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Project Title: A Multi-Asset Transportation Infrastructure Asset Management Framework And Modeling For Local Governments

Executive Summary: Local governments (LGs) in the United States are managing 3/4 of 4 billion miles of roadway and more than 1/2 of nearly 600,000 bridges, which are critical transportation infrastructure assets that support the mobility, economy, and homeland security on both the local and national levels. To maintain aging infrastructure in a state of good repair under shrinking budgets, LGs must incorporate a systematic approach to conduct cost-effective maintenance, rehabilitation, and reconstruction (MR&R) instead of relying on subjective individual knowledge and experience. Then, benefit from the scarce transportation budget could be maximized; and accountability could be demonstrated to the stakeholders. However, many factors can enable or inhibit the success of transportation asset management (TAM) in LGs, including agency size, organization, staff, budget, and technology. To address the above issues, this research aims to analyze the underlying factors that hinder LGs from adopting a well-defined TAM program through the distribution and analysis of an online survey. The survey investigates the knowledge gaps in TAM within Georgia's LGs. Based on the survey analysis, a multi-asset management guideline was developed for local governments to implement an asset management system. To better manage multiple assets, this research project also explored an innovative framework to maintaining interdependent assets, in which an objective measure was proposed to quantify the effectiveness of the entire transportation network. To demonstrate the benefit of the proposed framework, an interdependency-based mathematical optimization was developed by incorporating traffic capacity models, deterioration models, and treatment improvement models. The preliminary case study showed the promising results of integrating transportation infrastructure interdependency to enhance the objectivity in cross-asset management, improve the efficiency of network-level mobility, and reduce the risk of network failure.

Research Objectives:

The objectives of this project are: 1) to analyze the underlying factors that hinder LGs from adopting TAM to efficiently and cost-effectively maintain their transportation infrastructure assets in the state of good repair; 2) to propose a multi-asset management framework that considers the LGs' particularity in organization, workforce, and funding sources, and the similarity to the corresponding state DOTs; 3) to incorporate the most up-to-date technologies, such as 3D sensing, computer vision, crowdsourcing, cloud computing, GIS/GPS, and mobile and

web applications in asset inventory, condition assessment, and management; and 4) to explore a multi-asset, multi-facility mathematical programming to support the network-level MR&R decision-making.

Online Survey:

This project conducts a comprehensive literature review to explore the basic concept and components of a TAM program, in addition to the current practice at the local and state levels. This review is coupled with the results of an online survey that targeted the local agencies in the state of Georgia in order to validate the status-quo and to identify

the gaps in their TAM practice and shortcomings which are affecting the transportation assets' performance and network efficiency. The findings from this survey showed that few LGs are applying proper TAM practices with main weaknesses in organization, staffing, adopted technologies, available funding and resource allocation. Most local agencies lack a well-structured organizational chart with no roles and responsibilities being clearly set. Also, in addition to the shortage of human resources, the available staff lack the required skillset and training, which also affects the agency's capability of adopting new technologies within its TAM programs. Funding is a major issue facing LGs as their assets' increasing needs are not covered by the shrinking budgets. This is further aggravated by having a simple and subjective decision-making process, which affects the efficiency of resource allocation and contradicts agencies' requests to receive additional funding. No proper communication is being held within the agency itself and with other local and state agencies. Communication with involved stakeholders is also missing as no performance reports are being issued on a regular basis. Thus, TAM programs are still weak in LGs due to many factors which need to be addressed and remedied.

Transportation Asset Management Guideline:

Based on the analysis of the online survey, an asset management guideline was developed to suit the needs and capabilities of local transportation agencies in general, and those within the state of Georgia in particular. This guideline will assist the local agencies in understanding all the components of a proper TAM program, believing in its effectiveness, and knowing where to begin in case of new adoption or else how to ameliorate and develop the current practice. The guideline presents the TAM framework proposed by FHWA showing its critical components which are discussed in detail throughout the document. It also focuses on the importance of having a well-established organizational structure and the role that an asset management champion or steering committee can play in pushing toward the adoption and application of TAM practices by holding educational workshops, meetings, and information sessions. LGs should also conduct a self-assessment of their current practice to identify strengths,

weaknesses, and opportunities. Based on that, policies and plans can be clearly set to reflect the agency's goals and roadmap, while taking into consideration legal requirements, stakeholders' expectations, managed assets, and available resources. The guideline also pushes for having a solid asset inventory that acts as the cornerstone of a successful TAM program, in addition to having a proper data management system to store and manage this inventory. Performance-based asset management, which is supported by the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act, is also highlighted in the document. It also discusses the decision-making process that incorporates risk management, through which the agency should allocate its budget in an efficient and beneficial manner to achieve the best network performance. In that context, a well-studied financial plan that includes funding and budgeting affairs on the short, medium, and long terms is recommended. Finally, the guideline insists on having an accurate and frequent reporting process for internal purposes and how that helps in updating the TAM program, besides involving the public and all stakeholders in that whole initiative.

Cross-Asset Management Framework:

This project explores a new framework for cross-asset management decision making, in an attempt to improve the objectivity in similar models to reduce the subjectivity in allocating resources among different transportation assets. For that purpose, the mobility of the entire transportation network is used as the performance measure, as a concept from the traffic engineering discipline, with the objective being set to maximize the network mobility. Yet, the decisions are made in the discipline of pavement/bridge engineering, which is the maintenance programming for the asset facilities, i.e. pavements and bridges. To demonstrate the effectiveness of the proposed framework for objectively managing interdependent assets, a case study is performed using an interstate highway network around the City of Atlanta, Georgia, while considering only pavement and bridge utilities.

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