

APPENDIX D

Reimagining the C&P Report

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Reimagining the C&P Report

Over the past 50 years, the C&P Report series has provided an objective assessment of current system conditions and future investment needs. Its target audience includes the U.S. Congress, all levels of government, policy makers and analysts, academia, transportation associations, industry, news media, and the public. It raises public awareness of the physical conditions, operational performance, and financing mechanisms of highways, bridges, and transit systems, and promotes an understanding of the importance of these transportation investments.

The C&P Report is a dynamic and evolving product, which has periodically undergone substantial overhauls and enhancements. A good example is the introduction of benefit-cost analysis (BCA) to the process for estimating future investment needs through application of the Highway Economic Requirements System (HERS), introduced in the 1995 C&P Report; the Transit Economic Requirements Model (TERM), introduced in the 1997 C&P Report; and the National Bridge Investment Analysis System (NBIAS), introduced in the 2002 C&P Report. These models are presented and described in Appendices A, B, and C, respectively.

MAP-21 (the Moving Ahead for Progress in the 21st Century Act) incorporated performance management principles into its requirements. States will set targets for several key performance measures and report on their progress in meeting these targets. This shift toward more performance-driven and outcome-based programs has direct and indirect implications for the C&P Reports. At the most basic level, the introduction of other performance reporting requirements in MAP-21 might necessitate some content changes to the C&P Reports, both to take advantage of newly available data and to avoid unnecessary duplication of information presented elsewhere. The shift in the processes that States and metropolitan planning organizations (MPOs) use for planning and performance management also has implications for assessing future transportation investment needs. State and local agencies are adopting more outcome-based approaches to investment decision-making, which has significant implications for the potential impacts of future investment on system performance and how these impacts are simulated. In addition, the data, analytical tools, and techniques developed to support the implementation of performance management could yield new approaches that can be adapted to refine or replace HERS, NBIAS, and TERM.

With these issues in mind, the Federal Highway Administration (FHWA) initiated the *Reimagining the C&P Report in a Performance Management-Based World* effort in late 2012. Preliminary scoping work was conducted in 2013 to document who uses the C&P Report, to assess the utility of the report to FHWA program offices, and to identify options for presenting information more effectively. This effort identified two areas of potential improvement to align better with performance measures: methodology and communication. Two major research projects were initiated in 2014, with the objectives of improving estimation methodologies to compute investment needs and enhancing communication approaches, respectively.

Methodology Improvement

Simulation modeling inherently involves compromises, as the desire for detailed, reliable predictions must be balanced against data collection burdens and computational tractability. The tools and methodologies currently used in the C&P Reports reflect several analytical simplifications introduced to accomplish the desired analysis with the available data and resources. Since the initial introduction of these tools, a new generation of analytical tools and models has been developed that provides advanced methodologies in asset management and performance management.

HERS, NBIAS, and TERM have been constantly revised and updated to incorporate newly developed data and tools. Building on this ongoing improvement effort, a research project is currently underway to scan and compare methods for assessing investment needs and to propose new and improved methods for more precise and comprehensive needs estimation in the C&P Reports. Several analytical frameworks are being explored to identify potential alternative methodologies and upgrades to the current BCA approach. This project, initiated by FHWA, includes a systematic review of performance management tools that States and local governments currently use and potential new approaches to be incorporated in the analytical framework. The goal is to identify practical approaches for improving the C&P Report methodology in the future.

Evaluation of Alternative Methodologies

The first stage of this research effort involved evaluating alternative methodologies that could be used to replace or supplement the BCA-driven tools currently used in the C&P Report. Two specific decision methodologies were reviewed: the multi-criteria decision method (MCDM) and value for money.

MCDM allows for consideration of performance objectives that are difficult to monetize. Therefore, MCDM frequently includes some performance measures that are not limited to monetary terms or condition matrices. It is a flexible tool, enabling the evaluation of projects based on multiple performance measures such as environmental sustainability, livability, and safety. Its application, however, hinges on the selection of appropriate performance measures and assignment of weight to each performance measure, which could be challenging for national investment analysis, as well as being incompatible with the principles underlying the economic approach to investment modeling.

As defined in the Eddington Transport Study of the United Kingdom,¹ value for money is another methodology that measures wider economic and reliability benefits. It assesses the economic, environmental, social, distributional, and fiscal impacts of an investment based on both quantitative, monetized information and qualitative information at the project level. Although this approach helps guide the modeling of reliability and economic impacts, scaling the findings from individual projects to the national system and obtaining a strategic allocation of resources for infrastructure investment could be challenging.

Other assessed methodologies and tools that may be used to incorporate additional performance measures into the C&P Reports include broader economic impacts models, life cycle cost analysis models, highway operations and congestion cost measurement models, work zone models, bridge and pavement management models, and BCA models. Three modeling tools—Transportation Project Impact Case Studies (T-PICS, now called EconWorks Case Studies), the Transportation Economic Development Impact System (TREDIS), and the Prioritization Scenario Model (PRISM)—were examined closely for their potential contributions to C&P analytical framework improvement.

Although these alternative methodologies could provide a new framework for the C&P evaluation of a national investment program, it would be challenging to generalize them from individual projects to the entirety of the highway system at the national level. The BCA technique currently used in HERS remains an appropriate approach for examining traffic condition, capacity, and current and future traffic load.

Identification of Alternatives for Refining BCA

The second stage in this research effort involved identifying alternatives for refining the current BCA approach. After reviewing many options, four possible alternatives were picked for in-depth study to evaluate their feasibility and relevance to be integrated into the HERS framework: performance measures, trade-off analysis, freight analysis, and connected and automated vehicles (C/AV).

MAP-21 established national performance goals for Federal highway programs in safety, infrastructure condition, congestion reduction, system reliability, freight movement, environmental sustainability, and reduced delays in project delivery. After careful study, the research team selected performance measures related to pavement, safety, congestion and reliability, and bridge performance. These performance measures, which are similar to values already used in BCA methods, can be integrated into HERS predictive models in C&P analysis and reporting without substantial coding efforts.

Currently, project selection in HERS is based on the type of deficiency and the improvement's benefit-cost ratio (BCR). The trade-off analysis allows the user to intervene in this process by changing project selection priorities other than HERS's current economic analysis. Once HERS develops the ability to report costs and budgets by performance categories (safety, congestion and pavement), trade-off analysis can be performed by the priority order of performance categories based on BCR. In each funding period, projects are selected in the priority category until the category's budget is exhausted. Alternatively, projects could be selected based on the priority category with the highest BCR. For example, if both congestion and pavement projects are being evaluated by HERS and the priority category is pavement, then the pavement project is selected even if its BCR is lower than that of the congestion project.

Section 1116(h) of the Fixing America's Surface Transportation (FAST) Act requires a biennial report describing the conditions and performance of the National Highway Freight Network, which is included as Chapter 12 in this report. Options for enhancing freight analysis capabilities for the C&P Report are being explored as part of the reimagining the C&P effort. One option is to create a freight corridor sketch tool to display the freight performance measures on a national network based on the Freight Analysis Framework. The process will enable reporting of annual freight flows by region and easy extraction of routing data through existing travel demand models.

The aggressive and increasing deployment of connected and automated vehicles will have significant impacts on national highway conditions and performance. Many experts have indicated that this will represent the most significant discontinuity in the relationship between highway demand and supply since the development of the Interstate System. Although estimating the C/AV market penetration is highly uncertain at this point, it can affect highway system traffic patterns, VMT, safety, pavement, and infrastructure needs. Hence, C/AV merits consideration in C&P methodologies and reporting. A potential approach to incorporating C/AV analysis is to develop sensitivity testing of key C&P parameters that are presumed to be affected by increasing market penetration of C/AV, under different partial and full automation scenarios.

FHWA also considered the feasibility of integrating needs analysis of pedestrian and cycling infrastructure and integrating network analysis into the C&P highway needs assessment. However, these two options can be implemented only after the establishment of data standards and appropriate modeling approaches. For current research efforts, only the four alternatives would be further explored for the feasibility of being integrated into the HERS framework.

Integration of Performance Management and Needs Estimation

The systematic review of tools and potential new improvements is completed. The project has now moved to the next stage, which will involve integrating the findings identified in the assessments of BCA refinements and alternative decision methodologies with HERS modeling. This combination will enable a detailed evaluation and comparison of several comprehensive approaches to upgrading the current national needs estimation process. Once appropriate analytical frameworks are identified, new components could be added to HERS and NBIAS, or a new generation of analytical tools could replace these models.

Enhanced Communication

Currently, the C&P Report is issued in print form and the entire report is posted online using standard Adobe Acrobat and HTML formats. Several features were introduced in recent editions of the C&P Report to improve its visual appeal. These improvements include a shift from black and white to color, addition of several infographics, new maps and photos, and changes to the writing style and structure of the report. It is anticipated that the demand for improved visualizations will lead to additional changes to the C&P Report.

Although the C&P Report contains useful information and serves as a valuable reference document, its sheer size creates some problems for users. Because writing and reviewing the document is a lengthy process, the report is often transmitted to Congress after newer data have been published elsewhere. Even when this is not the case, many of the data series in the biennial report are updated annually, which means that readers must often look elsewhere to find the latest available data.

One option under consideration is to develop an interactive website to complement the print report. An interactive website may improve the readability, accessibility, and usability of the information in the report by:

- Incorporating enhanced visualization of the graphs and tables;
- Adding interactivity in the report website that will enable readers to drill down to various subsets or create desired views of information of interest;
- Migrating some detailed, supplementary analyses to the website, allowing the print version to focus on key findings;
- Enabling readers to view and access the underlying raw data tables with added capability to export charts and graphs as images;
- Facilitating more frequent data updates than are currently possible for the C&P Report.

A multiyear research effort is underway to explore alternatives for enhancing the current report, focusing on data visualization and an interactive Web-based design. The underlying goal is to facilitate ease of use by a wider audience of readers and enable the alignment of performance-based information in the C&P Report with the information obtained from State and MPO performance management processes.

Data Visualization

Data visualization is the representation of data in a pictorial or graphical format. It is the easiest way for the brain to receive and process large amounts of information quickly and intuitively. As part of this research effort, alternatives are being explored to improve the communication of data in print and on the Web through advanced data visualization tools and infographics. For the print version of the C&P Report, new static graphics are developed to help readers visualize complex information on highways, bridges, and transit, making the details easier to understand at a glance. Contents of each chapter could be condensed into a format that is more accessible to the public, such as bullet points, at-a-glance boxes, and content optimization for print layout.

For the online version, selected contents could be presented through interactive data visualization to convey information from in-depth and complex analytics. For example, an online platform might support the use of more dynamic and interactive graphics, such as customized dashboards and charts filtered per the user's unique needs. Through their intuitive interfaces, data visualization tools enable customized analytical views with flexibility and ease by multiple users with diverse demands.

Web-Based User Interface

As part of this research effort, a demonstration C&P website was developed. An immediate goal is to explore and evaluate visualization techniques and tools that could be used online. Another goal is to gather feedback from users regarding their preferences about the balance between the print and Web version of the report and the best ways to inform, attract, and retain users. Ultimately, a new digital publishing platform could integrate traditional formats such as PDF with many interactive elements such as embedded video and audio, and interactive graphs. To attract and maintain the attention of an increasingly mobile audience, an upgraded website could use a responsive Web design to accommodate data exploration and communication across all common types of devices, including touchscreen and mobile devices.

A critical part of developing an enhanced future C&P Report website is ensuring that it complements existing online resources and potential new resources coming online in response to the MAP-21 State and MPO performance reporting requirements. In many cases, providing links to information posted in other locations might be sufficient, allowing the C&P website to focus mainly on elements unique and central to the C&P Report.

Moving Forward

Although FHWA began the research initiatives described in this appendix, the Federal Transit Administration (FTA) is a full partner in the development of the C&P Report and is closely involved in these efforts. FTA has initiated its own reviews regarding future analytical approaches and report presentation and content. As potential enhancements become more fully refined through current research efforts, external outreach will be conducted to ensure that any changes to the report content and structure will improve its usefulness to Congress and other stakeholders. Although the objectives of the report will remain unchanged, the goal of this effort ultimately is to provide a multimodal product with cutting-edge analytics that improve users' experience.

ⁱ The Eddington Transport Study (2006). The case for action: Sir Rod Eddington's advice to Government. Available at <http://webarchive.nationalarchives.gov.uk/20090104005813/http://www.dft.gov.uk/about/strategy/transportstrategy/eddingtostudy/>.