

Background

As transportation systems become increasingly complex, there is a growing recognition of the need for a transdisciplinary approach to develop holistic and multimodal solutions.



- However, the way to operationalize synergies between siloed engineering and non-engineering disciplines to develop these solutions remains opaque and ad hoc.
- Thus, identifying existing synergies and gaps between engineering and non-engineering disciplines is crucial for informing the development of a transdisciplinary transportation workforce. The research questions this study sought to answer are:
 - RQ1. Disciplinary synergies: What are the most common disciplinary areas that are currently being incorporated well within the transportation sector?
 - RQ2. Disciplinary silos: What are the most common disciplinary areas that need bridging to meet the future needs of the transportation sector?

Data & Methods

We employed a Qualtrics survey with two open-ended questions.

70 transportation sector experts explained where they believe disciplinary synergies and silos currently exist.

Survey questions as informed by the study research questions

- Which disciplinary areas (i.e., civil engineering, economics, social sciences, etc.) do you believe are most effectively being bridged and/or integrated currently in the transportation sector to address the transportation challenges you mentioned earlier?
- Which disciplinary areas are not currently being bridged and/or integrated effectively in the transportation sector (i.e., they are siloed disciplines) to address the transportation challenges you mentioned earlier?

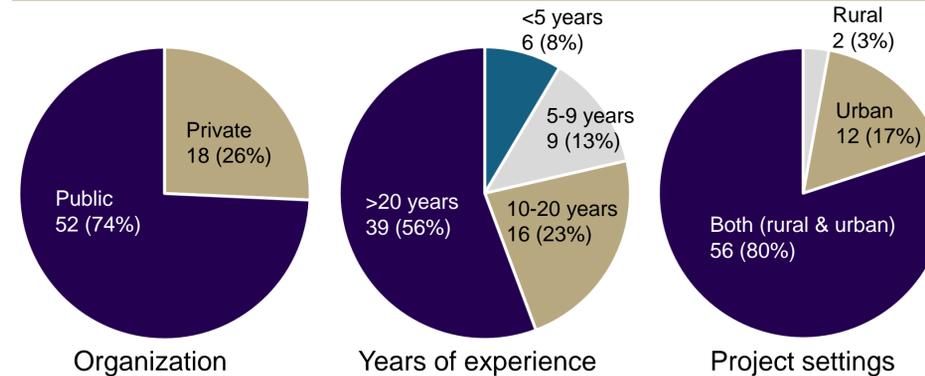


qualtrics.^{XM}

Data collection and analysis structure



Results



Survey Respondents - Sector and Experience Attributes

Approximately 65% of these respondents were from WSDOT, with the remainder representing DOTs from Ohio, Oregon, California, Colorado, Michigan, South Dakota, and Utah. The respondents hold a wide range of positions.

Summary of Code-counts (participant references) for Disciplinary Synergies (n = 69)

| Coded Disciplinary Synergy | Frequency |
|-----------------------------|-----------|
| Civil Engineering | 14 |
| Computer Science | 12 |
| Transportation Planning | 9 |
| Environmental Sciences | 6 |
| Social Sciences | 6 |
| Technology Integration | 6 |
| Economics | 4 |
| Safety | 4 |
| Transportation Equity | 4 |
| Electrical Engineering | 3 |
| Mechanical Engineering | 3 |
| Project Management | 3 |
| Computer Engineering | 2 |
| GIS | 2 |
| ITS | 2 |
| Policy Development | 2 |
| Structural Engineering | 2 |
| Traffic Engineering | 2 |
| Urban Planning | 2 |
| Health Sciences | 1 |
| Information Technology (IT) | 1 |
| Material Sciences | 1 |
| Multidisciplinary Research | 1 |

Civil Engineering is related primarily to the structural engineering sub-discipline given the close tie with transportation infrastructure; however, survey participants also mentioned the nexus with other sub-disciplines including environmental engineering and the integration of civil engineering technology and modeling.

Participant reference to *Computer Science* related to artificial intelligence and machine learning, enhancing safety, asset management, and real-time traffic solutions. Participants mentioned that this collaboration is evident in the development of intelligent transportation systems (ITS) and the use of robust computer modeling for various transportation disciplines.

Transportation Planning rounded out the top 3 referenced disciplinary synergies.

Results

Summary of Code-counts (participant references) for Disciplinary Silos (n = 61)

| Coded disciplinary silo | Frequency |
|------------------------------------|-----------|
| Social Sciences | 17 |
| Economics | 11 |
| Computer Science | 11 |
| Transportation Planning | 8 |
| ITS | 4 |
| Transportation Equity | 3 |
| Urban Planning | 3 |
| Civil Engineering | 2 |
| Electrical Engineering | 2 |
| Environmental Science | 2 |
| Health Sciences | 2 |
| Law and Legal Studies | 2 |
| Policy Development | 2 |
| Telecommunications Engineering | 2 |
| Advanced Driver Assistance Systems | 1 |
| Architecture | 1 |
| Construction Management | 1 |
| History | 1 |
| Information Technology | 1 |
| Mechanical engineering | 1 |
| Project Management | 1 |
| Real Estate | 1 |
| Systems Engineering | 1 |
| Technology Integration | 1 |
| Writing and Literature | 1 |

Participants mentioned that bridging *Social Sciences* is crucial for developing user-centered, equitable, and sustainable transportation solutions that consider the diverse needs and values of different communities.

Participants mentioned that *Economics* is essential for addressing the financial impacts of infrastructure demands and achieving a balance between economic feasibility and long-term sustainability goals. This interdisciplinary approach is about equipping transportation planners and engineers to have a better understanding of funding mechanisms, economic development, and the broader societal value of projects, leading to more informed and proactive decision-making.

Computer Science rounded out the top 3 referenced disciplinary silos.

Conclusions & Way Forward

- This study sought to identify and characterize key disciplinary areas that are currently being bridged (synergies) and those that need to be bridged (silos) better in the future.
- This study found that the disciplinary areas where synergies already exist relate to traditional non-transportation civil engineering disciplines (i.e., structural and environmental engineering), application of computer and data science fields, as well as fields in the environmental sciences and sustainability.
- Conversely, areas where disciplinary silos are present include social sciences, economics, transportation planning, as well as computer science, specifically AI and machine learning.
- The study findings indicate that future research and practice should focus on leveraging the promising bridges already forming in areas like computer science, social sciences, and transportation planning.

Acknowledgment

This poster is prepared based on information collected for a research project funded by the US DOT through the Rural Equitable and Accessible Transportation (REAT) Center.

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