Research Statement Title:
Integrating Existing and Emerging Transportation Data Collection Activities to Maximize Analytical Capacity.

Problem Description and Discussion:
Transportation data collection and analysis is nothing new, but technology advancements have increasingly expanded both opportunities for data collection as well as data requirements to support modern analyses. Because the costs of data collection remain significant, a good steward of finite public/private resources should avoid duplication of effort in data acquisition and ensure that collected data is made usable and available for as many purposes as possible. Unfortunately, organizational silos and a lack of coordination largely prevent multi-purpose data acquisition and sharing of existing data for similar analysis needs, while maintaining an archival system capable of supporting multi-purpose future uses. Privacy concerns present an additional obstacle as organizations collecting high-resolution travel data require safeguards to prevent misuse such as attempts to identify an individual from an anonymous data set. Addressing these issues and coordinating a diverse mix of data sets (from public and private sources, with both coarse and fine resolution, as well as intermittent and continuous collection intervals) requires a high-level concerted research effort.

Bringing Together Traditional and Emerging Data Collection/Analysis Activities:
Coordinating data acquisition across a range of ground transportation sectors will require some effort, but each (planning, operations, engineering, manufacturing, research, etc) will benefit from the improvements in resource efficiency and data availability. Expanded data accessibility would also assist new stakeholders from emerging or previously unrecognized analysis areas. The below list summarize just a few of the currently isolated efforts that could experience synergetic benefits if coordinated.

<u>Travel Behavior Surveys</u> – particularly on the national level, do provide potential for combined data collection benefiting multiple end users. However, the various current efforts could be better coordinated with each other and with activities in different areas. (Sporadic funding is one challenge). The studies are typically conducted as home interview surveys using telephone random digit dialing (RDD) with diary assistance.

- The National Household Travel Survey (NHTS) is undertaken about every 5 years and for the past 40 years has traced national and regional travel behavior patterns on a national level.
- Metropolitan Planning Organizations (MPOs) undertake somewhat more focused household interview surveys for the specific purposes of updating or calibrating travel demand models. Data requirements include vehicle trace, origin to destination and the average speed and travel time across their network.
- In recent years, the use of Global Positioning System (GPS) devices has matured to the point where they can be effectively used to assist traditional surveys to assess missed trips on the part of the respondent.
    - In Australia, they have been used as the sole survey device and tracked respondent travel behaviors over long periods of time as compared to the more typical travel day survey.

    - GPS surveys can collect precise positioning of the respondent, returning coordinates, altitude, acceleration, deceleration as well as dwell time. GPS surveys when coupled with highly accurate Geographic Information System (GIS) networks for travel modeling can easily show flow activity on the network.
- Several agencies have recently incorporated the GPS-instrumented vehicle technique into studies on congestion pricing (in order to address both concerns with traffic management and means to pay for infrastructure improvements).

Probe Vehicle Surveys – have similarly proliferated due to GPS technology advancements and can provide an alternate assessment of network transit times and speed calculations. System operators require real-time reporting of vehicle speeds and the presence of vehicles within the stream to resolve incidents and improve roadway performance. Companies involved in Intelligent Transportation System (ITS) work and in-vehicle navigation systems desire this same information in order to provide intelligent traffic routing, accurate travel time predictions and information to help drivers avoid traffic jams. Air quality analysts also benefit from data on temporal and seasonal variation of speeds and operating states for the different types of vehicles on the roadway.

- The I-95 Corridor Coalition Vehicle Probe Survey provides one example of using personal cellular telephones to identify light-duty vehicle travel. This survey is testing cellular probe technology and validating the data streams from onboard blue tooth devices communicating with roadside receivers. INRIX, the vendor for this project, has also produced several reports using the travel times and speeds to illustrate vehicular stream performance as well as constructed a national dataset.
- Similar surveys can use GPS-enabled cell phones to collect transit time and speeds in sections and point locations for traffic engineering needs such as signalization regimes.
- The technology has been taken further in trucks, where devices log the GPS travel profile as well as operation data from the vehicle information bus. The American Transportation Research Institute and the Federal Highway Administration have examined such data as a means for assessing speed as a performance measure. CALMAR is another firm aggregating truck GPS/data bus information.

Climate Change and Energy Security Concerns – are at the forefront of contemporary challenges driving new analysis and data needs. Session 661 at the 2009 Transportation Research Board Annual Meeting ("Extending Travel Survey Data Utility with Novel Vehicle Fuel Use and Climate Change Research") illustrated several analysis issues that could benefit from better coordination and availability of collected transportation data.

- Automobile researchers and manufacturers developing hybrid and plug-in hybrid electric vehicles (HEVs and PHEVs) are interested in second-by-second GPS surveys in order to extract real-world information such as acceleration, deceleration, cruise speed, and dwell time/location. When combined with vehicle simulation tools, this information helps inform design decisions (engine, motor, battery sizing, etc), permits analysis of different vehicle charging scenarios and fueling/recharge station locations, and allows estimation of fuel savings relative to conventional technologies under "real-world" operating profiles.

- Utility companies also need to understand the electrical grid impact of powering a fleet segment of PHEVs, and require travel behavior data in order to understand the temporal and seasonal variation of this added load on the grid. The significant add-on components in the 2008 NHTS could be a potential source for geographically-specific travel information overlapping with particular electric utility service areas.
- Analysts assessing various strategies to reduce green house gas (GHG) emissions require better access to on-going data from panel surveys or passive data collection instruments. This information is needed to give more rapid feedback to policymakers on the actual outcomes of GHG reduction initiatives and to sort out phenomena such as rebound effects (i.e. simply driving efficient vehicles farther).
- Researchers and companies working on fuel-saving vehicle deployment could also consider trip making characteristics of different socio-demographic populations to target particular households with technologies that would provide the most benefit based on their travel patterns.
- Travel demand modelers are interested in the vehicle trace, origin to destination and the average speed and travel time across their network. Air quality analyses within the urban environment and especially in non-attainment areas seek to model temporal and seasonal differences as well as speed and operational characteristics for the vehicles by type on the roadway.

Lastly, policy makers are concerned with resource needs, allocation and how to pay for infrastructure improvements, and look at public and private partnerships as well as congestion pricing mechanisms to share costs.

Proposed Research Activity:
Task 1a – Review existing data collection efforts from planning, operations, private and administrative sources, as well as recent advancements in passive data collection. Determine the value of combining and repurposing these existing sources to meet the range of traditional and emerging needs. Outcomes could include efficiency-improving principles such as "collect once, use many times" and data recycling, with special attention toward the implementation of efficient archiving procedures.
Task 1b – Recommend a protocol or framework for how to integrate presently siloed efforts with varying survey focuses. Highlight methods for maintaining awareness amongst the different constituencies so that they can form partnerships.

Task 2a – Examine the issues involved with integrating GPS/ITS technology and traditional data collection methods to meet the needs of the diverse planning, operation, engineering, manufacturing and research stakeholders. Include consideration of the new analyses required for moving to a “greener” transportation system.
Task 2b – Develop a protocol or framework for how GPS/ITS and traditional survey data should be interrelated, integrated, formatted, collected and stored for archival purposes.

Task 3a – Evaluate ways to address privacy concerns from integrating GPS and diary survey data while maintaining the ability to use the data for analyses. (Note that

modeling, simulation and calibration of analysis engines often require availability of data in its native form).
Task 3b – Recommend a protocol or framework to strike an appropriate balance between privacy protection and data accessibility. Existing efforts, such as from the Census Bureau's Longitudinal Employment and Household Dynamics (LEHD) program, could help suggest techniques for managing privacy and combining GPS with traditional survey data. For example, "LEHD's On the Map" provides data (much of it modeled or synthesized) that ordinarily would not meet disclosure and privacy concerns but is now available for display and use.

Task 4 – Evaluate the stability of market segmentation, socio demographics, household activity and vehicle usage patterns for GPS and diary surveys collected in different temporal periods.

Estimate of Problem Funding and Research Period:
Estimated Time: 24 months
Estimated Cost: $600,000

Urgency, Payoff Potential and Implementation:
This high priority project will improve coordination and partnership opportunities between organizations—leading to more effective use of limited resources by reducing the number of related but disjointed efforts and expanding the number of end users who benefit from each data set. The project will help advance work on mining existing data with regards to data fusion, optimize technical solutions brought about by new field surveys utilizing GPS, and more fully integrate new technology solutions between existing as well as non-traditional stakeholders. In addition to the efficiency improvement payoff of the proposed project, the resulting cross-collaboration will foster learning across different ground transportation sectors. For instance, engineering field monitoring for the purposes of operations or design can benefit from the social-demographic and activity-based data in the planning and marketing side of survey design.

Persons Developing the Research Proposal:

Nathan Erlbaum*	**Catherine T. Lawson, Ph. D.**	**Jeffrey D. Gonder**
Associate Transportation Analyst	Director, MRP Program	National Renewable Energy Laboratory
New York Department of Transportation	Associate Professor	Center for Transportation Technologies & Systems
Office of Policy, Planning & Performance	University at Albany	1617 Cole Blvd, MS 1634
50 Wolf Road, 6th Floor,	Geography & Planning	Golden, CO 80401
Albany, New York 12232	AS 218 1400 Washington	Office: 303-275-4462
Office: 518-457-2967	Albany, New York 12222	Fax: 303-275-3765
Fax: 518-457-4944	(518) 442-4775	Jeff.Gonder@nrel.gov
nerlbaum@dot.state.ny.us	(518) 442-4742 FAX	
	lawsonc@albany.edu	

*Problem Monitor/Contact