UTC Project Information	
Project Title	MPC-533 – Use of Life Cycle Cost Analysis to Enhance Inspection Planning for Transportation Infrastructure
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Brief Description of Research Project	The poor current condition and continued deterioration of transportation assets, including bridges and other structures, is a well-documented concern in the United States (ASCE 2017). State Departments of Transportation (DOTs) are challenged with the need to improve (or at least maintain) the condition of large networks of assets with inadequate budgets. Inspection is an important part of the asset management process that provides the information upon which maintenance and repair decisions are made. This proposal focuses on the specific issues associated with bridges, but the framework is anticipated to have applications to other types of infrastructure. For the past several decades, U.S. bridge inspection practices have been based on a model that requires most bridges be inspected on a fixed two-year cycle, and where the vast majority of inspections are conducted visually. There is a growing recognition that bridge inspection practices are in need of enhancement in order to provide for public safety and the most effective use of maintenance and repair budgets (ASCE/SEI-AASHTO Ad Hoc Group, 2009). For example, recent research has studied the development of risk based inspection practices

	that seek to extend inspection periods for low risk bridges and focus inspection efforts on the most critical elements (Washer et. al., 2014). A significant body of research has also investigated the application of a variety of nondestructive evaluation (NDE) techniques to bridge inspection (particularly bridge decks) (Gucunski, et.al. 2013). The potential of NDE methods beyond visual inspection to enhance our understanding of bridge condition has been demonstrated; but challenges remain in the effective utilization of NDE by DOTs. One significant limitation is the difficulty in interpretation of collected data that limits the accuracy of NDE techniques. For example, recent analysis of commercially conducted NDE bridge deck scans on four Colorado bridges showed that the scanned results often did a poor job of identifying areas on bridge decks in need of repair and in estimating the level of repair needed (Vemuri and Atadero, 2016). Another issue limiting the application of NDE (beyond visual inspection) by state transportation agencies is the cost. States currently have well established practices by which they conduct and pay for routine visual inspections. Introducing other NDE methods as routine is challenging because they are not yet in a position to replace visual inspection, and thus are viewed as an additional cost that must be paid. Paying for NDE might reduce the funding available to conduct preventive maintenance or repair structures. On the other hand, NDE might be a cost savings measure if its findings are accurate enough to prevent mobilizing a large construction crew for only a limited amount of repair work, or if it ensures that repairs are conducted in a timely fashion while repair costs are still lower (i.e., the structure has not deteriorated to a poorer condition stage where the cost of repair is significantly higher). In order for transportation agencies to adjust their inspection practices to best use the capabilities of various NDE techniques beyond visual inspection, they must have confidence in the methods to inspect the bridge and an understanding of the lifecycle cost implications of NDE use. This study will focus specifically on the lifecycle cost implications of using NDE methods besides visual inspection to inspect bridges. Research Objectives: 1. Identify all relevant cost items to be included in the Life Cycle Cost Analysis (LCCA) model for bridge inspection using visual and other NDE methods. 2. Gather data from sources such as DOT records and NDE contactors to define well established costs for bridge inspections.

	3. Develop models to determine costs for parameters that are not well established, for example the cost of a missed maintenance opportunity. 4. Use the LCCA model to analyze different scenarios and study the impact of different inspection schemes on the lifecycle costs for an individual bridge. 5. Conduct a preliminary investigation into how lifecycle costs for an individual bridge would impact lifecycle costs for inspection of a small bridge network 6. Produce guidance for decision-makers on how best to incorporate NDE techniques into existing inspection practices based on the results of the previous objectives The goal of this study is to develop a Life Cycle Cost Analysis model that incorporates costs associated with different types of inspections in order to provide bridge management decision makers the information they need to most effectively integrate advanced inspection strategies such as NDE methods beyond visual inspection into their inspection practices. The objectives listed above are designed to meet this goal.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	
Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links • Reports • Project Website	