

**Quarterly Progress and Performance Indicators Report:**

**Project Number and Title:** 4-2 Future-Proof Transportation Infrastructure Through Proactive, Intelligent, and Public-involved Planning and Management

**Research Area:** Thrust 4 Connectivity for enhanced asset and performance management

**PI:** Jin Zhu, Ph.D. Assistant Professor, University of Connecticut

**Reporting Period:** September 2021-December 2021

**Submission Date:** December 31, 2021

**\*\*\*IMPORTANT: Please fill out each section fully and reply with N/A for questions/sections with nothing to report. For ease of reporting to the USDOT, please do not remove, or change the order of, any sections/text. You may remove/add each rows in tables as needed. Thank you! \*\*\***  
**The report is due on the last day of the reporting period in .doc format to tidc@maine.edu.**

**Overview:**

Provide **BRIEF** highlights of activities performed during the reporting period. This summary should be written in lay terms for a general audience to understand. This should not be an extensive write up of findings (those are to be included in the final report), but a **high-level overview of the activities conducted during the last three months no more than 3 bullet points at no more than 1 sentence each** ....

During the past three months, we focused on the following activities:

1. Finalizing a journal article submitting to a special issue in ASCE Journal of Computing in Civil Engineering;
2. Developing a computational model to future-proof transportation infrastructure
3. Meeting with researcher in the Citadel to discuss potential collaboration

**Meeting the Overarching Goals of the Project:**

*How did the previous items help you achieve the project goals and objects? Please give one bullet point for each bullet point listed above.*

- Activity 1 helps to disseminate the findings from this research project;
- Activity 2 helps to produce the final product as a decision support tool;
- Activity 3 helps form collaboration with non-member universities and make broader impact

**Accomplishments:**

*List any accomplishments achieved under the project goals in bullet point form...*

1. A conference paper titled “The Usage of Association Rule Mining towards Future-proofed Transportation Infrastructure Planning” presented at ASCE International Conference on Computing in Civil Engineering was invited to a special issue in ASCE Journal of Computing in Civil Engineering and the manuscript is ready to submission;
2. The scope, format and platform of the computational interactive model was created

**Task, Milestone, and Budget Progress:**

*Complete the following tables to document the work toward each task and budget (add rows/remove rows as needed, make sure you complete the Overall Project progress row and include all tasks even if they have ended or have not been started)...*

**Table 1: Task Progress**

<b>Task Number: Title</b>	<b>Start Date</b>	<b>End Date</b>	<b>% Complete</b>
Task 1: Identify future risks and opportunities in transportation infrastructure durability planning and management.	October 1, 2018	September 30, 2019	100%
Task 2: Model the effects of future-proofing transportation durability planning and management strategies.	October 1, 2019	December 30, 2021	90%
Task 3: Develop a decision-support system for durability planning and management.	Jan 1, 2021	June 30, 2022	35%
Overall Project: 4-2 Future-Proof Transportation Infrastructure Through Proactive, Intelligent, and Public-involved Planning and Management	October 1, 2018	June 30, 2022	75%

**Table 2: Milestone Progress**

<b>Milestone #: Description</b>	<b>Corresponding Deliverable</b>	<b>Start Date</b>	<b>End Date</b>
n/a	n/a	n/a	n/a

**Table 3: Budget Progress**

<b>Project Budget</b>	<b>Spend – Project to Date</b>	<b>% Project to Date (include the date)</b>
\$252,300	the information will be provided by the Institutional Lead	the information will be provided by the Institutional Lead

**Is your Research Project Applied or Advanced?**

- Applied** (*The systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.*)
- Advanced** (*An intermediate research effort between basic research and applied research. This study bridges basic (study to understand fundamental aspects of phenomena without specific applications in mind) and applied research and includes transformative change rather than incremental advances. The investigation into the use of basic research results to an area of application without a specific problem to resolve.*)

**Education and Workforce Development:**

Answer the following questions (N/A if there is nothing to report):

1. Did you provide any workforce development or training opportunities to transportation professionals (already in the field)? If so, what was the training? When was it offered? How many people attended? (i.e. The research team provided an in the field training for the SAR technology for 3 maintenance crew members of the MassDOT on 3/31/2021. The members learned how to use the technology and interrupt the data.)  
n/a
2. Did you hold meetings with any transportation industry organizations or DOTs? If so, what was the meeting’s purpose? When was it offered? How many people attended? (i.e. The research team held a meeting with MaineDOT to update them on the progress of the research findings and how the findings can be implemented on 3/31/2021. 15 DOT maintenance members were present at the meeting.)  
n/a
3. Did you host/participant in any K-12 education outreach activities? If so, what was the activity? What was the target age/grade level of the participants? How many students/teachers attended? When was the activity held? (i.e. 25 8<sup>th</sup> graders and 2 teachers visited the concrete lab and created small concrete trinkets like Legos on 3/31/2021. They learned about the different types of fibers that can be used in the concrete.)  
n/a

**Technology Transfer:**

Complete all of the tables below and provide additional information where requested. Please provide ALL requested information as this is one of the most important sections for reporting to the USDOT. **ONLY provide information relevant to this reporting period.**

Use the table below to complete information about conference sessions, workshops, webinars, seminars, or other events you led/attended where you shared findings as a result of the work you conducted on this project:

<b>Table 4: Presentations at Conferences, Workshops, Seminars, and Other Events</b>					
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Event &amp; Intended Audience</b>	<b>Location</b>	<b>Date(s)</b>
Seminar	The Usage of Association Rule Mining towards Future-proofed	Chowdhury, S. and Zhu, J. (2021). The Usage of Association Rule Mining towards Future-proofed	Fourth Annual CMMSE Virtual Research Symposium	Online	November 5, 2021

	Transportation Infrastructure Planning	Transportation Infrastructure Planning. Fourth Annual CAMMSE Virtual Research Symposium.			

Use the table below to report any publications, technical reports, peer-reviewed articles, newspaper articles referencing your work, graduate papers, dissertations, etc. written as a result of the work you conducted on this project. Please list only completed items and exclude work in progress.

<b>Table 5: Submitted/Accepted Publications, Technical Reports, Theses, Dissertations, Papers, and Reports</b>				
<b>Type</b>	<b>Title</b>	<b>Citation</b>	<b>Date</b>	<b>Status</b>
Peer-reviewed Journal	Developing a Future-proofed Transportation Infrastructure Planning Framework Using Topic Modeling and Association Rule Mining	n/a	n/a	Invited to ASCE Journal of Computing in Civil Engineering special issue, to be submitted by mid-January

Answer the following questions (N/A if there is nothing to report):

- Did you deploy any technology during the reporting period through pilot or demonstration studies as a result of this work? If so, what was the technology? When was it deployed?  
n/a
- Was any technology adopted by industry or transportation agencies as a result of this work? If so, what was the technology? When was it adopted? Who adopted the technology?  
n/a
- Did findings from this research project result in changing industry or transportation agency practices, decision making, or policies? If so, what was the change? When was the change implemented? Who adopted the change?  
n/a
- Were any licenses granted to industry as a result of findings from this work? If so, when? To whom was the license granted?  
n/a
- Were any patent applications submitted as a result of findings from this research? If so, please provide a copy of the patent application with your report.

n/a

6. Did industry organizations or DOTs provide cost-share (cash or in-kind) to your research during the reporting period? Who was the organization? Please provide an in-kind support invoice from the organization with your report (this is kept confidential and used for record keeping purposes only).

n/a

*Please add figures/images that can be included on the website and/or in marketing/social media materials to further clarify your research to the general public. This is very important to our Technology Transfer initiatives.*

### **Insert figures here**

*Describe any additional activities involving the dissemination of research results not listed above under the following headings:*

#### **Outputs:**

*Definition: Any new or improved process, practice, technology, software, training aid, or other tangible product resulting from research and development activities. They are used to improve the efficiency, effectiveness, and safety of transportation systems. List any outputs accomplished during this reporting period:*

n/a

#### **Outcomes:**

*Definition: The application of outputs; any changes made to the transportation system, or its regulatory, legislative, or policy framework resulting from research and development activities. List any outcomes accomplished during this reporting period:*

n/a

#### **Impacts:**

*Definition: The effects of the outcomes on the transportation system such as reduced fatalities, decreased capital or operating costs, community impacts, or environmental benefits. The reported impacts from UTCs are used for the assessment of each UTC and to make a case for Federal funding of research and education by demonstrating the impacts that UTC funding has had on technology and education. NOTE: The U.S. DOT uses this information to assess how the research and education programs (a) improve the operation and safety of the transportation system; (b) increase the body of knowledge and technologies; (c) enlarge the pool of people trained to develop knowledge and utilize technologies; and (d) improves the physical, institutional, and information resources that enable people to have access to training and new technologies. List any outcomes accomplished during this reporting period:*

The research results can aid DOTs in assessing their transportation infrastructure under the impacts of multiple stressors with high level of uncertainty and re-evaluating their plans of design, construction, and maintenance. The results could provide useful data for decision making in multiple sectors including the Asset Management Group, Sustainability & Resiliency, and Highway Operations.

#### **Participants and Collaborators:**

Use the table below to list individuals (compensated or not) who have worked on the project other than students.

Table 6: Active Principal Investigators, faculty, administrators, and Management Team Members				
Individual Name & Title	Dates involved	Email Address	Department	Role in Research
Jin Zhu, Assistant Professor	October 1, 2018	jzhu@uconn.edu	Civil and Environmental Engineering	PI

Use the table below to list **all** students who have participated in the project during the reporting period. (This includes all paid, unpaid, intern, independent study, or any other student that participated in this project.) **ALL FIELDS ARE REQUIRED.**

Table 7: Student Participants during the reporting period								
Student Name	Start Date	End Date	Advisor	Email Address	Level	Major	Funding Source	Role in research
Sudipta Chowdhury	Oct 1, 2018	-	Jin Zhu		PhD	Transportation Engineering	TIDC	Conducting literature review, model development, and report writing
Kaitlyn Kondos	Sep, 1, 2021	-	Jin Zhu		Undergraduate	Civil Engineering	TIDC and UConn CEE Undergraduate Research Initiative	Conduct literature review

Use the table below to list any students who worked on this project and graduated or received a certificate during this reporting period. Include information about the student's accepted employment during the reporting period (i.e. the student is now working at MaineDOT) or if they are continuing their students through an advanced degree (list the degree and where they are attending).

Table 8: Students who Graduated During the Reporting Period			
Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
			Please list the organization or degree

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Use the table below to list any students that participated in Industrial Internships during the reporting period:

Table 9: Industrial Internships			
Student Name	Degree/Certificate Earned	Graduation/Certification Date	Did the student enter the transportation field or continue another degree at your university?
			Please list the organization or degree

Use the table below to list **organizations** that have been involved as partners on this project and their contribution to the project during the reporting period.

Table 10: Research Project Collaborators during the reporting period						
Organization	Location	Contribution to the Project				
		Financial Support	In-Kind Support	Facilities	Collaborative Research	Personnel Exchanges
		List the amount	List the amount	Mark with an "x" where appropriate		

Use the table below to list **individuals** that have been involved as partners on this project and their contribution to the project during the reporting period. (**List your technical champion(s) in this table.** This also includes collaborations within the lead or partner universities who are not already listed as PIs; especially interdepartmental or interdisciplinary collaborations.)

Table 11: Other Collaborators				
Collaborator Name and Title	Contact Information	Organization and Department	Date(s) Involved	Contribution to Research
Mostafa Batouli, Assistant Professor	sbatouli@citadel.edu	The Citadel, Civil Engineering Department	December 2021	Research idea discussion
Karen Riemer, Principal Engineer	Karen.Riemer@ct.gov	CTDOT	June 2019	Technical champion

Use the following table to list any transportation related course that were taught or led by researchers associated with this research project during the reporting period:

<b>Table 12: Course List</b>						
<b>Course Code</b>	<b>Course Title</b>	<b>Level</b>	<b>University</b>	<b>Professor</b>	<b>Semester</b>	<b># of Students</b>
CE 5030	Sem in Transportation and Urban Engineering	Grad	University of Connecticut	Jin Zhu	Fall 2021	15
CE 4999	Independent Study Civil Engineering	Undergrad	University of Connecticut	Jin Zhu	Fall 2021	1

**Changes:**

List any actual or anticipated problems or delays and actions or plans to resolve them (list no-cost extension requests here)...

List any changes in approach and the reasons for the change...

**Planned Activities:**

List the activities planned during the next quarter.

1. Submit the journal article
2. Finish developing and testing the computational model
3. Final report writing