Framework and Case Studies for Calculating the Return on Investment for Transportation Asset Management Systems and Process Improvements

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Overview

- Description of NCHRP Project 20-100
- Case study summary
- Framework for calculating Return on Investment (ROI)
- Conclusions and next steps for the research

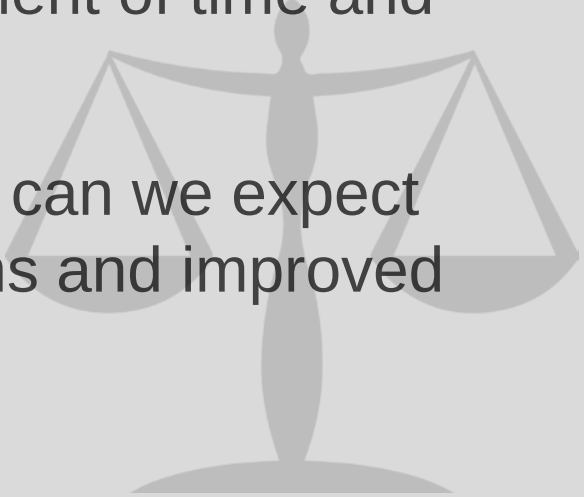
NCHRP Project 20-100

NCHRP Project 20-100: Return on Investment in Transportation Asset Management Systems and Practices

- Objectives
  - Assess the investments made and returns realized by selected agencies that have adopted TAM systems
  - Develop guidance for estimating the return on investment (ROI) for adopting or expanding TAM systems in an agency
- Project Team
  - Spy Pond Partners, LLC
  - HDR, Inc.
  - Harry Cohen

Example Questions

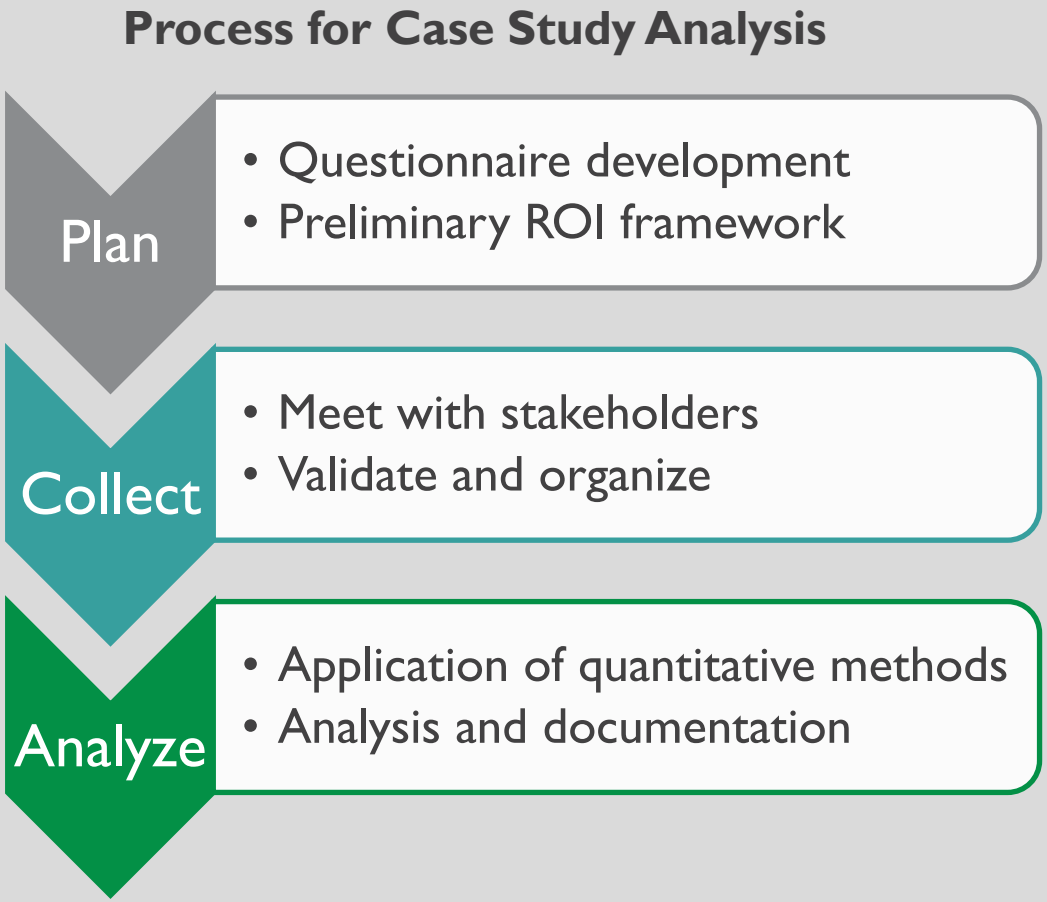
- What is the ROI of implementing a new Pavement Management System (PMS) that will foster a preservation approach in the agency?
- What is the payback period for a new asset management system that will require an initial investment of time and money, but save staff time in the future?
- What types of agency and user benefits can we expect from a set of investments in new systems and improved processes?



Project Case Studies

- Conducted three case studies to illustrate the framework and provide examples of the benefits of asset management system/process investments
- Selected case studies to obtain range of investment types, geography and other factors
- Case studies:
  1. Western State: pavement management system (PMS) implementation
  2. Eastern State: bridge management system (BMS) implementation
  3. Southern State: maintenance management system (MMS) implementation

Case Study Analysis Process



Case Study 1: Western State

- Analyzed effects from 1999-2012 of implementing a PMS
- Changes in business process following PMS implementation
  - Increased emphasis on preservation: agency specified a minimum for districts to budget for preservation treatments
  - Requirement for a specified percent of projects to match PMS recommendations
- Modeling the effects
  - Performed a simulation outside the PMS to determine effect of shift to increased preservation: equivalent to approximately $19M/year
  - Used historic simulation results from the agency's PMS to estimate effect of a $19M/year cut on conditions

Case Study 1 Results

Case Study 1 Analysis Results (2012 $M)

Description	Total	NPV	Annualized
Agency costs	17.3	23.2	0.93
User benefits	47.7	56.1	2.24
Increased residual value	182.4	182.4	7.30
Total benefit	230.1	238.5	9.64
Net benefit	212.8	215.3	8.61

- Benefit cost ratio of PMS implementation: ~10
  ($238.5 million NPV of total benefit / $23.2 million NPV of total cost)
- ROI of investing in the BMS: 41%
  ($9.54 million annual benefit / $23.2 million NPV of costs)
- Largest component of the benefit: increased residual value of the pavement network

Case Study 2: Eastern State

- Analyzed effects from 2009 to 2013 of investing in a new BMS
- Changes in business process following BMS implementation
  - Staff reported that use of the BMS enabled a shift in bridge spending to focus on preservation rather than bridge replacement
  - $10M/year + one-time investment of $100M
- Modeling the effects
  - Performed a simulation in the National Bridge Investment Analysis System reproducing observed spending and conditions
  - Simulated an alternative scenario in which preservation spending was limited

Case Study 2 Results

Case Study 2 Analysis Results (2012 $M)

Description	Total	NPV	Annualized
Agency costs	2.9	3.0	0.12
User benefits	-202.4	-201.3	-8.05
Increased residual value	283.9	273.0	10.92
Total benefit	81.5	71.7	2.87
Net benefit	78.6	68.7	2.75

- Benefit cost ratio of BMS implementation: ~24
  ($71.7 million NPV of total benefit / $3.0 million NPV of total cost)
- ROI of investing in the BMS: 96%
  ($2.87 million annual benefit / $3.0 million NPV of costs)
- Largest component of the benefit: increased residual value of bridges

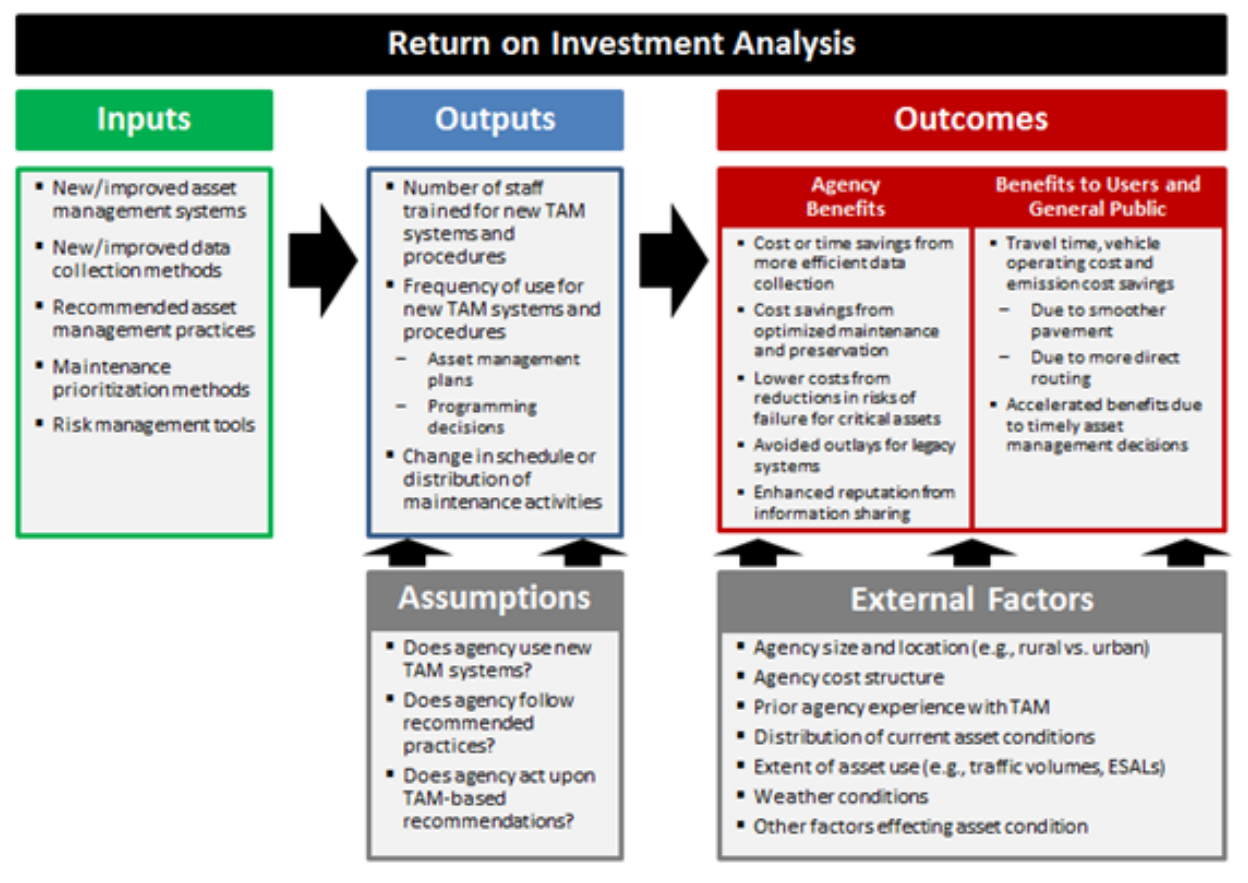
Case Study 3: Southern State

- State implemented a maintenance levels of service approach in 2007 followed by a new management system
- Used a time series approach to estimate benefits of MMS implementation
  - Linear regression model predicting LOS scores over time given budgets, presence of the MMS and other variables
  - Requires sufficient historic data on costs and investment effects
- Input data
  - Maintenance spending per mile by maintenance activity and district
  - LOS scores by maintenance category, district, and year

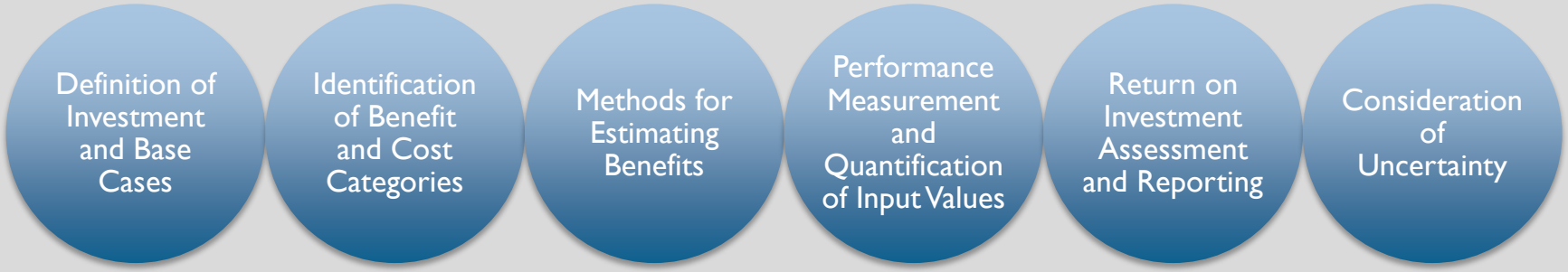
Case Study 3 Conclusions

- Models provided evidence that implementation of the new TAM system resulted in more cost-effective management of LOS maintenance conditions
  - Showed a statistically significant relationship between increased spending and score improvements relative to objectives
- Case study did not yield conclusive financial results
  - Study would have benefited from additional data
  - System implementation occurred at same time as a major change in budget, confounding the analysis
- Basic approach nonetheless shows promise for historic analysis

Analytical Methods Needed



Elements of ROI Framework



Potential Benefits of TAM Investments

Direct and Indirect Agency Cost Savings

- Staff time savings from improved data collection and accessibility
- Cost savings from the optimization of investment strategies
- Lower costs from reductions in failure risks for critical assets (e.g., bridges)
- Avoided outlays for legacy systems, including hardware maintenance and software updates
- Enhanced reputation and level of public trust gained through information sharing
- Delayed capital expenditures due to increased asset life (residual value of assets)
- Worker safety (due to bundling of projects)
- Residual value

Potential Benefits of TAM Investments (cont'd)

User Cost Savings

- Vehicle operating cost savings (e.g., reduced wear-and-tear, and reduced fuel consumption) from smoother pavements or more direct routing (e.g., with bridge availability)
- Travel time savings
- Accelerated improvements from timely asset management decisions or increased capacity to program maintenance and rehabilitation projects due to cost efficiency
- Reduced work zone delays
- Safety benefits

Benefits to the General Public (Social Benefits)

- Emission cost savings
- Reduced noise generation

Costs of TAM Investments

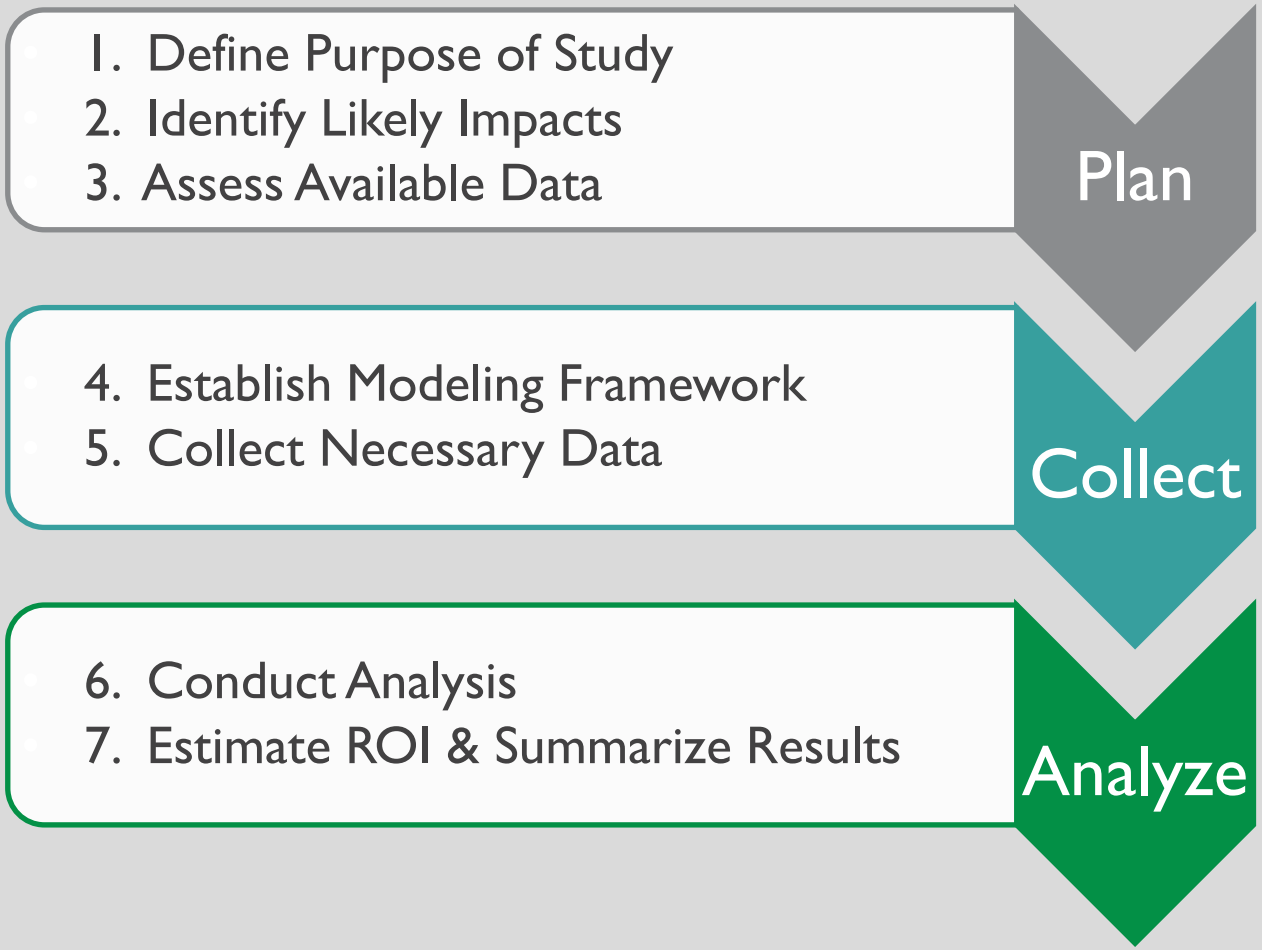
Non-Recurring Costs

- Hardware and software acquisition
- Installation
- Training
- Decommissioning

Recurring Costs

- Maintenance and repair
- Operating expenses
- Software maintenance costs
- Software updates
- Data collection and data analysis costs

ROI Calculation Steps



Conclusions/Next Steps

- The ROI framework and calculation process will help agencies:
  - Make the case for needed asset management investments
  - Demonstrate the positive impacts of past investments
- The case studies illustrated the benefits of asset management investments
  - Increased focus on asset preservation
  - Improved system conditions
  - Reduced user costs
- Work is underway to finalize the calculation guidance and spreadsheet tool