NORTH CAROLINA
Department of Transportation

NCDOT Research Implementation Analysis: Evaluation and Benefit / Costs

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Connecting people, products and places safely and efficiently with customer focus, accountability and environmental sensitivity to enhance the economy and vitality of North Carolina

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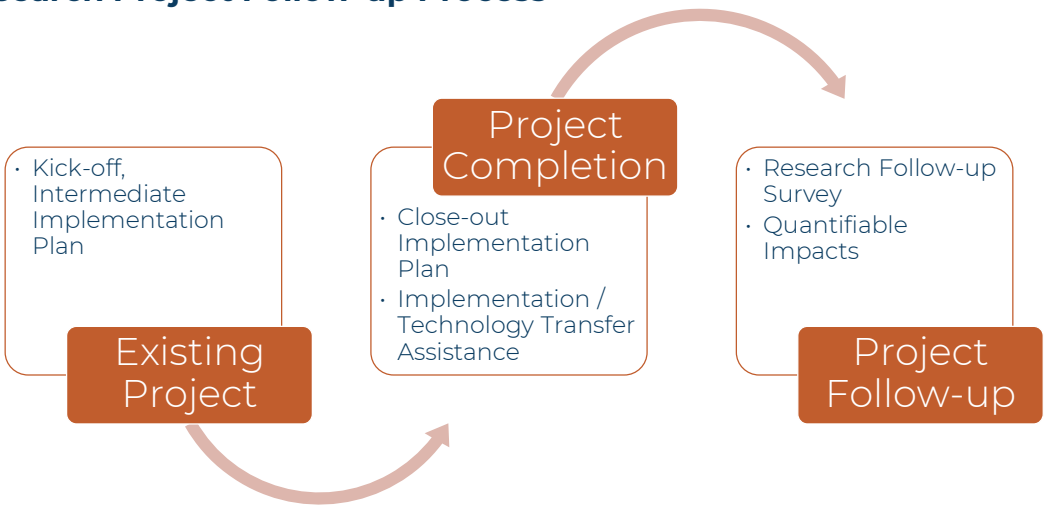


Criteria for Research Post Project Evaluation

Eligible Projects

- 1 – 18 months following completion of the Research Project

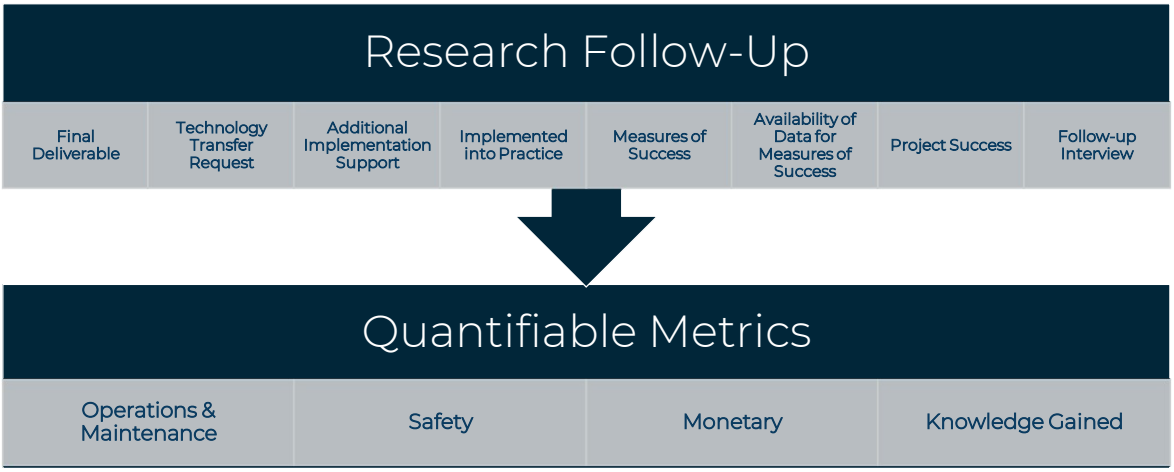
Who do we contact

- Project Champions / Chairs / Principal Investigators

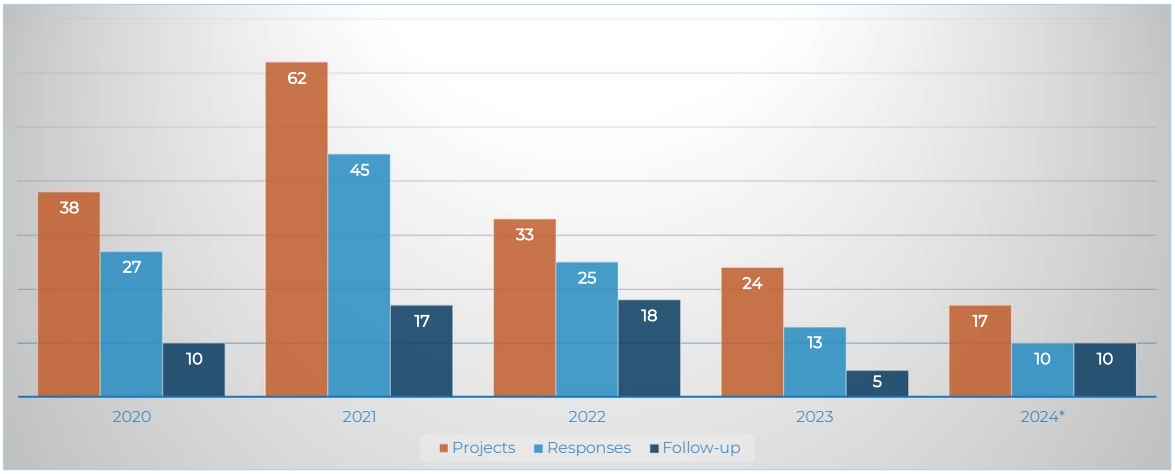
How Often

- Annually / Biannually

Survey Questions

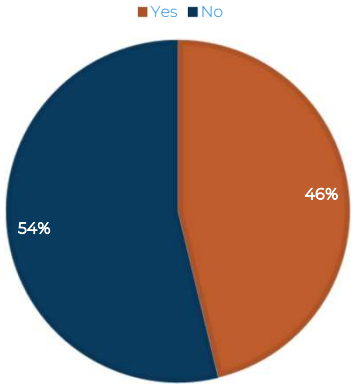


Research Follow-up Survey Participation

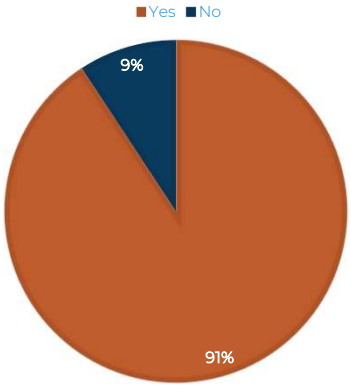


Project Evaluation Initiative (2020 – 2024)

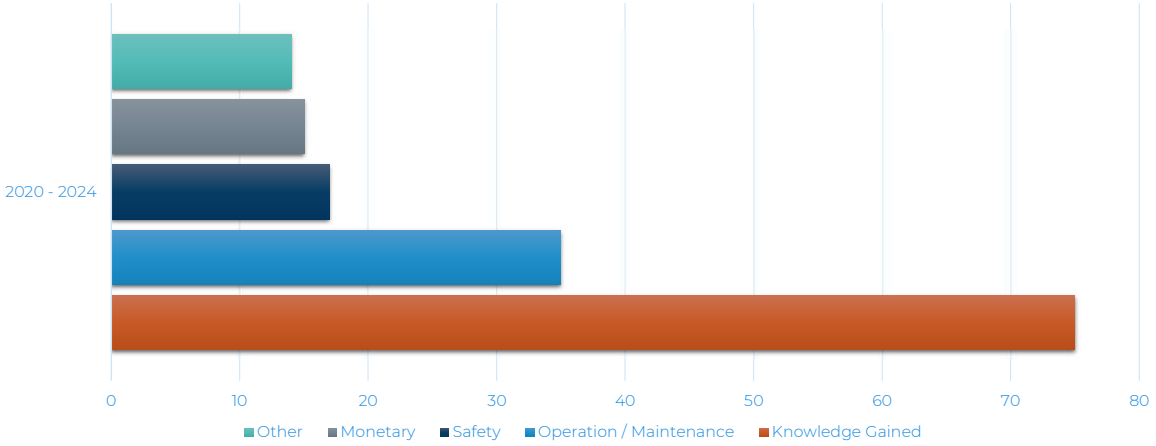
PROJECT IMPLEMENTATION



PROJECT SUCCESS



Measures of Success



Research Follow-up Update

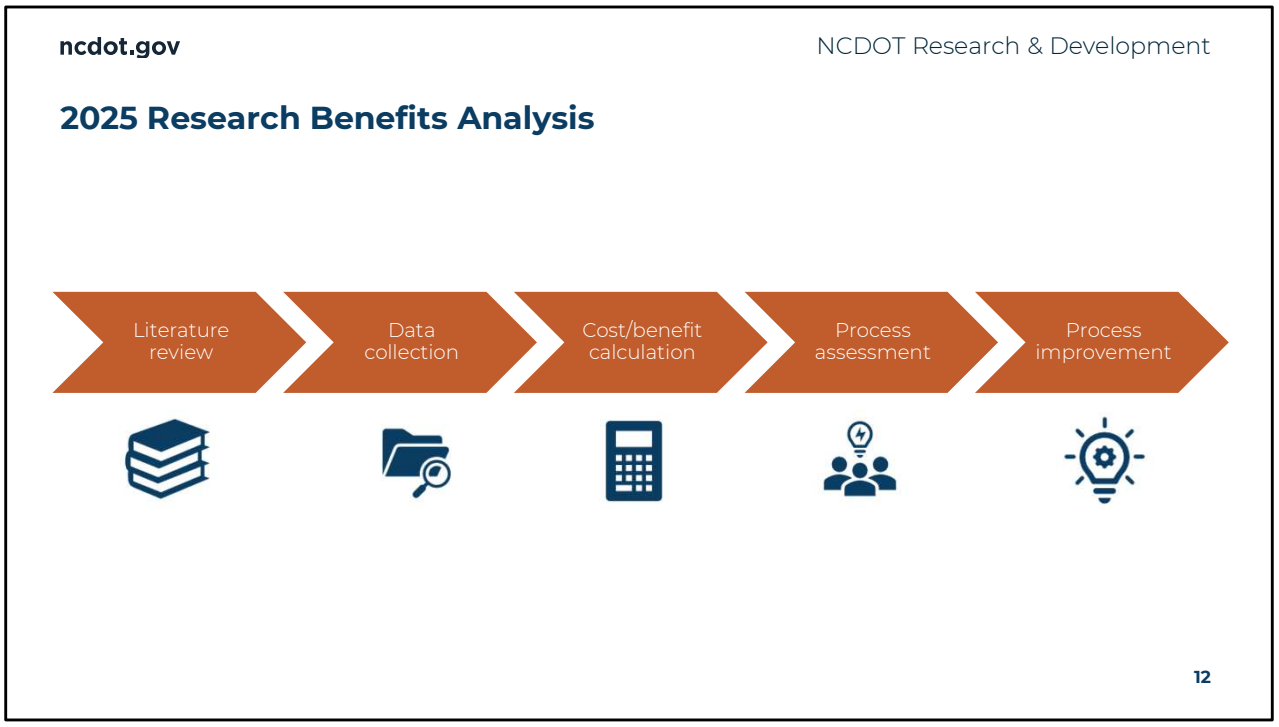
Why do we need to improve our Research Benefits Analysis?

1. 
Difficulty in Gathering Data

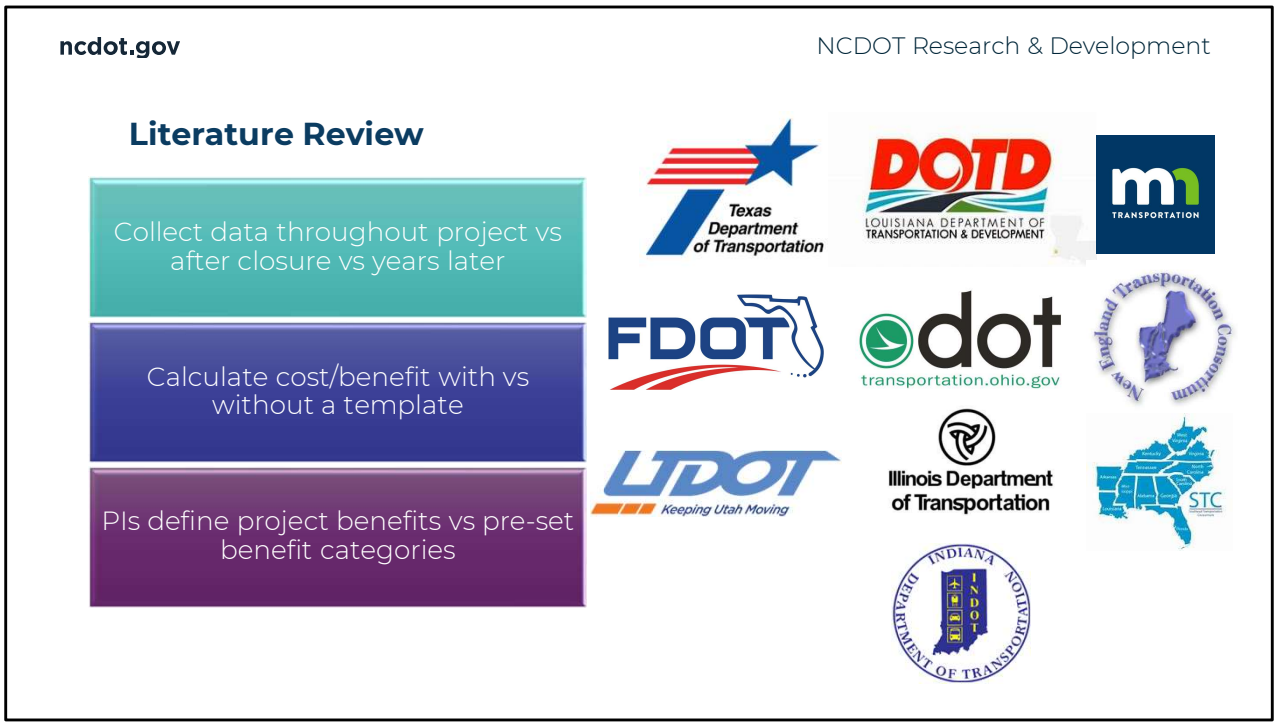
2. 
Needed More In-Depth Analysis

3. 
Increasing Focus on Tangible Benefits/ROI

4. 
Validate Survey Results / Responses



Goal: Evaluate the benefits of implemented research to demonstrate the investment's value and justify future funding for impactful projects



- We conducted a literature review to assess how other state Departments of Transportation (DOTs) evaluate their research programs
- Reports, presentations, and templates from 10 DOTs were reviewed
- Reports, presentations, and templates from **10 DOTs** were reviewed to evaluate how qualitative and quantitative cost/benefit data were collected, the analysis methodology, and how benefits were communicated
- DOTs were grouped by their overall strategy:
    - Real-time cost/benefit analysis of every project
    - Periodic cost/benefit analysis of the whole program
    - Periodic cost/benefit analysis of select projects
- For each agency, evaluated their methodology and pros/cons of the strategy, with a tailored focus to the applicability to the R&D unit's objectives
- Literature review concluded with a recommendation of what elements of different DOTs' methodologies to integrate to NCDOT's practices

Through our literature review, we found that there were many trade-offs at play in deciding our research benefits strategy:

- When you collect data throughout the project or right after closure, that's a bigger lift on PIs but can allow you to capture more data. Capturing data years later is a bigger lift in calculating the benefits since it can be hard to identify active staff who can provide the data
- Allowing PIs to define project benefits might make them fit the project better, but run the risk of methodology not being standardized
- Similar with a template—could provide more rigidity but methodology is then standardized
- When you capture as many types of benefits as possible, you can find more benefits but run the risk of methodology concerns. Conversely, if you keep the analysis focused on benefits that are easy to quantify, you might not capture as many benefits but your methodology might be less susceptible to critiques

These are some of the factors we considered when we discussed the tradeoffs:

- Level of effort
- How many types of benefits are captured
- Data reliability
- Methodology standardization
- Sustainable methodology

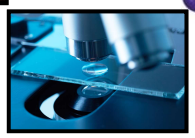
NCDOT Follow-up Approach

Overall Methodology

Project Implementation

Research Evaluation Surveys

Benefit and Cost Analysis



Quality Assurance / Quality Control Analysis

Add QA / QC Analysis

Literature Review - Recommendation

1. Adapt the New England Transportation Consortium's **cost/benefit tool**
2. Integrate a **decision-tree framework** to guide project teams to the best way to communicate their project's benefits
   - Which benefit categories apply: If so, qualitatively, quantitatively, or a combination?

For each sub-category, if there is a corresponding qualitative or quantitative benefit for your project, provide the phase and narrative in the applicable cells.

Applicable Phase			Category	Sub-Category	Description	Storytelling/Qualitative Narrative (if applicable)	ROI/Quantitative Narrative (if applicable)	If quantitative, data source/notes
Planning /design	Installation /construction	Operation /maintenance						
x			Engineering & administrative costs	Engineering & administrative costs	Costs related to planning & designing			
	x		Construction Costs	Direct labor costs	Direct labor costs for construction/installation/establishment			
	x			Material & Equipment costs	Material & equipment costs for construction/installation/establishment			
		x	Operation & Maintenance Costs	Direct labor costs	Direct labor costs for operation & maintenance			
		x		Material & Equipment costs	Material & equipment costs for operation & maintenance			
x	x	x	Lifecycle Costs	Lifecycle costs	Costs related to change in average lifecycle			
			Road User Costs	Road user costs	Costs related to time and money of road users			
			Safety costs	Safety costs	Costs related to reduction of crash frequency/severity			
			Environmental costs	Direct labor costs	Direct labor costs related to treating/recycling wastes, hazardous materials			
				Material & Equipment costs	Materials & equipment costs related to treating/recycling wastes, hazardous materials			
				Emission & Pollution Costs	Costs related to pollution caused by emission, wastes, hazardous materials			
			Risk management costs	Risk management costs	Costs related to tort liability, fines			
			Others	Others	Other costs			

- Among the recommendations included adaptation the New England Transportation Consortium's cost/benefit tool
  - We chose to leverage a tool because it was important to us to standardize how we calculate projects' cost/benefits
- As a quantitative analysis is not necessarily the best fit for every projects, we decided to integrate a decision-tree framework similar to Ohio DOTs' to guide project teams to what the best way is to communicate their benefits (what benefit categories, and qualitatively, quantitatively, or a combination)

3 Pilot of Benefit / Cost Tool

Title

Mechanically-Fastened FRP to Retrofit Existing Prestressed Concrete Bridge Beams

Description

Rapid and easy-to-install repair that allows bridges with deteriorated beams to stay open for traffic until replacement, rather than being closed for 3-5 years.

Factors

- Materials / Labor cost of retrofit
- Traffic volume over treated bridges
- Cost of a detour per vehicle

Benefit / Cost Ratio

608:1

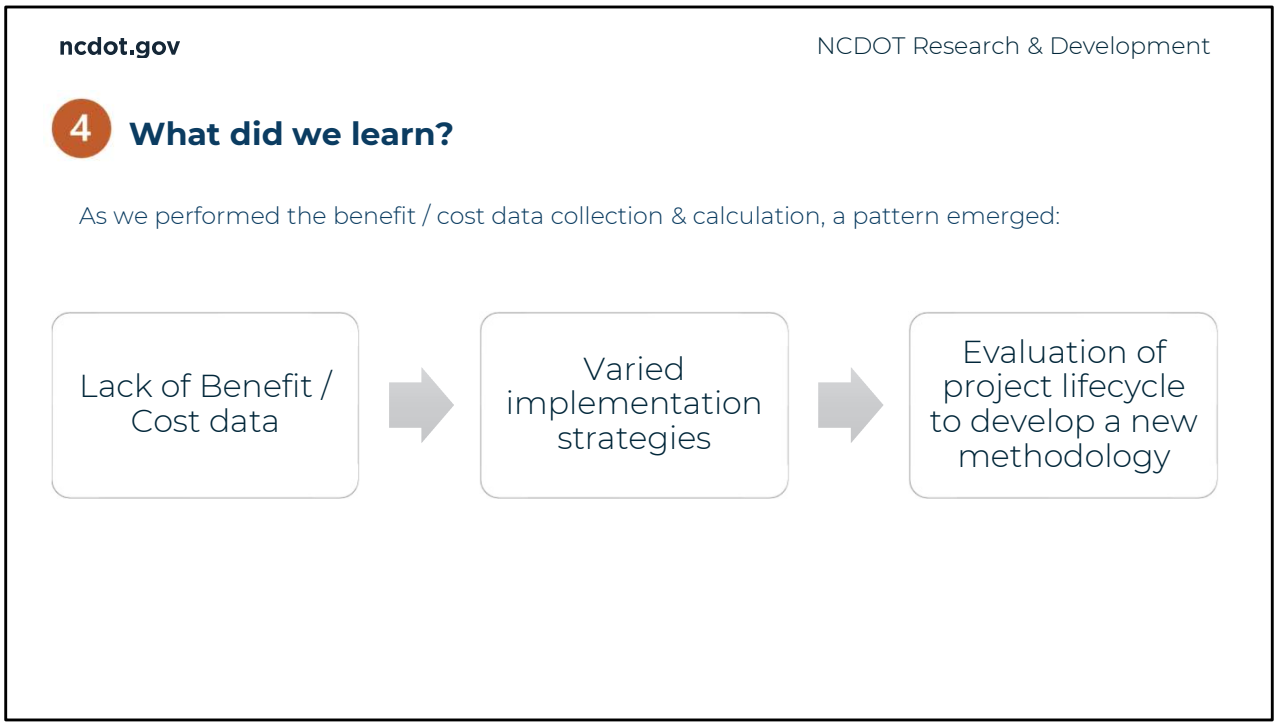
INPUTS	
Labor hours per beam (both stems)	16
Cost per beam (2025)	$1,977
Labor rate (2025)	$20.00
Average detour cost per vehicle per way (2025)	$23

COST CALCULATION	
Project	
Cost of project materials + labor (2025)	$25,267
Project cost (2025)	$214,257

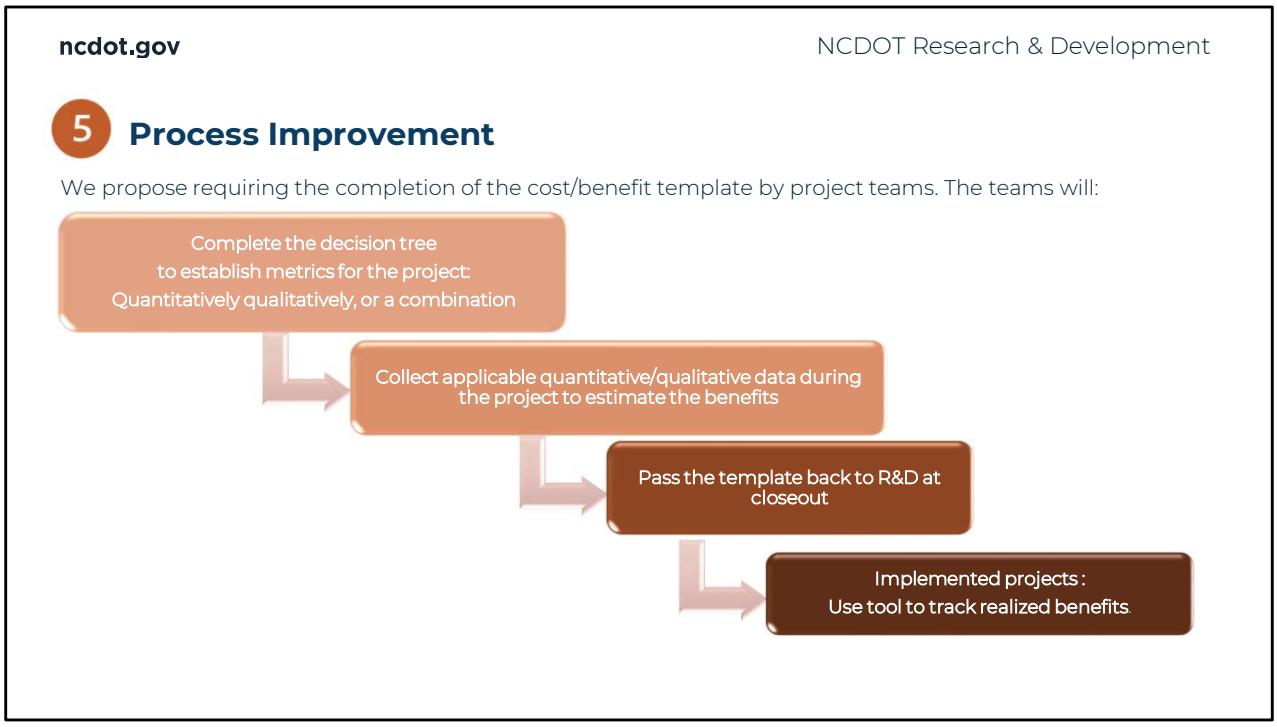
BENEFIT CALCULATION	
Benefit of no detour	$130,290,400
Materials + labor discount of project method	($25,267)
Total benefit	$130,265,133
Project benefit-cost	**$130,050,876**
Project benefit/cost ratio	**608:1**

NOTES
Average daily traffic from NCDOT 2023 Interactive Traffic Volume Map
Crane & Project materials & labor not included a total cost to not double count, as it is used in the materials + labor discount calculation
Average detour cost per vehicle calculated by Cavalline et al. (2015)
Alternative method referenced is a C-channel type beam replacement
2025 labor rate from General Decision NC20250088
This retrofit allows bridges to be open for the 3-5 years where they are usually closed; I used the midpoint, 4 years, for the estimation of the detour cost savings.

Lessons Learned / Future Modifications



- When data are not collected during the project or immediately after closure, the data collection lift is shifted to years after the project concludes → finding active staff to help is difficult
- Implementation varied because:
  - Priorities can shift between during the project and implementation → are we understanding our target audience?
  - Different divisions have different priorities
  - The gap between the project's recommendation and actual implementation made us unable to leverage any estimations from the reports



Benefits of this recommendation:

Audit-Proof Calculations: Template maintains full data traceability and calculation methodology is standardized

Capture more projects' benefits: By introducing the template at kick-off, project teams are aware of our goal and required data before the project begins, so can plan to collect the applicable during the project

Intact Teams: Since the template is passed back to R&D following closeout, if data quality concerns or missing information arise, the R&D team can resolve with the actual project teams, not different staff years later

Thank you!

https://connect.ncdot.gov/projects/research/Pages/default.aspx

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