Benefit Cost Analysis (BCA) Basics for Rural Projects

Webinar Logistics

The webinar will be recorded & available on our website along with the slides

Submit questions in the Chat box at anytime

You can minimize or move the video boxes on your screen

Email us at rural@dot.gov if you have technical issues

www.transportation.gov/rural

Rural Transportation Challenges

Rural transportation networks are critical for trade, travel, and quality of life for all Americans, yet they face unique challenges related to safety, infrastructure condition, and usage.

19% of Americans live in rural areas but 69% of our nation's total lane-miles are in rural areas

Urban areas have 1,064 lane miles per 100,000 residents

Rural areas have 9,925 lane miles per 100,000 residents

RURAL TRANSPORTATION CHALLENGES

1. **SAFETY**
2. **INFRASTRUCTURE CONDITION**
3. **USAGE**

Notes: Urban refers to a Census-defined Urbanized Area and rural is defined as falling of a Census-defined Urbanized Area
Source: R.O.U.T.E.S. website, www.transportation.gov/rural

R.O.U.T.E.S. Initiative's Priorities

The Rural Opportunities to Use Transportation for Economic Success (R.O.U.T.E.S.) Initiative aims to address disparities in rural transportation infrastructure and improve safety and economic competitiveness nationwide

R.O.U.T.E.S. is a USDOT initiative that is…

Engaging with stakeholders through listening sessions, requests for information (RFIs), and other events to gather feedback on rural infrastructure project needs and challenges

Providing user-friendly information and technical assistance to assist stakeholders in understanding funding opportunities and applying for USDOT discretionary grants

Collecting data and analyzing trends to better assess needs and benefits of rural transportation infrastructure projects, particularly related to enhancing safety and sparking economic growth in rural communities

Poll Questions

Today's Presenters

- Dr. Darren Timothy,
  - Chief Economist, USDOT
- Ermias Weldemicael
  - Economist, USDOT
- Jordan Riesenberg
  - Economist, USDOT

Outline

- Introduction to BCA
- Key Resources
- Potential Data Sources
- Hypothetical Example #1
- Hypothetical Example #2

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

Why do we do BCA (cont'd)?

[This] called for systematic analysis of the transportation problem, using the "best scientific understanding"…With these intellectual tools…Tobin and his associates could with some confidence settle (in Bailey's apt phrase) "on the sunnier side of doubt."

Jameson Doig, *Empire on the Hudson*

BCA and USDOT Programs

- **BCAs are required for most USDOT discretionary grant programs for transportation infrastructure:**
  - Office of the Secretary of Transportation: BUILD, INFRA
  - Federal Railroad Administration: CRISI, SOGR
  - Federal Highway Administration: CHBP, CARSI, NSFLTP
  - Maritime Administration: PIDP

BCA and USDOT Programs

- May be used to:
  - Consider benefits and costs
  - Evaluate program selection criteria
  - Make cost-effectiveness determinations

BCA Submission Format

- Methodology description
- Calculations workbook
- Results summary

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
  - Determine the extent to which project benefits exceed (or do not exceed) costs.
  - Assign a confidence rating to that determination.

Framing a BCA

- "Costs" and "benefits" of a proposed project are measured by comparing two states of the world:
  - Baseline alternative, where the proposed project is not implemented (often called the "no-build scenario")
  - "Build scenario", where the project is implemented

Framing a BCA

- What is the proposed project scope?
- What problem are you trying to solve?
  - Ex: improve safety, reduce travel time, preserve existing infrastructure, etc.
- How does your proposed project solve that problem?
  - Impact on baseline conditions—reduce frequency of crashes, allow for higher travel speeds, improve physical condition, etc.
- What is the context of the project?
  - Location, traffic, economic, etc.

BCA Benefits

- Common Benefit Types
  - Travel time savings
  - Operating cost savings
  - Reduced injuries, fatalities, and property damage
  - Reduced emissions
- Not every project will yield every benefit type!

BCA vs. Economic Impact Analysis

- BCA measures the value of a project's benefits and costs to society.
- Economic Impact Analysis (EIA) measures the impact of increased economic activity within a region attributable to a project.
- EIA represents the translation of "first order" benefits into other economic outcomes—not added "benefits" to be counted in BCA.
- Economic development can affect the future use of the improved facility and thus the projected benefits.

BCA Costs

- Capital Costs:
  - Design, ROW acquisition, construction
- Maintenance Costs:
  - May be positive or negative on net

Discounting

- Conceptually, benefits today are worth more than benefits in future years (same with costs)
- Federal guidance recommends using a discount rate of 7% for capital projects
- We'll cover how to apply discounting in the later examples.

Demand Forecasts

- Most benefit estimates depend on ridership or usage estimates.
- Provide supporting information on forecasts.
  - Geographic scope, assumptions, data sources, methodology, economic development implications on usage (if applicable)
- Provide forecasts for intermediate years and exercise caution about long-term growth rates.
- Exercise caution with regional model outputs.
  - Document any assumptions and the geography being analyzed

BCA vs. Financial Analysis

- Project may be expected to generate increased revenues – tolls, fares, user charges, taxes, etc.
  - Are both a cost to users and a benefit to the recipient – would be considered a transfer for BCA purposes
- Costs should be considered at the time they are incurred (not necessarily when they are "paid for," if financed)

Key Resources

- USDOT BCA Guidance – START HERE!
  - Covers all USDOT discretionary grant programs.
  - Current guidance available at https://www.transportation.gov/office-policy/transportation-policy/benefit-cost-analysis-guidance-discretionary-grant-programs-0
  - Will be updated for FY 21 programs

Key Resources – Cont.

- USDOT BCA Webinars
  - Generally, each round of a grant program for which BCA is required will have a webinar dedicated to explaining BCA concepts and methodology.
  - Usually includes a live Q&A session and information on who to contact with further questions.

Key Resources – Cont.

- USDOT Economists
  - Can submit technical questions to the respective discretionary grant program email inbox
  - May also participate in applicant debriefs

Potential Data Sources

- Smaller local governments might not always have internal data sources readily available to use in the creation of a BCA, but may use documents from other government entities.
- Documents or forecasts that may be relevant or useful in creating a BCA:
  - Traffic studies/Corridor-level studies
  - Engineering/Environmental documents
  - HPMS data*/Future traffic forecasts
  - Travel demand modeling
  - Safety-related modeling
- Check with your county, state DOT, or MPO if applicable.

*Contact your State DOT for HPMS data.

Potential Data Sources – Cont.

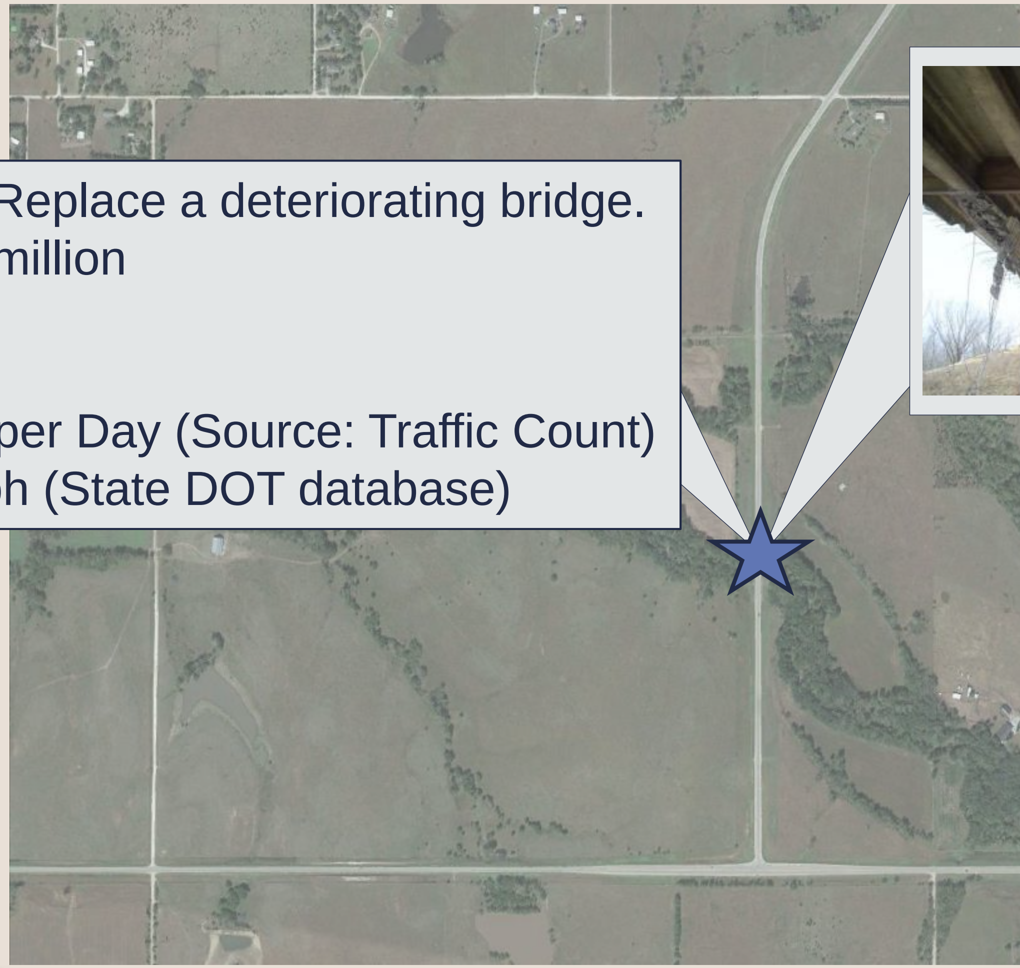
- USDOT has several data sources that may be of use to applicants:
  - NHTSA's Fatality Analysis Reporting System* (https://cdan.dot.gov/query)
  - FHWA's National Bridge Inventory (https://www.fhwa.dot.gov/bridge/nbi.cfm)
  - FTA's National Transit Database (https://www.transit.dot.gov/ntd/ntd-data)
  - FRA's Grade Crossing Accident Database (https://safetydata.fra.dot.gov/OfficeofSafety/PublicSite/Crossing/Crossing.aspx)
  - FHWA's National Performance Management Research Data Set** (https://ops.fhwa.dot.gov/perf_measurement/)

*May also use newspaper articles for crash documentation.
**Contact your State DOT.

Potential Data Sources – Cont.

- Other potential sources of data sources and examples include:
  - Crash Modification Factors Clearinghouse (http://www.cmfclearinghouse.org/)
  - BCAs for previously awarded projects (often on project sponsor websites)
  - State and local transportation agency websites
    - California Department of Transportation (https://dot.ca.gov/programs/transportation-planning/economics-data-management/transportation-economics)
    - Minnesota Department of Transportation (http://www.dot.state.mn.us/planning/program/benefitcost.html)
  - AASHTO's Asset Management Tools (https://www.tam-portal.com/resources/tools/)

Hypothetical Example #1



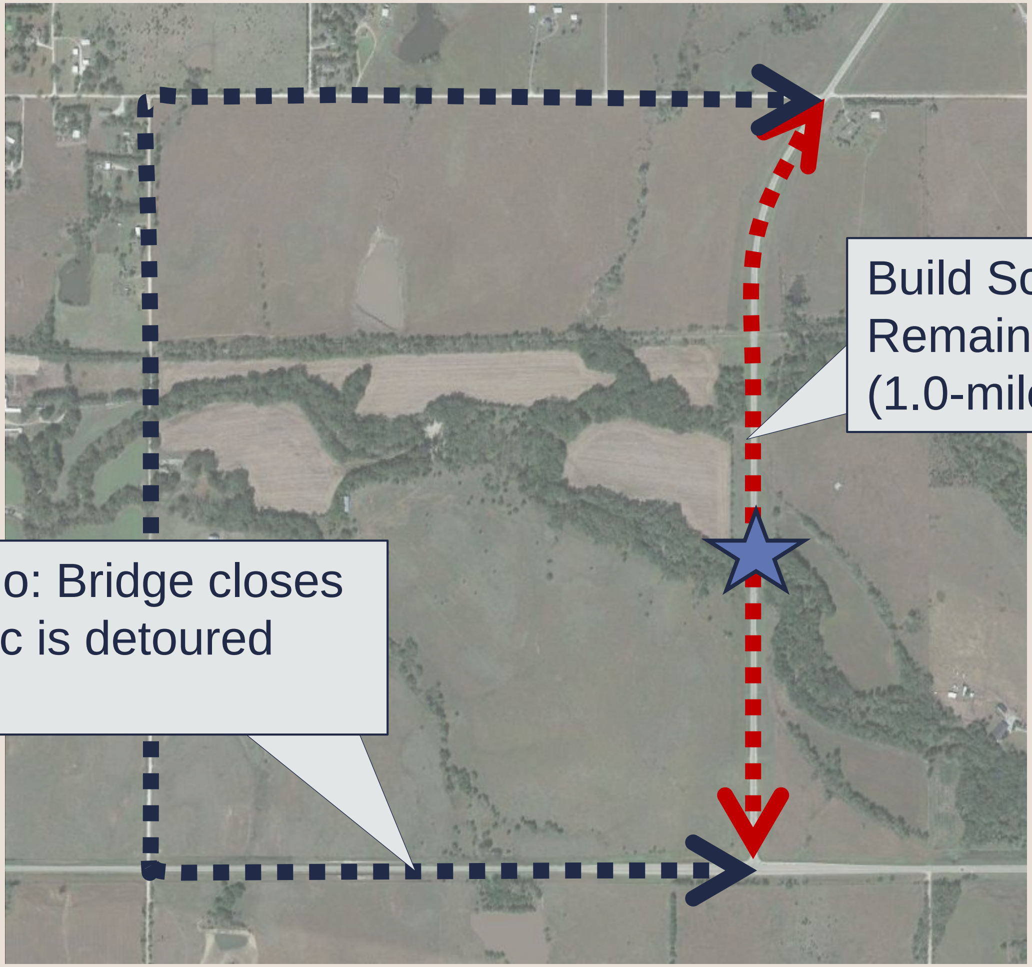
Proposed Project: Replace a deteriorating bridge.
Project Cost: $2.5 million

2019
AADT: 1,000 Cars per Day (Source: Traffic Count)
Avg. Speed: 45 mph (State DOT database)

Hypothetical Example #1

No-Build Scenario: Bridge closes in 2024 and traffic is detoured (2.6-mile route).

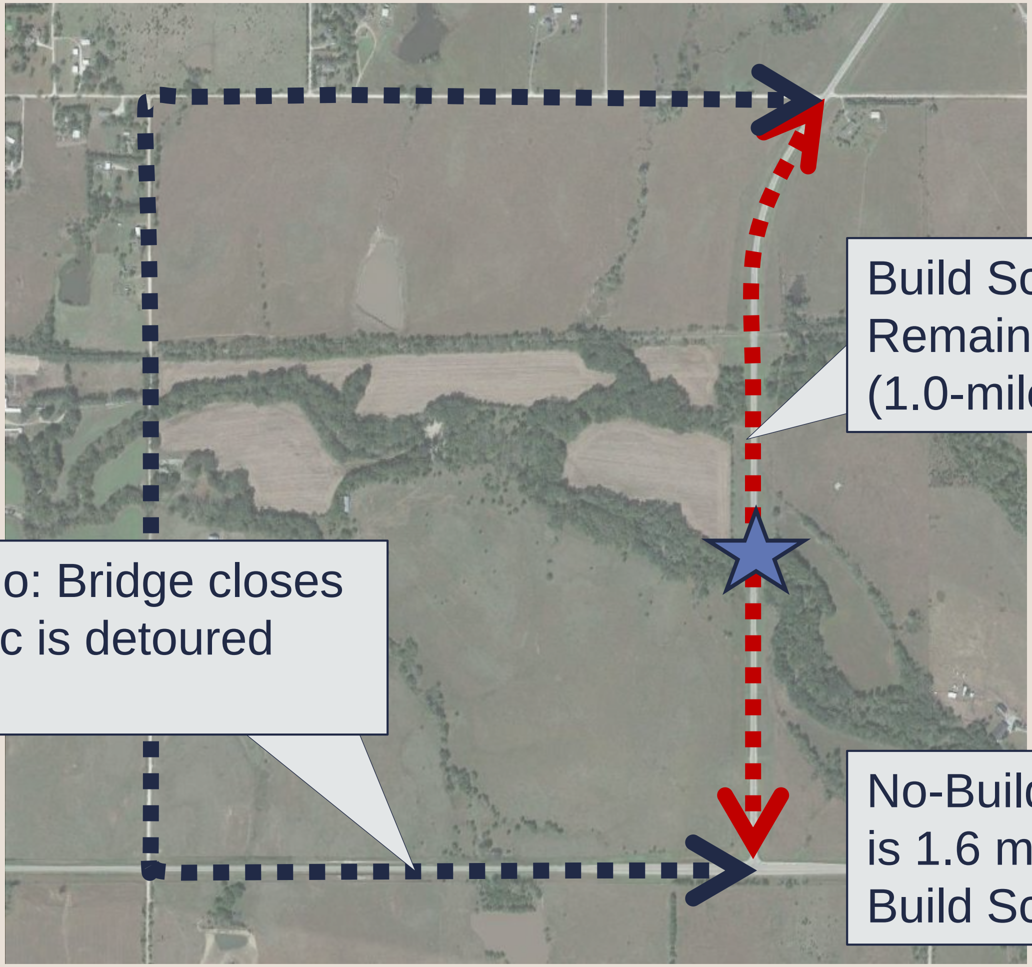
Hypothetical Example #1



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

No-Build Scenario: Bridge closes in 2024 and traffic is detoured (2.6-mile route).

Hypothetical Example #1



Approach

- We want to compare the state of the world with and without the proposed project improvement.
  - No-Build Scenario: Bridge closes in 2024, 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 2024.

Vehicle Operating Cost Savings

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

$$\text{Annual Vehicle Operating Cost Savings*} = \text{Incremental Detour} \times \text{AADT} \times \text{Vehicle Operating Cost Per Mile} \times \text{Annualization Factor}$$

*Undiscounted.

Vehicle Operating Cost Savings

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

$$\text{Annual Vehicle Operating Cost Savings*} = \text{Incremental Detour} \times \text{AADT} \times \text{Vehicle Operating Cost Per Mile} \times \text{Annualization Factor}$$

$$\text{Annual Vehicle Operating Cost Savings*} =$$

*Undiscounted.

Vehicle Operating Cost Savings

- **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

- **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	1,000				

Recent traffic count

*Undiscounted.

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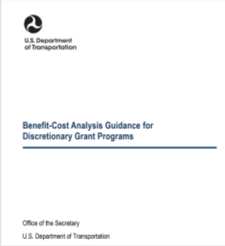
Vehicle Operating Cost Savings

- **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	1,000	x	$0.41		

USDOT BCA Guidance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Benefit-Cost Analysis Guidance for Discretionary Grant Programs

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(Appendix A)

*Undiscounted.

Vehicle Operating Cost Savings

- **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	1,000	x	$0.41	x	365

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

*Undiscounted.

Vehicle Operating Cost Savings

- **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	1,000	x	$0.41	x	365
	=	$239,440 Per Year						

*Undiscounted.

Travel Time Savings

- 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

- **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

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

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

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}000 \times$$

Recent traffic count

*Undiscounted.

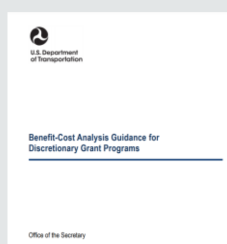
Travel Time Savings

- 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

Annual Vehicle Travel Time Savings* = $\frac{\text{1.6 Miles}}{\text{45 mph}}$ x 1,000 x $16.60

USDOT BCA Guidance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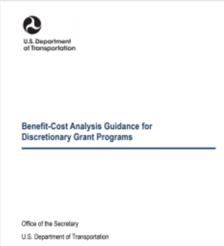
Travel Time Savings

- 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

Annual Vehicle Travel Time Savings* = $\frac{\text{1.6 Miles}}{\text{45 mph}}$ x 1,000 x $16.60 x 1.67

USDOT BCA Guidance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Travel Time Savings

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

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}000 \times \$16.60 \times 1.67 \times 365$$

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

*Undiscounted.

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Travel Time Savings

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

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

$$\text{Annual Vehicle Travel Time Savings*} = \frac{1.6 \text{ Miles}}{45 \text{ mph}} \times 1{,}000 \times \$16.60 \times 1.67 \times 365$$

$$= \$359{,}770 \text{ Per Year}$$

*Undiscounted.

Hypothetical Example #1

- Assume construction in 2021, ten years of project operations, and no difference in bridge maintenance costs between the scenarios.

Year	Capital Cost		Vehicle Operating Cost Savings	Vehicle Travel Time Savings	
2021	$2,500,000		$0	$0	
2022	$0		$0	$0	
2023	$0		$0	$0	
2024	$0		$239,440	$359,770	
2025			$239,440	$359,770	
2026			$239,440	$359,770	
2027	$0		$239,440	$359,770	
2028	$0		$239,440	$359,770	
2029	$0		$239,440	$359,770	
2030	$0		$239,440	$359,770	
2031	$0		$239,440	$359,770	

Bridge Closure Year (No-Build Scenario)

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Hypothetical Example #1

- **Next we discount costs and benefits using a 7% 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
2021	$2,500,000	$2,336,449	$0	$0	$0
2022	$0	$0	[illegible]	[illegible]	[illegible]
202[illegible]	[illegible]	$0	$0	$0	[illegible]0
2024	$0	$0	$239,440	$359,770	$457,134
2025	$0	$0	$239,440	$359,770	$427,228
2026	$0	$0	$239,440	$359,770	$399,279
2027	$0	$0	$239,440	$359,770	$373,158
2028	$0	$0	$239,440	$359,770	$348,746
2029	$0	$0	$239,440	$359,770	$325,931
2030	$0	$0	$239,440	$359,770	$304,608
2031	$0	$0	$239,440	$359,770	$284,680

$2,500,000 / (1+0.07)^(2021-2020)

(239,440+359,770) / (1+0.07)^(2024-2020)

(239,440+359,770) / (1+0.07)^(2031-2020)

Hypothetical Example #1

- 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
2021	$2,500,000	$2,336,449	$0	$0	$0
2022	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0
2024	$0	$0	$239,440	$359,770	$457,134
2025	$0	$0	$239,440	$359,770	$427,228
2026	$0	$0	$239,440	$359,770	$399,279
2027	$0	$0	$239,440	$359,770	$373,158
2028	$0	$0	$239,440	$359,770	$348,746
2029	$0	$0	$239,440	$359,770	$325,931
2030	$0	$0	$239,440	$359,770	$304,608
2031	$0	$0	$239,440	$359,770	$284,680
TOTAL		**$2,336,449**			**$2,920,764**

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
	=	$2,920,764	-	$2,336,449
	=	**$584,315**		

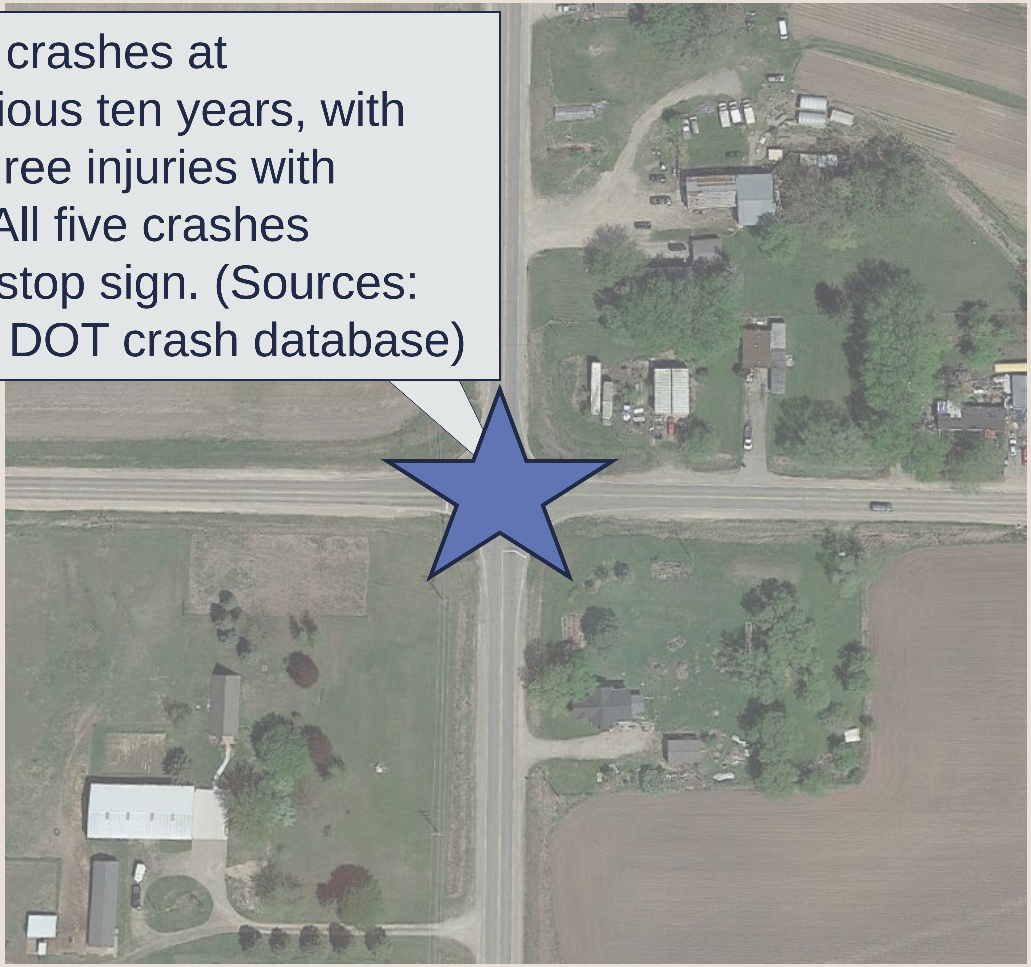
$$\text{Benefit-Cost Ratio (BCR)} = \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} = \frac{\$2{,}920{,}764}{\$2{,}336{,}449} = \mathbf{1.3}$$

Hypothetical Example #2

Proposed Project: Replace a rural stop-controlled intersection with a roundabout.
Project Cost: $3.0 million

Hypothetical Example #2

Crash history: Five crashes at intersection in previous ten years, with two fatalities and three injuries with severity unknown. All five crashes involved running a stop sign. (Sources: FARS report, State DOT crash database)



Approach

- The main benefits appear to be safety-related (though there could also be travel time savings), and the proposed project is expected to reduce crashes at the intersection.
- Safety benefits in a given year will be the difference in safety/crash costs between the No-Build Scenario and the Build Scenario.

Annual Safety Benefits*	=	Annual No-Build Scenario Safety Costs*	-	Annual Build Scenario Safety Costs*

*Undiscounted.

Safety Benefits

- **To start, we need to estimate a baseline of crashes for the no-build scenario:**

$$\text{Annual No-Build Scenario Safety Costs*} = \left[\text{Average Fatalities Per Year} \times \text{Value of Statistical Life}\right] + \left[\text{Average Injuries Per Year} \times \text{Injury Value (Severity Unknown)}\right]$$

*Undiscounted.

Safety Benefits

- **To start, we need to estimate a baseline of crashes for the no-build scenario:**

$$\text{Annual No-Build Scenario Safety Costs*} = \left\{\text{Average Fatalities Per Year} \times \text{Value of Statistical Life}\right\} + \left\{\text{Average Injuries Per Year} \times \text{Injury Value (Severity Unknown)}\right\}$$

$$= \left\{\frac{\text{2 Fatal}}{\text{10 Years}} \times \qquad \right\} + \left\{\frac{\text{3 Injuries}}{\text{10 Years}} \times \qquad \right\}$$

We take our baseline crash data from FARS or another crash database.

*Undiscounted.

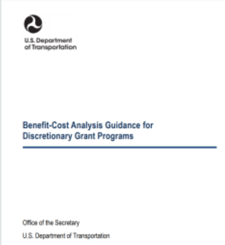
Safety Benefits

- To start, we need to estimate a baseline of crashes for the no-build scenario:

$$\text{Annual No-Build Scenario Safety Costs*} = \left\{ \text{Average Fatalities Per Year} \times \text{Value of Statistical Life} \right\} + \left\{ \text{Average Injuries Per Year} \times \text{Injury Value (Severity Unknown)} \right\}$$

$$= \left\{ \frac{\text{2 Fatal}}{\text{10 Years}} \times \$9{,}600{,}000 \right\} + \left\{ \frac{\text{3 Injuries}}{\text{10 Years}} \times \$174{,}000 \right\}$$

USDOT BCA Guidance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*Undiscounted.

Safety Benefits

- **To start, we need to estimate a baseline of crashes for the no-build scenario:**

$$\text{Annual No-Build Scenario Safety Costs*} = \left\{ \text{Average Fatalities Per Year} \times \text{Value of Statistical Life} \right\} + \left\{ \text{Average Injuries Per Year} \times \text{Injury Value (Severity Unknown)} \right\}$$

$$= \left\{ \frac{\text{2 Fatal}}{\text{10 Years}} \times \$9{,}600{,}000 \right\} + \left\{ \frac{\text{3 Injuries}}{\text{10 Years}} \times \$174{,}000 \right\}$$

$$= \$1{,}972{,}200 \text{ Per Year}$$

*Undiscounted.

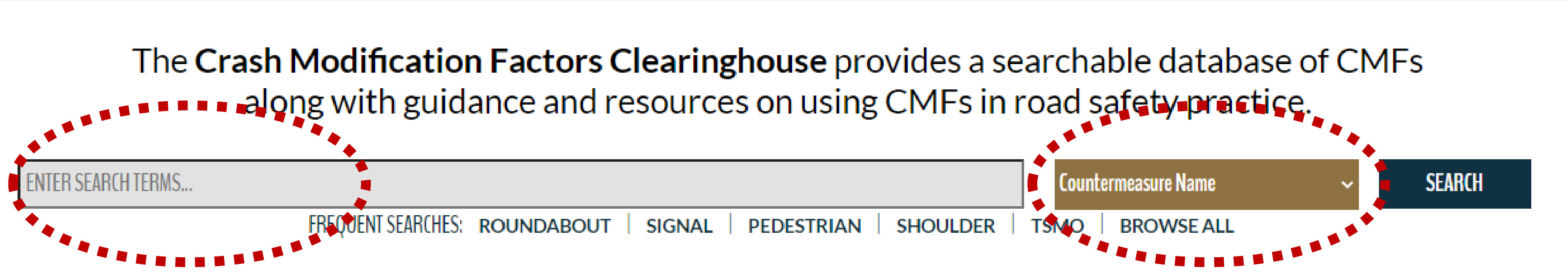
Safety Benefits

- To estimate safety costs under the build scenario, we're going to need a crash modification factor (CMF).
- This factor assists us in estimating what change in crashes a proposed transportation safety project will have.

Annual Build Scenario Safety Costs = Annual No-Build Scenario Safety Costs x Crash Modification Factor (CMF)

Crash Modification Factors

- One useful source for CMFs is the Crash Modification Factors Clearinghouse:
  - http://www.cmfclearinghouse.org/
- Simply enter project keywords in the search bar on the main page to see if there is a CMF readily available.
  - Hint: It's helpful to switch the default "Countermeasure Name" to "All Fields" to widen search results.



Crash Modification Factors

- In this example we've searched "roundabout."
- Under "Intersection geometry" -> "Intersection geometry reconfiguration" we find "Convert high-speed rural intersection to roundabout," an appropriate category for our proposed example project.

Countermeasure: Convert high-speed rural intersection to roundabout

Compare	CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
☐	0.33	67	★★★★☆	All	All	Rural	ISEBRANDS, 2012	
☐	0.13	87	★★★★☆	All	Serious injury,Minor injury	Rural	ISEBRANDS, 2012	
☐	0.17	83	★★★☆☆	Angle	All	Rural	ISEBRANDS, 2012	
☐	0.85	15	★★★☆☆	Rear end	All	Rural	ISEBRANDS, 2012	

Crash Modification Factors

Countermeasure: Convert high-speed rural intersection to roundabout

Compare	CMF	CRF(%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
☐	0.33	67	★★★★☆	All	All	Rural	ISEBRANDS, 2012	
☐	0.13	87	★★★★☆	All	Serious injury,Minor injury	Rural	ISEBRANDS, 2012	
☐	0.17	83	★★★☆☆	Angle	All	Rural	ISEBRANDS, 2012	
☐	0.85	15	★★★☆☆	Rear end	All	Rural	ISEBRANDS, 2012	

- **Pay attention to the star rating (the higher the better), the types of crashes, crash severity, and area types.**
- **In this example, the top CMF is most appropriate for our rural project, since it's the most generalized for our data.**

Safety Benefits

- Clicking the CMF will open up more details, including its ID number.
- The top CMF was #4695, with a CMF of 0.33, a crash reduction factor of 67 percent.

Annual Build Scenario Safety Costs*	=	Annual No-Build Scenario Safety Costs	x	Crash Modification Factor (CMF)
	=	$1,972,200	x	0.33
	=	$650,826 Per Year		

*Undiscounted.

Safety Benefits

- **Now we compare the no-build scenario and build scenario safety costs to get at our annual safety benefit.**

Annual Safety Benefit*	=	Annual No-Build Scenario Safety Costs*	-	Annual Build Scenario Safety Costs*
	=	$1,972,200	-	$650,826
	=	$1,321,374 Per Year		

*Undiscounted.

Hypothetical Example #2

- Assume construction in 2021, ten years of project operations, and for simplicity no traffic growth.

Year	Capital Cost		Safety Benefits	
2021	$3,000,000		$0	
2022	$0		$1,321,374	
2023	$0		$1,321,374	
2024	$0		$1,321,374	
2025	$0		$1,321,374	
2026	$0		$1,321,374	
2027	$0		$1,321,374	
2028	$0		$1,321,374	
2029	$0		$1,321,374	
2030	$0		$1,321,374	
2031	$0		$1,321,374	

Hypothetical Example #2

- **Next we discount costs and benefits using a 7% discount rate.**

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

Year	Capital Cost	Discounted Costs	Safety Benefits	Discounted Benefits
2021	$3,000,000	$2,803,738	$0	$0
2022	$0	$0	$1,321,374	$1,154,139
20[illegible]	[illegible]	$0	$1,321,374	$1,078,635
2024	$0	$0	$1,321,374	$1,008,070
2025	$0	$0	$1,321,374	$942,121
2026	$0	[illegible]	[illegible]	$880,487
2027	$0	[illegible]	[illegible]	$822,885
2028	$0	$0	$1,321,374	$769,052
2029	$0	$0	$1,321,374	$718,740
2030	$0	$0	$1,321,374	$671,720
2031	$0	$0	$1,321,374	$627,775

$3,000,000 / (1+0.07)^(2021-2020)

1,321,374 / (1+0.07)^(2025-2020)

1,321,374 / (1+0.07)^(2031-2020)

Hypothetical Example #2

- Next we sum discounted costs and benefits to get total discounted costs and total discounted benefits.

Year	Capital Cost	Discounted Costs	Safety Benefits	Discounted Benefits
2021	$3,000,000	$2,803,738	$0	$0
2022	$0	$0	$1,321,374	$1,154,139
2023	$0	$0	$1,321,374	$1,078,635
2024	$0	$0	$1,321,374	$1,008,070
2025	$0	$0	$1,321,374	$942,121
2026	$0	$0	$1,321,374	$880,487
2027	$0	$0	$1,321,374	$822,885
2028	$0	$0	$1,321,374	$769,052
2029	$0	$0	$1,321,374	$718,740
2030	$0	$0	$1,321,374	$671,720
2031	$0	$0	$1,321,374	$627,775
TOTAL		**$2,803,738**		**$8,673,624**

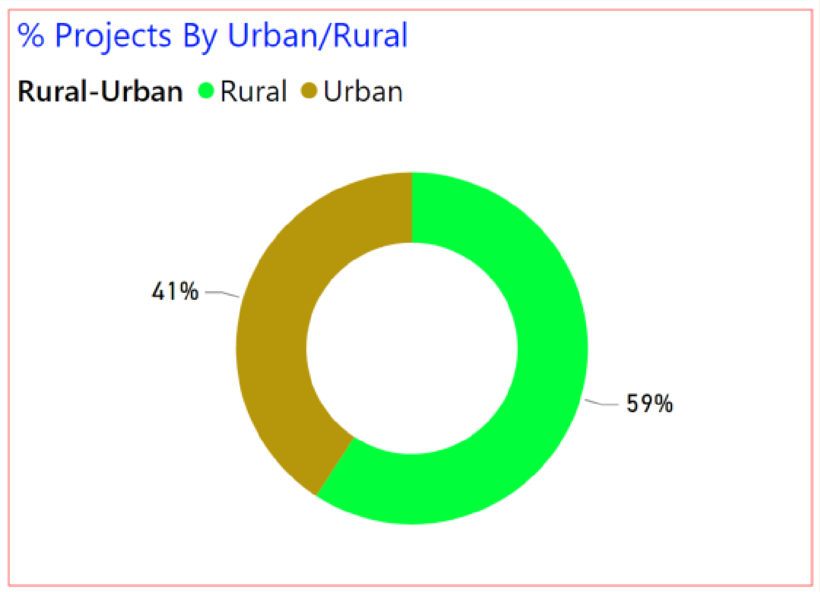
Results – The NPV and BCR

- **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
	=	\$8,673,624	-	\$2,803,738
	=	**\$5,869,886**		

$$\text{Benefit-Cost Ratio (BCR)} = \frac{\text{Total Discounted Benefits}}{\text{Total Discounted Costs}} = \frac{\$8{,}673{,}624}{\$2{,}803{,}738} = \mathbf{3.1}$$

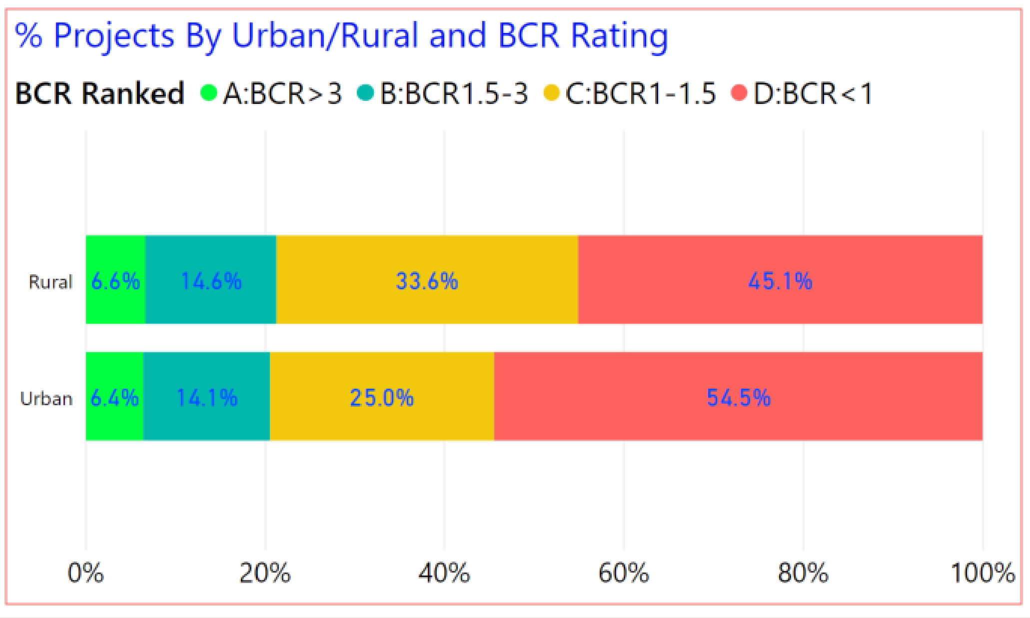
BUILD Grant Applications



- Rural* projects represented roughly 59 percent of BCAs reviewed from 2019-2020 under the BUILD Grant Program.

*Rural defined here as located outside a census-designated urbanized area with a population greater than 200,000.

BUILD Grant Applications



- **The distribution of BCR ratings given by the Department is similar for rural* and urban projects.**

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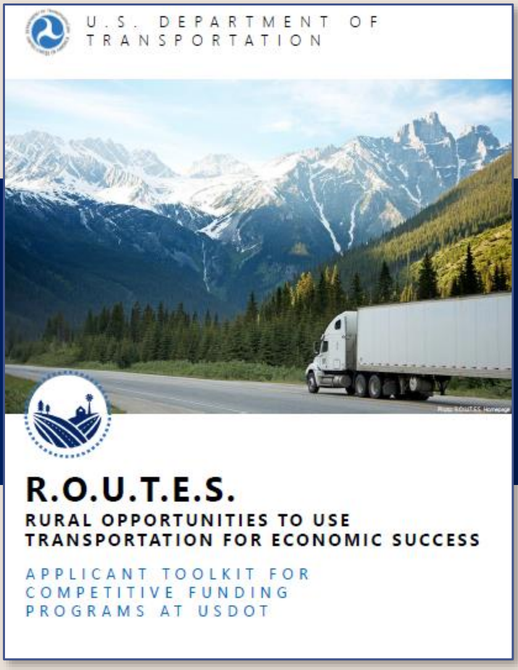
*Rural defined here as located outside a census-designated urbanized area with a population greater than 200,000.

Questions?

Applicant Toolkit



Applicant Toolkit

We will walk through three major sections of the Applicant Toolkit in these training modules and we encourage you to review the other sections on your own.

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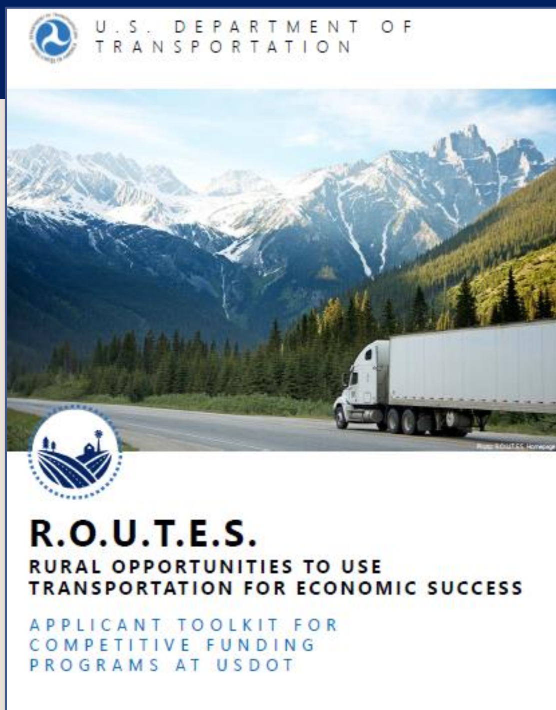
TRAINING MODULES

USDOT Discretionary Grant Process & Applicant Roadmap: Illustrates applicant and USDOT activities during each stage of the funding lifecycle (p.14)

USDOT Discretionary Grant Funding Matrix: Organizes grant programs by eligible applicant and project type for easy reference (p.17)

Maximizing Award Success: Outlines how to navigate program Notices of Funding Opportunity and key application components such as a benefit-cost analysis (p.73)

www.transportation.gov/rural/toolkit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