

NCHRP

23-06

A Guide to Computation and Use of System Level Valuation of Transportation Assets

Research Report and Implementation Recommendations for NCHRP Project 23-06

**Spy Pond Partners, LLC
Arlington, Massachusetts**

**KPMG LLP
New York City, New York**

**HDR, Inc.
San Francisco, California**

January 7, 2022

ACKNOWLEDGMENT OF SPONSORSHIP

This work was sponsored by the American Association of State Highway and Transportation Officials, in cooperation with the Federal Highway Administration, and was conducted in the National Cooperative Highway Research Program, which is administered by the Transportation Research Board of the National Academies.

COPYRIGHT INFORMATION

Authors herein are responsible for the authenticity of their materials and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used herein.

Cooperative Research Programs (CRP) grants permission to reproduce material in this publication for classroom and not-for-profit purposes. Permission is given with the understanding that none of the material will be used to imply TRB, AASHTO, FAA, FHWA, FTA, GHSA, NHTSA, or TDC endorsement of a particular product, method, or practice. It is expected that those reproducing the material in this document for educational and not-for-profit uses will give appropriate acknowledgment of the source of any reprinted or reproduced material. For other uses of the material, request permission from CRP.

DISCLAIMER

The opinions and conclusions expressed or implied in this report are those of the researchers who performed the research. They are not necessarily those of the Transportation Research Board; the National Academies of Sciences, Engineering, and Medicine; the FHWA; or the program sponsors.

The Transportation Research Board does not develop, issue, or publish standards or specifications. The Transportation Research Board manages applied research projects which provide the scientific foundation that may be used by Transportation Research Board sponsors, industry associations, or other organizations as the basis for revised practices, procedures, or specifications.

The Transportation Research Board, the National Academies, and the sponsors of 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 the report.

The information contained in this document was taken directly from the submission of the author(s). This material has not been edited by TRB.

Memorandum

To: Andy Lemer, Transportation Research Board (TRB)
From: Bill Robert, Spy Pond Partners, LLC (SPP)
Date: January 7, 2022
Re: Research Report and Implementation Recommendations for NCHRP Project 23-06

Overview

This memorandum comprises the research report and implementation recommendations for National Cooperative Highway Research Program Project (NCHRP) 23-06, A Guide to Computation and Use of System Level Valuation of Transportation Assets. It is intended to meet the requirements for two of the deliverables required for Task 7 of the project: a research report and implementation memorandum. The other two deliverables required for Task 7 of the project are the printed and web-based versions of the Asset Valuation Guide. The printed version of the guide has been posted on TRB's Workfront system. The web-based version of the guide is available at the following URL: <https://www.assetvalueguide.com>. The following sections provide a report describing the conduct of the research and referencing the different products provided separately as part of the research effort, and detail the research team's recommendations for implementation of the research.

Research Report

This section provides a summary of the research effort. The following subsections summarize the objectives of the research, and describe the seven tasks performed as part of the research effort. For each task a brief description of the task is provided, along with an overview of how the task was conducted and a summary of the deliverables provided through the task.

Research Objectives

As stated in the Request for Proposals (RFP), the objective of NCHRP Project 23-06 is to develop a guidebook that state transportation agencies and others can use for calculation and communication of the value of transportation assets, and for selecting valuation methods to be used in transportation asset management. This guidebook, applicable to transit as well as highway modes, should (1) present a standardized terminology for discussing asset value, (2) describe currently accepted valuation methods, (3) describe the merits and shortcomings of these methods to produce measures of asset value useful for communicating among stakeholders and making resource allocation decisions, and (4) present advice on determining which valuation methods will be most useful in communication and decision-making for a particular agency.

As detailed in the project RFP, the guidebook developed through the research shall include:

- Terminology and definitions of asset value (a) determined by generally accepted accounting principles, considering initial acquisition or construction costs and depreciation, (b) based on engineering estimates to replace the asset (considering age, condition, obsolescence, and the like), (c) based on estimates of revenues that could be produced from the assets if they were operated as a business venture, (d) based on socio-economic returns to a region's economy and wellbeing, or (e) other relevant definitions;
- Current best practices for computation and presentation of each of the definitions of value listed above, presented in a manner that can be used by transportation agencies;
- Analysis of the advantages and shortcomings of the value methods as factors to be considered in system-level resource allocation decisions, for example, investment planning, maintenance budgeting, lifecycle management, and presentations for public discussion;
- Identification and description of needs for data and information for value computations;
- A capability-maturity model that an agency can use to characterize its valuation practices and needs and strategies for improvement;
- Advice on incorporating valuation estimates into the agency's asset management practices.

The guidebook developed through the research may be published by the American Association of State Highway and Transportation Officials (AASHTO), and should be developed in a manner compatible with the print and web-based versions of AASHTO's TAM Guide.

Work on the project began on July 9, 2020 and was originally scheduled for completion by November 19, 2021. The project was extended to end on February 19, 2022 due to delays in completing the research.

Task 1. Kick-Off Meeting

Task Scope

The initial task performed as part of the research was to conduct the project kick-off meeting. The research team was to prepare an amplified work plan detailing the project tasks and schedule. The team would then conduct a web conference with the project panel to review the work plan as well as the overall objectives, scope and technical approach to the project. This meeting was intended to provide an opportunity for panel members to share their ideas and suggestions for the project. Following the meeting the research team was to make further updates to the amplified work plan as required, and prepare meeting minutes.

Activities Performed

This task was performed as outlined above. The project kick-off meeting was held on July 21, 2020. The team provided notes on the kickoff meeting on July 28, 2020 and submitted the amplified work plan on July 31, 2020.

Task Outcomes

This task resulted in delivery of an amplified work plan, a kick-off meeting, and kick-off meeting notes.

Task 2. Literature and Practice Review

Task Scope

In this task the research team's objective was to review relevant literature, guidance documents research findings, asset management plans and other information concerning asset valuation approaches. In performing the review, the team would draw upon a number of different resources published in the last decade, including recent Transportation Asset Management Plans (TAMPs) published by State Departments of Transportation (DOTs), publication of the Federal Highway Administration (FHWA), AASHTO and other professional associations, and other materials obtain through searching the TRB Transportation Research Information Services (TRIS) and Worldcat online databases.

The results of the review were to be described in Interim Report 1.

Activities Performed

The project team conducted the literature and practice review as described in the project scope. The team prepared a draft version of Interim 1 documenting the literature review on September 23, 2020. The review includes 63 references related to asset valuation, in addition to review of the 52 State DOT TAMPs prepared in 2019.

The research team met with the project panel on October 29, 2020 to discuss the draft report and next steps. A finalized version of Interim Report 1 was submitted on October 30, 2020.

Note that the Asset Valuation Guide developed in Task 5 was informed by the literature review, and includes much of the material from Interim Report 1, such as examples of best practices. However, the details of the review and annotated bibliography accompanying the review do not appear in the Guide.

Task Outcomes

The primary outcome of this task is Interim Report 1 incorporated by reference.

Task 3. Framework and Annotated Outline

Task Scope

For this task the research team's objective was to prepare a set of materials need to facilitate preparation of the Asset Valuation Guide in Task 5. These materials included:

- An annotated outline of the Guide.
- Draft layout for the printed and web-based versions of the Guide.
- Schedule for delivery of draft guide chapters for review.
- Overall asset valuation framework that defines the key components of an asset valuation approach, basic steps in calculating asset value at a system level to support TAM, and

applications of asset value once calculated. The framework will be used to help structure the Guide and assessment model described below.

- Assessment of the advantages and shortcomings of different asset valuation approaches identified in Task 1.
- Identification of the data and information needs required to support a comprehensive asset valuation methodology that can help support TAM decision-making.
- Assessment model for evaluating the level of maturity of an agency's current asset valuation approach and opportunities for improvement

The result of this task were to be incorporated into Interim Report 2. Also as part of the task the research team was schedule to participate in a panel meeting via web conference to review the research and discuss plans for the remaining tasks.

Activities Performed

The team developed an asset valuation framework and annotated outline of the Asset Valuation Guide as outlined above. These materials are detailed in Interim Report 2 submitted on January 26, 2021. The team met with the panel to review the report and discuss next steps on March 3, 2021. Shortly following the meeting, the team provided a revised version of the report, finalizing this task.

The framework provided in Interim Report 2 also appears in Chapter 2 of the Asset Valuation Guide. Other materials from the interim report appear in Chapters 3 and 4 of the Guide.

Task Outcomes

The primary outcome of this task is Interim Report 2 incorporated by reference.

Task 4. Guidance and Testing Plan Development

Task Scope

This task was focused on two related topics critical for successful implementation of the Guide: guidance for use of asset valuation in TAM decision-making; and the plan for performing validation testing. Regarding the use of asset valuation to support TAM decision-making, many of the documents reviewed in Task 1 allude to this issue without providing specific examples applicable to a U.S. transportation agency. The guidance developed in this task was intended to address how to use system-level data on asset valuation to help answer questions such as:

- How much should we spend on our existing assets?
- How should funds be allocated between different assets or networks?
- What's the best life cycle strategy for our assets?

This task also was intended to address the goals for the validation testing performed in Task 6. The research team was to develop a plan for performing the validation testing, including specification of what activities the testing will include, the data and level of commitment on the part of the test agency to participate in the test, and the recommended strategy to obtaining a mix of test participants that address the range of different users of the research products.

The results of this task were to be incorporated into Interim Report 3.

Activities Performed

Work on this task was performed in accordance with the scope outlined above. The research team defined a set of six basic TAM-related questions information about asset value can help answer. The team defined a set of seven measures, including asset value, and prepared a matrix showing which measures can help which questions. The team next defined a set of seven cases that collectively demonstrate how to answer the different questions and calculate the different measures. Further, the team prepared a test plan to use for the validation testing to be performed in Task 6, suggested a potential set of test participants, and recommended criteria for the panel to use in finalizing the set of test participants.

The team research team prepared a draft version of Interim Report 3 detailing the results of this task. This draft was sent for panel review on May 10, 2021. The research team then met with the project panel on June 18, 2021 to review the report and discuss the approach to performing testing. At the meeting the team and panel discussed the approach to performing validation testing and agreed to proceed with testing for five agencies: Denver Regional Transportation District (RTD); Illinois DOT; Iowa DOT; Minnesota DOT; and North Carolina DOT. On July 19, 2021 the research team prepared a revised version of Interim Report 3 incorporating panel comments and the discussion from the panel meeting.

Task Outcomes

The primary outcome of this task is Interim Report 3 incorporated by reference.

Task 5. Draft Guidebook

Task Scope

In this task, the team's objective was to prepare the initial draft version of the Guide. The guidance would include a draft guide, worked examples, a web-based version of the guide, and an executive summary.

These materials were to be provide to the panel for review, and used to support the validation testing performed in Task 6. Subsequent revisions to the draft materials were to be addressed as part of Task 7.

Activities Performed

Through this task the team developed a draft version of the Asset Valuation Guide as described in the project scope. Chapters 1 to 3 of the Guide were developed largely utilizing materials prepared for Interim Report 1 and 2. These initial chapters were sent to the panel for review on April 16, 2021. On August 2, 2021 the team submitted the primary technical chapters of the Guide for review, Chapters 4, 5 and 6. Then on August 14, 2021 the team submitted the two remaining chapters, 7 and 8.

Per discussion with the panel the team did not prepare a draft version of Chapter 9 including worked example as initially planned. The team recommended developing the examples based on the

validation tests, and the panel agreed that this chapter could thus not be completed until following work on Task 6.

Task Outcomes

This task resulted in draft versions of Chapters 1 to 8 of the Asset Valuation Guide.

Task 6. Validation Testing

Task Scope

This task included conducting a set of validation tests to test the draft guide. The tests were intended to serve two main functions. First, they would help identify the need for changes or improvements in the guidance to incorporate in finalizing the research. Second, the tests would provide examples that could be included in the final report to help illustrate the step-by-step guidance.

For this task the team committed to perform three to four validation tests. At the start of this task, the team was to meet with panel via web conference to discuss with the panel the approach to the testing and potential test participants. The research team would then meet with each of the testing participants to confirm the scope of the testing, review the draft research products, and collect data. Research team members would walk through the use of the draft guidance together with the test participants through web meetings, including a meeting to walk through guidance steps, mapping the steps to the agency's data and processes. The team would then prepare a write-up for each test addressing:

- Scope of the validation test.
- Discussion of the agency's target-setting process and related processes.
- Summary of the testing process.
- Recommended improvements or enhancements to the guidance based on the testing.

The testing write-ups were to be detailed in technical memoranda provided to the test participants for review.

Activities Performed

As established at the end of Task 4, the team agreed with the panel to attempt validation tests with five agencies. While this is more than described in the scope, the intent of testing with extra agencies was to allow for completion of the tests with at least three agencies even if one or more of the tests were delay.

A similar approach was used for each test. First the team met with the representative from the agency to discuss the scope of the testing and who from the agency would be involved. Then the team conducted a meeting with the agency to review the asset valuation guidance and different approaches and options for calculating asset value. Following this meeting the team requested any additional data required to support the asset value calculation, performed the calculation, and reported back the results.

Below is a summary of the activities performed with each agency.

- Minnesota DOT

- Conducted initial meeting on July 27, 2021.
- Conducted a follow-up meeting to review the validation guidance on August 9, 2021.
- Conducted a follow-up meeting to review the approach to bridge valuation on September 10, 2021.
- Requested data, obtained data, and began work to calculate asset value for bridges.
- Prepared a technical memorandum documenting the results of the testing on October 28, 2021.
- Illinois DOT
 - Conducted initial meeting on July 28, 2021.
 - Conducted a follow-up meeting to review the validation guidance on August 20, 2021.
 - Requested data to perform asset value calculations for pavement and bridges.
 - Ultimately this test was not completed.
- Iowa DOT
 - Conducted initial meeting on July 26, 2021.
 - Conducted a follow-up meeting to review the validation guidance on August 16, 2021.
 - Requested data, obtained data, and performed initial asset value calculations quantifying the value of the state-owned highway system from an economic perspective.
 - Prepared a technical memorandum documenting the results of the testing on November 11, 2021
- North Carolina DOT
 - Conducted initial meeting on August 2, 2021.
 - Conducted follow-up meeting to discuss valuation of pavement, bridges, vehicles and ferries on August 25, September 1, and September 14, 2021.
 - Requested data, obtained data, and began work to calculate asset value for pavement, bridges, vehicles and ferries.
 - Prepared a technical memorandum documenting the results of the testing on November 9, 2021.
- Denver RTD
 - Conducted initial meeting on August 13, 2021.
 - Requested data, obtained data, and performed initial asset value calculations for transit vehicles, track and facilities.
 - Prepared a technical memorandum documenting the results of the testing on October 29, 2021.
 - Met with RTD to review the results on November 10, 2021.

One outcome of the initial meetings was that when performing the Minnesota, North Carolina and Denver tests the team members found that Chapter 5 of the draft guide (on treatments and treatment effects) over-emphasized the identification of treatments and treatment effects, which were not particularly significant in these cases. This informed edits to Chapter 5 of the document. Also, the validation tests were used to develop a set of three work examples for Chapter 9 of the Guide: a Northern Agency example based on the MnDOT and NCDOT tests; a Midwestern Agency example based on the Iowa DOT test, and a Western Transit Agency Example based on the RTD test.

Task Outcomes

This task resulted in technical memorandum describing the results of each test, incorporated by reference.

Task 7. Final Products

Task Scope

Following the completion of the validation test, the remaining task was to finalize the products of the research. In this task the team would update the Guide prepared in Task 5 based on panel comments and the results of the testing conducted in Task 6. These materials would then be provided as preliminary draft final research products.

Based on comments from the panel, the research team would then prepare draft final versions of the research products and submit these to TRB, as well as written responses to all panel comments.

The research team would also prepare an additional technical memorandum with recommendations regarding the implementation of the research findings.

Activities Performed

This task has been performed as described in the project work plan. Revised draft guide chapters were submitted for panel review on November 19. Along with the revised drafts of Chapters 1 to 8, the team also prepared an initial draft of Chapter 9. This chapter includes the three worked examples discussed above, and two international case studies. Further, the team prepared an executive summary to accompany the Asset Valuation Guide.

In addition to preparing a printed version of the Guide, the team prepared a web-based version of the document as well. The web-based version has the same material as the printed guide, but is formatted for viewing through a browser. The basic approach used to develop the web-based version is that used previously for development of the web-based version of the AASHTO TAM Guide developed through NCHRP Project 08-109.

Other materials prepared through this task include the research report and implementation recommendations provided in this document.

Task Outcomes

The outcomes of this task include the printed Asset Valuation Guide, a web-based version of the Guide, and this memorandum documenting the research and implementation recommendations.

The printed version of the guide has been posted on TRB's Workfront system. The web-based version of the guide is available at the following URL: <https://www.assetvalueguide.com>.

Implementation Recommendations

As discussed in the project work plan, the key product of this project is the Asset Valuation Guide for computing and using system-level asset value. Through the project the research team has prepared printed and web-based versions of the guide.

The research team and panel have discussed that the ideal pathway for implementation of the research products is to transfer the Guide and web site from TRB to the AASHTO Subcommittee on Asset Management, following the approach recently used for implementing the TAM Guide through NCHRP Project 08-109. With this approach AASHTO will take responsibility for the final production of the Asset Valuation Guide, and for hosting the web version of the document going forward. Members of the research team are currently under contract for supporting TAM and performance management web portals, and equipped to provide ongoing support. Further, AASHTO has confirmed that the organization is prepared to host the research products.

Other recommended activities for implementing the research include the following:

- Disseminating materials to announce the availability of the Asset Valuation Guide.
- Conducting a project webinar to review the guide materials and examples. The webinar might follow the example of the recent “TAM Book Clubs” in which one or more webinars are conducted, with each splitting time between reviewing the research products and presenting practical examples related to the guidance.
- Initiating an additional research project to support implementation of the research through NCHRP Project 20-44, the NCHRP Implementation Support Program. The AASHTO Subcommittee on Asset Management has indicated an interest in pursuing such research and prepared an initial problem statement for consideration of this topic. This draft problem statement is included by reference.