pavement distress indicators from the WisDOT PMS.

Threshold Levels

It was difficult to determine the appropriate threshold levels for the fifth year of the warranty, i.e., the values for each performance indicator at which remedial actions are required of the contractor. The warranty specification uses 12 pavement distress indicators to measure longevity and rutting. Friction is measured when there is an indication of a potential friction problem. WisDOT analyzed the historic data in its PMS to establish the threshold levels for the fifth year of the warranty. WisDOT generally found a clear distinction between pavements that were acceptable and those that were not acceptable after 5 years of service life. The threshold levels for the pavement distress indicators were set such that 90 percent of the analyzed pavements had satisfied the threshold values. Use of the PMS historic data allowed WisDOT to establish threshold levels that are reasonable, assured WisDOT that a pavement that meets the threshold levels will be a quality pavement, and assured contractors and sureties that the threshold levels are actually attainable.

When the PMS data were analyzed, the following 12 distress indicators were found to define performance history:

- Alligator cracking,
- Block cracking,
- Edge raveling,
- Flushing,
- Longitudinal cracking,
- Longitudinal distortion,
- Rutting,
- Surface raveling,
- Transverse cracking,
- Transverse distortion,

- Patching, and
- Disintegrated areas.

The threshold values stipulated by WisDOT for each distress indicator are listed in column 2 of Table A1.

Determination of Remedial Actions

A team of WisDOT, FHWA, and contractor personnel established the appropriate remedial actions for each type of distress. These remedial actions are required of the contractor if any of the warranted pavement reaches or exceeds the threshold values for any of the pavement distress indicators. The remedial actions required by WisDOT for each distress indicator that exceeds the listed threshold value are listed in column 3 of Table A1.

Bonding

The warranty bond for a warranty project must be in effect for the entire 5-year period of the warranty. This may consist of a single bond or of a 1-year bond and two 2-year renewable, noncumulative bonds for successive terms. The bond(s) is required to "insure the proper and prompt completion of required warranty work following the completion of the pavement." This bond(s) covers only the warranted AC pavement. Although it is possible that the entire pavement could fail within 5 years, the most likely remedial action to be required was deemed to be a thin overlay. The warranty bond requirement for the specification was based on the estimated cost of this remedial action in order to keep the bond's penal value reasonable, thereby enabling the contractors to obtain the bonds from their sureties.

Surety companies were informed that the performance indicator threshold levels were based on WisDOT's historic PMS data. These historical data provided evidence that contractors could meet the performance criteria and have, in fact, met them.

If the contractor fails to renew the warranty bond, a payment equal to 20 percent of the penal value of the bond will be made to WisDOT and the contractor will be considered in default. Additionally, the bonding company used by the contractor must have an A.M. Best rating of A– or better for the warranty period and must provide proof of the 5-year bond commitment to begin the contract.

Conflict Resolution Team

A conflict resolution team (CRT) was formed for each warranty project. The CRT consisted of two WisDOT representatives, two contractor representatives, and one mutually agreed upon representative from a third party. The cost of this third party representative is shared equally by WisDOT and the contractor. The CRT has the authority to make a final decision on matters of conflict between WisDOT and the contractor. If the conflict resolution process does not result in a satisfactory solution, WisDOT's normal claims process is followed.

Pavement Performance Surveys

The WisDOT warranty specification lays out the method for conducting surveys of the pavement performance. The project is divided into 1-mile nominal-length sections, as shown in Figure A4. Two 0.1-mile-long segments within each section will be evaluated each year. The segment 0.3 to 0.4 mile from the start of each section will be evaluated, as well as one other segment in each section chosen at random. If areas outside the two surveyed segments are suspected of meeting or exceeding a threshold level, WisDOT may survey any and all of the 0.1-mile segments to determine the extent of the distress. Remedial actions dictated by the WisDOT specifications are listed in Table A1.

WisDOT's personnel will conduct these evaluations annually, between April 15 and May 15, basing the distress measurements on WisDOT's *Pavement Distress Manual*. Notification of any disputes with the findings of WisDOT distress evaluation must be provided to WisDOT by June 15, 30 days after the final day of the distress evaluation period.

Execution of Remedial Actions

Once an annual evaluation is completed, a report is made to the contractor. If the contractor disagrees with the results of the performance surveys, and notifies WisDOT of this disagreement by June 15, the CRT will make a recommendation to resolve the dispute within 30 days. If any of the threshold levels are met or exceeded and the contractor does not dispute the findings, the contractor must perform the remedial actions contained in the specifications on any and all segments that meet or exceed a threshold level.

Remedial actions must be made within 1 year of the survey in which the threshold level was found to have been met or exceeded. These actions are generally applied to the entire segment(s) in which the threshold level is met or exceeded. If 30 percent or more of the project segments require or have received remedial action at any point during the warranty period, the entire project will receive a remedial action agreed upon by WisDOT and the contractor. The contractor is also responsible for repairing any pavement markings, adjacent lane(s), or shoulders disturbed by corrective actions.

TABLE A1 WisDOT distress indicators for AC pavements

Distress Indicator	Threshold Value	Remedial Action
Alligator Cracking[a]	10% of area in a 0.1 mile segment	Remove and replace distressed layers, the area to be equal to 150% of the distressed area to a depth not to exceed the warranted pavement.
Block Cracking	10% of area in a 0.1 mile segment	Remove and replace distressed layers, the area to be equal to 110% of the distressed area to a depth not to exceed the warranted pavement.
Potholes, Slippage Areas, and Other Disintegrated Areas	Existence	Remove and replace the distressed area(s), the area to be equal to 150% of the distressed area to a depth not to exceed the warranted pavement.
Edge Raveling	10% of the 0.1-mile segment length	Remove and replace distressed layers, the area to be equal to 110% of the distressed area.
Flushing	20% of the 0.1-mile segment length	Remove and replace distressed surface mixture full depth.
Longitudinal Cracking	--1000 linear feet for cracks that average 0.5 in. or less in width	--Rout and seal all cracks with rubber crack-filling material or agreed upon equal.
	-OR-	
	--25 cracks per segment with 25% of the linear feet of cracking having band cracking or dislodgment	--Remove and replace distressed layer(s) to a depth not to exceed the warranted pavement.
Longitudinal Distortion	1% of the 0.1-mile segment length	Remove and replace the distressed layer(s), the area to be equal to 110% of the distressed surface to a depth not to exceed the warranted pavement.
Patching	150 linear feet of patching per segment (excluding longitudinal cracking remedial action)	Remove and replace the surface layer or place a 1.25-in. overlay.
Rutting[b]	--0.25 in. deep	--Remove ruts by milling surface with fine-tooth mill, overlaying, or microsurfacing.
	--0.5 in. deep	--Remove and replace surface layer.
Surface Raveling	A rating of "none" must be maintained. For segregation this means less than 3 segregated areas per segment that are 30 ft^2 or more in size.	Apply a chip seal coat or a partial depth repair.
Transverse Cracking	--25 cracks per segment that average greater than 0.5 in. in width	--Rout and seal all cracks with rubber crack-filling material or agreed upon equal.
	-OR-	
	--25 cracks per segment with 25% of the linear feet of cracking having band cracking or dislodgment	--Remove and replace distressed layer(s) to a depth not to exceed the warranted pavement.
Transverse Distortion	1% of the 0.1-mile segment length	Remove and replace distressed layer(s), the area to be 110% of the distressed area to a depth not to exceed the warranted pavement.

[a]The contractor will be relieved of responsibility for remedial action for alligator cracking if the pavement in the area in question is of proper thickness (not thinner than 0.5 in. from plan thickness) and the asphalt cement is of acceptable penetration (average recovered penetration of the surface course is above 30) and at least one of the following is true: the base is at least 2.0 in. thinner than plan thickness, the subgrade density is less than 90 percent of the optimum, or the actual accumulated equivalent single-axis loadings (ESALs) are 50 percent above the projected fifth-year accumulated ESALs.

[b]The rutting threshold level is waived when the accumulated ESALs are 50 percent above the projected fifth-year accumulated ESALs. The contractor will only be responsible for mixture and placement problems.

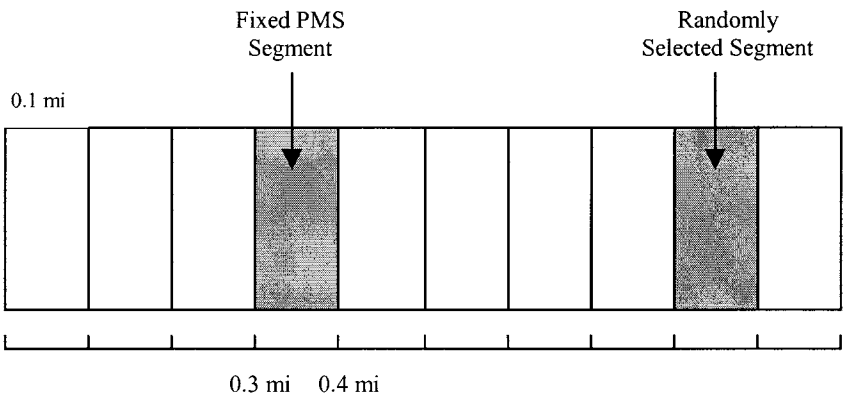

Figure A4. Pavement evaluation segment diagram.

"Contractors will not be held responsible for distresses caused by factors beyond their control." Two specific applications of this policy are alligator cracking and rutting. If the pavement is the correct thickness, the asphalt penetration meets WisDOT standards, and the subgrade is deficient or the accumulated equivalent single-axle loadings are at least 50 percent higher than projected, the contractor may be relieved of responsibility for alligator cracking and rutting.

Method of Measurement

As on a traditional project, the contractor is paid for AC pavement by the megagram (ton) of mixture. This includes:

- Furnishing of materials,
- Preparation of materials,
- Hauling of materials,
- Mixing of materials,
- Placement of materials,
- Compaction of materials,
- Obtaining of warranty bonds,
- Performance of warranty work,
- Design of the job mix formula,
- Development of QC plan,
- Testing,
- Record keeping,
- Sampling,
- Traffic control, and
- All labor, equipment, and incidentals necessary to complete the work.

No more than 105 percent of the plan quantity will be paid for, unless a change in field conditions has occurred requiring a change order to be issued.

Step 10. SHA Selects Pilot Project

The WisDOT, WAPA, and FHWA team selected three projects from the scheduled 1995 AC pavement projects on which to pilot the warranty specifications. The specification development team felt that it was important to involve several contractors and different WisDOT districts in the warranty program from the beginning. This approach led to the decision that the first three pilot warranty projects would be selected from three different geographical locations within the state. The team also selected projects with consistent subgrade or basic layers, where the levels of distress were relatively uniform over the full length of the project, thus reducing project complexity and eliminating many other variables that might impact performance. WisDOT described the three warranted projects as rural, two-lane roadways on a well-established base, asphaltic concrete over a reprocessed asphaltic base (milled and re-laid old asphaltic concrete), and the traffic volumes require mix designed for medium traffic. Table A2 lists the specific attributes of the three projects.

Bid Analysis (Steps 12–15)

Five of the first nine warranty projects were awarded on the basis of single bids; however, this is not an unusual situation. Single bids are becoming common on asphalt paving projects. WisDOT estimates the average number of bidders on asphalt paving projects to be two for each project.

The nine warranty projects constructed from 1995 to 1997 ranged in size from 12,000 to 75,000 tons, and in value from $0.5 million to $2.5 million. The awards ranged from 5 percent below the engineering estimate to 18 percent above. In Wisconsin, six of the eight WisDOT districts have been involved, and five different prime contractors have built warranty projects. See Table A3 for a listing of

TABLE A2 Attributes for WisDOT 1995 warranty pavements

Wis-DOT District	County	Contractor	Traffic			Projected Cumulative 20-Year ESALs	Length (km)	Pavement Structure				
			ADT (1994)	Projected ADT (2014)	% of Trucks			AC Thickness (mm)	AC Quantity Mg (tons)	Reprocessed AC (mm)	Existing Base (mm)	Existing Subbase (mm)
1	Rock	Rock Road Construction, Inc. Janesville, Wis.	4,650	5,525	9.1	1,810,400	7.2	125	2,500	125	250	225
6	Eau Claire	Mathy Construction, Inc. Onalaska, Wis.	2,450	3,300	9.3	657,000	6.1	75	12,650	150	Varies	—
7	Langlade	Northeast Asphalt, Inc. Appleton, Wis.	3,800	5,000	10.5	1,114,000	13.21	125	45,600	150	Varies	—

Notes: ADT = average daily traffic; ESAL = equivalent single-axis load; Mg = megagrams.

TABLE A3 Attributes of WisDOT warranty projects

Year Constructed	Name of Project	Location (County)	Penal Value of Warranty Bond ($)	Warranted Asphalt Concrete (tons)	Unit Bid Price ($/ton)	Cost of Warranted Asphalt[a] ($)	Total Bid Amount ($)	Project Length (miles)	Cost per Mile ($/mile)
1995	STH 85	Eau Claire	300,000	11,742	28.35	332,886	497,551	4.05	122,852
1995	USH 45	Langlade	300,000	41,360	21.58	892,549	1,276,366	8.12	157,188
1995	STH 11	Rock	200,000	22,700	24.40	553,880	1,168,636	4.87	239,966
1996	STH 70	Oneida	250,000	32,450	21.72	704,814	1,359,904	7.98	170,414
1996	STH 35	Pepin	300,000	29,450	28.37	835,497	1,196,768	6.7	178,622
1996	STH 23	Fond du Lac	340,000	34,580	23.77	821,967	1,497,836	7.97	187,934
1997	STH 21	Monroe	300,000	48,606	25.99	1,263,270	2,080,914	14.63	142,236
1997	USH 63/STH 29	Pierce	400,000	34,456	20.08	691,876	1,284,370	10.2	125,919
1997	STH 54	Kewaunee/Brown	110,000	12,461[b]	28.50	355,139	1,435,698	4.38	356,196
				6,800[c]	18.30	124,440			

Notes: STH = state highway; USH = U.S. highway.
[a]Column 5 times column 6.
[b]Warranted.
[c]Nonwarranted.

the attributes of all nine AC pavement projects undertaken from 1995 to 1997. Figure A5 shows the average cost per mile of the warranted projects completed in Wisconsin for the same period.

Step 16. Contractor Performs Construction

Under the traditional system of specifications, the DOT prescribes the mix design, construction methods and techniques, and the incentives/disincentives to be used on a project. The QC tests to be performed are also specified (often including asphalt cement content, air voids, and density).

Under the WisDOT warranty specification, the contractor chooses the mix design, construction methods and techniques, and the QC plan. WisDOT does, however, specify the pavement thickness. WisDOT does not perform any QA testing on warranty projects, nor does it have any paving inspectors at the hot-mix asphalt plant or on site. Some limited tests on the materials and pavements were conducted on the three pilot projects. These data will be used for research and documentation.

State Highway (STH) 11

WisDOT found that the contractor's frequency of QC tests was approximately 30 percent less than what WisDOT would have required, illustrating one of the potential benefits of warranties. Not only is the state's duplicative testing eliminated, but the total amount of testing may also be decreased. The contractor was confident that the quality was consistent and that more testing was unnecessary. As stated by WisDOT, "This is precisely the contractor option and risk that is envisioned in a warranty."

The contractor performed QC tests for aggregate gradation and air voids, as well as a modified Rice test. A comparison of contractor QC test results with state-specified requirements for nonwarranty projects is given in Table A4.

The air void target specified by the contractor was close to what would have been specified by the state. The minimum

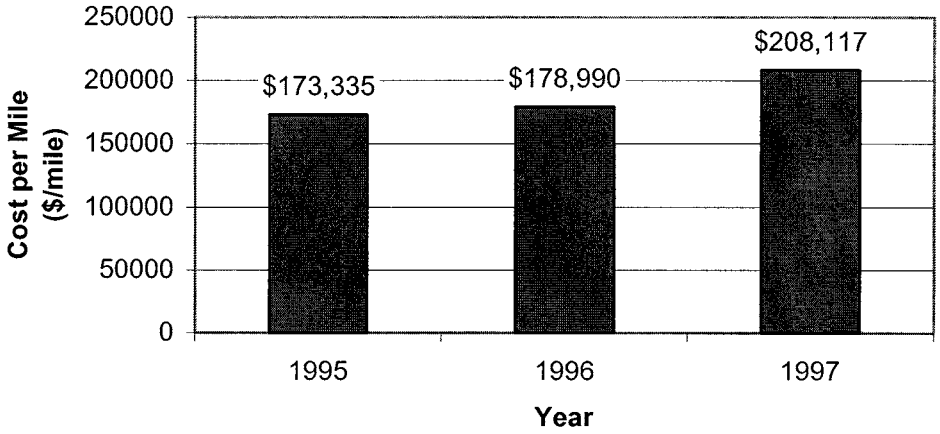

Figure A5. Average cost per mile of warranted asphalt pavement projects.

density achieved by the contractor was acceptable to WisDOT, and the California Profilograph test results were better than the average results for pavements in the project area.

State Highway 85

The QC tests conducted on the STH 85 project were the same as would normally be required by WisDOT. Density testing frequency was reduced once tests indicated that proper compaction was being attained. The average California Profilograph reading after construction was 0.006 m/km (0.40 in./mi), indicating a very smooth roadway.

U.S. Highway 45

The QC tests conducted on the USH 45 project were the same as would normally be required by WisDOT. A satisfactory density was reached on USH 45, and the average California Profilograph reading after construction was 0.003 m/km (0.20 in./mi). This may be compared with a normally constructed "control" project studied by WisDOT, which had an average reading of 0.004 m/km (0.25 in./mi).

Step 17. Initiation of Warranty Period

The WisDOT warranty specification states that the warranty bond will be in effect for 5 years from the date on which all the warranted AC pavement has been placed and opened to traffic. For example, if a project was 10 miles of paving, the warranty would not be in effect until all 10 miles of the pavement was completed and opened to traffic.

Step 18. HA Collects Performance Data of Constructed Product

WisDOT collects performance data on the warranty projects once each year as described in the sections on Pavement Performance Surveys. The distress indicators measured are those listed in Table A1.

TABLE A4 STH11 quality control tests

Property	Contractor Testing Results	State Average Specified Requirement
Air void (%)	3.5	4.0
Density (based on maximum theoretical density) (%)	92 minimum	91[a] 92[b]
California Profilograph (m/km)	0.020	0.036 (local average)

[a]Percent for medium and low volume (MV and LV) mixes.
[b]Percent for high volume (HV) mixes.

Step 19. SHA Analyzes Performance Data to Determine Remedial Action, if Necessary

WisDOT compares the data collected with the threshold values for each distress indicator listed in column 1 of Table A1. If any of the threshold values are met or exceeded, remedial actions will be necessary. The remedial actions specified by WisDOT for each pavement distress type are listed in column 3. Figure A6 illustrates the timeline for performing pavement distress survey and remedial action on a typical warranty project.

Step 21. Notify Contractor of Required Remedial Action

The contractor will be notified of the pavement performance survey results within 14 days after completion of the survey, i.e., no later than May 29. Once notified of the required remedial work, the contractor has until June 15 to notify WisDOT of any disputes. If the contractor does not dispute the pavement performance survey results, it must remedy any distresses that meet or exceed the threshold levels by the end of the current calendar year.

Step 27. Identification of Maintenance Needs

Besides required remedial actions, maintenance may take two forms under the WisDOT warranty specification. Both elective/preventive action and routine preventive maintenance are discussed in the WisDOT warranty specification.

WisDOT authorizes the contractor to perform elective/preventive maintenance, but does not require it: "Elective/

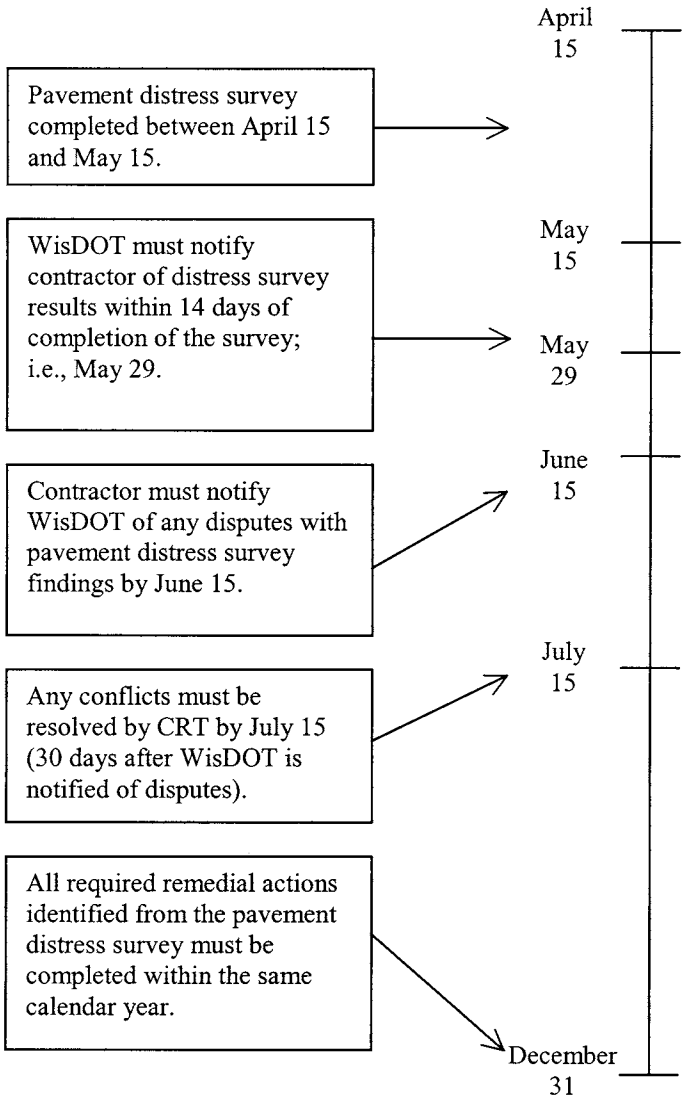

Figure A6. Timeline for completion of pavement distress survey and remedial actions.

Preventive action will be a contractor option with the approval of the [WisDOT] engineer."

Required preventive maintenance is the other form of maintenance covered in the WisDOT warranty specification. In addition to any remedial actions required by the warranty contract, the contractor is responsible for routing and sealing cracks that extend through the full depth of the surface course within the first 4 years of the warranted pavement life. This action is considered to be included in the bid price and is not paid for separately.

Step 30. Final Inspection/Warranty Termination

Because none of the WisDOT warranty projects have so far reached the end of the warranty period, the warranty expiration process has not yet been used. If the contractor has not completed any required remedial actions by the expiration of the warranty period, the contractor must extend the warranty bond. If the remedial actions are not completed or the warranty bond extended, the contractor will be held in default.

Step 31. Evaluate Warranty Effectiveness

Although none of its pilot warranty projects have yet reached the end of the warranty period, WisDOT has issued a 3-year progress report on asphaltic pavement warranties. This document contains the types of data that will need to be collected to evaluate the performance of warranty projects and to compare them with traditional projects. Both cost and performance data were collected and were combined to determine the cost-effectiveness of the warranty program. The progress report cautioned that individual projects differ greatly and that comparison is difficult with such a small number of observations. Therefore, the findings are not conclusive. The comparison of costs and quality was used to indicate where further analysis could be beneficial.

Cost Comparison

Three major areas of cost were documented and compared in the WisDOT progress report. The cost analysis focused on a comparison of (1) bid prices to engineering estimates, (2) unit prices for warranty and nonwarranty projects, and (3) project engineering costs for warranty and nonwarranty projects. The comparison of warranted to nonwarranted projects showed that the total construction price for five single-bid warranty projects from 1995 to 1997 was 1.4 percent over estimate, 2.5 percent below estimate for single-bid nonwarranty projects from 1990 to 1996, and 7 percent below estimate for all project contracts awarded.

Comparison of Bid Prices to Engineering Estimate

The primary difference between bid prices and engineering estimates on warranty projects concerned the asphaltic pavement warranted item. This value varied widely, with bid prices ranging from $10.60 per ton below estimate to $10.80 per ton above. On projects that had multiple bids, all bids were either below or above the estimated cost. Thus, the variation was mostly among projects, and not among bids on a single project. The mobilization and crushed aggregate base course items also contributed to differences between the bid prices and the engineering estimate. Mobilization, in particular, was thought to have been used as a hedge for the additional, unknown risks that the contractors felt they were assuming on a warranty project.

Comparison of Unit Costs for Warranty Versus Nonwarranty Projects

WisDOT used two similar projects built on adjacent sections of a roadway to compare unit costs between warranty and nonwarranty projects. One was a traditional project used as a control, the other was a warranty project. The comparison between these two projects shown in Table A5 was made between the warranted experimental segment and the nonwarranted control segment.

State Project Delivery Costs

Costs for state personnel charged directly to warranty projects, i.e., all staff charges and construction management costs associated directly with the projects, are used to determine the state project delivery costs. The average state delivery cost for nonwarranted projects in fiscal year 1995 was 13.7 percent, and the average in fiscal year 1996 was 14.9 percent of the total project cost. The average of these two values is 14.3 percent. These values include all 3R (restoration, rehabilitation, and resurfacing) projects, and may be high for asphalt paving projects. Comparing these data with that shown in Table A6, warranties appear to have reduced state project delivery costs by anywhere from 1 to 8 percent of the total project cost. WisDOT's best estimate of the actual average project delivery savings is 4 to 5 percent.

Performance Comparison

None of the warranted pavements in the WisDOT warranty program have reached the end of the warranty period. Nevertheless, none of the distress thresholds have been exceeded on any of the warranted pavements during the first 2 to 3 years after construction. Two values, the International Roughness Index (IRI) and the Pavement Distress Index (PDI), give a composite reading of pavement performance. The WisDOT report gives the average IRI and PDI values for both warranted and nonwarranted pavements (see Table A7).

IRI values (m/km) are measured on a scale that ranges from 0 to an indefinite upper limit. A perfect ride gives a value of 0, and a value near 4.0 is considered a very rough

TABLE A5 Comparison of warranted with nonwarranted unit prices

Item	Warranted Project	Nonwarranted Project
Crushed Aggregate Base Course ($/ton)	3.80	4.19
Mobilization ($ lump sum)	28,000	1,000
State Delivery Costs (% of total project cost)	2.2	3.1

TABLE A6 State delivery costs for warranted projects

Type of Project	State Delivery Costs (%)		
	Minimum	Maximum	Average
Warranted Projects (Excluding Overhead)	2.2	5.2	3.8
Warranted Projects (Including Overhead)	4.1	7.7	6.2

TABLE A7 Asphaltic pavement performance for warranted and nonwarranted projects

Performance Indicator	Pavement Age			
	New	1 Year	2 Years	3 Years
State Average IRI—Nonwarranted	1.00	1.12	1.29	1.36
Average IRI—Warranted	0.80	0.83	0.79	0.80
State Average PDI—Nonwarranted	0	4	11	18
Average PDI—Warranted	0	2	5	8

ride. PDI values range from 0 (best condition) to 100 (worst condition). Table A7 shows the average IRI and PDI values for warranted and non-warranted projects.

Project-Specific Evaluations

Table A8 lists the average PDI values for each of the warranty projects, as well as for a typical, nonwarranted project. Figure A7 shows these data graphically. Some of the projects have maintained a PDI of zero and thus are plotted along the X-axis.

During the first 2 to 3 years after construction, all of the warranted projects exhibited average IRIs well below that of a typical, nonwarranted pavement. Table A9 lists the average IRI values for each of the warranty projects, as well as for a typical, nonwarranted project. Figure A8 presents these data graphically. Some of the projects have IRI data for only 1 year and thus are plotted as a single point on the chart.

Cost Effectiveness

WisDOT based their comparisons on a life expectancy of approximately 15 years. Generally, WisDOT has found that pavement distress rather than roughness usually controls the life of a pavement. At the time of failure, the PDI was determined to be in the range of 65 to 75, and the IRI was approximately 2.5 units.

WisDOT compared the project costs to the added quality displayed by the plots in Figures A7 and A8. Although a truly conclusive comparison cannot be made until long-term trends are evident, a preliminary comparison based on the data available at this point in the pavement life cycle can be made. Also, to make a valid cost comparison with standard projects, all extra costs incurred on warranted projects must be included. Table A10 lists the items WisDOT feels are necessary to conduct a valid cost comparison between standard contracts and warranty contracts.

TABLE A8 PDI for warranted projects

Age	Typical Non-Warranted	STH 11	STH 85	USH 45	STH 35	STH 70	STH 23	STH 21	STH 54	USH 63
0	0	0	0	0	0	0	0	0	0	0
1	4	2	8	6	0	0	2	0	1	0
2	11	3	14	6	0	0	3	---	---	---
3	18	2	15	7	---	---	---	---	---	---
4	23	---	---	---	---	---	---	---	---	---
5	29	---	---	---	---	---	---	---	---	---

Notes: ---, represents an age for which WisDOT has no pavement data.

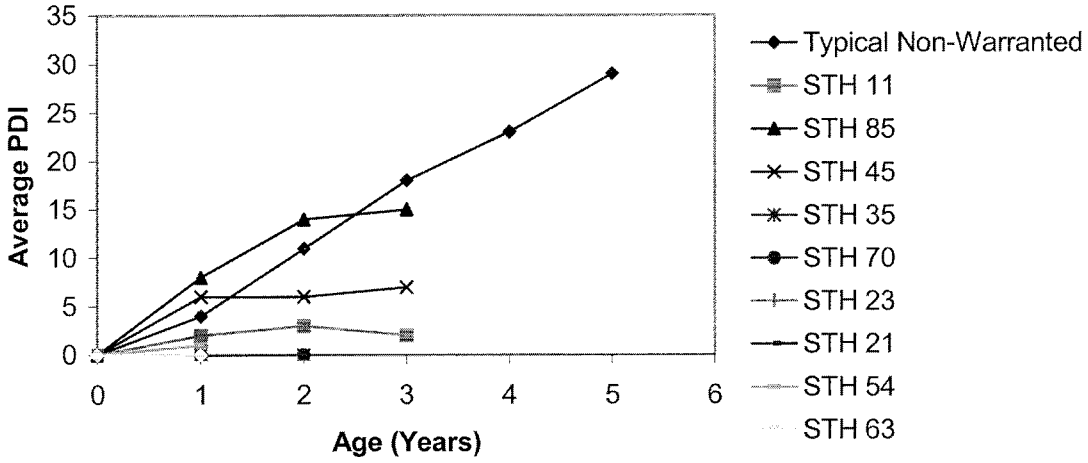

Figure A7. Average PDI for WisDOT asphaltic pavements.

TABLE A9 IRI for warranted projects

Age	Typical Non-Warranted	STH 11	STH 85	USH 45	STH 35	STH 70	STH 23	STH 21	STH 54	USH 63
0	1.00	0.83	0.72	0.66	---	---	---	---	---	---
1	1.12	0.85	0.83	0.76	0.79	1.02	0.77	0.74	0.89	0.87
2	1.29	0.81	0.92	0.65	---	---	---	---	---	---
3	1.36	---	---	---	---	---	---	---	---	---
4	1.41	---	---	---	---	---	---	---	---	---
5	1.55	---	---	---	---	---	---	---	---	---

Notes: ---, represents an age for which WisDOT has no pavement performance data.

Cost Comparison

WisDOT has performed a cost comparison with the data available on the current warranty projects. As shown in Tables A11 and A12, the cost per ton of warranted pavement is less than the cost per ton of pavement under a standard contract ($24.82/ton warranted versus $25.53/ton nonwarranted). This does not take into account the differences in the delivery costs paid by WisDOT, base course costs, or mobilization costs. As stated previously, WisDOT estimates an average savings in project delivery costs of from 4 to 5 percent. The cost per ton of the standard projects would increase to $26.55/ton when the effect of a conservative 4 percent change in project delivery cost is considered.

WisDOT concluded that "warranty projects cost less per ton than standard projects and the difference appears to be signif-

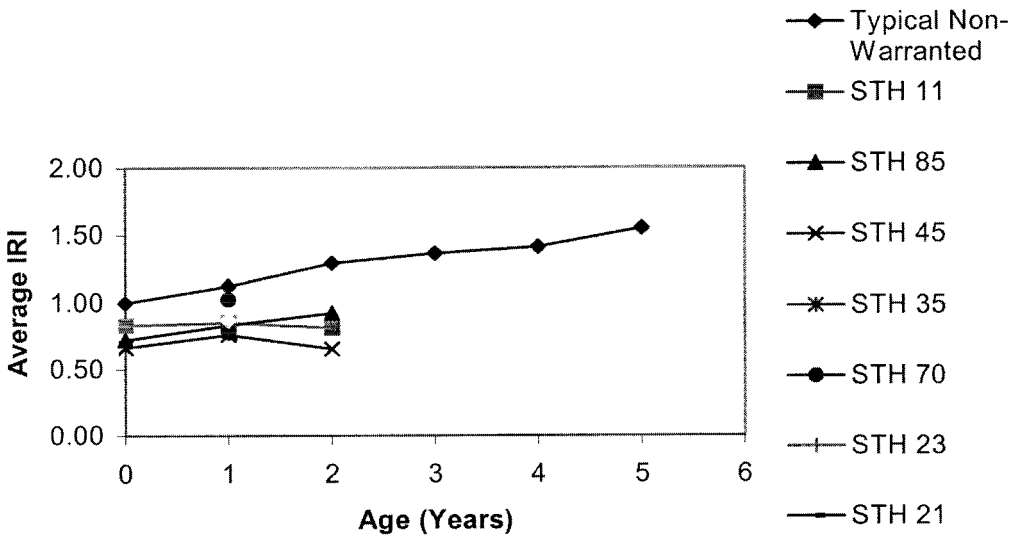

Figure A8. Average IRI for WisDOT asphaltic pavements.

TABLE A10 Items for cost comparison

Cost Items Included in Standard Contracts	Cost Items Included in Warranty Contracts
Mixture bid price	Asphalt pavement warranted bid price
Asphalt bid price	Costs of training and use of CRT
Tack coat bid price	State delivery costs
Quality management bid price	Extra distress surveys and reports
State delivery costs	Extra tests for disputes, traffic counts, etc.
State maintenance costs for 5 years	
Conflict resolution	

TABLE A11 Typical costs for a warranted asphalt pavement project

Item	Estimated Cost for a Warranted Project ($/ton)
Mixture Bid + Asphalt Bid + Tack Coat Bid	24.75
Distress Surveys and Reports	0.02
Training and Use of Conflict Resolution Team	0.04
Testing for Disputes and Traffic Counts	0.01
TOTAL	24.82

TABLE A12 Typical costs for a standard asphalt pavement project

Item	Estimated Cost for a Standard Contract Project ($/ton)
Mixture Bid + Asphalt Bid + Tack Coat Bid	24.16
Quality Management	0.60
State Maintenance	0.77
TOTAL	25.53

icant. For the first nine projects, the available data indicate warranties are cost-effective—they not only cost less, but they also [appear to] give better performance."

Explanations of Cost Differences

WisDOT offered three possible explanations for the differences in cost between warranty projects and standard projects:

1. Warranty pilot projects have been carefully selected to eliminate projects with a large number of other variables affecting pavement performance;
2. Appropriate construction practices and materials have been used; and
3. Contractors have been free to concentrate on project-specific issues rather than "generic" routine tests and inspections prescribed in more traditional QC/QA specifications.

Step 34. Recommend Changes in Warranty Program

Concerns were solicited from both contractor and WisDOT personnel for inclusion in the 3-year progress report on asphaltic pavement warranties. These concerns were synthesized into a set of recommendations made by WisDOT concerning the future of the warranty program.

Contractor concerns included the following:

- That there may be too many unnecessary or redundant performance indicators measured under the warranty specification;
- That there was a lack of acceptance of warranty contracts by design personnel;
- That not all projects are suitable for warranties;
- That the pavement contractor could warrant only the AC pavement that they produced and had direct control over; and
- That there are factors, such as the quality of subgrade, which are beyond the control of the paving contractor, but may affect how the pavement performs.

Some unresolved concerns regarding the WisDOT warranty program include:

- The impact of other factors (such as subgrade performance) on the performance indicators included in the warranty specification.
- The need to keep a record of all the innovative practices applied by contractors on warranty projects to determine the possible usefulness of these practices in future state contracts.
- The potential for warranty projects to become a shortcut for implementing research projects.
- The likelihood that there will be no users of warranties outside of the state DOT. If WisDOT is the sole purchaser of warranted asphalt, there will be no sharing of the risk associated with warranty contracts between WisDOT and other customers. If, however, other agencies in the area begin to implement warranties, the risk will be distributed between more projects and more customers, and the price per warranted project should be reduced. The cost of the estimated risk must either be placed on the buyer or absorbed by the contractor.
- It is unlikely that all projects bid with a warranty will require remedial actions. However, because contractors must add the costs of expected remedial actions to their bids, they stand to collect extra profit from those jobs that do not require such actions. Therefore, the more owners that use warranties, the more the cost of the risk associated with jobs that require remedial actions can be divided among the various users. If WisDOT remains the only user of warranties in the state, all of the costs associated with these risks will be borne by WisDOT.

Recommendations

The following 10 recommendations, formulated from WisDOT's observations and evaluations, were listed in the 3-year progress report on asphaltic pavement warranties:

1. An incentive provision could be included to decrease the warranty period or increase the contractor's payment for exceptional pavement performance.
2. The performance criteria should either be "tightened up" or the warranty period extended.
3. The warranty concept must be included earlier in the design process.

4. All projects could be bid conventionally and with a warranty; WisDOT would make the award based on the conventional bid and then decide whether or not to buy the warranty.
5. Project selection criteria must be more clearly defined based on pre-established factors or a combination of factors (e.g., proximity, length, contractor, and initial cost estimate).
6. Pavements with subgrade deficiencies should not be considered for warranty projects unless the deficiencies are properly addressed.
7. WisDOT should be informed of the use of all innovations so that a monitoring plan can be developed. Materials records, construction practices, etc., should be furnished to the state.
8. The WisDOT district office must approve any innovative change to the typical section of the plan.
9. WisDOT should consider pursuing a full warranty implementation program for all projects considered to be warranty candidates.
10. WisDOT should develop a method of evaluating subgrade conditions prior to or during the construction phase so that the issue of subgrade quality is eliminated from pavement performance evaluations.

Final recommendations proposed during the specification development process were designed to expand the warranty specifications to other end products, and consider including grading and/or base course in future AC pavement warranties.

Step 35. Refine Warranty Program Using Recommended Changes

Constant improvement is the key to any development process and a pivotal step in this process is to evaluate where the program is and to recommend changes based on the experiences of the department. The WisDOT 3-year progress report on asphaltic pavement warranties was an important step toward improving the warranty program. The recommendations can be incorporated into the next draft of the department's warranty specifications. Changes are already being planned based on progress report recommendations. It is anticipated that future projects will have more restrictive threshold levels.

Step 36. Continue and Expand Implementation of Warranties

Based on cost-effectiveness and improved performance, the WisDOT warranty program appears to be gaining acceptance; accordingly, WisDOT is continuing its implementation. To date, nine AC pavement projects have been completed. WisDOT also implemented a PCC pavement warranty program in 1998, and is contemplating a more comprehensive AC pavement warranty that will warrant the entire pavement structure.

Other Advantages of Warranty Projects

WisDOT listed the following additional advantages of warranty contracting in the progress report:

- It promotes the team concept among contractor's employees.
- It makes contractors' employees and subcontractors more aware of the importance and quality of their phase of the project.
- It allows contractors to react immediately to changes in the process, when necessary.
- It allows for contractor innovation during construction.

Innovation on WisDOT Warranty Projects

The following are some examples of innovative construction methods used on WisDOT warranty projects:

- Checking mix design durability before pavement production using the Georgia Loaded Wheel Tester, Homberg Tester, and Superpave Level III testing;
- Using better materials in mix design than currently required by WisDOT specifications;
- Closer monitoring of QC processes;
- Requiring subcontractors and suppliers to meet stricter specifications;
- Basing choices of subcontractors on quality criteria rather than purely the low bid;
- Using a rounded sand interlayer to slow reflective cracking;
- Using polymer combinations, additives, and performance-graded asphalt; and
- Scheduling work to allow traffic to use lower lifts of pavement as a test of pavement and grade performance before lay-down of the final lift.

Such contractor innovations are among the advantages inherent in a warranty contract. Ideally, these and other innovations will lead to better performing pavements at a lower cost than would be possible under WisDOT's standard specifications.

Other Possible Obstacles to the Warranty Program

Some obstacles that WisDOT feels need to be addressed as the warranty program moves forward include:

- Optimum timing for involving district-level personnel in the management of warranty projects.
- Distinction of maintenance responsibilities between WisDOT and the contractor.
- Personnel change during the warranty period.
- Contractor's concern about the impact of minor subgrade imperfections on performance and liability.