IDENTIFY THE RISK FACTORS THAT CONTRIBUTE TO FATALITIES AND SERIOUS INJURIES AND IMPLEMENT EVIDENCE-BASED RISK ELIMINATION AND MITIGATION STRATEGIES

Quarterly Progress Report
For the period ending August 31, 2019

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Submitted to:
ABC-UTC
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1 Background and Introduction

Construction activities related to bridge replacement and rehabilitation are significant contributors to safety hazards. The safety hazards attributed to construction work zones are alarming and accordingly, safety is a major focus of 2018-2022 US DOT Strategic plan. One of the most important advantages of ABC is to improve the safety, which is achieved by reducing onsite construction activities and thereby reducing accidents, injuries to workers and public. No good documentation is available yet for this major ABC advantage. This collaborative project with FIU and ISU aims at filling such gap. The overall objective of this project is to provide quantitative data supporting the fact that ABC does improve safety relative to conventional construction. The output of this project can provide future evidence and justification that can be used by state DOTs to further implement ABC and consider ABC for new construction.

2 Problem Statement

Construction activities related to bridge replacement and rehabilitation are important contributors to traffic jams and reduced mobility and, most importantly, to safety hazards. The safety is a major focus of 2018-2022 US DOT Strategic plan. The safety hazards attributed to construction work zones are alarming. “There were 87,606 crashes in work zones in 2010. There were 37,476 injuries in work zones in 2010. This equates to one work zone injury every 14 minutes (over 102 per day), or about four people injured every hour. In 2010, there were 514 fatal motor vehicle crashes in work zones, resulting in 576 fatalities. These 576 fatalities equate to one work zone fatality every 15 hours” (http://www.ops.fhwa.dot.gov/). One of the most important advantages of ABC is to improve the safety, which is achieved by reducing onsite construction activities and thereby reducing accidents, injuries to workers and public. However, up until now there has been no good documentation of this ABC advantage. This project will provide quantitative data supporting the fact that ABC does improve safety.

3 Research Approach and Methods

Onsite construction time required for a bridge replacement can be reduced from a year or more using conventional construction, to a few weeks or less using ABC technologies. This significant reduction of time in the work zone translates to vastly improved safety for the traveling public and construction crews. A benefit/cost analysis for the reduced number of days of work zones due to the use of ABC requires 1) an estimate of the number of crashes avoided, and 2) the monetary value of each avoided crash, including a breakdown of fatalities and injuries for each. The U.S. DOT’s Value of Statistical Life (VSL) can be used to determine the monetary value of each avoided crash, as discussed on the U. S. DOT Office of Safety website. Also discussed is the use of the Maximum Abbreviated Injury Scale (MAIS) for fractional values to assess the benefit of preventing an injury crash.

In this project, the data described above can be compiled and interpreted through collaborative efforts between UNR, FIU, and ISU. A detailed research plan will be outlined. However, a

preliminary plan is for data that can be provided by FIU and processed and interpreted between UNR and ISU. The overall objective of this project is to provide quantitative data supporting the fact that ABC does improve safety relative to conventional construction. Literature search will include work of USDOT Office of Safety and recently completed ABC-UTC total costs research projects at FIU. The output of this project can provide future evidence and justification that can be used by state DOTs to further implement ABC and consider ABC for new construction.

4 Description of Research Project Tasks

Based on the identified problem statement above, proper data is not yet available and accordingly, the following research tasks are proposed and will be conducted to provide foundational work for future safety analysis. A summary of the proposed research tasks is as follows:

Task 1 – Conduct a thorough literature review to identify safety analysis procedures and results related to work zones in general, and specify any bridge-related analyses.

Literature review report:

Chapter 1 Introduction

1.1 Background Information

It concludes work zone definition, the influence of work zone to local traffic(delay, safety data added.)

1.2 Work Zone Characteristics

It introduces the definitions for work zone type, network form, size and analysis dimension.

1.3 Work Zone Performance Measures

It introduces some performance measures for evaluating work zone (safety, mobility, construction efficiency and effectiveness, public perception(1)).

Chapter 2 Existing workzone mobility analysis methods

2.1 Summary of Analysis tools

It concludes the comparison(advantage and disadvantage) for existing analysis tools and the criteria and method for selecting tools according to demand.

2.2 Some methods from other reports from other states

Try to find some other methods or models used in other states.

2.3 Methods and tools available to use

It introduces the methods that we can use in this project more detailed

Chapter 3 Workzone safety analysis

Table 1 National Work Zone Fatal Crashes(2)

Year	Work Zone Fatal Crashes	Truck-involved Work Zone Fatal Crashes	Pedestrian-involved Work Zone Fatal Crashes	Work Zone Worker Fatalities
2017	710	216	129	132
2016	687	186	113	143
2015	654	175	107	130
2014	608	183	104	119
2013	536	151	100	105

Table 2 Nevada Work Zone Fatal Crashes(2)

Year	Work zone Fatal Crashes	Truck-involved Work Zone Fatal Crashes	Pedestrian-involved Work Zone Fatal Crashes	Work Zone Worker Fatalities
2017	13	4	4	2
2016	11	2	1	0
2015	11	2	1	3
2014	8	1	3	2
2013	5	1	1	2

Table 3 National Work Zone Crashes(2)

Year	Work Zone			Truck-involved Work Zone			Pedestrian-involved Work Zone	
	Total Crashes	Injury-involved Crashes	Injuries	Pedestrian-involved Work Zone Fatal Crashes	Injury-involved Crashes	Injuries	Total Crashes	Injuries
2017	94,000	25,000	37,000	18,000	2,000	4,000	2,000	1,000
2016	158,000	42,000	61,000	23,000	3,000	4,000	2,000	2,000
2015	97,000	25,000	35,000	16,000	3,000	4,000	1,000	1,000
2014	89,000	22,000	31,000	16,000	2,000	3,000	400	400
2013	68,000	17,000	25,000	9,000	2,000	3,000	1,000	1,000
2012	76,000	20,000	30,000	10,000	3,000	4,000	1,000	1,000
2011	91,000	25,000	39,000	9,000	2,000	3,000	1,000	1,000

Task 2 – Acquire traffic safety data using the NDS database. This task is in progress where the CATER center at UNR team is working with Virginia Tech Transportation Institute (VTTI) to get relevant SHRP2 NDS data pertaining to bridge construction projects. The approach and type of data we are attempting to acquire is as follows.

Approach

The initial activity is to provide CATER with supporting materials to help their application get approved. Then, the next activity will be to assist with the execution of a Data Use License for the requested SHRP2 NDS data. CATER is interested in obtaining time series data, front video, and rear video for 8 Near-Crash and 5 Baseline events which contain both a work zone and a bridge (where work zone data is obtained from the Event Table and bridge information is obtained from the RID). VTTI will deliver the following data elements to CATER:

☐ Front video
☐ Rear Video
☐ Time series variables:

- Latitude
- Longitude
- Speed_network
- Speed_gps
- Acceleration, x-axis
- Processed Radar data for all 8 tracks (Target ID, Radar Range Forward X and Y)
- Video_frame

VTTI will synchronize the time series data to a 10 Hz clock and deliver data in CSV files. Forward and rear video will be provided in separate MP4-format files which will be linked by name to the time series data file.

Task 3 – Conduct preliminary analysis using data from Task 2 to quantify safety in work zones versus bridge sites as it relates to construction time, which can set the stage for quantifying lower safety risks for future ABC projects.

5 Expected Results and Specific Deliverables

- Final Report

6 Schedule

The expected timeline for each task is as follows:

Task 1: complete by September 2019 (in progress)

Task 2: complete by June 2019 (Data Received)

Task 3: complete by December 2019

The percentage of completion of this project is as follow:

Item	% Completed
Percentage of Completion of this project to Date	50

REFERNCES

[1]. What's A Work Zone? Available at https://www.fhwa.dot.gov/publications/publicroads/99mayjun/workzone.cfm

[2]. Evaluation of Work Zone Mobility by Utilizing Naturalistic Driving Study Data. (format need to be modified)

[3]. National Work Zone Safety Information Clearinghouse. Available at https://www.workzonesafety.org/crash-information/work-zone-fatal-crashes-fatalities/#national

[4]. FHWA Work Zone Facts and Statistics. Work Zone Management Program. FHWA. U.S. Department of Transportation. https://ops.fhwa.dot.gov/wz/resources/facts_stats.htm. Accessed Mar. 5, 2019.

[5]. Traffic Analysis Tools Volume IX: Work Zone Modeling and Simulation：A Guide for Analysts. Available at https://ops.fhwa.dot.gov/wz/traffic_analysis/tatv9_wz/sec2.htm#21

[6]. Work Zone Impacts Assessment –An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects 2006,08 Available at https://ops.fhwa.dot.gov/wz/resources/final_rule/wzi_guide/index.htm

[7]. Traffic Analysis Tools Volume Ⅸ: Work Zone Modeling and Simulation A Guide for Analysts

Available at https://ops.fhwa.dot.gov/wz/traffic_analysis/tatv9_wz/index.htm)

[8]. Traffic analysis toolbox volume Ⅰ: traffic analysis tool primer

[9]. Traffic Analysis Toolbox Volume XII: Work Zone Traffic Analysis – Applications and Decision Framework

[10]. Traffic Analysis Toolbox Volume VIII: Work Zone Modeling and Simulation - A Guide for Decision-Makers

[11]. traffic analysis toolbox volume Ⅱ：Decision Support Methodology for Selecting Traffic Analysis Tools Available at https://ops.fhwa.dot.gov/trafficanalysistools/tat_vol2/Vol2_Methodology.pdf

[12]. Highway Capacity Manual 6th Edition: A Guide for Multimodal Mobility Analysis. Transportation Research Board., Washington, D.C., 2016.