I-95 CC – Volume & Turning Movement Project
Steering Committee Meeting #4
April 13, 2017

Agenda:

#	Topic	Speaker
1	Project Tasks Status Update	Stan Young, National Renewable Energy Laboratory (NREL)
2	Statewide Traffic Volume Estimation Using GPS Traces: INRIX Dataset - Maryland	Kaveh Sadabadi, UMD CATT
3	Real-time Volume Estimation – Denver Area	Yi Hou, NREL
4	FHWA Travel Monitoring Analysis System (TMAS)	Steven Jessberger, FHWA
5	Wrap Up	Stan Young, NREL & Denise Markow, I-95 Corridor Coalition

Next Steering Committee Meeting: Thursday, July 20, 2017 at 10:30am - 12:00pm (EDT)

Meeting Notes:

- *Welcome*
  - Denise Markow (I-95 CC) posed questions to the members regarding their use of this data in planning and operations. (**please see the end of the minutes for follow-up questions to be answered by the Committee members**)
  - She also noted that the team is looking for use case scenarios.

- *Project Tasks Status Update*
  - Stan Young (NREL) reviewed the background of the project and explained the key players in this effort.
  - Stan briefly explained the status of currently available volume data and its limitations. The goal and objectives were reviewed as well as where the effort currently stands related to these objectives.
  - Stan presented the project flow chart and explained how it is evolving and how roles have changed. UMD is working with the INRIX data and NREL is working with the TomTom data while HERE's plan has not changed. TMAS is anticipated to be the heart of the calibration testbed and TTI will take the lead on validation. Stan noted that the products will remain the same.
  - The status of the project elements was reviewed
    - INRIX/UMD Data – Expanding analysis to more locations and procuring more data
    - TomTom/NREL – Data is flowing, work has started
    - HERE – still in process
    - Studying the FHWA TMAS data in anticipation for use in calibration
    - Beginning to collaborating with TTI regarding the validation

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- o Real-time vs. Archived data – The current work is using archived data. To get to real-time data the vendor data needs to evolve to a real-time API format and the calibration testbed also needs to be in a real-time API format. Historical analyses can be converted to simulate real-time accuracy.

- *Statewide Traffic Volume Estimation Using GPS Traces: INRIX Dataset - Maryland*
  - o Kaveh Sadabadi (UMD CATT) described the progress made by UMD CATT over the last quarter with the INRIX data. The work focused on estimating travel volumes using GPS traces provided by INRIX.
  - o He reviewed the need for both speed and volume in performance measurement and reporting, noting speed data is available through vehicle probes (such as VPP and NPMRDS) while volume data is limited. Kaveh discussed the issues with the currently available volume data and explained the current practice of determining volumes, noting that this method is not accurate enough for operational purposes.
  - o Kaveh reviewed the objective of their effort which is to build a model to accurately estimate the statewide traffic volumes using probe volumes (processed from GPS traces), other archived data, and ATR counts.
  - o The two-step process of taking raw GPS waypoints to a level where probe volumes can be estimated was explained. It includes snapping (to the actual map) and map matching (running the routing algorithm to build the route that is consistent with the underlying map). 18.7 million out of 19.7 million trips (95%) were processed as final data resulting in twice as many probe volumes at ATR stations, on average. The average hourly penetration rates and average probe volumes were reviewed.
  - o For regression analysis and modeling a Multi-Layer Artificial Neural Network (ANN) was used. More than 211K coefficients were calibrated with the use of both local GPU and AWS for training with AWS being more efficient. 35 ATR stations were selected for analysis – 34 used for training/calibration and one for evaluation/test. Initial results of the analysis were presented.
  - o Contribution of GPS Trace data was discussed. It was noted that the error is less when probe volumes are included as inputs (22%) with all of the data in the model.
  - o Kaveh discussed the evaluations and noted that the R^2 is consistent throughout except on low volume roadways and US highways. He also noted that as the volume increased the error decreased.
  - o Questions regarding this presentation included:
    - It was asked if bias might have been introduced by selecting the ATR locations with the cleanest data. Kaveh responded that they did not believe it introduced bias. During last round, the 12 ATR stations used were located on major interstates or near urban areas. This round the stations were spread out and higher volume roadways were not necessarily chosen for that reason.
    - Erik Sabina (Colorado DOT) asked how stable this model will be over time as conditions changes (such as congestion) or as the share of volume that the GPS trace data volume covers increases. As the penetration rate of probe data increase, it is anticipated that the accuracy of this model (and other ones) will increase with the higher correlation between probe vehicle volumes and actual vehicle volumes. It was also noted that as changes occur, continuous calibration will be needed with sensor based data (such as TMAS data). Erik noted that this approach does not replace the need

for ATRs at the DOT but provides better modeled data where they do not have ATRs. Kaveh reiterated that the data is more accurate, provides more coverage and is more flexible.

- Wenjing Pu (FHWA) asked about a UMD study that compared the traditional AADT profile to estimate volume. The methodology was implemented but Kaveh is not sure if it is documented. Currently, UMD is working on a document to report on the performance of this method in distributing AADT estimates to hourly counts during a typical week.
- Wenjing Pu asked how the model was selected. It was noted that various models were looked at and currently the Artificial Neural Network (ANN) was selected as the best model. The Recurrent Neural Network is also being considered and may be used moving forward. Also, after snapping of traces to the map, basic models (such as linear regression) are being revisited to evaluate simple (but accurate enough) alternatives for traffic count estimations.
- Mike Fontaine (VDOT) asked about the values shown on the performance evaluations. Kaveh noted that the values shown represent the median not the average. Kaveh said that he would verify it with the analysts.
- Wenjing Pu asked about the R^2 being higher during the off peak vs. the peak. Kaveh explained that during the off-peak volumes are likely lower so if the model is making the same mistake during each period, it is magnified in the peak. Stan noted that the off-peak is more predictable than peak which is bumping against capacity.
- Mena Lockwood (VDOT) asked if volume or volume to capacity ratio should be used for the R^2. Since capacity at a given location is considered a constant, estimating R^2 using either measure will lead to identical results.

o Next steps by UMD CATT were reviewed and include looking at different time granularities, grouping ATR locations based on factors, and pick two states/regions for INRIX to provide GPS trace data and repeat the analysis.

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- ***Real-time Volume Estimation – Denver Area***
  o Yi Hou (NREL) described the effort being undertaken by NREL using the TomTom data in the last few weeks.
  o He discussed the FHWA TMAS data (station, volume and vehicle classification) that they have been studying. He also noted that they are looking at weather data from Weather Underground and TomTom data including travel time, speed, probe vehicle count, speed limit, street name and segment ID. Using their API to query the data.
  o Yi showed 15 ATR stations in the Denver area that are being matched with the TomTom network.
  o He provided a table showing a snapshot of combined data. A "segment ID" is included for each entry. This will be matched with TomTom data to build a model, similar to UMD, using data shown as inputs to predict volume (last column). Once this model is built it will be generalized to get ubiquitous data throughout the network. NREL is currently working on this step.
  o Yi Hou noted that they have developed a web app framework prototype. He demonstrated how it will be used but noted that TomTom data is not yet included.

- o He noted that an advantage of the TomTom data is that they provide the probe volumes (not the waypoints like the INRIX data) which is less work in setting up the model.
- o Wenjing asked about the data in the prototype. Yi Hou noted that the volume data is from TMAS. It will be used for validation and calibration.
- o Yi Hou reviewed their planned future work.

- **FHWA Travel Monitoring Analysis System (TMAS)**
    - o Steven Jessberger (FHWA) introduced the TMAS system and explained the difference between TMAS and HPMS.
        - TMAS represents temporal data (24/7) for most permanent traffic monitoring sites in the US. It comes from continuous count stations (not ATRs). (over 5000 sites)
        - HPMS represents spatial data for all federal aid roadways in the US.
    - o He explained how agencies can access the TMAS data. He noted that there is no "TMAS format" – they are Traffic Monitoring Guide (TMG) ASCII text files. The TMAS volume and station data is updated every six months (in 6 month increments) on the public website. Data is uploaded by states on a monthly basis. The amount of data has been doubling every year in the last few years as more classification and weight data sites are being collected and sent into FHWA.
    - o Steven reviewed the data that is included in TMAS – station data, volume data (currently hourly only), classification data, weight data. He also noted that nonmotorized, speed and PVF data would be coming soon (in 2016 TMG formats).
    - o He noted that all incoming data is quality checked. QC can be set on a site by site basis.
    - o Steven reviewed the TMAS 3.0 Features and noted that they strive to collect data <u>once correctly</u> and use it many times. He noted that speed data (5, 15 or 60 minute increments is permitted) is coming soon. He also noted that a lot of states are moving to "per vehicle format (PVF)" records (and FHWA is recommending it) as it allows for gap and headway, better classification and advanced QC. It also has signatures (inductive, magnetometer or other) included so that the vehicles can be reidentified and states can get travel time, O-D, and other information.
    - o Steven reviewed the reports available including:
        - 4 volume reports
        - 3 analytical reports
        - 5 classification reports
    - Steven noted that the above noted reports are open to all states and that FHWA plans to provide a public portal to access the great TMAS data.
    - o Steven offered demos for all agencies. (*Contact info is at the end of the minutes*)
    - o Questions regarding this presentation included:
        - Some clarifications on the TMAS data. Most TMAS data is hourly volume data but other (lesser) increments will be accepted. Volume is generated from class if available. TMAS data comes from mostly permanent count stations but they have some portable sites.
        - Sutapa Bhattacharjee (NJTPA) asked about the coverage of data/facility types. Steven noted that usually higher functioning roads are included however the lower functional classification roadways are important. He offered to send the Growth Factors Report which includes the 5,000 sites

by state and which functional classification they are on. It is important that each state represent their system through the location of their sites on various roadway types.

- Sutapa Bhattacharjee asked about the non-motorized data. Steven noted that it will be more detailed, from various agencies (counties, MPOs and private agencies), and not all roadways will be covered. It is currently being tested.
- Mena Lockwood (VDOT) asked if states can send in older data for non-motorized data. FHWA will except data in 2016 TMG format. For four years, back agencies can upload or they can send it to FHWA – even ten years back but must be in 2016 TMG format. Older data further back can be sent to FHWA for headquarters to load into TMAS. FHWA accepts data from any time frame in the TMG acceptable formats.

- o Stan Young noted that TMAS is an excellent calibration data source.

- *Wrap Up*
  - o Stan Young reviewed the UMD results and noted the improvement from the initial results. The team is hoping to have information for TomTom data in the coming months.
  - o Project Team Next Steps – move validation forward, UMD to select additional areas, acquire, and test methodology, NREL to complete initial volume estimates using TomTom data in select areas, and HERE to initiate analysis. In addition, research to begin on confidence score.
  - o The Steering Committee was asked to contact Denise Markow, Stan Young and/or Kaveh Farokhi with any questions and to provide additional input.

- *Next Steering Committee Meeting*:
  - o **Thursday, July 20, 2017 at 10:30am - 12:00pm (EDT)**
  - o Topics:
    - Validation methodology
    - Data Analysis Update – UMD/INRIX, NREL/TomTom, HERE
    - Confidence score
    - Discussion on consistent format

Follow up Questions – For Steering Committee was asked to provide their feedback on the following questions
(Please send responses to dmarkow@i95coalition.org**:)**
- How do volume estimates need to be packaged/formatted for agency use?
- Are the accuracy discussions using R^2, MAPE and ECR meaningful?
- What are the concerns to get from research to product?
- What ways would agencies use this data for planning and/or operations?

Presenter Contact Info:

Real-time Volume Estimation - Denver Area
Yi Hou, PhD, National Renewable Energy Laboratory (NREL)
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FHWA - Travel Monitoring Analysis System
Steven Jessberger – System Owner, FHWA – Office of Highway Policy Information
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Project Contact Info:

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Co-PI – Denise Markow (I-95 Corridor Coalition) 301-789-9088 or
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Co-PI – Stanley Young (NREL) 301-792-8180 or Stanley.Young@nrel.gov

Logistics –Joanna Reagle (KMJ Consulting, Inc.) 610.228.0760 or jreagle@kmjinc.com

Action Items:

#	Action Item	Whom	Status
	VTM Steering Committee Meeting – April 13, 2017		
1	Determine if a report documenting the methodology used by UMD to compare traditional AADT profiles to estimate volumes is available. If so, to provide it to Wenjing Pu and the rest of the Steering Committee.	Kaveh Sadabadi	Currently being prepared. Once this report is complete it will be shared with the Steering Committee.
2	Verify the values shown on the performance evaluations with the analysts and provide clarification to the Steering Committee.	Kaveh Sadabadi	Ongoing. A brief report is being prepared to address the questions and to provide more insight into the model evaluation results.
3	Send the Growth Factors Report which includes the 5,000 sites by state and their functional classification.	Steven Jessberger	Attached to the follow-up email.
	Previous VTM Steering Committee Meetings		
1	Separate the data by time of day and compare the results to the findings for the 24-hour period.	Nikola and Przemyslaw	
2	Follow up with Shawn Turner (TTI) on the possibility of using Factor Groups to separate the data.	Stan Young	

Participants:

Project Team:
Denise Markow, Marygrace Parker, I-95 Corridor Coalition Stan Young, NREL Kaveh Sadabadi, Nikola Marković, UMD CATT

Steering Committee:	
Erik Sabina	Colorado DOT
Greg Hiller, Jesse Buerk	DVRPC
Jimmy Chu, Wenjing Pu	FHWA
Tom McQueen	Georgia DOT
Susan Klasen	New Hampshire DOT
Daivamani Sivasailam	MWCOG
Sutapa Bhattacharjee	NJTPA
Jeremy Freeland	Pennsylvania DOT
Mike Fontaine, Mena Lockwood	Virginia DOT
Shawn Turner	Texas A&M Transportation Institute
Joe Guthridge	HERE
Amy Lopez	INRIX
John Allen	UMD CATT Lab
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Joanna Reagle, KMJ Consulting, Inc.	