LRRB Knowledge Building Priorities (for Fall 2022 RFP)

Background

Knowledge Building (KB) Priorities engage LRRB in identifying long-term challenges that can benefit from research. They generate research that addresses long-term, complex issues to advance the state of knowledge on critical transportation topics.

CTS leads the KB Priorities effort, in partnership with LRRB and MnDOT. LRRB considers innovative research proposals in response to KB Priorities from University of Minnesota faculty and research staff.

KB 1: Environment

Climate change may have major impacts in Minnesota, but what these future impacts could be is unclear. More extreme weather events and increased precipitation could stress transportation infrastructure and system resiliency. The use, operation and maintenance of transportation services can also affect the environment. Research is needed to understand environmental effects and the impacts of climate change on transportation systems and propose designs and adaptions to address them.

- Use modeling and data to improve forecasting of the magnitude of impacts from extreme weather events.
- Understand transportation impacts holistically as they relate to climate change – design changes, infrastructure damage, higher life-cycle costs, changes in roadside vegetation, management of invasive species, economic impact of road closures, etc.
- Assess flood plain management on a systemic level to clarify how roadway (e.g., drainage, culverts) and road-adjacent infrastructure (e.g., field tiling) contribute to flood management.
- Assess and optimize water quality and hydrologic impact management at a watershed (systematic) level, including placement of treatment where most effective and efficient.
- Investigate better methods for managing sediment and nutrients in runoff from roadways, including understanding the relationships between long-term performance and maintenance of management practices.
- Explore funding mechanisms that are and that ought to be used to address flood plain management based on contributing factors.
- Understand how the transportation sector contributes to greenhouse gas emissions and explore potential mitigation strategies.
- Assess the costs and benefits of environmental permitting processes.
- Identify effective management and treatment approaches to mitigate environmental impacts of snow and ice operations, including the effects of salt and chlorides on groundwater
- Determine how emerging technologies will impact climate change.

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KB 2: Planning

Minnesotans are adapting to rapidly developing technologies and changing demographic trends, especially an aging population and migrations from rural areas to cities and towns. Minnesota is also becoming more diverse and is experiencing greater socioeconomic disparities. Research is needed to help local agencies plan for the issues and options associated with evolving transportation needs.

- Define and measure equity in transportation design, decisions, policies, and services within the context of rural, suburban, and urban communities.
- Assess how transportation can help address socioeconomic disparities that have persisted in recent decades, and determine what fiscal investments are necessary to address them.
- Assess how to incorporate equity into transportation investment decisions.
- Explore the potential roles of transportation in shaping human experience, and incorporate empathy – the understanding of people's lived experiences – into transportation planning.
- Identify how land use policies can shape future development and transportation demand.
- Determine how rural population and related tax base declines will impact rural transportation service.
- Explore and define agency relationships (e.g., permitting, regulating, taxing) and opportunities with Transportation Network Companies (TNCs).
- Determine impacts of shared mobility services on transportation infrastructure and finance (e.g., parking, road network, curb space).
- Explore intergovernmental fiscal arrangements across levels of government or across local jurisdictions in the development of transportation infrastructure.

- Understand local and intercity travel demand and infrastructure investments/operations if high population growth continues in small metropolitan areas.
- Explore potential roles for local transportation agencies in supporting infrastructure for electric vehicles.
- Explore potential impacts that disruptions (e,g, innovative and emerging technologies, natural disasters, climate change, or pandemics)may have on strategic planning, service delivery, and performance of transportation agencies.
- Determine how to plan for autonomous vehicle deployments to achieve synergistic benefits in social equity, environmental sustainability, and economic prosperity.
- Understand how connected and automated vehicles will impact community development and redevelopment.

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KB 3: Traffic and Safety

Transportation management and operations is evolving as communities experience new transportation services and changing demands from the public and business community. Such changes have the potential to generate more traffic and impact mobility. Additionally, Minnesota has reached a plateau in its journey Toward Zero Deaths that drives a need to explore new safety improvement opportunities. Research is needed to help local agencies learn about future traffic and safety impacts and how best to manage them.

- Explore how new and evolving sources of data can be established and used for traffic management and operations.
- Determine public sector role in managing low altitude air space, which could reduce congestion on streets and highways but create new challenges with local air space.
- Assess how decreases in per-capita vehicle miles traveled in the Twin Cities will affect investments in transit, bicycling, walking, and shared mobility infrastructure.
- Explore how increased per-capita vehicle miles traveled in Greater Minnesota will affect transportation investments.
- Assess how expanded legalization of marijuana and increased opioid abuse will impact impaired driving and appropriate safety responses.
- Identify causes of and appropriate strategies to address increasing motorcycle, bicycle, and pedestrian crashes.
- Explore new safety strategies to drive further reductions in traffic deaths.
- Assess the traffic flow implications of increased vehicle automation on Minnesota roads.
- Investigate the impact of connected and automated vehicles on roadway safety and personal security.

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KB 4: Connected and Automated Vehicles (CAV)

Vehicles are increasingly connected, and features to support automation are being introduced by automobile manufacturers. This will have policy and engineering implications for transportation. Research is needed to help local agencies explore their role in providing supporting infrastructure and how to potentially leverage connectivity and automation to improve transportation operations and safety.

- Identify how CAV can positively vs. negatively impact equity in transportation design, decisions, policies, and services within rural/suburban/urban communities and transportation-challenged populations (e.g., elderly, people with disabilities, low-income).
- Explore how automation could be used for transportation functions that require worker interaction with traffic (e.g., traffic control, roadway testing) on local roads.
- Explore how driver-assist-equipped vehicles will influence traffic and safety on Minnesota roads.
- Consider how CAV technology will overcome the challenges posed by Minnesota's winter weather.
- Understand how CAVs may change traditional roadway hierarchy and related network planning, management and operation.
- Assess the budgetary implications of CAV on the development of transportation infrastructure, as well as long-term impacts on infrastructure management, operations, and maintenance.
- Determine likely scenarios and implications related to the transition toward CAV, including the interaction of traditional vehicles and CAV during the transition, legal and policy implications, and public attitudes towards emerging technologies.
- Explore the regulatory framework of CAV at the state and local level.
- Determine if and how CAVs may operate on rural lower volume or even gravel roadways.
- Assess how traditional infrastructure may change or be repurposed to support automated and shared mobility, particularly during the transition to these technologies..
- Explore how CAV will impact residential and commercial development.
- Identify how and where AVs may impact congestion on local roads.
- Understand local government roles for influencing and managing CAV implementation.
- Explore how CAV will impact recreation/tourism travel to rural areas.

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KB 5: Materials

Identifying optimal materials for roadway and bridge construction and maintenance remains essential to local agencies as cost-effectiveness, life-cycle performance, and environmental impact are of continued importance. Monitoring the performance of various materials is another variable for agencies to understand and manage. Research is needed to continue exploring alternative materials and monitoring options to improve transportation performance.

- Explore new approaches that allow for year-round pavement performance monitoring.
- Identify pavement materials that could minimize or eliminate the need for chemical deicing (e.g., additives that generate heat).
- Determine how precision driving by automated vehicles could impact pavement materials.
- Understand how material selections impact construction and maintenance needs in relation to life-cycle performance.
- Explore new certification and warranty processes to support faster implementation into practice.
- Determine how long materials may be expected to last, especially considering varied use and environmental conditions.
- Investigate new materials, such as plastic additives, for greater resilience in local roadways and bridges.

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KB 6: Design and Construction

Roadway design and construction are constantly evolving to meet changing needs due to factors such as new traffic patterns, advancements in vehicle designs, new materials, increasing material and labor costs, and stricter safety standards. Design and construction methods and standards must also incorporate a system-wide approach to achieve maximum efficiency and effectiveness in meeting varied and multimodal transportation demands. Research is needed to identify design and construction changes that will optimize transportation services.

- Determine how to incorporate scalable/flexible designs to match available funding priorities.
- Understand how context guidance, environmental justice, accessibility, equity, and connectivity should be factored into design to meet localized needs and effectively manage broader network impacts.
- Explore how design standards can flex to allow for infrastructure adaptation and resiliency following destructive events.
- Identify barriers to use of the safest road designs and how they may be overcome.
- Determine how risk management approaches can be incorporated into design.
- Assess how designs encourage tourism by providing appropriate transportation to facilities designed to attract tourists and to enhance the appeal of tourist destinations.
- Explore new approaches for educating the public when new designs are explored and implemented.
- Identify methods for expediting and modernizing design and construction to deliver high-quality projects faster.
- Investigate the use of intelligent systems for monitoring heavy-axle vehicle frequency on local bridges.
- Assess how design and construction methods may be impacted by connected and automated vehicle technology and infrastructure.

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KB 7: Financial and Asset Management

Transportation needs have continued to outpace available funding. In addition to exploring new funding alternatives, agencies are adopting asset management practices to optimize capital and maintenance investments over the life of transportation assets. Research is needed to explore financial and asset management techniques that will maximize available funding.

- Identify management solutions for asset categories (e.g., pavements, bridges) that will be especially challenging to maintain within funding and satisfaction parameters on the local network.
- Identify approaches for optimizing spending priorities among maintenance, operations, performance, safety, growth, and political factors.
- Assess the trends, patterns, and implications of variable maintenance expenditures at the local level and the impact on local road and bridge conditions.
- Examine changes in vehicle-miles traveled by different road categories and the implications for transportation investment.
- Assess local vs. state agency asset management approaches and standards to establish consistent data parameters and practices.
- Explore opportunities for and effectiveness of additional/new funding sources for local agencies (e.g., sales tax, street utility fees, development impact fees, soil and watershed conservation districts).
- Assess the value and contribution of local agency transportation investments on the broader transportation system.
- Determine if and how declining gas tax revenues and the state's traditional distribution model will impact taxpayers in urban and rural areas.

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