U.S. Department of Transportation

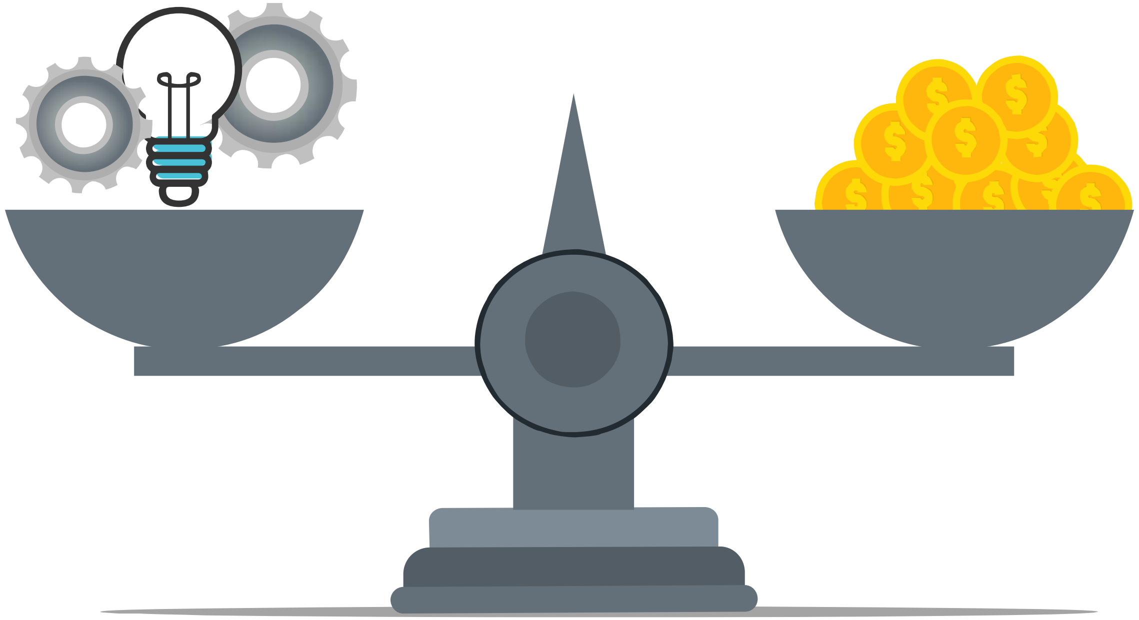
Preparing a Benefit-Cost Analysis for the Nationally Significant Multimodal Freight and Highway Projects (INFRA) program

Today's Presenter

- **Jordan Riesenberg, Economist, USDOT**

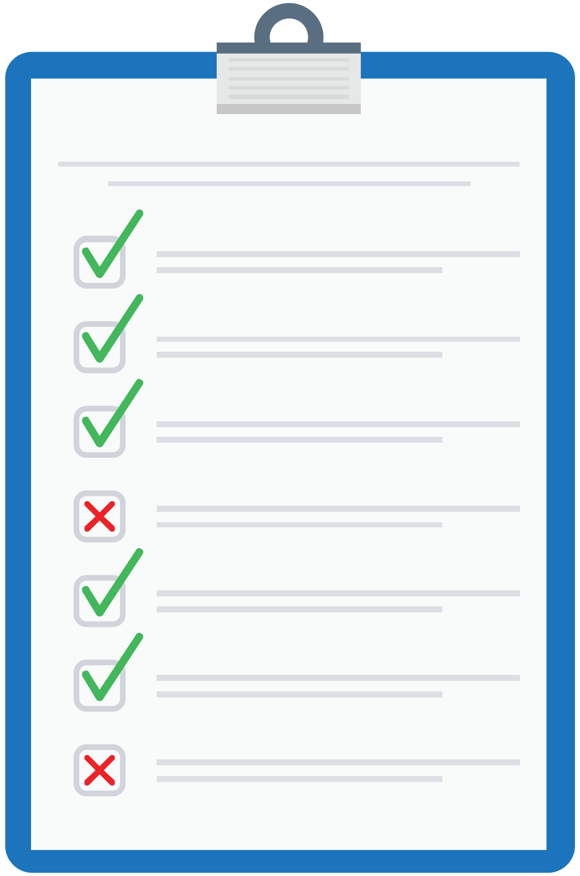
What is BCA?

- Benefit-cost analysis (BCA) is a systematic process for identifying, quantifying, and comparing expected economic benefits and costs of a proposed infrastructure project.



Why do we do BCA?

- Provides a useful benchmark from which to evaluate and compare potential transportation investments
- Adds a degree of rigor to the project evaluation process
- Required by executive orders, OMB guidance, and by statute for certain programs and Department activities.



BCA and INFRA

- All project sponsors should submit a benefit-cost analysis (BCA) as part of their INFRA grant application
- Use of the BCA in INFRA
  - Evaluation of the Economic Analysis selection criterion
  - Assessment of project cost-effectiveness

Use of the BCA in INFRA Project Evaluation

- USDOT will consider the relative magnitude of estimated project benefits and costs in its evaluation
- Assign projects one of five ratings
  - **High:** The project's benefits will exceed its costs, with a benefit-cost ratio of at least 2.0
  - **Medium-High:** The project's benefits will exceed its costs
  - **Medium:** The project's benefits are likely to exceed its costs
  - **Medium-Low:** The project's costs are likely to exceed its benefits
  - **Low:** The project's costs will exceed its benefits

Cost Effectiveness Requirements

- **INFRA Large Projects**
  - USDOT must determine that the project will be cost effective in order for it to be selected
- **INFRA Small projects**
  - USDOT must consider project cost-effectiveness in making selections
- **Cost-effectiveness determinations based on results of the BCA**
  - Projects must be found to have estimated benefits that are reasonably likely to exceed costs in order to be considered cost effective

USDOT BCA Review

- USDOT economists will review the applicant's BCA
  - Examine key assumptions
  - Correct for any technical errors
  - Perform sensitivity analysis on key inputs
  - Consider any unquantified benefits

What do I need to do BCA?

- **Clear understanding of:**
  - The problem the project is intended to solve (baseline conditions)
  - How the project addresses the problem (measures of effectiveness)
- **Well-defined project scope and cost estimate**
- **Monetization factors for key project benefits**

Developing a BCA

1. Identification and analysis of the problem to be solved (baseline conditions)

2. Estimation of the costs of the proposed investment

3. Projection of the expected impacts of the investment (e.g., measures of effectiveness)

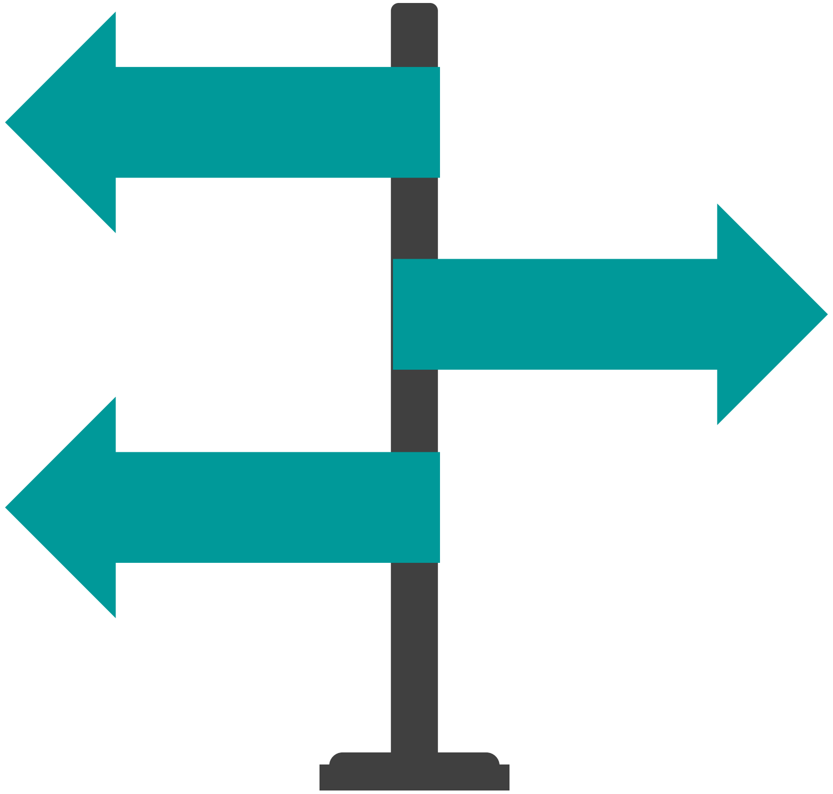
4. Monetization of expected impacts into estimated benefits

5. Conversion of benefit and cost streams into their present value (discounting) and calculation of the benefit-cost ratio (BCR)

6. Consideration of any unquantified benefits

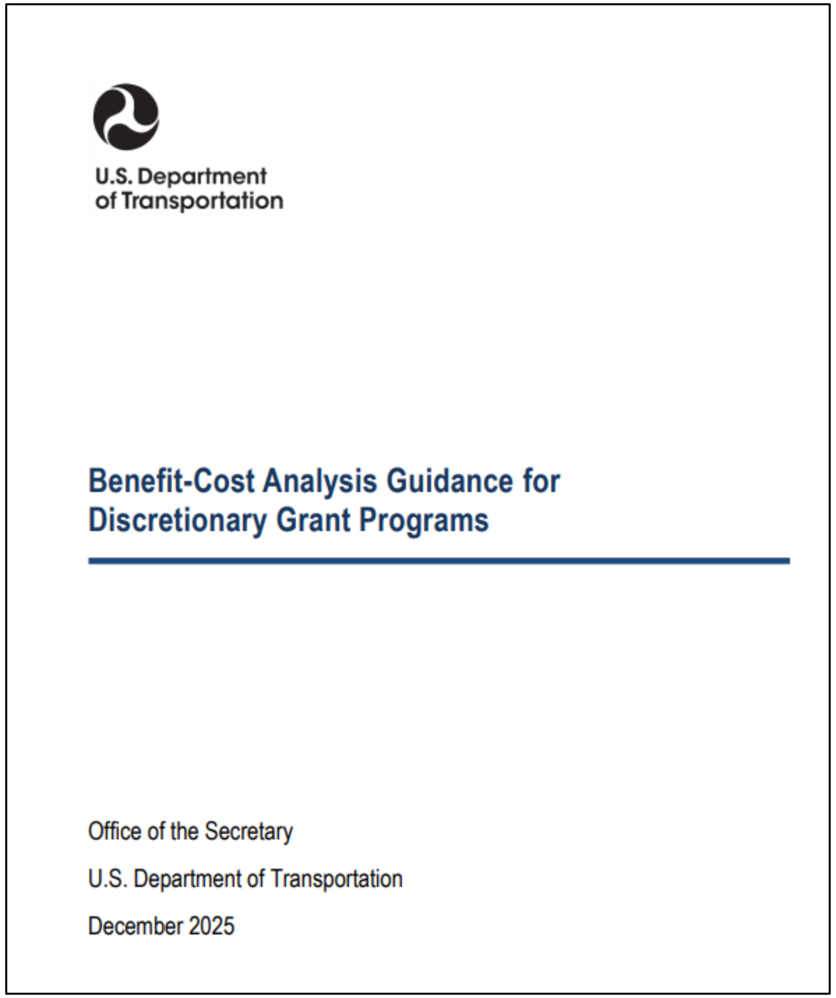
What do I need to do BCA?

- Sources of information may include:
  - Project planning and engineering documents
  - Industry technical references and analytical tools
  - DOT BCA Guidance
  - Partners



USDOT BCA Guidance

- Covers all USDOT discretionary grant programs
- Structure of the Guidance
  - Overview of BCA ("how to get started")
  - BCA methodologies
  - Recommended input values
  - Sample calculations
- Available at https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance


U.S. Department of Transportation

Benefit-Cost Analysis Guidance for Discretionary Grant Programs

Office of the Secretary

U.S. Department of Transportation

December 2025

What's new for 2026?

- **The 2026 update to the BCA Guidance (released December 2025) includes:**
  - Updated parameter and monetization values
- **Note that the May 2025 update to the BCA Guidance included two other key changes:**
  - Revised discount rates in accordance with the reinstatement of OMB Circular A-94 of October 1992
  - Removal of monetization values for carbon dioxide emissions

What should my BCA submission include?

- Technical memo/discussion describing the analysis, including any unquantified benefits, and documenting sources of information used (assumptions and inputs)
  - If provided as an appendix, does not count against the page limit for the application narrative
- An unlocked spreadsheet (e.g., an Excel workbook) showing the calculations used to produce the estimates of benefits and costs

Baselines

- **Should measure costs and benefits of a proposed project against a baseline alternative ("base" or "no build")**
- **"Do's"**
  - Factor in any projected changes that would occur even in the absence of the requested project
  - Factor in ongoing routine maintenance
  - Consider the full long-term impacts of the no build
  - Explain and provide support for the chosen baseline
- **"Don't's"**
  - Assume that the same (or similar) improvement will be implemented later
  - Use unrealistic assumptions about alternative traffic flows or travel

Demand Forecasts

- **Most benefit estimates depend on ridership or usage, including for walking and cycling projects**
- **Provide supporting info on forecasts**
  - Geographic scope, assumptions, data sources, methodology
- **Provide forecasts for intermediate years**
  - Or at least interpolate –don't apply forecast year impacts to interim years
- **Exercise caution about long-term growth assumptions**
  - Consider underlying capacity limits of the improved and/or replacement facility

Analysis Period

- **Should cover both initial development/construction and a subsequent operational period**
- **Generally tied to the expected service life of the improvement or asset**
  - I.e., the number of years until you would anticipate having to take the same action again
  - Lesser improvements should have shorter service lives
  - Recommend 20 years maximum for capacity expansion or other operational improvements
- **Avoid excessively long analysis periods (over 30 years of operations)**
  - Use residual value to cover out-years of remaining service life for long-lived improvements

Inflation and Discounting

- **Inflation Adjustments**
  - Recommend using a 2024 base year for all cost and benefit data
  - Index values for the GDP Deflator included in the BCA guidance
- **Discounting**
  - Use a 7% discount rate for all benefits and costs.
  - Recommend using a 2024 base year for discounting

Scope of the Analysis

- **Project scope included in estimated costs and benefits must match**
  - Don't claim benefits from an entire project, but only count costs from the grant-funded or other, lesser portion
- **Scope should cover a project that has independent utility**
  - May need to incorporate costs for related investments necessary to achieve the projected benefits (which should be funded/underway)
- **Project elements with independent utility should be individually evaluated in the BCA**
  - BCA evaluation will cover both independent elements and the submitted project as a whole

Benefits

- **Should be presented on an annual basis**
- **Avoid double-counting**
- **Negative outcomes should be counted as “disbenefits”**
- **Any estimated benefits should be clearly tied to the project scope and expected outcomes**
- **Some common benefit categories estimated in BCAs for transportation projects are presented in the following slides**
  - Applicants may also include other benefit categories or approaches in their BCAs

Safety Benefits

- **Typically associated with reducing fatalities, injuries, and property damage**
- **Projected improvements in safety outcomes should be explained and documented**
  - Justify assumptions about expected reductions in crashes, injuries, and/or fatalities
  - Document any crash modification factors (CMFs) used
  - Show clear linkage between project and improved outcomes
  - Use facility-specific data history for the baseline where possible
- **Crash-related injury and fatality data may be available in different forms**
  - KABCO injury scales
  - Fatal/Injury crashes vs. fatalities/injuries
  - BCA Guidance provides values covering all of these

Travel Time Savings

- **Recommended monetization values found in BCA Guidance**
  - See footnotes for discussion of value of time for walking, cycling, waiting, standing, transfers, long-distance travel, business travel
- **Can be a function of both changes in travel speed and/or travel distance (e.g., new connections allowing for shorter trips)**
  - May need to account for travel time disbenefits in affected modes
- **Consider vehicle occupancy (since values are per-person)**
  - Local/facility-specific values preferred, but national-level values provided in BCA Guidance
- **If valuing travel time reliability:**
  - Carefully document methodology and tools used
  - Show how valuation parameters are distinct from general travel time savings

Operating Cost Savings

- **Avoid double counting operating savings and other impacts**
  - E.g., truck or rail travel time savings, reduced fuel consumption
- **Localized, specific data preferred**
- **Standard per-mile values for light duty vehicles and commercial trucks**
  - Should not be converted to per-hour values
- **Values for hourly operating costs for commuter, intercity, and freight rail provided in BCA Guidance**

Emissions Reduction Benefits

- **For infrastructure improvements, emission reductions will typically be a function of reduced fuel consumption**
- **Recommended year by year unit values for SO_x, NO_x, and $PM_{2.5}$ found in BCA Guidance**
  - Be careful about the measurement units being applied
  - Check for $PM_{2.5}$ versus PM_{10}
- **In accordance with Executive Order 14154, "Unleashing American Energy," and OMB Memorandum M-25-27, DOT is no longer recommending that applicants monetize the impacts of reductions in emissions of carbon dioxide and other greenhouse gases in their benefit-cost analyses.**

Amenity Benefits

- **Pedestrian, cycling, and transit facility/vehicle improvements can improve the quality or comfort of journeys**
- **Recommended values for different types of improvements found in BCA Guidance**
  - Pay attention to whether value is on a “per-trip” or “per-person-mile” basis
- **Carefully document baseline amenities, as well as specifically how the proposed project will add any amenity benefit categories being claimed**

Health Benefits

- Trips diverted to active transportation (walking and cycling) from other modes may yield health benefits to users
- Recommended monetization values, on a per trip basis, are found in DOT BCA Guidance
- Absent local data on existing mode share and estimated age profiles of users, applicants may apply national averages included in the BCA Guidance

Work Zone Impacts

- **Transportation infrastructure improvements often involve work zones that can have a negative impact on travelers during the construction period**
  - Ex: travel time, safety
- **Applicants should account for any work zone impacts in their analysis**
  - If expected to be minimal, the analysis should describe characteristics of the project or delivery method that would mitigate such impacts

Benefits to Existing and Additional Users

- **Primary benefits typically experienced directly by users**
- **Includes both "existing" users (under baseline) and "additional" users attracted as a result of the improvement**
  - Standard practice in BCA values benefits to additional users less than those for existing users (see BCA Guidance)

Mode Shift and Modal Diversion

- **Projected magnitude**
  - Should be based on careful analysis of local conditions and potential for shift from other modes that might be attributable to the project
- **Benefit estimates should not be based on comparing user costs of "old" and "new" mode**
  - Would be reflected in benefits to additional users
  - Reductions in external costs would be relevant
    - Per-mile values for congestion, noise, safety, and emissions costs provided in BCA Guidance
- **Where "new" mode is entirely unavailable in the baseline, it may be appropriate to compare costs between modes, but only for the portion of the journey needed to access the "better" mode**

Other Benefits Topics

- **Agglomeration Economies**
- **Noise, Stormwater Runoff, and Wildlife Impact Reduction**
- **Emergency Response**
- **State of Good Repair**
- **Resilience**
  - Consider expected frequency of events and their consequences
- **Property Value Increases**
  - Is a measure rather than a benefit –avoid double-counting

Unquantified Benefits

- **Many potential benefits of INFRA projects may be difficult to quantify and monetize**
- **Any claimed unquantified benefits should be explained as well as possible**
  - Should clearly link specific project outcomes to any claimed unquantified benefits
  - Should quantify magnitudes/timing of the impacts wherever possible
  - Should only include impacts that would be counted as benefits, if quantified

Capital Costs

- **Include all costs of implementing the project**
  - E.g., design, ROW acquisition, construction
  - Regardless of funding source
  - Include previously incurred costs
- **Total capital costs for the project should be clearly presented in three forms**
  - Nominal dollars (project budget)
  - Real dollars (base year)
  - Discounted Real dollars (use in BCA)

Maintenance Costs

- **Net maintenance costs may be positive or negative**
    - New facilities would incur ongoing maintenance costs over the life of the project
    - Rehabilitated/reconstructed facilities may result in net savings in maintenance costs between the build/no-build

Residual Value

- **For assets with remaining service life at the end of the analysis period, may calculate a "residual value" for the project**
  - Recall that service life does not necessarily match the physical life of the asset
- **Simple approach: assume linear depreciation**
- **Be sure to properly apply discounting**

Comparing Benefits to Costs

- **Net Present Value (Benefits – Costs)**
- **Benefit-Cost Ratio (Benefits / Costs)**
  - Denominator should only include capital costs (i.e., net maintenance costs and residual value should be in the numerator)
  - Dis-benefits should be subtracted from the numerator

Other Types of Economic Analysis

- BCA considers the **increased economic efficiency** resulting from a project, and assesses the net change to overall societal welfare
- This is distinct from other types of economic analysis, such as
  - Economic Impact Analysis (e.g., job creation)
  - Financial Analysis (e.g., revenue impacts)
- These other types of analysis can be used to answer important questions and aid in decision-making; however, they use different approaches and answer fundamentally different questions than does BCA
- Importantly, these analyses do not provide estimates of additive benefits to be considered in BCA

BCA Examples

EXAMPLES

Hypothetical BCA Example #1

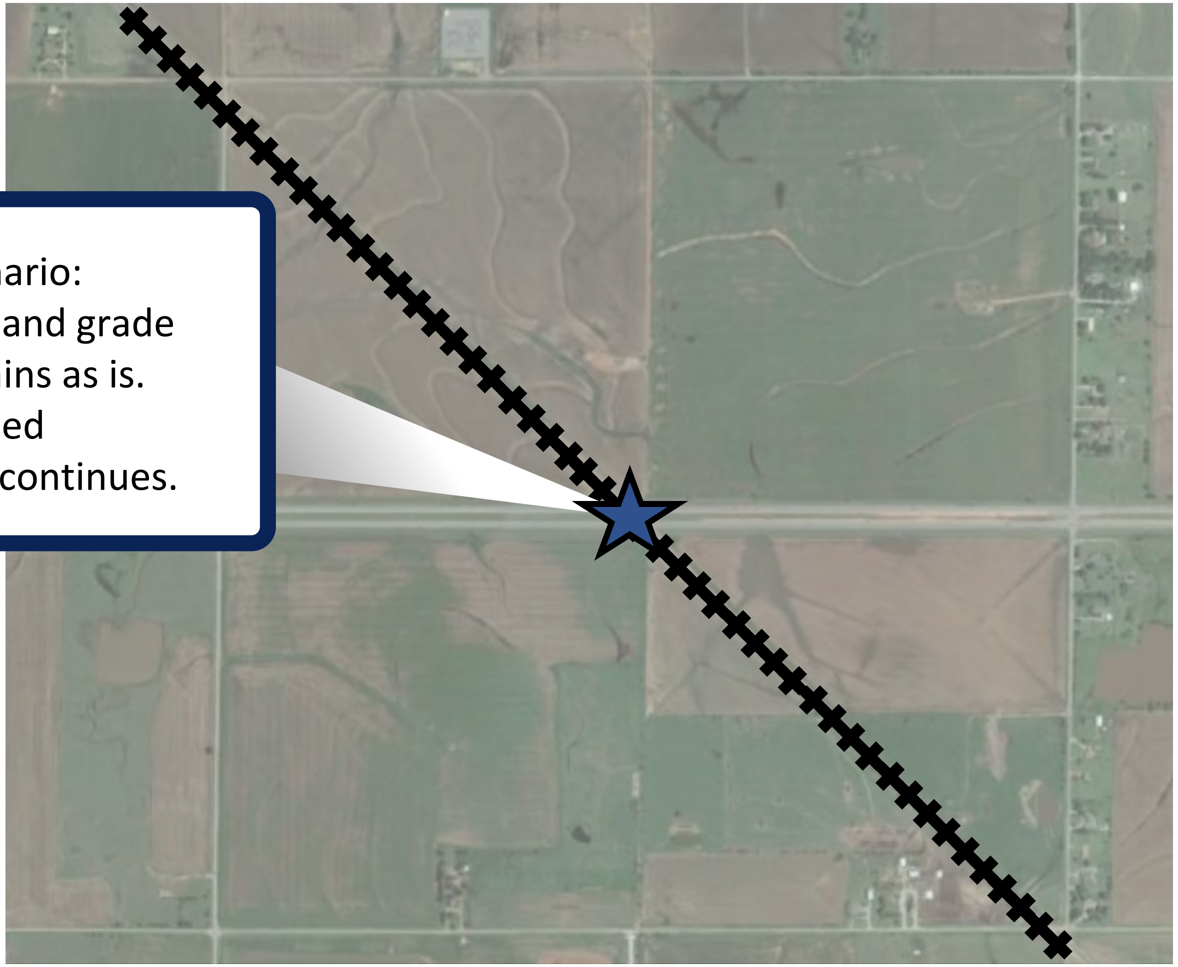
Hypothetical BCA Example #1

Proposed Project: Improve track class and state of good repair on two miles of track and grade-separate one highway-rail at-grade crossing.
Project Cost: $50.0 million

2026
AADT: 1,000 Cars Delayed per Day
Avg. Delay: Two minutes
Source: Observed at Crossing

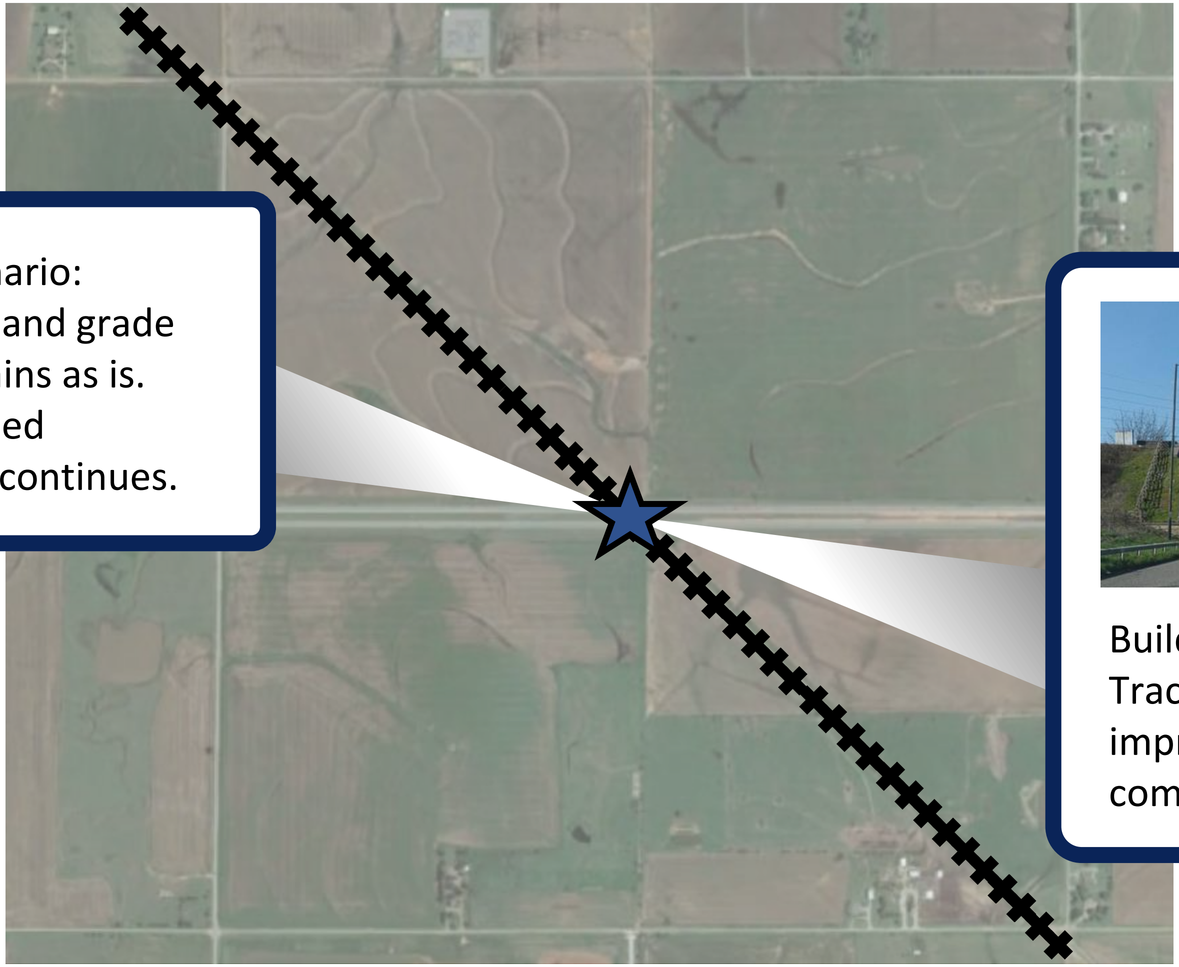
Average Annual Fatalities: Seven Fatalities in Previous 10 Years
Source: FRA Crossing Inventory

Hypothetical BCA Example #1



No-Build Scenario: Current track and grade crossing remains as is. Regular planned maintenance continues.

Hypothetical BCA Example #1



No-Build Scenario:
Current track and grade crossing remains as is. Regular planned maintenance continues.

Build Scenario:
Track class and state of good repair improved; grade-separation completed.

Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Current track and grade crossing remains as is and regular planned maintenance continues
  - Build Scenario: Track class and state of good repair improved; grade-separation completed
- **The expected major benefit categories in this case would be travel time savings and safety benefits from the grade-separation component**
- **There are more potential benefits of this project, to be discussed later**

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Travel Time Savings*	=	Avg. Delay Time	x	AADT Delayed	x	Hourly Value of Time	x	Vehicle Occupancy	x	Annualization Factor

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings}^* = \text{Avg. Delay Time} \times \text{AADT Delayed} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings}^* = \frac{2\text{ mins}}{60}$$

Observed train gate downtime is four minutes, thus delay time for an automobile that must stop is two minutes, on average.

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Avg. Delay Time} \times \text{AADT Delayed} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{2 \text{ mins}}{60} \times 1{,}000$$

Recent traffic observations.

*Undiscounted.

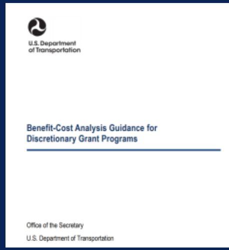
Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Travel Time Savings* = Avg. Delay Time x AADT Delayed x Hourly Value of Time x Vehicle Occupancy x Annualization Factor

Annual Vehicle Travel Time Savings* = $\frac{2 \text{ mins}}{60}$ x 1,000 x $21.80

USDOT BCA Guidance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(Appendix A)

*Undiscounted.

Travel Time Savings Example

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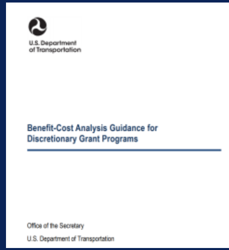
$$\text{Annual Vehicle Travel Time Savings*} = \frac{2\text{ mins}}{60} \times 1{,}000 \times \$21.80 \times 1.52$$

USDOT BCA Guidance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Travel Time Savings Example

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$$\text{Annual Vehicle Travel Time Savings*} = \text{Avg. Delay Time} \times \text{AADT Delayed} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{2 \text{ mins}}{60} \times 1{,}000 \times \$21.80 \times 1.52 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Avg. Delay Time} \times \text{AADT Delayed} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{2 \text{ mins}}{60} \times 1{,}000 \times \$21.80 \times 1.52 \times 365$$

$$= \$403{,}155 \text{ Per Year}$$

*Undiscounted.

Safety Benefits Example

- **For simplicity, let's assume the grade separation project mitigates all future fatalities at the crossing**

Annual Safety Benefits* = Average Annual Fatalities x Value of Statistical Life

*Undiscounted.

Safety Benefits Example

- **For simplicity, let's assume the grade separation project mitigates all future fatalities at the crossing**

$$\text{Annual Safety Benefits*} = \text{Average Annual Fatalities} \times \text{Value of Statistical Life}$$

$$\text{Annual Safety Benefits*} = \frac{\text{7 Fatalities}}{\text{10 Years}}$$

FRA Grade Crossing Accident Database

*Undiscounted.

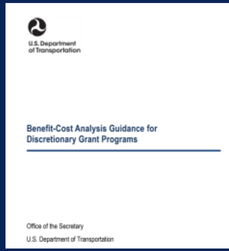
Safety Benefits Example

- **For simplicity, let's assume the grade separation project mitigates all future fatalities at the crossing**

$$\text{Annual Safety Benefits}^* = \text{Average Annual Fatalities} \times \text{Value of Statistical Life}$$

$$\text{Annual Safety Benefits}^* = \frac{7 \text{ Fatalities}}{10 \text{ Years}} \times \$13{,}700{,}000$$

USDOT BCA Guidance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Safety Benefits Example

- **For simplicity, let's assume the grade separation project mitigates all future fatalities at the crossing**

$$\text{Annual Safety Benefits*} = \text{Average Annual Fatalities} \times \text{Value of Statistical Life}$$

$$\text{Annual Safety Benefits*} = \frac{\text{7 Fatalities}}{\text{10 Years}} \times \$13{,}700{,}000$$

$$= \$9{,}590{,}000 \text{ Per Year}$$

*Undiscounted.

Hypothetical BCA Example #1

- **Assume construction in 2027, ten years of project operations, and no change in net maintenance costs between the scenarios**

Year	Capital Cost	Discounted Costs	Safety Benefits	Vehicle Travel Time Savings	Discounted Benefits
2027	$50,000,000		$0	$0	
2028	$0		$9,590,000	$403,155	
2029	$0		$9,590,000	$403,155	
2030	$0		$9,590,000	$403,155	
2031	$0		$9,590,000	$403,155	
2032	$0		$9,590,000	$403,155	
2033	$0		$9,590,000	$403,155	
2034	$0		$9,590,000	$403,155	
2035	$0		$9,590,000	$403,155	
2036	$0		$9,590,000	$403,155	
2037	$0		$9,590,000	$403,155	

Hypothetical BCA Example #1

- **Next, we discount costs and benefits using a 7.0% discount rate**

Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)

Year	Capital Cost	Discounted Costs	Safety Benefits	Vehicle Travel Time Savings	Discounted Benefits
2027	$50,000,000	**$40,814,894**	$0	$0	$0
2028	[illegible]	$0	$9,590,000	$403,155	**$7,623,730**
[illegible]	[illegible]	$0	[illegible]	[illegible]	[illegible]4,981
2030	$0	$0	[illegible]	[illegible]	[illegible]8,861
2031	$0	$0	$9,590,000	$403,155	$6,223,234
2032	$0	$0	$9,590,000	$403,155	$5,816,107
2033	$0	$0	$9,590,000	$403,155	$5,435,614
2034	$0	$0	$9,590,000	$403,155	$5,080,013
2035	$0	$0	$9,590,000	$403,155	$4,747,676
2036	$0	$0	$9,590,000	$403,155	$4,437,080
2037	$0	$0	$9,590,000	$403,155	**$4,146,804**

$50,000,000 / (1+0.07)^(2027-2024)

($9,590,000+$403,155) / (1+0.07)^(2028-2024)

($9,590,000+$403,155) / (1+0.07)^(2037-2024)

Note: Totals may differ slightly due to rounding

Hypothetical BCA Example #1

- **Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs**

Year	Capital Cost	Discounted Costs	Safety Benefits	Vehicle Travel Time Savings	Discounted Benefits
2027	$50,000,000	$40,814,894	$0	$0	$0
2028	$0	$0	$9,590,000	$403,155	$7,623,730
2029	$0	$0	$9,590,000	$403,155	$7,124,981
2030	$0	$0	$9,590,000	$403,155	$6,658,861
2031	$0	$0	$9,590,000	$403,155	$6,223,234
2032	$0	$0	$9,590,000	$403,155	$5,816,107
2033	$0	$0	$9,590,000	$403,155	$5,435,614
2034	$0	$0	$9,590,000	$403,155	$5,080,013
2035	$0	$0	$9,590,000	$403,155	$4,747,676
2036	$0	$0	$9,590,000	$403,155	$4,437,080
2037	$0	$0	$9,590,000	$403,155	$4,146,804
TOTAL		**$40,814,894**			**$57,294,100**

Note: Totals may differ slightly due to rounding

Results – The NPV and BCR

- **Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)**

Net Present Value (NPV) = Total Discounted Benefits - Total Discounted Costs

= \$57,294,100 - \$40,814,894

= **\$16,479,207**

$$\text{Benefit-Cost Ratio (BCR)} = \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}}$$

$$= \frac{\$57{,}294{,}100}{\$40{,}814{,}894}$$

= **1.4**

Note: Totals may differ slightly due to rounding

Hypothetical BCA Example #1

- **Other potential benefits such a project might have:**
  - Net maintenance cost savings from improved state of good repair
    - Though these may be partially or fully offset by new maintenance costs for the new crossing
  - Reduced risk of derailment from improved state of good repair
  - Reduced emergency response delays
  - Reduced freight rail operating costs if track class upgrade allows for faster train movements or heavier trains
    - Same freight movements with fewer train-car miles of fewer crew-hours
    - Remember to cite sources and document assumptions such as crew per train or cost per hour.
- **This is not meant to be an exhaustive list**

Hypothetical Example #2

Hypothetical Example #2

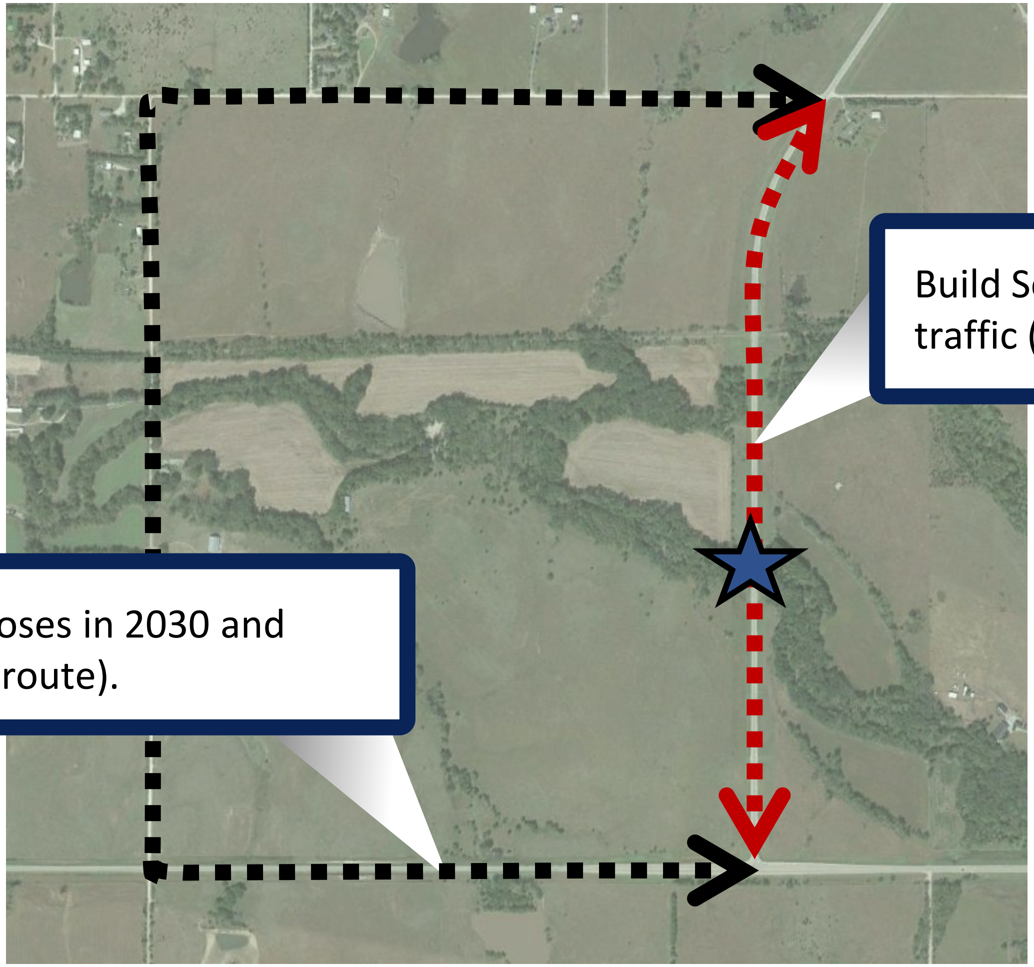
Proposed Project: Replace a deteriorating bridge.
Project Cost: $6.3 million

2026
AADT: 1,800 Cars per Day (Source: Traffic Count)
Avg. Speed: 45 mph (State DOT database)

Hypothetical Example #2

No-Build Scenario: Bridge closes in 2030 and traffic is detoured (2.6-mile route).

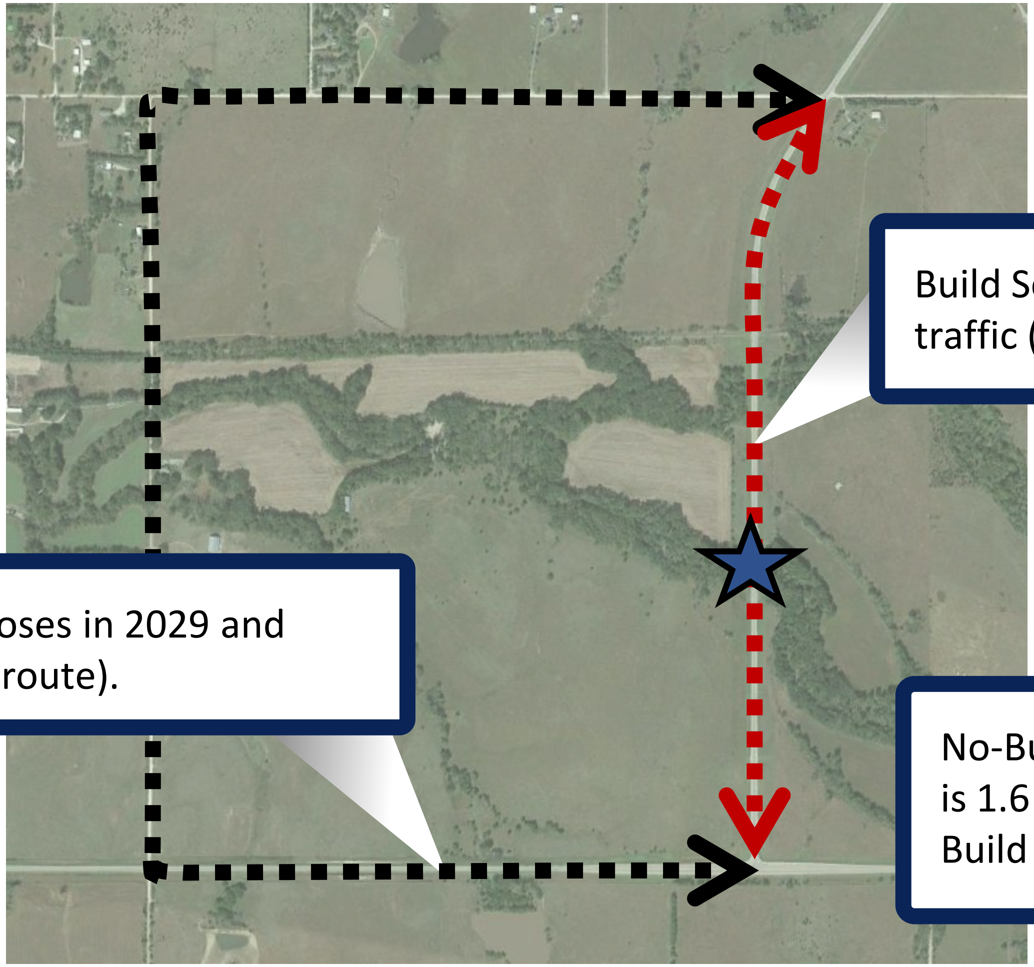
Hypothetical Example #2



Build Scenario: Bridge remains open to traffic (1.0-mile route).

No-Build Scenario: Bridge closes in 2030 and traffic is detoured (2.6-mile route).

Hypothetical Example #2



Build Scenario: Bridge remains open to traffic (1.0-mile route).

No-Build Scenario: Bridge closes in 2029 and traffic is detoured (2.6-mile route).

No-Build Scenario detour is 1.6 miles longer than Build Scenario route.

Approach

- **We want to compare the state of the world with and without the proposed project improvement**
  - No-Build Scenario: Bridge closes in 2030, traffic detours 2.6 miles
  - Build Scenario: Bridge remains open, existing route is 1.0 miles
- **The expected major benefit categories in this case would be vehicle operating cost savings and travel time savings for mitigating 1.6 miles of additional travel, starting in 2030.**

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings* = Incremental Detour x AADT x Vehicle Operating Cost Per Mile x Annualization Factor

*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings*	=	Incremental Detour	x	AADT	x	Vehicle Operating Cost Per Mile	x	Annualization Factor
Annual Vehicle Operating Cost Savings*	=							

*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings* = Incremental Detour x AADT x Vehicle Operating Cost Per Mile x Annualization Factor

Annual Vehicle Operating Cost Savings* = 1.6 Miles

No-Build Scenario Route: 2.6 miles
Build Scenario Route: 1.0 miles

*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings* = Incremental Detour x AADT x Vehicle Operating Cost Per Mile x Annualization Factor

Annual Vehicle Operating Cost Savings* = 1.6 Miles x 1,800

Recent traffic counts.

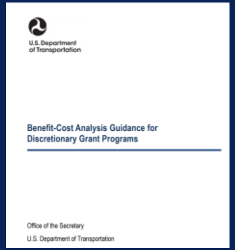
*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings*	=	Incremental Detour	x	AADT	x	Vehicle Operating Cost Per Mile	x	Annualization Factor
Annual Vehicle Operating Cost Savings*	=	1.6 Miles	x	1,800	x	$0.56		

USDOT BCA Guidance


U.S. Department of Transportation

Benefit-Cost Analysis Guidance for Discretionary Grant Programs

Office of the Secretary
U.S. Department of Transportation

(Appendix A)

*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings*	=	Incremental Detour	x	AADT	x	Vehicle Operating Cost Per Mile	x	Annualization Factor
Annual Vehicle Operating Cost Savings*	=	1.6 Miles	x	1,800	x	$0.56	x	365

We expect this project to have an impact each day (not just weekdays, for example).

*Undiscounted.

Vehicle Operating Cost Savings Example

- **For simplicity, let's assume no heavy trucks and no traffic growth**

Annual Vehicle Operating Cost Savings*	=	Incremental Detour	x	AADT	x	Vehicle Operating Cost Per Mile	x	Annualization Factor
Annual Vehicle Operating Cost Savings*	=	1.6 Miles	x	1,800	x	$0.56	x	365
	=	$588,672 Per Year						

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

Annual Vehicle Travel Time Savings* = Marginal Detour Time x AADT x Hourly Value of Time x Vehicle Occupancy x Annualization Factor

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} =$$

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6\ \text{Miles}}{45\ \text{mph}}$$

No-Build Scenario Route: 2.6 miles
Build Scenario Route: 1.0 miles

Speed: Observed average speed on both routes

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}800$$

Recent traffic counts.

*Undiscounted.

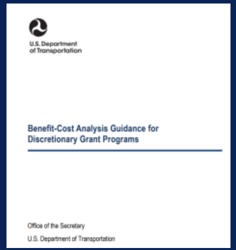
Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}800 \times \$21.80$$

USDOT BCA Guidance


U.S. Department of Transportation

Benefit-Cost Analysis Guidance for Discretionary Grant Programs

Office of the Secretary
U.S. Department of Transportation

(Appendix A)

*Undiscounted.

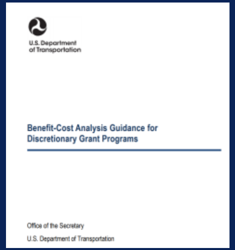
Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6\ \text{Miles}}{45\ \text{mph}} \times 1{,}800 \times \$21.80 \times 1.52$$

USDOT BCA Guidance



U.S. Department of Transportation

Benefit-Cost Analysis Guidance for Discretionary Grant Programs

Office of the Secretary
U.S. Department of Transportation

(Appendix A)

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}800 \times \$21.80 \times 1.52 \times 365$$

We expect this project to have an impact each day (not just weekdays, for example).

*Undiscounted.

Travel Time Savings Example

- **For simplicity, let's assume no heavy trucks, an average speed of 45 mph, and no traffic growth**

$$\text{Annual Vehicle Travel Time Savings*} = \text{Marginal Detour Time} \times \text{AADT} \times \text{Hourly Value of Time} \times \text{Vehicle Occupancy} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Travel Time Savings*} = \frac{\text{1.6 Miles}}{\text{45 mph}} \times 1{,}800 \times \$21.80 \times 1.52 \times 365$$

$$= \$774{,}057 \text{ Per Year}$$

*Undiscounted.

Hypothetical BCA Example #2

- **Assume construction in 2027, ten years of project operations, and no change in bridge maintenance costs**

Year	Capital Cost	Discounted Costs	Vehicle Operating Cost Savings	Vehicle Travel Time Savings	Discounted Benefits
2027	$6,300,000		$0	$0	
2028	$0		$0	$0	
2029	$0		$0	$0	
2030	$0		$588,672	$774,057	
2031	$0		$588,672	$774,057	
2032	[illegible]		$588,672	$774,057	
2033	[illegible]		$588,672	$774,057	
2034	$0		$588,672	$774,057	
2035	$0		$588,672	$774,057	
2036	$0		$588,672	$774,057	
2037	$0		$588,672	$774,057	

Bridge Closure Year
(No-Build Scenario)

Hypothetical BCA Example #2

- **Next, we discount costs and benefits using a 7.0% discount rate**

Discounted Value = Future Year Value / (1+Discount Rate)^(Future Year - Base Discounting Year)

Year	Capital Cost	Discounted Costs	Vehicle Operating Cost Savings	Vehicle Travel Time Savings	Discounted Benefits
2027	$6,300,000	**$5,142,677**	$0	$0	$0
2028	$0	$0	$0	$0	$0
[illegible]	$0	$0	$0	$0	$0
2030	$0	$0	$588,672	$774,057	**$908,044**
2031	$0	$0	[illegible]	[illegible]	$848,639
2032	$0	$0	$588,672	$774,057	$793,121
2033	$0	$0	$588,672	$774,057	$741,234
2034	$0	$0	$588,672	$774,057	$692,742
2035	$0	$0	$588,672	$774,057	$647,423
2036	$0	$0	$588,672	$774,057	$605,068
2037	$0	$0	$588,672	$774,057	**$565,484**

$6,300,000 / (1+0.07)^(2027-2024)

($588,672+$774,057) / (1+0.07)^(2030-2024)

($588,672+$774,057) / (1+0.07)^(2037-2024)

Note: Totals may differ slightly due to rounding

Hypothetical BCA Example #2

- **Next, we sum the discounted benefits and costs to get total discounted benefits and total discounted costs**

Year	Capital Cost	Discounted Costs	Vehicle Operating Cost Savings	Vehicle Travel Time Savings	Discounted Benefits
2027	$6,300,000	$5,142,677	$0	$0	$0
2028	$0	$0	$0	$0	$0
2029	$0	$0	$0	$0	$0
2030	$0	$0	$588,672	$774,057	$908,044
2031	$0	$0	$588,672	$774,057	$848,639
2032	$0	$0	$588,672	$774,057	$793,121
2033	$0	$0	$588,672	$774,057	$741,234
2034	$0	$0	$588,672	$774,057	$692,742
2035	$0	$0	$588,672	$774,057	$647,423
2036	$0	$0	$588,672	$774,057	$605,068
2037	$0	$0	$588,672	$774,057	$565,484
TOTAL		**$5,142,677**			**$5,801,755**

Note: Totals may differ slightly due to rounding

Results – The NPV and BCR

- **Lastly, we calculate the project's net present value (NPV) and benefit-cost ratio (BCR)**

Net Present Value (NPV) = Total Discounted Benefits - Total Discounted Costs

= \$5,801,755 - \$5,142,677

= **\$659,078**

Benefit-Cost Ratio (BCR) = $\frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}}$

= $\frac{\$5,801,755}{\$5,142,677}$

= **1.1**

Note: Totals may differ slightly due to rounding

Hypothetical BCA Example #2

- **Other potential benefits such a project might have:**
  - Travel time savings for trucks, cyclists, and pedestrians
    - If the bridge repair maintains new shorter-distance connections
  - Reduced crash, congestion, and emission costs from reduced vehicle miles traveled due to mitigated detours
- **This is not meant to be an exhaustive list**

Key Resources for BCA

- **DOT BCA Guidance**
  - https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-guidance
- **Additional project examples provided in BCA webinars for previous USDOT discretionary grant programs**
  - https://railroads.dot.gov/rail-network-development/training-guidance/webinars-0
  - https://www.transportation.gov/office-policy/rural/routes-webinar-bca
  - Note that parameter values are updated each year
- **Project engineering and planning documents**

Remember Key Resources

- **Local traffic counts and travel survey data**
- **U.S. Census Bureau**
- **Project partners (higher levels of government, MPOs, universities, etc.)**
- **Many BCAs submitted for other programs are publicly available via web search**
- **FRA's Crossing Inventory and Accident Reports**
  - https://safetydata.fra.dot.gov/OfficeofSafety/PublicSite/Crossing/Crossing.aspx
- **NHTSA's Fatality Analysis Reporting System**
  - https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars
- **The Crash Modification Factors Clearinghouse**
  - https://www.cmfclearinghouse.org/
- **Technical questions can be submitted to MPDGrants@dot.gov**

Key Resources for BCA

- **DOT BCA Spreadsheet Template**
  - Developed by DOT as an optional template to aid applicants in structuring their BCA and performing certain calculations common to all analyses.
  - Designed as an open-ended template that can handle any project type
  - Available at: https://www.transportation.gov/mission/office-secretary/office-policy/transportation-policy/benefit-cost-analysis-spreadsheet-template
- **Bridge Investment Program BCA Tool**
  - Supports estimates of the benefits of bridge preservation or replacement investments using National Bridge Inventory data
  - Also provides a default methodology consistent with DOT BCA Guidance
  - Applicable to roadway bridge projects for any DOT program where BCA is required
  - Available at: https://www.fhwa.dot.gov/bridge/bip/bca/

THANK YOU!