Using GPS & GIS Technologies to Improve Transport Planning

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Presentation Outline

- **Transport Planning Background**

- **Overview of Borlange Safety Study**

- **Characteristics of GPS Dataset**

- **Trip End Identification**

- **Trip Activity / Purpose Imputation**

- **Study Conclusions and Next Steps**

- **Transport Planning Opportunities**

Transport Planning

- **Travel Demand Models use sample households to represent regional and statewide mobility patterns**

- **These sample household typically report travel information for one to two days**
  - **1-2 days of travel may not represent real travel behavior**
  - **Increasing data needs has increased respondent burden**
  - **Reporting accuracy is suspect**
  - **Response rates are declining**

- **Key challenge: to find methodology to passively collect accurate, detailed travel data for longer durations**

Swedish Intelligent Speed Adaptation Study

- **GPS-based units were installed in hundreds of cars in 3 cities**

- **Drivers were provided feedback (sound or display) whenever posted speed limit was exceed based on GIS network database**

- **Vehicles were observed for up to two years**

- **In Borlange, speed and location data of each vehicle was sent to central server for later analysis**

- **These data were processed prior to storage**
  - **Trip ends identified based on engine on / off events**
  - **GPS points snapped to link (including off network travel)**
 - **Out of area travel truncated at area boundary**

Data Sets Available for Transport Analysis

- **Processed vehicle files**
  - trip summaries
  - GPS point files

- **GIS files**
  - road network
  - land use

- **RES Data (2000-2001 Swedish National Travel Survey)**

Vehicle File Statistics

- 186 private vehicles with GPS data (>30 days) and s/e information

- June 22, 2000 through March 4, 2002

- 49,667 vehicle days of travel

- 240,435 trips inside study area

- 9,873 trips starting or ending outside study area

- 148 vehicles – maximum number observed on any one day
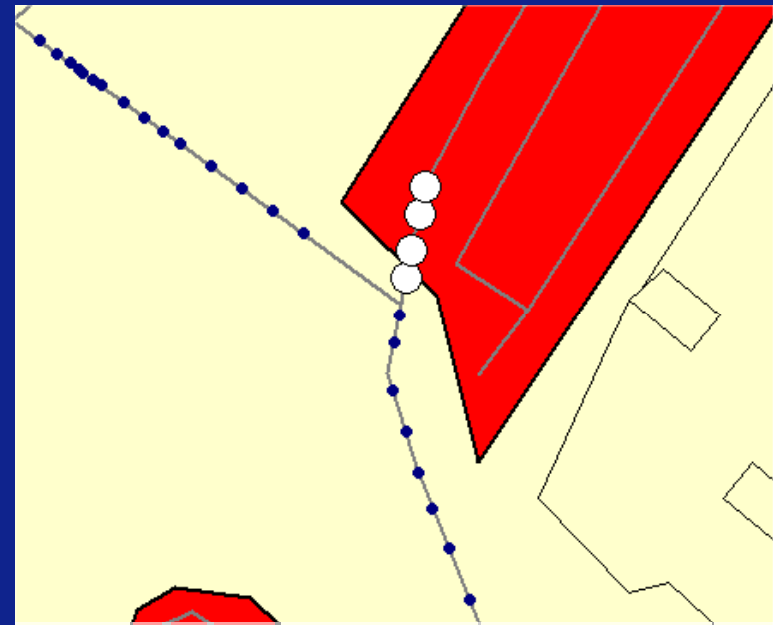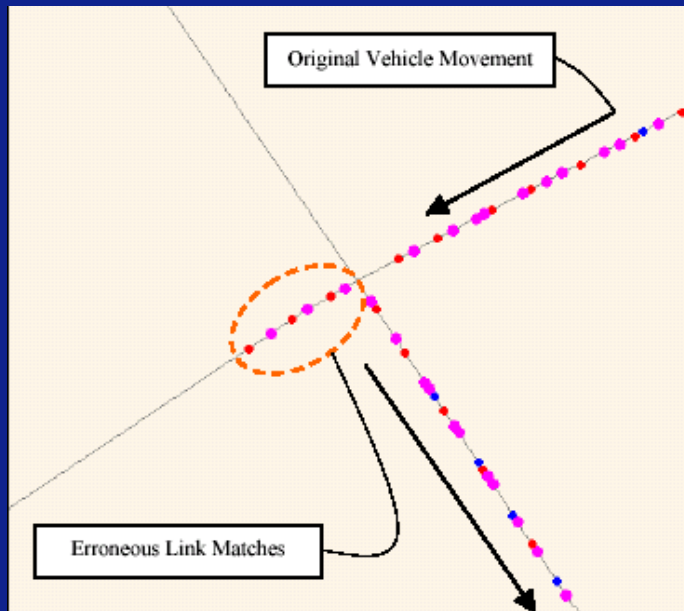
Number of Vehicles Traced by Week
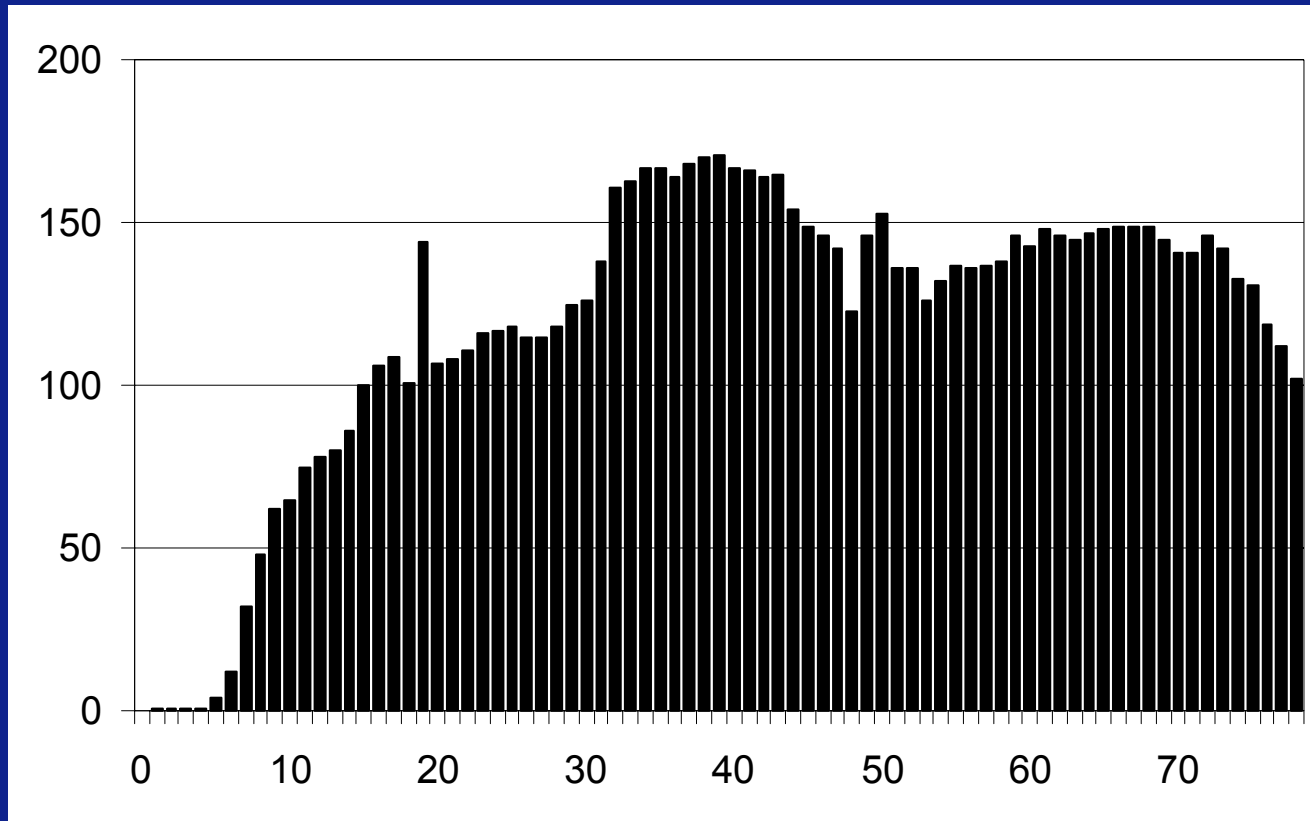
Comparison of Trip Lengths < 25km
(Borlänge GPS and 2001 RES)
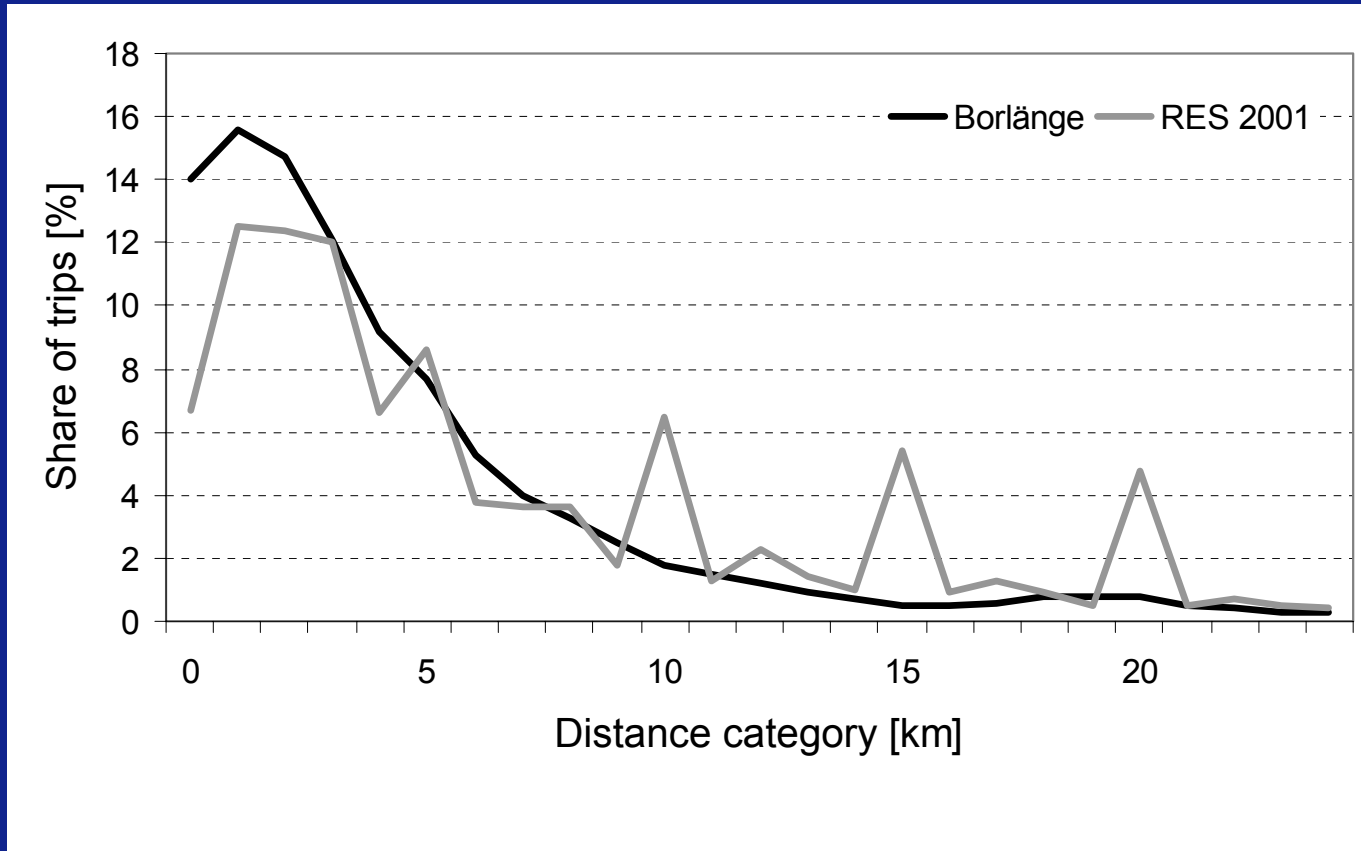
Correcting the Traces – Bad or Missing Points

Examples of False Deviation From Path

Identifying All Trip Ends

- Some trip ends were missing within the initial trips
  - Short stops that do not involve an engine on /off event

- Some trip ends could be false
  - Possibly an engine stall
  - Driver could turn off engine during congestion delay

- Some trips may include abandoned trips

Summary of Vehicle GPS File Import Results

- **24 vehicle datasets imported**

- **13,375 trips identified initially**

- **2421 travel days**

- **3,393,570 GPS points**

- **1 second and 10 second logging frequencies used**

- **36,492 points filtered (1.1%)**

Identification of Missing Trip Ends

**Example of High-Circuity with Overlap**

Trip End Identification Results

- 13,375 trips initially tagged for the 24 vehicles

- 4 trip ends were reclassified as engine stalls

- 3006 additional trip ends were found (22.5% increase)
  - 235 trips based on vehicle stops greater than 5 minutes
  - 420 trips based on vehicle stops between 2 and 5 minutes
  - 1751 trips based on high circuity routes with 5-120 second delay
  - 600 trips based on habitual destination

- 324 trips contained abandoned trip ends

- 5517 delays were tagged as 'probable congestion'

Info Sources for Activity Purpose Imputation

- **GPS Traces**

  - **Destination location, activity duration, day of week, time of day, frequency of visit across study period**

- **Associated Surveys**

  - **Age, gender, education, profession, working hours, hobbies and social commitments, home locations of friends & relatives**

- **Other Sources**

  - **Cross-sectional or panel travel diary survey**

  - **Land use database or map, parcel-level information**

Clustering of observed last positions (crosses) to cluster centres / activity locations (boxes)
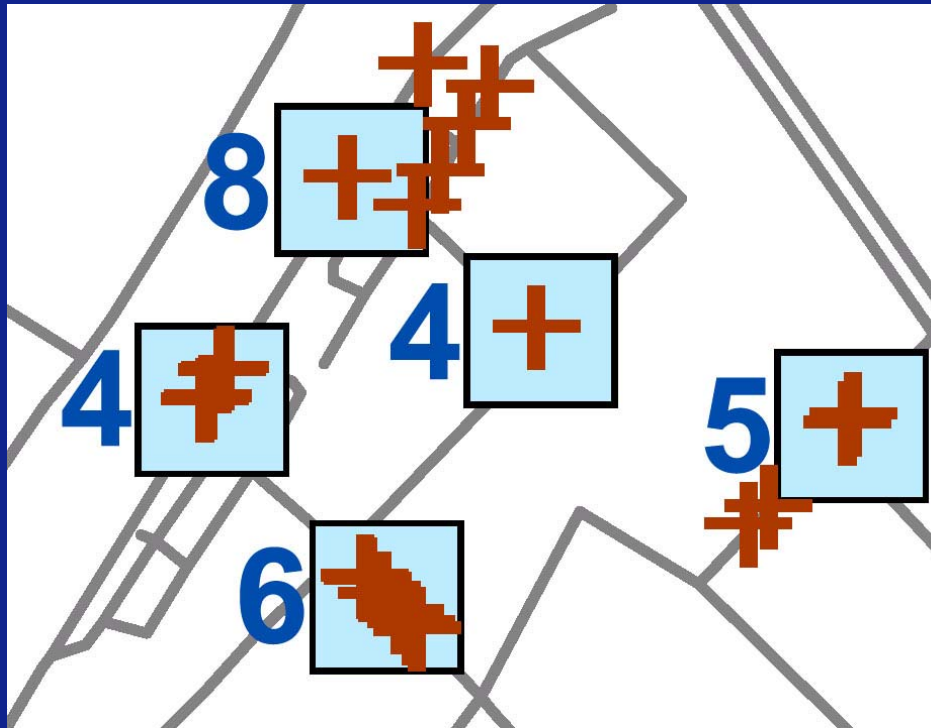
Identification of Trip Purposes by Land Use
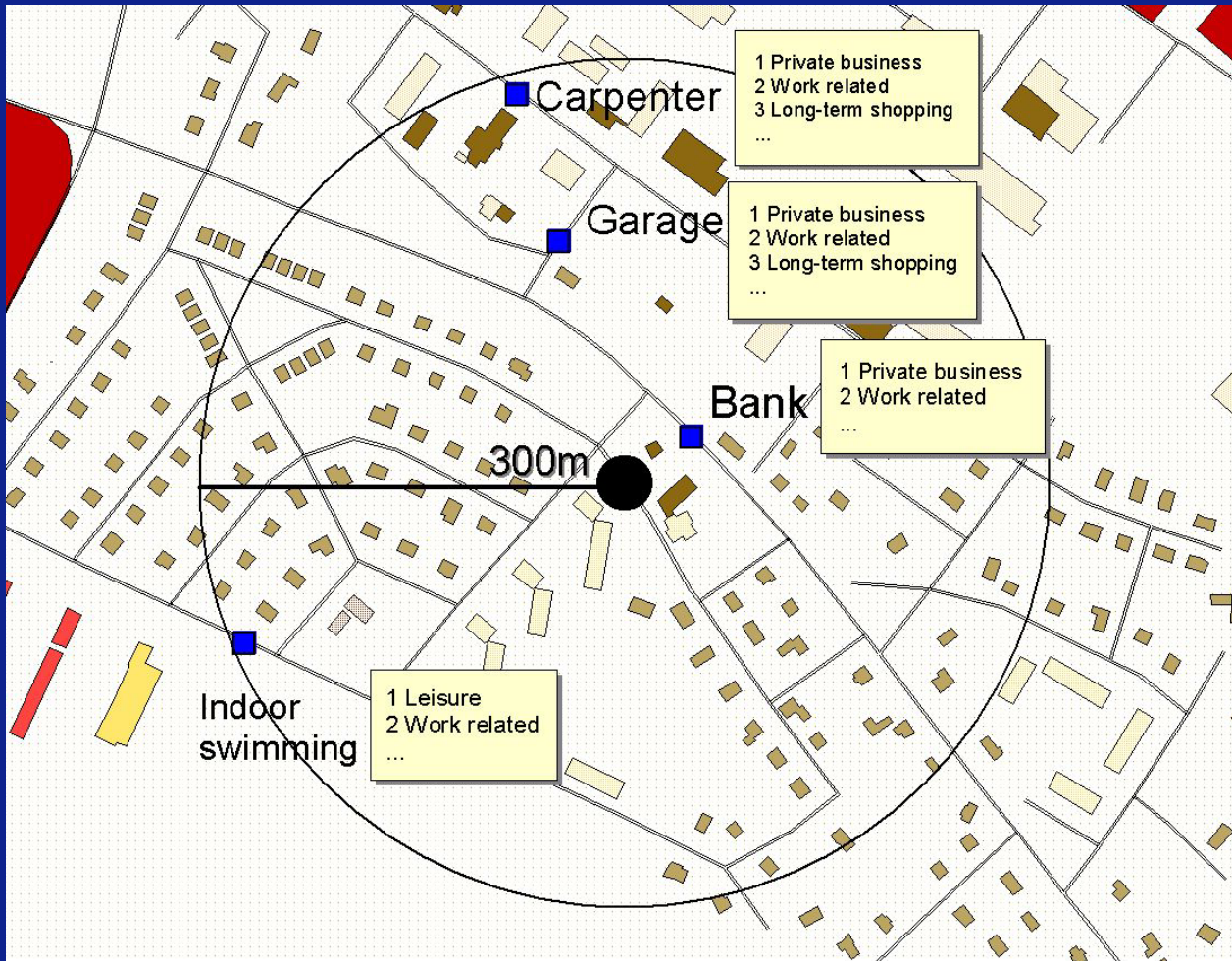
Borlänge GPS Data Compared with RES data: Selected Mobility Characteristics

| Variable	Retirees				Fulltime workers			
	RES		Borlänge GPS		RES		Borlänge GPS	
Mean number of daily trips (Std.)	3.8	-3.8	4.3	-2.8	4.8	-5.7	3.9	-2.4
Mean daily trip distance [km] (Std.)	24.6	-33.7	16.3	-12.5	32	-45.3	13.2	-11.3
Mean daily trip duration [min] (Std.)	44.1	-55.2	31.8	-22.4	58.7	-82.1	24.4	-18.2

[*] **Local car trips made by respective groups; Sample sizes: RES weighted by sex & age, N(Fulltime workers) = 1516, N(Retirees) = 440; Borlänge: N(Fulltime workers) = 28, N(Retirees) = 11**

Borlänge GPS Trip Purpose Assignment Compared with RES Data: % Trip Purpose Shares

Trip purpose	Retirees		Fulltime workers	
	RES	Borlänge GPS	RES	Borlänge GPS
Pick up / Drop off	6.8	7	8.9	8.6
Private business	4.6	10	3.7	8.2
Work related	0.1	9.8	8.3	5.7
School	-	0.1	0	0.1
Work	0.3	-	16	10.2
Daily shopping	12.4	4.4	6.1	1.5
Long-term shopping	8.6	7.3	5.7	7.9
Leisure	20.7	23.6	10.6	20.4
Other	5.2	-	4.1	-
Home	41.3	37.8	36.6	37.4

* **Local car trips made by respective groups; all days; RES weighted by sex and age, N(retirees) = 1516, N(fulltime workers) = 440; Borlänge: N(Fulltime workers) = 28, N(Retirees) = 11**

Variety Seeking in Location Choice
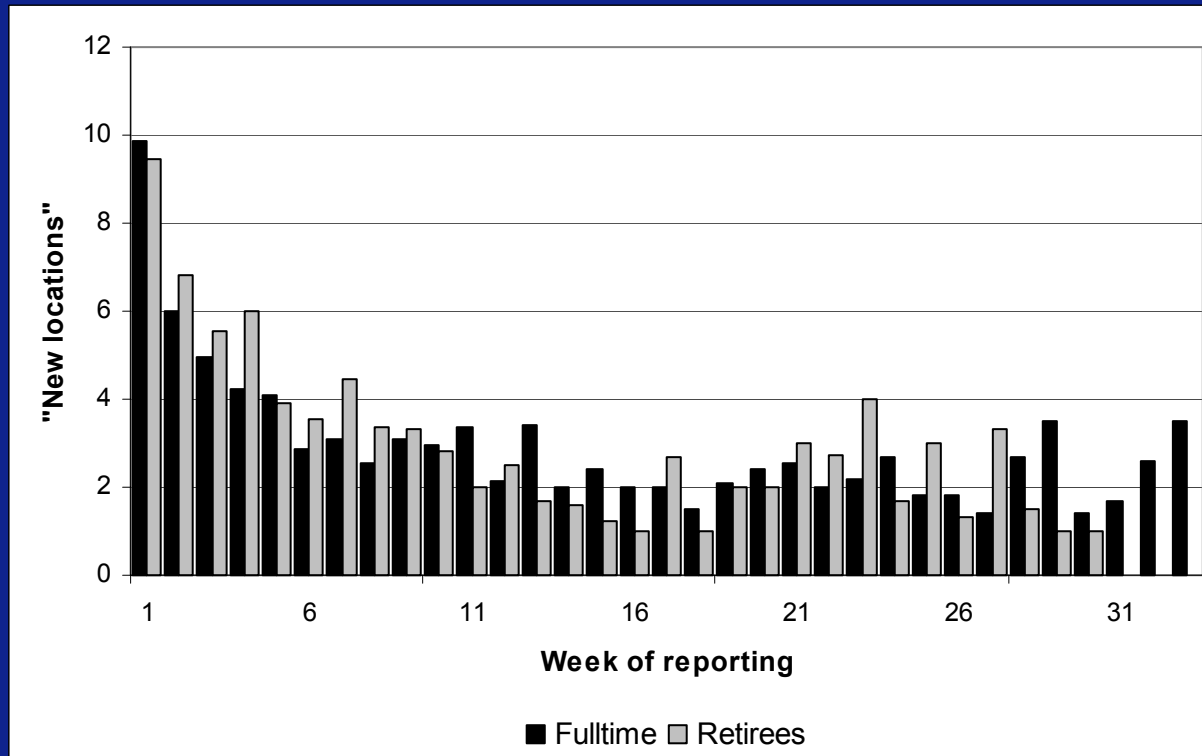
Mean weekly number of "new" locations, i.e. locations which had not been previously visited during the observation

Study Conclusions and Next Steps

- **Initial results show promise in use of GPS and GIS data collected in safety study for use in transport planning**

- **Great potential for intense spatial and temporal investigation of daily life travel (variability and regularity of trip making)**

- **Trip end identification may be improved by performing sensitivity analyses on key variable settings**

- **Trip activity / purpose identification may also be improved by further evaluation of activity buffer range**

- **These tasks will be performed using the same vehicle datasets**

GPS/GIS Opportunities for Transport Planning

- **GPS-enhanced Household Travel Surveys**

- **GPS-based Prompted Recall Surveys**

- **GPS data collected for other purposes can be archived and used for transport planning**
  - **AVL data**
  - **Safety studies**
  - **Behavioral change studies (to reduce travel)**

- **In all cases, GIS is the key to unlocking the information contained in the GPS data**