2020 UDOT RESEARCH PROBLEM STATEMENT

Problem Statement deadline is March 16, 2020. Submit statements to UTRAC@utah.gov

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Title: Incorporating Travel Time Reliability into Transportation Project Prioritization Process **No. (Office Use): 20.05.07**

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Select ONE Subject Group ☐ Materials/Pavements ☐ Maintenance ☐ Traffic Mgmt/Safety ☐ Structures/Geotech ☒ Planning ☐ Aeronautics ☐ Public Transportation ☐ Other

1. Write a brief research project objective:

To develop a modeling framework to quantify travel time reliability of future projects and to directly incorporate travel time reliability measures into the transportation project prioritization process.

2. Explain the problem and why this research is important: (*Importance reflects 50% of the statement score*)

Transportation Investment Fund (TIF) is primarily used for capacity improvement. To prioritize candidate projects, transportation agencies have been traditionally focused on improving system efficiency (i.e., travel time). This is typically done by evaluating the potential improvement in average travel time. However, travelers tend to perceive the transportation system performance based on high-delay days instead of based on average travel days. Therefore, it is not sufficient to only know the average (mean) travel time but also the possible travel time variations, typically called travel time reliability (TTR). Common TTR measures include 90th or 95th percentile travel times, buffer index, and planning time index. TTR has been adopted as one of the key traffic operation performance measures for UDOT. TTR of existing roadways can be measured through field data collection and/or big-data probe-vehicle platforms, such as HERE or INRIX. Various traffic management techniques (e.g., incident management, work zone management, and active traffic/demand management) have been proposed to improve travel time reliability. Nevertheless, TTR was largely overlooked in transportation planning (e.g., the project prioritization process). One critical challenge is how to quantitatively access the TTR impacts of candidate projects using existing regional planning models. Essentially, no field data on TTR could be obtained for future projects. In this project, we propose to fill this research gap by developing a TTR prediction procedure for future projects and a modeling framework to directly incorporate TTR measures into the transportation project prioritization process.

3. Describe how the research results will be implemented and benefit Utah: (*Implementation reflects 50% of the statement score*)

The causes of travel time variations have two major sources: demand uncertainty (e.g., day-to-day demand variations) and supply uncertainty (e.g., capacity variations due to weather and incidents). The current practice of transportation planning typically assumes travel demand and road capacity to be deterministic. To capture the inherent variations in travel time, we propose the following TTR prediction procedure using the existing planning models/tools.

Based on historical traffic data (e.g., PeMS and HERE data) and OD tables, we can estimate the probability distributions of OD demands and link capacities. Using Monte Carlo simulation techniques, scenarios can be generated by randomly drawing from the distributions of OD demands and link capacities. Once the scenario set is generated, each scenario (a fixed OD and capacity pattern) will be feed to the traffic assignment module of the planning models and produce/forecast travel time information. By running the models for a relatively large number of scenarios, we can then obtain a synthetic travel time distribution. By comparing the travel time information generated by the nominal (i.e., mean) distribution/scenario, TTR measures (e.g., buffer time index) can be obtained.

We propose two potential approaches to utilize the above mentioned TTR predication procedure to prioritize transportation projects: (1) A TTR index can be quantitatively obtained for each candidate project. This index can be directly incorporated in the current TIF highway project prioritization model. (2) A more advanced TTR-based network design model. This model will directly maximize this probability that the total travel time will not exceed a certain threshold (a classical definition of TTR) in the framework of network design. A genetic algorithm (GA)-based multi-objective optimization model will be developed in conjunction with the TTR prediction procedure to select/prioritize candidate projects in the regional transportation network. The benefit of this more advanced approach is it explicitly considers the possible interdependency among different candidate projects, and hence will provide a more accurate assessment of the potential reliability impacts of candidate projects.

We envision that proposed models will help UDOT improve the current practice of transportation project prioritization process.

4. List the major research tasks:

1. Undertake a literature review related to travel time reliability and its applications in transportation planning.
2. Develop the travel time reliability prediction procedure.
3. Propose a TTR index that is in line with the current UDOT operation/planning practice using the TTR prediction procedure developed.
4. Develop the TTR-based network design approach and conduct case studies to demonstrate the effectiveness of the proposed models.
5. Work with the UDOT TAC team to provide recommendations to improve the current transportation project prioritization process.
6. Prepare a final report and presentation.

5. List the expected research deliverables (reports, manual, specification, design method, training, video, etc.):

1. A technical report documenting the findings and policy recommendations.
2. A TTR prediction procedure for future projects.
3. A modeling framework that directly incorporates TTR measures into the transportation project prioritization process.

6. Requested from UDOT: $50,000 **Other/Matching Funds:** $50,000 **Total Cost:** $100,000

Briefly explain funding sources: MPC/UTC Funding

7. Outline the proposed schedule, including start and major event dates:

The proposed research will be carried out over a period of 18 months after the project is funded. The project will follow the schedule below:

- Literature review: 2 months
- Development of the TTR prediction procedure development: 3 months
- Development of the TTR-based network design model: 5 months
- Case studies: 3 months
- Project prioritization process improvement: 3 months.
- Report preparation: 2 months