TRANSPORTATION POOLED FUND PROGRAM
QUARTERLY PROGRESS REPORT

Lead Agency (FHWA or State DOT): Wisconsin DOT

INSTRUCTIONS:
Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.

Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(274)	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) X Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)

Project Title:
Technology Transfer Activities for Midwest Freight Pooled Fund

Name of Project Manager(s): Lori Richter	**Phone Number:** (608) 264-8435	**E-Mail** Lori.Richter@dot.wi.gov
Lead Agency Project ID: 0092-13-10	**Other Project ID (i.e., contract #):**	**Project Start Date:** 11/19/2012
Original Project End Date: 11/18/2014	**Current Project End Date:** 11/18/2014	**Number of Extensions:** 0

Project schedule status:

X On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$40,000	$10,428	25%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$0; 0%	$0	0%

Project Description:

The purpose of this interagency agreement is to provide the following technology transfer activities and services related for Midwest Freight Research:

1. Attendance at pooled fund research presentations
2. Presentation of pooled fund research findings at Mid-Continent Forum
3. Research documents and communication materials

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):
No travel or presentations during the current quarter.

Anticipated work next quarter:
Activities related to attending and administration of the Midcontinent Transportation Research Forum.

Significant Results:
n/a

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).
n/a

Potential Implementation:
n/a

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Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(274)	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) X Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)	
Project Title: Wisconsin Study on the Impact of OSOW Vehicles on Complex Bridges		
Name of Project Manager(s): Michael Oliva & Teresa Adams	**Phone Number:** 608-262-7241	**E-Mail** oliva@engr.wisc.edu
Lead Agency Project ID: 0092-13-11	**Other Project ID (i.e., contract #):** CFIRE 08-03	**Project Start Date:** 8/8/2013
Original Project End Date: 10/7/2015	**Current Project End Date:** 10/7/2015	**Number of Extensions:** 0

Project schedule status:

X On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$270,000	$55,152	25%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
$46,172 17%	$32,887	20%

Project Description:
As the freight industry grows, the need to move oversize and overweight loads increases every year. Load such as pressure vessels, transformers used in power plants, boilers, military hardware, and wind turbine components require vehicles with unusual configurations. These vehicles may also weigh five to six times normal legal truck weight. The combination of uncommon configurations and carrying loads of these trucl make common bridge evaluation methods inapplicable. Determining the effects of oversize and overweigh loads on complex bridges has become a time consuming task for the Wisconsin Department of Transporta There are no established procedures and the possibility of errors in estimating the impact of oversize and overweight loads on these structures could affect safety and restrict the flow of goods. This study aims to develop a simplified analytic method to determine the effects of oversize and overweight vehicles on a var of complex bridge configurations, such as steel tied arches, rigid frame, truss, and bascule bridges. The prc team will develop analytical models of complex bridges and validate these models using load test data.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

• Jin Yu is recruited as the new research assistant who will lead this project from May 2014.

On April 28th, A quarterly meeting was held at WisDOT.
o Discussion started regarding details about instrumentation and load testing of the Cameron Ave. bridge in LaCrosse (B-32-202-0002 Eastbound) including:
o The pedestrian walkway is on the south side of the bridge and can be used for instrumentation without requiring lane closures;
o David Bohnsack. suggested that the best times to temporarily stop traffic for load testing would be around 2PM when the traffic is not heavy.
o The traffic closure might be done through the State Patrol with County help.
o Additional discussion focused on instrumentation and possible load testing of the steel box girder approach spans on the Cameron Ave. bridge.
o The Mirror Lake (B-56-0048/0047) was discussed next. The intial intent is to install instrumentation and conduct a load test during the scheduled inspection in October.
o Discussion concluded with an examination of the Marinette bascule bridge (B-38-16-0003). Sofia, Jin and Moon (U.W. grad students) had just returned from an inspection of the bridge using a snooper in the morning.

• A kick-off meeting was held on the 31st of May 2014 for the 4 undergraduate students recruited to work on the project during summer when bridge tests will be started. During this meeting an introduction of the project was presented. In adition, a definite schedule of model building for bridge analyses and testing was determined.

• 6 finite-element models are under developing using CSiBridge. They include:
o A rigid frame bridge on I-90/94 over Mirror Lake in Sauk County, B-56-0048 or its twin B-56-0047,
o A tied arch bridge on STH64 and Bridge St. over the Chippewa River, B-09-0087
o A tied arch bridge on US 14/16/61 over the Mississippi in LaCrosse (Cass St.), B-32-0202-0002,
o A steel truss bridge, on USH14/61/16 over the Mississippi, B-32-300, in LaCrosse
o A double-leaf bascule bridge on Ogden St over the Menominee river,B-38-16-0003, in Marinette-

Menominee,
o A double-leaf bascule bridge on STH116 and main St over Wolf river, B-70-913-0002, , in Winneconne, Winnebago County,

• Based on the analytical models developed for the tied arch bridge over the Mississippi River in La Crosse (Cass St.) B-32-0202-0002, critical stress locations were predicted to be near the No.2 Hanger from the west end.
• A load test plan for the tied arch bridge over the Mississippi River in La Crosse on July 23rd was developed according to the analytical results from the finite-element model. The researchers plan to use a combination of vibrating wire gages and weldable uniaxial foil strain gages on the bridge. On signal conditioning/acquisition, we plan to use a portable NI scanning and conditioning box with a DaqCard A/D converter in a laptop.

Anticipated work next quarter:
• The research team will finish the above analytic models and then move on to the rest of the list, including:
o A tied arch bridge over the Fox River on IH 43 in Green Bay, B-05-158-0010,
• The researchers will further finalize the load test plan for the tied arch bridge over the Mississippi River in La Crosse.
• Contact will be made with the WisDOT bridge inspectors and the La Crosse County for the snooper truck schedule and one lane closure during the instrumentation. Communication with the state patrol and the county will be made to ensure the traffic control during the load testing. Two loaded dump truck will be provided by the county as the stationary loading for the test.
• Training will be provided for the team members in applying tack weld gages and using the data acquisition system.
• Critical test data collected from the load test will be analyzed and compared with that from the analytical model under the same stationary loading condition. Further refinement to the analytical model be made accordingly.

Significant Results:

n/a

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

Field instrumentation and testing are dependent on available resources and coordination with WisDOT authorities. Therefore, during the kickoff meeting Bill Oliva and Kelly Young agreed to make contacts with the county to identify methods and possible funding for the cost of setting road block and apply traffic control during instrumentation.

Potential Implementation:

n/a

Task	Schedule (July 2013-June 2014)											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June
1. Reference Study												
2. Load test schedule												
3. Analytic modeling	First test bridge							remaining bridges				
4. Field test plans											other test bridges	
5. Interim Meeting												
6. Test instrumentation			First test bridge									
7. Analytical verification					First test bridge							
8. Interim Meeting												
9. Simplified analysis												
10. Analysis guides												
11. Final report												

Task	Schedule (July 2014-June 2015)											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	March	April	May	June
1. Reference Study												
2. Load test schedule												
3. Analytic modeling						remaining bridges						
4. Field test plans												
5. Interim Meeting												
6. Test instrumentation		other bridges										
7. Analytical verification					other test bridges							
8. Interim Meeting												
9. Simplified analysis												
10. Analysis guides												
11. Final report												

Task	Schedule (July 2015-Jan 2015)						
	July	Aug	Sept	Oct	Nov	Dec	Jan
1. Reference Study							
2. Load test schedule							
3. Analytic modeling							
4. Field test plans							
5. Interim Meeting							
6. Test instrumentation							
7. Analytical verification							
8. Interim Meeting							
9. Simplified analysis							
10. Analysis guides							
11. Final report							

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Transportation Pooled Fund Program Project # *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(274)	**Transportation Pooled Fund Program - Report Period:** ☐ Quarter 1 (January 1 – March 31) ✓ Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)

Project Title: A GUIDEBOOK FOR FREIGHT TRANSPORTATION PLANNING USING TRUCK GPS DATA

Name of Project Manager(s): Dr. Sabya Mishra	**Phone Number:** 901.678.5043	**E-Mail:** smishra3@memphis.edu
Lead Agency Project ID: 0092-14-16	**Other Project ID (i.e., contract #):** CFIRE 09-04	**Project Start Date:** 09/01/13
Original Project End Date: 12/31/14	**Current Project End Date:** 12/31/14	**Number of Extensions:** none

Project schedule status:

✓ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$150,000	$58,434.53	40%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
38.95% and 15.19%	$22,792.83	15%

Project Description:
One of the main difficulties in freight transportation planning is the lack of accurate and detailed truck trip data. The majority of truck movement data is reported at the inter-county level and is represented by aggregated tonnages that should be split into truck trips. The American Transportation Research Institute (ATRI) in collaboration with the Federal Highway Administration (FHWA) developed the Freight Performance Measures Web-Based (FPMweb) Tool. The FPMweb Tool estimates the operating speed of highway segments using truck GPS devices for 25 interstate corridors. The suggested research will produce a guidebook for TDOT on how truck GPS data can be used for long term transportation planning and for development of operational transportation strategies in the State of TN.

This project has the following objectives: 1) Develop performance measures for transportation facilities (travel times, flows, demand, bottlenecks, etc.); 2) Provide key performance indicators for freight intermodal terminals in TN; 3) Develop truck trip generation rates for different intermodal and transmodal terminals; 4) Analyze TN truck corridors with a particular focus on travel time and flow; 5) Analyze inter- and intra-city truck travel patterns; 6) Provide data to support development, calibration, and validation of TN's State and MPO's travel demand models (both for the freight and passenger components).

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):
During this quarter, the design of a custom algorithm (Direction Rectification Algorithm-DRA) for calculating bi-directional speeds at links of the FAF network was developed. The algorithm assigned directions (main and opposite) to each link based on its spatial disposition. This was achieved by estimating coordinates of start and end points for links. The DRA output included link ID, number of observations (snapped to the link), and the majority of freight performance measures (FPMs), revealed in the literature. The research team noticed existence of observations with spot speeds, which were significantly lower than the estimated mean speed in the given direction of a link. It was crucial to develop a procedure for identifying outliers, which negatively affected the mean speed (either increase or decrease). A statistical test that employed the Chauvenet's criterion was applied to detect and remove outliers. The next step was to check the accuracy of computed mean speeds. This task was accomplished based on comparison of the link speeds, obtained by the DRA, with the ones, retrieved from the FPMweb Tool. The data available for the I-40 segment, located in the State of TN, were downloaded from the FPMweb Tool. Proximity Analysis Toolbox, provided by ESRI ArcGIS 10.0, was used to associate the FPMweb Tool observations with links of the FAF network. The results of comparison indicated that the DRA mean speeds (with and without application of the Chauvenet's criterion) were close to the ones, computed using the FPMweb Tool data, for both West and East directions of the I-40 segment.

A similar comparative procedure was undertaken for the FPMweb Tool network. The same I-40 segment was separated into 3-mile sections. The DRA again provided mean speeds close to the FPMweb Tool mean speeds. An important step was to determine potential drawbacks of the DRA. The research team found that the DRA could assign an observation to the wrong direction at some links, which had sharp turns. Links with sharp turns were defined based on their tortuosity values. Percent of tortuous links comprised less than 5% for the FAF network. This fact confirms than the DRA may be inaccurate only for a few links in the worst case. The DRA was implemented using all observations, available for January 3, and mean speeds were calculated for 4 time periods: AM (6am – 9am), MD (9am – 2pm), PM (2pm – 6pm), and OP (6pm – 6am).

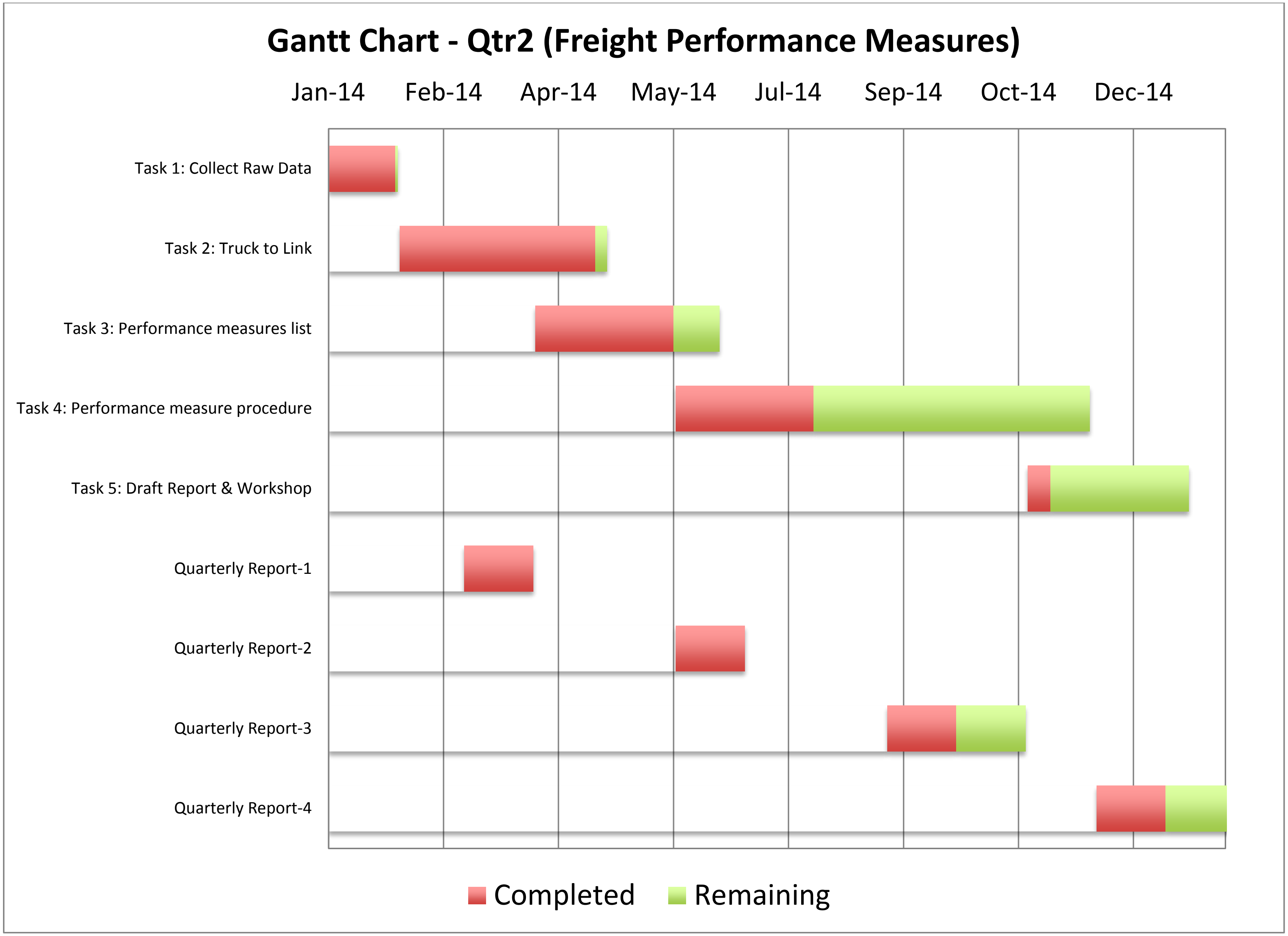
Anticipated work next quarter:
So far, the research team successfully designed and implemented the procedure for calculating bi-directional speeds for links of the FAF network. The suggested DRA was found to be accurate for the FPMweb Tool network as well. As revealed by the literature review, several studies also provided trip travel speeds along with link travel speeds for the given area of study. In the following quarter the research team expects to develop the methodology for estimating truck trips using available GPS data. This task is quite challenging, since for the majority of trucks time interval between consecutive observations exceeds 15 min. Within a large time interval a truck driver can make stops that are not caused by traffic congestion (e.g., fueling, rest stops, technical deficiencies, etc.). Some of those stops represent destination of one trip and origin of a new trip (e.g., pick up/delivery at the facility). The travel time, spent in such stops, should be deducted from the total trip travel time. Otherwise, it will make the analysis of a given route erroneous (estimated trip travel time will be higher than true trip travel time).

Significant Results:
The procedure for estimating bi-directional speeds for given links was developed. A supplementary statistical test, which employed the Chauvenet's criterion, was applied to detect and remove outliers. The suggested algorithm was validated using the data, retrieved from the FPMweb Tool, for the I-40 segment, located in the State of TN. The comparative analysis demonstrated the DRA accuracy for both FAF and FRMweb Tool networks. The algorithm was launched to compute mean speeds at all links of the FAF network for January 3. Different time periods were considered.

Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

No challenges/problems were encountered in the second quarter.

Potential Implementation:
At this point the research team validated and implemented the methodology for estimating bi-directional mean speeds for all links of the FAF network for the State of TN. The proposed DRA can be also launched for multiple days. Based on the DRA output, it is possible to identify those freight corridors, which have low mean speeds and my need future improvements. Once the procedure for estimating truck trips is complete, the analysis can be conducted not only for links, but also for particular routs, which will be useful in freight transportation planning.



Gantt Chart - Qtr2 (Freight Performance Measures)
Jan-14
Feb-14
Apr-14
May-14
Jul-14
Sep-14
Oct-14
Dec-14
Task 1: Collect Raw Data
Task 2: Truck to Link
Task 3: Performance measures list
Task 4: Performance measure procedure
Task 5: Draft Report & Workshop
Quarterly Report-1
Quarterly Report-2
Quarterly Report-3
Quarterly Report-4
Completed
Remaining

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Transportation Pooled Fund Program Project # *S2458 PP14* TPF-5(274)	**Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ☑Quarter 2 (April 1 – June 30) ☐Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31)

Project Title:

EFFECT OF PRIMARY AND SECONDARY CRASHES: IDENTIFICATION, VISUALIZATION AND PREDICTION

Name of Project Manager(s): Sabyasachee Mishra	**Phone Number:** (901) 678-5043	**E-Mail** smishra3@memphis.edu
Lead Agency Project ID: 0092-14-05	**Other Project ID (i.e., contract #):** CFIRE 09-05	**Project Start Date:** 01/01/2014
Original Project End Date: 12/31/2014	**Current Project End Date:** 12/31/2014	**Number of Extensions:** None

Project schedule status:

☑On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

Total Project Budget	Total Cost to Date for Project	Percentage of Work Completed to Date
$150,000	$70,293.83	50%

Quarterly Project Statistics:

Total Project Expenses and Percentage This Quarter	Total Amount of Funds Expended This Quarter	Total Percentage of Time Used to Date
46.86% and 17.84%	$26,706.38	50%

Project Description:

Traffic crashes are a major source of congestion on freeway and arterial system. A “Primary crash” leads to reduction of roadway capacity which may result in another crash, known as “a secondary crash”. Though a relatively small proportion of all the crashes are secondary crashes, it is important to identify the contributing factors as well as their characteristics because secondary crashes can increase congestion, delays, fuel consumption and emissions. A number of states have proposed various programs to reduce secondary crashes and estimate their benefits in crash reduction. Therefore, understanding the characteristics of primary and secondary crashes can help decision makers’ select better traffic operation and safety programs.

The purpose of the study is to identify secondary crashes, develop prediction models for incident duration, probability of secondary crash occurrence, associated delays and queue length and apply them to Shelby County, TN. Once the models are established, frameworks will be developed for Hot Spot Visual Tool (HSVT) - to identify the locations which are likely to encounter secondary crashes and Crash Identification Toolbox (CIT) - to obtain specifics of a crash for a set of criteria. Part of the research also will study impact of secondary crashes on freight operations and consequently identify and evaluate strategies that could be used to reduce the impact for hot spots. Identification of the secondary crashes involves extensive literature review to learn different temporal/spatial threshold, methodologies used in the past studies. It also includes developing an algorithm. Developing prediction models would involve identifying the contributing factors using data analysis and based on that, statistical models will be generated that can predict incident duration, probability of secondary crash occurrence, associated delays and queue length.

Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):

As the first step, based on the past studies, different temporal/spatial thresholds and methodologies are identified. During this quarter, crashes occurring in Shelby county, TN within the time period of January 1, 2010 to December 31, 2012 were analyzed. Using the Geodatabase that includes all the necessary attributes of a particular crash a total of 91,325 crashes were analyzed in order to identify the secondary crashes. Two different approaches are used for the identification purpose- Static and Dynamic.

For static, different temporal and spatial thresholds are used to identify secondary crashes. It helped to determine the sensitivity when changing the thresholds for different facility types. Temporal thresholds of 30, 60, 120, 180 and 300 minutes are used along with spatial thresholds of 0.5, 1, 2, 3 and 5 miles.

For dynamic approach, the principle of “Shockwave” is used in order to find the associated queue length and impact area for a particular crash, which led to the identification of a secondary crash.

Anticipated work next quarter:

Since now that the secondary crashes are identified (using both static and dynamic thresholds), primary contributing factors leading to a secondary crashes will also need to be identified as a prerequisite for the prediction models. The team has also started performing the data analysis using the data obtained from TRIMS in order to identify the primary contributing factors. The next step would be to develop prediction models for incident duration, secondary crash occurrence and associated delays and queue Length.

Significant Results:

The identified secondary crashes are classified into two categories based on the type of facility-Freeway and Arterials. Freeway and arterials encounter flow, speed and density significantly different to each other. It is necessary to separate them for the purpose of comparing them to each other and also for comparing the two different approaches used in the identification process. The secondary crashes are then broken down by hours of day, days of week and also by month of year. The result for freeway showed that a significantly high percentage of secondary crashes occur during the morning peak and afternoon peak (spread between 4-7 pm).

The results also showed that secondary crash identified by dynamic vs. static thresholds differ significantly. The reason is static threshold may give false positive and false negative results to a significant extent.

Also, the team has identified several hotspots (locations that are more likely to encounter secondary crashes) on freeways and also on arterials.

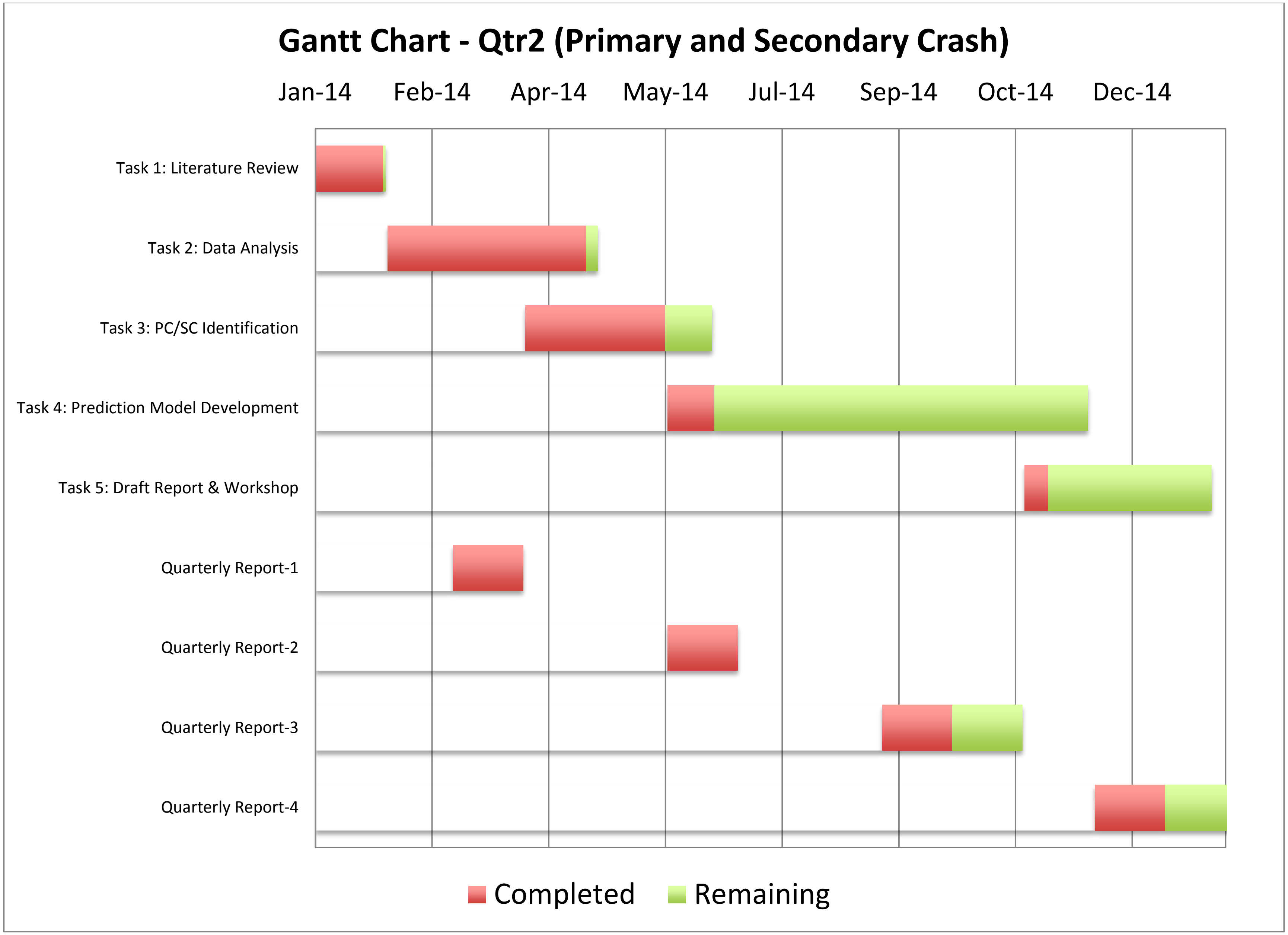
Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).

None

Potential Implementation:

The research team has established a process of collecting crash, exposure, highway geometry, environmental data for any county in state of TN. All the data are stored in a database and further linked to a shape file for visualization.
At the end of Phase I the state can use the data for following implementation:

- Visualizing predominant crash locations
- Identifying secondary crash locations by user defined thresholds
- Determining same direction and opposite direction secondary crashes


Gantt Chart - Qtr2 (Primary and Secondary Crash)
Jan-14
Feb-14
Apr-14
May-14
Jul-14
Sep-14
Oct-14
Dec-14
Task 1: Literature Review
Task 2: Data Analysis
Task 3: PC/SC Identification
Task 4: Prediction Model Development
Task 5: Draft Report & Workshop
Quarterly Report-1
Quarterly Report-2
Quarterly Report-3
Quarterly Report-4
Completed
Remaining