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## 2020 RESEARCH PROJECT STATEMENT

### Research Topic:

3D Printing Additive Manufacturing Feasibility for Highway Infrastructure Construction and Maintenance [max. award - \$100,000]

### Problem Statement and Objectives

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In recent years there has been a significant increase in interest in additive manufacturing (also frequently referred to as 3D Printing), a design platform largely unexplored within infrastructure projects. Harnessing the new capabilities of additive manufacturing, researchers have managed to access design space, which was unreachable until recently. This revolutionary progress, however, has not been reflected in applications focused on transportation infrastructure. The proposed project will explore additive manufacturing innovations and their capabilities related to transportation infrastructure and as a potential future resource to assist MassDOT Highway Division's ongoing rehabilitation of bridge, tunnel, and highway structures, as well as classic recurring maintenance activities. The interest in feasibility study of the 3D printing additive manufacturing focuses on transportation applications, which could result in reduced road closure times for maintenance and prolonged longevity of existing infrastructure components.

The project's main research objective will be to develop draft MassDOT business process recommendations. The recommendations will focus on the organizational processes, to support successful procurement activities and resulting quality assurance review of received objects that have been created using the 3d printing additive manufacturing techniques.

The research effort is expected to be composed of two phases:

#### Phase I

- Engage with MassDOT six Districts maintenance and engineering sectors to build an inventory of possible candidate objects for test printing using Additive Technology based techniques during Phase II.
- Perform appropriate research to assess the pros and cons, and cost efficiency of using 3D printing additive manufacturing to create replacement parts directly compared to using it for building models of needed parts, which could then be used to drive acquisition through a standard procurement.



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## Phase I (cont.)

- Reach out to colleagues in the transportation industry to learn more about their experience with 3D printing additive manufacturing efforts.

## Phase II

- Phase II research is expected to include some of the following topics:
- Review of engineering code approaches, which include but are not necessarily limited to AASHTO, ASTM, MassDOT bridge and highway manuals studies. Research should also include discussions of the critical elements found to impact the feasibility of integrating 3D Printing Additive Manufacturing techniques into future MassDOT projects (Examples: constraints involving object size, material properties, and cost of production).
- Research study on upgrade and modification of the 3D printing (machine) technology, which will be feasible to the application of transportation elements.
- From the research, develop an initial set of draft internal MassDOT business process recommendations for procuring, installing, and quality assurance testing objects created via 3D Printing Additive Manufacturing techniques.

## Anticipated Outcomes and Deliverables

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- Literature review on the current use and potential of the 3D printing additive manufacturing in highway, tunnel, and bridge maintenance.
- Provide information to MassDOT departments about the 3D printing additive manufacturing capabilities. Review applicability to possibly support ongoing MassDOT construction, rehabilitation, and maintenance activities.
- A Summary statement to MassDOT in potentially using the 3D printing additive manufacturing and their operational applications, helping meet the ongoing codes requirement and responsibilities.
- Guidance on how to setup an environment to import a 3D scan and prepare it for printing. Pilot testing of the creation and/or installation of 3D-printed objects (could be maintenance parts or rehabilitation focused structural components).
- Review of the costs incurred in producing pilot objects via 3D Printing. Was significant customization of the 3D printer's configuration required to make it feasible to use in creating objects relevant to the needs of MassDOT?