

DIVISION OF RESEARCH, INNOVATION & SYSTEM INFORMATION

Research Initial Scope of Work

SUBMITTAL FORM – FY 15/16

I. **Project Number:** P972

Project Title: Multi-Objective Decision Analysis for Caltrans SHOPP Project Prioritization

II. **Task Number:** 2921

Task Title: Decision Making for Caltrans SHOPP Project Prioritization - Phase 2

III. **Project Problem Statement:**

Caltrans needs to implement a decision analysis framework to support project prioritization under the *State Highway Operation and Protection Program (SHOPP)*.

IV. **Objective:**

This project will build upon the recent work completed under the Caltrans *SHOPP Pilot Project*, which resulted in a prototype project prioritization framework and tool. The primary objective of this research is to identify any shortcomings from the prior work and improve the decision analysis framework. Specifically, this project is expected to:

- Refine the objectives hierarchy and validate alignment with principles of a *multi-objective decision analysis (MODA)* framework.
- Develop improved value function sub-models to better characterize the benefits associated with objectives.
- Identify new data requirements to support an improved project prioritization framework.
- Define the approach for weighting, scaling and amalgamation based on best practices and the Caltrans use case.
- Conduct sensitivity analysis of the model to variations in objective data and weighting.
- Test the new project prioritization method using a portfolio of SHOPP projects and assess validity.
- Produce a report documenting the findings of this research and

V. **Task Description of Work and Expected Deliverables:**

This research project is expected to meet the objectives through a series of tasks, as follows:

Task 1: Assess current procedures for project prioritization in the SHOPP.

Review existing Caltrans business processes within the SHOPP where

decision making methods and tools are used. Review procedural documents and convene meetings and/or interviews with process owners to capture information. Identify the business use-cases, the persons/groups interacting with tools, key stakeholders, types of analyses carried out, and report products generated. Document the baseline for current SHOPP project prioritization practice. This assessment will serve to capture as-is practices, identify shortcomings, and inform the research team to provide context for subsequent tasks.

Deliverable: Interim Report

Task 2: Evaluate the findings, recommendations, and deliverables from the SHOPP Pilot Project.

The SHOPP Pilot Project concluded in May 2015 with the publication of the report, “SHOPP Pilot Project – A Framework for Project Prioritization,” available through the Caltrans website or by request. The research team will review key elements of the decision analysis framework produced by that work, including:

- Fundamental objectives and sub-objectives
- Strategic alignment of objectives to the Department’s mission, vision, and goals
- Value function and sub-models
- Data sources
- Scaling approach
- Weighting of objectives
- Amalgamation at higher levels in the hierarchy
- Sensitivity analysis of raw objective function data variability and weights.
- Reports and outputs in the Microsoft Excel prototype

Findings from the review will be documented and should include observations on the validity of the approach, deviations from best practices, and other issues found. The research team will address the limitations and recommendations cited in the SHOPP Pilot Project report and propose a course of action that will lead to an improved project prioritization framework. A work plan will be proposed, subject to review and approval by the Caltrans contract manager.

Deliverable: Interim Report with Work Plan

Task 3: Develop an improved project prioritization process.

Execute the approved work plan produced under Task 2 leading to the new project prioritization framework. The research team will engage Caltrans subject matter experts and SHOPP stakeholders throughout this development process. A document detailing the calculation and analysis procedures will be produced. The analytical framework will be implemented in a spreadsheet or other prototype tool (with functionality at

least comparable to the one produced by the SHOPP Pilot Project) to demonstrate prioritization outcomes.

Deliverable: Documentation and tool

Task 4: Test the new process with sample project portfolio.

Using a sample portfolio of SHOPP projects, evaluate the validity of the project prioritization outcomes. Engage Caltrans stakeholders in the process of establishing weights. Assess if project priorities produced by the new process differ from expectations. Analyze discrepancies, study cause and effects, and identify any modifications required. Prepare a Final Report.

Deliverable: Final Report

VI. Background:

In April 2015 a team of Caltrans engineers completed a project in developing and applying a *Multi-Objective Decision Analysis (MODA)* framework to prioritize projects within the *State Highway Operation and Protection Program (SHOPP)*. Under the sponsorship of Caltrans Executive Management, the team pursued an extensive scope of work from July 2014 through March 2015. As decision analysis is a highly specialized area of study, the team initially consulted with top decision analysis experts as well as the literature to help identify best practices in project prioritization. With input from Caltrans subject matter experts, a preliminary decision analysis framework was developed that facilitated the calculation of project “value” using available project-specific data. A prototype tool was implemented in Microsoft Excel to carry out calculations, test the framework, and demonstrate to sponsors the potential benefits of a MODA-based project prioritization approach.

Given the constrained timeline and rapidly acquired knowledge of the team, the project prioritization framework and Excel tool should be considered a “proof of concept” rather than a comprehensive and rigorous calculation framework ready for operational implementation. Despite this limitation, a number of important conclusions can be drawn from this pilot effort. A MODA-based approach will bring more transparency to the project prioritization process, provide a quantitative basis for decision making, and provide a mechanism to communicate the alignment of project priorities with strategic objectives. Furthermore, in contrast to the existing SHOPP project prioritization process, a MODA-based approach breaks down funding “silos” by ranking projects based on objective value with direct consideration of cost.

Moving forward, a major effort will need to be pursued to fully develop the work that has been started with this pilot project. The compilation of more comprehensive data sets will drive the development of more focused calculations to better reflect project value. Changes in business processes, policies, and tools in the SHOPP will need to follow to support this paradigm shift. A research project will be initiated to identify shortcomings and change and/or improve the decision analysis framework. An expanded analysis of the 2016 SHOPP using the pilot

project framework will provide an opportunity more fully evaluate the effectiveness of the approach.

VII. Estimate of Duration: 18 Months

VIII. Deployment Potential:

This research is anticipated to produce an improved project prioritization process for the SHOPP.

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x. Date: May 11, 2015