



Data Science for Smart Cities

CE88

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CE88 in title



Today

Urban data collection, handling and processing.

Agenda:

Lecture 5. Data acquisition: measurement and crowd-sensing.

Lecture 6. Community surveys, population census,
open government data, APIs.

Break

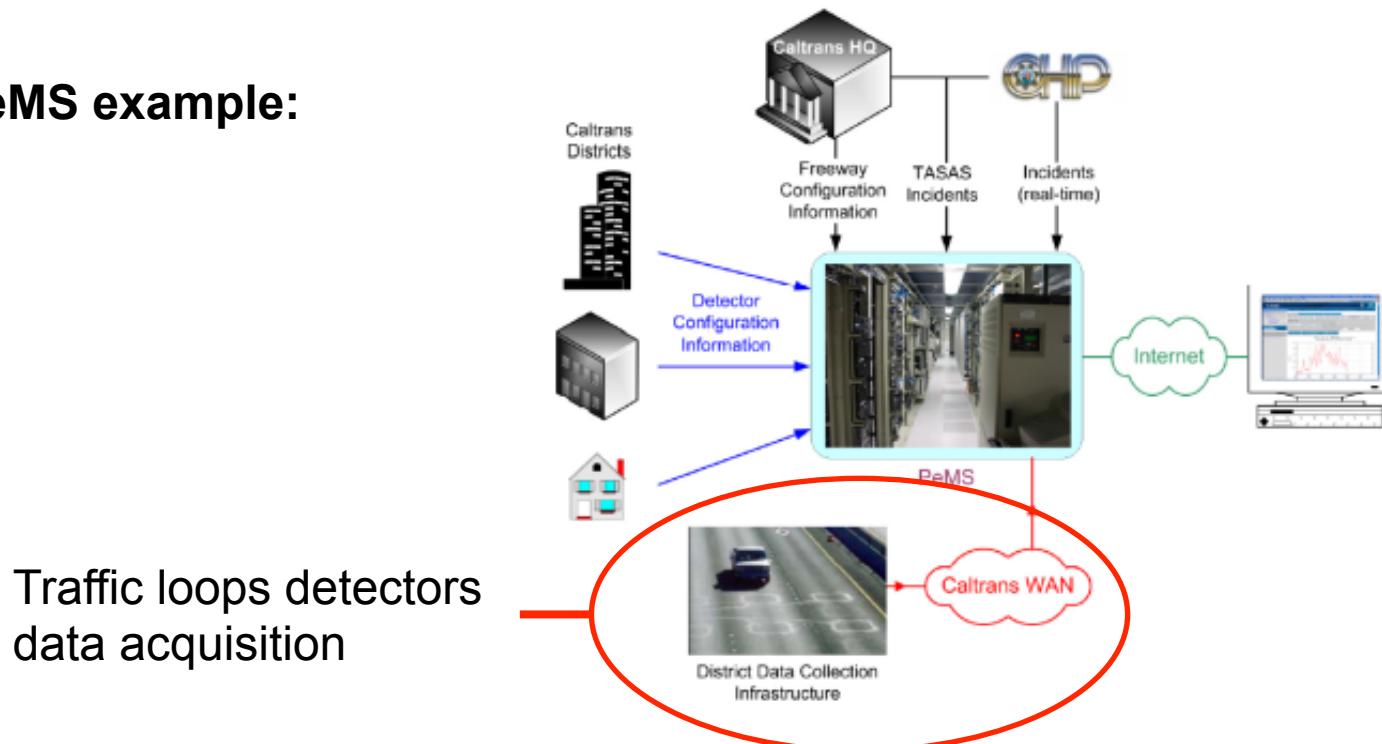
Mini-lab

Data acquisition

Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values. Primary way of collecting data on performance of infrastructures.

- performed by a dedicated hardware installation
- may require significant investments for installation and maintenance(!)
- purposefully designed, therefore often includes data quality control
- can be combined with controls (SCADA systems)

PeMS example:





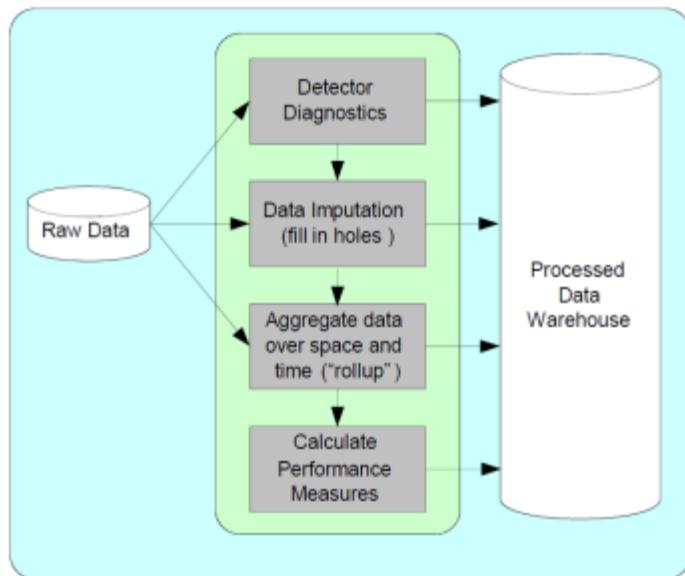
Data quality and data aggregation

Individual sensors occasionally malfunction, stop working or cease sending data. These errors occur for different reasons, and result in gaps in data. Well designed data acquisition systems include data quality diagnostic tests and detector ‘health’ information.

Common strategies to deal with the missing data situation are:

- insert a default value indicating that the reading is not available
- impute a ‘reasonable’, estimated value instead of a real reading

**PeMS
example**



Discussion:
Communication costs
vs
Computation costs



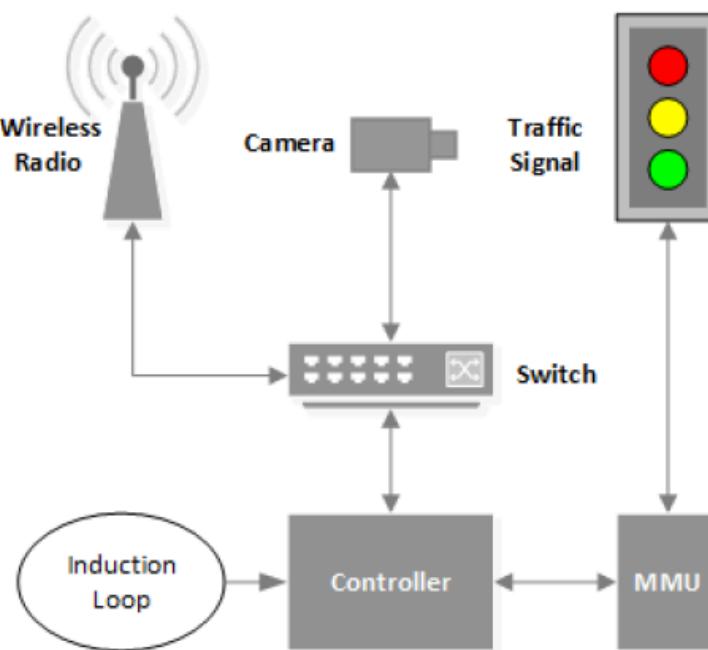
SCADA

SCADA (**supervisory control and data acquisition**) is a type of system for remote monitoring and control of physical infrastructures.

- operates with coded signals over communication channels;
- may be combined with a data acquisition system by adding the use of coded signals over the same communication channels;
- acquires information about the status of the remote equipment for display or for recording functions.

Example

http://thehackernews.com/2014/08/hacking-traffic-lights-is-amazingly_20.html





How do we collect data about people?



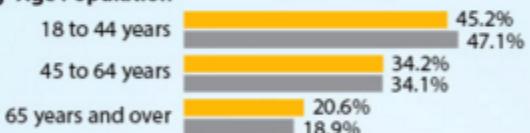
Topics
Population, Economy Geography
Maps, Products Library
Infographics, Publications Data
Tools, Developers Surveys/Programs
Respond, Survey Data Newsroom
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Search



Voting-Age Population



Demographic and Economic Profiles of Iowa's Electorate

In advance of the Iowa caucuses on Feb. 1, the Census Bureau presents a variety of statistics that give an overall profile of each state's voting-age population and industries.



Population Clock

U.S. Population

3 2 2 , 9 2 7 , 3 0 8

World Population

7 , 3 0 2 , 8 3 4 , 8 6 7

Feb 02, 2016 16:22 UTC (+8)

[Learn More >>](#)

QUICKFACTS

Did You Know

35.3%

of persons 25 years+ in Cook County, Illinois have a bachelor's degree or higher

Source: American Community Survey

Select a state to begin



U.S. Census Bureau Economic Indicators

Construction Spending	\$1,116.6 B	
December 2015 Report		0.1%
Released 10:00 AM EST, 2/1/16		
Advance International Trade: Goods	-\$81.5 B	
December 2015 Report		2.0%
Released 8:30 AM EST, 1/29/16		
Homeownership Rate	63.8%	
View All		* change not statistically significant
		* significance not reported / applicable

* change not statistically significant

* significance not reported / applicable

Latest News

FFF: Women's History Month: March 2016

February 01, 2016

This edition highlights and celebrates the varied accomplishments of women and provides statistical information on demographic and economic topics.



2014 Manufacturing and International Trade Report (MITR)

January 29, 2016

This report provides a comprehensive comparison between detailed manufacturing product class data and associated import and export data.



Stat of the Day

Construction Spending

Total construction activity for December 2015 (\$1,116.6 billion) was 0.1 percent (+/-1.2%) above the revised November 2015 (\$1,116.0 billion).

[Read More](#)



What they do

The Census Bureau's mission is to serve as the leading source of quality data about the nation's people and economy.

How they do it

The US Census Bureau conducts more than 130 surveys a year, including:

- Household surveys, the American Community Survey
- Business Survey, Annual Retail Trade surveys
- and many more.



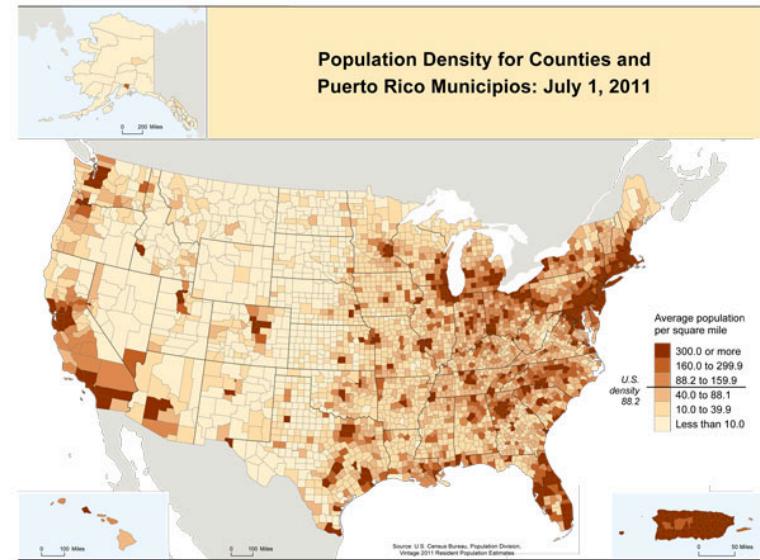
US Census Bureau

Census is used to distribute more than \$400 billion in federal funds to local, state and tribal governments each year. Census data informs how states and communities allocate funding for:

- Neighborhood improvements
- Public health
- Education
- Transportation
- Much more

For example: to make planning decisions about community services, such as where to:

- Provide services for the elderly
- Build new roads and schools
- Locate job training centers



and also:

- To determine the distribution of Congressional seats to states.
- Used to apportion seats in the U.S. House of Representatives
- Used to define legislature districts, school district assignment areas and other important functional areas of government

American Community Survey

<http://www.census.gov/programs-surveys/acs/>



Topics
Population, Economy

Geography
Maps, Products

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News, Blogs

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American Community Survey (ACS)

About the Survey

Respond to the Survey

News & Updates

Data

Guidance for Data Users

Geography & ACS

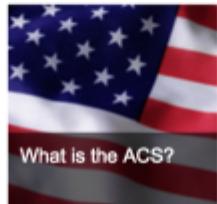
Technical Documentation

Methodology

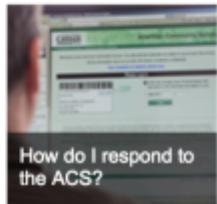
Library

Operations and Administration

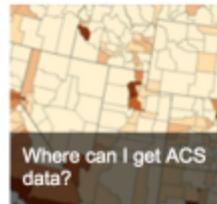
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What is the ACS?



How do I respond to the ACS?



Where can I get ACS data?



Latest

Data

News

Events

Library

2014 Data Release

Learn more about the latest ACS 5-year data release on December 3rd, including changes for this release and links for more information.

2014 State Ranking Tables

Get 2014 ranking tables that order the nation, 50 states, DC, and Puerto Rico, based on 89 different demographic, social, economic, and housing measures.

Data Tables and Tools

Your Help Needed

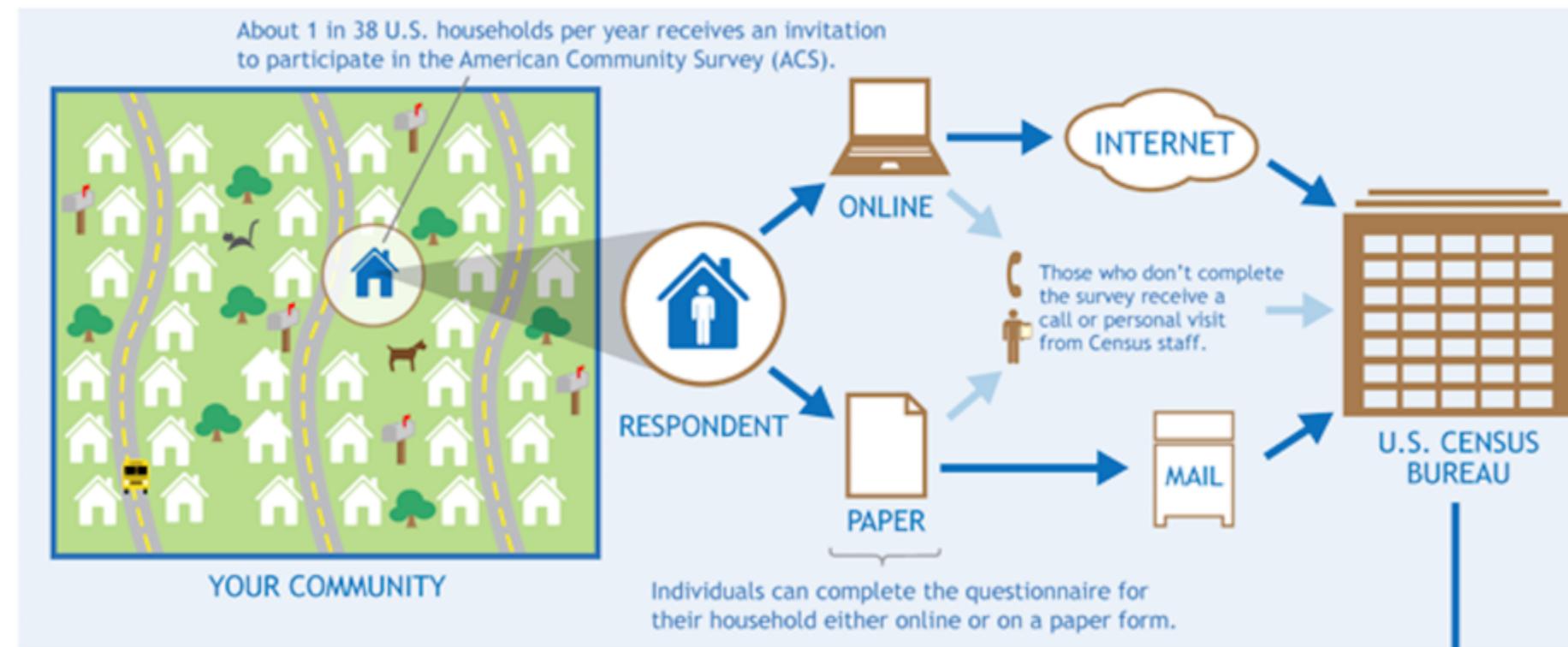
Participate in a brief [online usability test](#) to improve this website



American Community Survey

The American Community Survey (ACS) is an ongoing survey that provides vital information on a yearly basis about the nation and its people. Information from the survey generates data that help determine how more than \$400 billion in federal and state funds are distributed each year.

How the American Community Survey Works for Your Community





American Community Survey

PROCESSING & DISSEMINATION



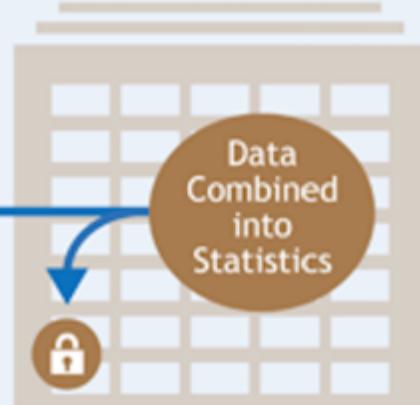
CENSUS WEB SITES



REPORTS, TABLES & APPLICATIONS



Personal information removed and kept confidential



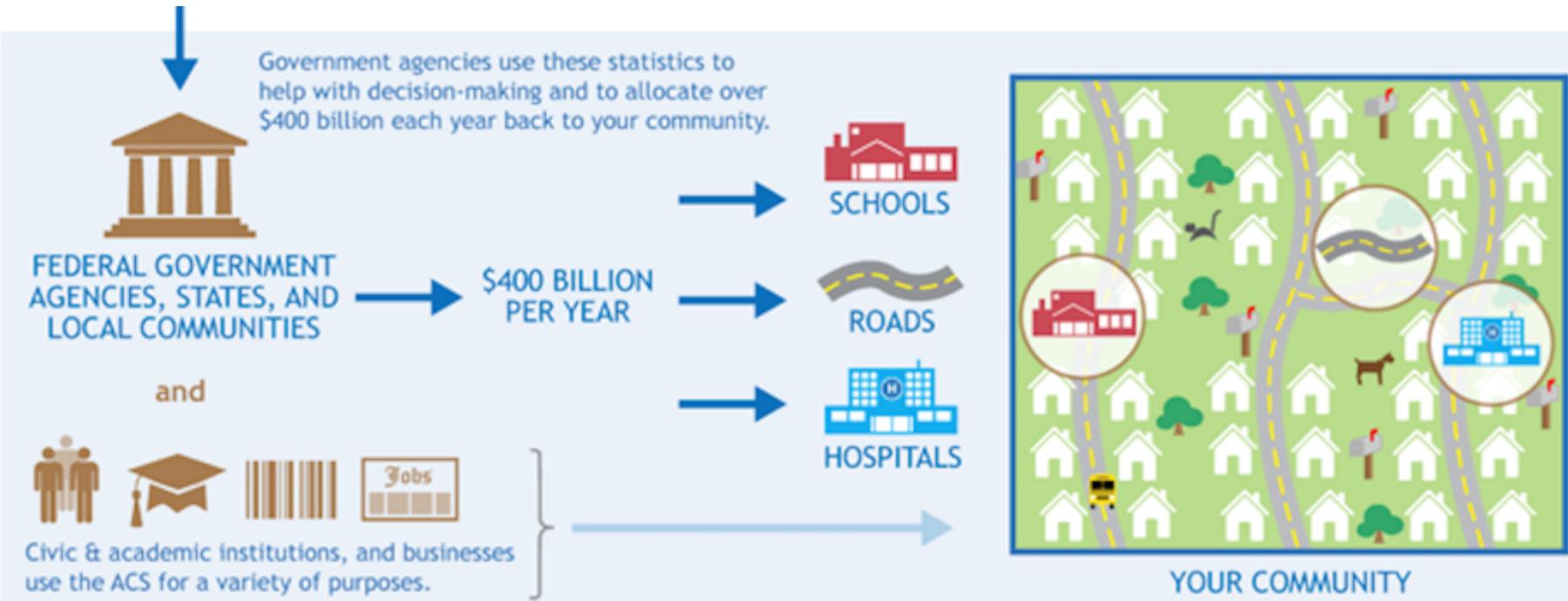
U.S. CENSUS BUREAU

The Census Bureau publishes statistics as reports, tables, and other products through its Web sites, American FactFinder, and QuickFacts.



American Community Survey

DATA-DRIVEN DECISIONS



National Household Travel Survey

[http://nhts.ornl.gov/
index.shtml](http://nhts.ornl.gov/index.shtml)

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About the NHTS

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The NHTS Academy



The [NHTS Academy](#) is a series of short, informational videos on NHTS topics of interest to new users and experienced analysts. The Academy has grown to five subject areas with nine videos.

NHTS at TRB

The TRB Task Force on Understanding New Directions for the NHTS sponsored a Poster Session and a Workshop at the 2016 TRB Annual Meeting. [The posters and presentations are now online.](#)

2015 Compendium Updated

The NHTS Team has released its [latest 2015 Compendium](#), which covers 376 cited publications from January through December. Topics range from bicycle/pedestrian studies to automated vehicle feasibility to energy consumption and greenhouse gas emissions.

2016 NHTS Pretest is Underway

On October 27, 2015, the Office of Management and Budget issued clearance to conduct the 2016 NHTS. This major milestone allows the 2016 NHTS to proceed with pretesting. The NHTS team anticipates that the first pretest respondent will be able to log into the online questionnaire by the first week of December. Pretesting began in mid-November with recruitment survey mail outs and will continue until January.

Are you a participant in the NHTS survey? If so, please visit the [NHTS survey site](#). It has everything you need to get started.

Expert Panel Review Summary Report

A Panel of Expert Survey Methodologists met at the USDOT Headquarters on April 28, 2015 to review the 2016 NHTS Data Collection Plan, provide suggestions for improvement and discuss the future of the NHTS Program. The NHTS was fortunate to tap these world-renowned experts for measures of caution in the survey redesign and response analysis process. [The summary report can be found here \[PDF\]](#).

Stay Informed

[Join the NHTS News mail list.](#)

NHTS News is a light-traffic mail list with announcements and other information of interest to the NHTS Community.

Recent Publications

[2015 NHTS Compendium of Uses](#), now through December.

CDC report [Active Transportation Surveillance — United States, 1999–2012](#).

TRB NHTS Task Force mid-year meeting minutes [\[PDF\]](#).

TRB NHTS Task Force Phase One Report: [Exploring New Directions for the National Household Travel Survey](#).



National Household Travel Survey

The National Household Travel Survey (NHTS) provides information to assist transportation planners and policy makers who need comprehensive data on travel and transportation patterns in the United States.

What they do

The NHTS/NPTS serves as the nation's inventory of daily travel. Data is collected by surveying recent trips taken by household members, and includes:

- purpose of the trip (work, shopping, etc.);
- means of transportation used (car, bus, subway, walk, etc.);
- how long the trip took, i.e., travel time;
- time of day when the trip took place;
- day of week when the trip took place; and
- if a private vehicle trip:
- number of people in the vehicle , i.e., vehicle occupancy;
- driver characteristics (age, sex, worker status, education level, etc.); and
- vehicle attributes (make, model, model year, amount of miles driven in a year).



National Household Travel Survey

NHTS data are used to:

- quantify travel behavior,
- analyze changes in travel characteristics over time,
- relate travel behavior to the demographics of the traveler, and
- study the relationship of demographics and travel over time.

The NHTS data are used primarily for gaining a better understanding of travel behavior. The data enable DOT officials to assess program initiatives, review programs and policies, study current mobility issues, and plan for the future.

The transportation research community, including academics, consultants and government, use the NHTS extensively to examine:

- travel behavior at the individual and household level;
- the characteristics of travel, such as trip chaining, use of the various modes, amount and purpose of travel by time of day and day of week, vehicle occupancy, and a host of other attributes;
- the relationship between demographics and travel; and
- the public's perceptions of the transportation system.



Crowd-sensing

Crowd-sensing is a jargon term for crowd-sourced data collection, i.e. data acquisition done by combining readings from numerous sensors/devices carried by different individuals. May or may not require implicit interaction with users.

This approach:

- is cost effective
- does not require hardware installation and maintenance
- has variable and somewhat uncontrolled coverage, both spatially and temporally



Examples:

Google maps provide travel time estimates based on crowd-sourced data from android phones. What other applications can we build?

Can we measure speed? Detect accidents? Detect traffic volumes?
Can we build traffic light control system based on crowd-sourced data?



Issues with crowd-sensing

Sampling bias: data is collected in such a way that some members of the intended population are less likely to be included than others. Can take various forms:

non-response, preferential selection, spatial effects, network effects, ...
(think of an example of each)

Why does it matter?

The data you collect may not be accurate in representing the whole population

How can we know if it is the case?

By being thoughtful in comparing the characteristics of respondents to what you know about the population in general

What can we do about it?

Be careful about how we report the results. Be aware that the conclusions may only hold for a part of the population. Design crowd-sensing thoughtfully.



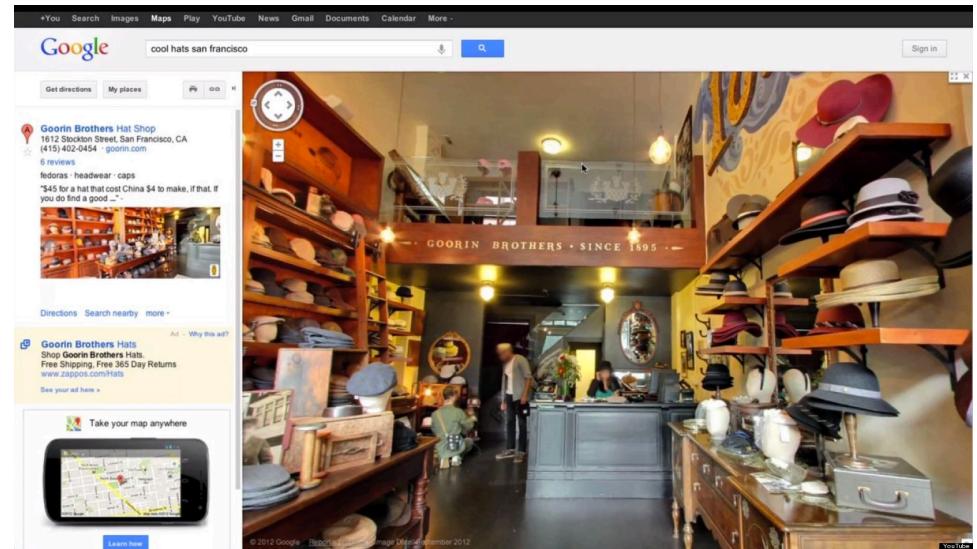
Who uses crowd-sourced data and crowd-sensing



WIKIPEDIA
The Free Encyclopedia



OpenStreetMap





Waze

waze

LIVE MAP

MAJOR EVENTS

SUPPORT

BLOG

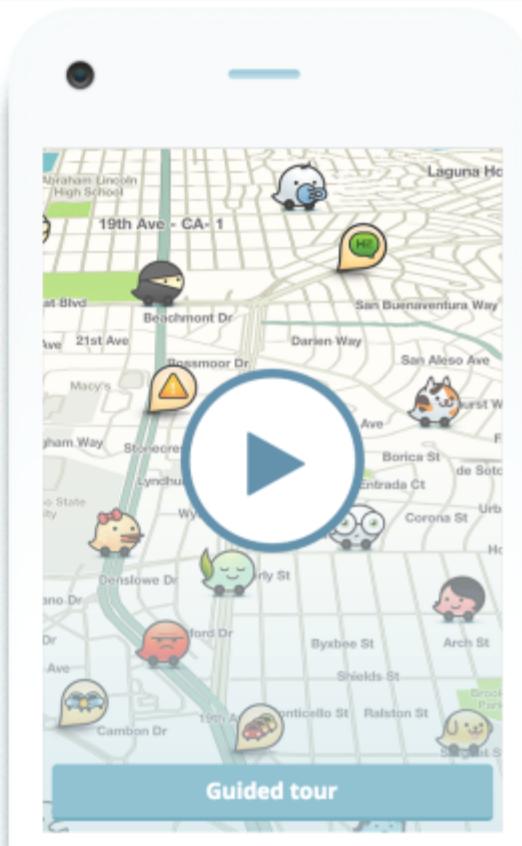
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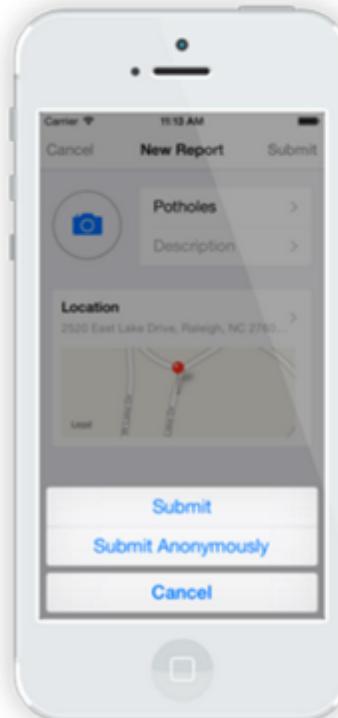
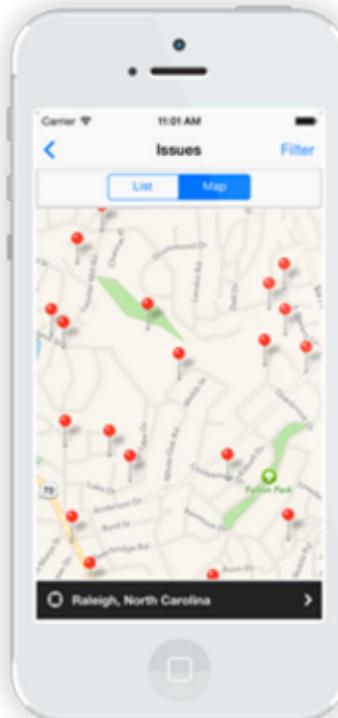
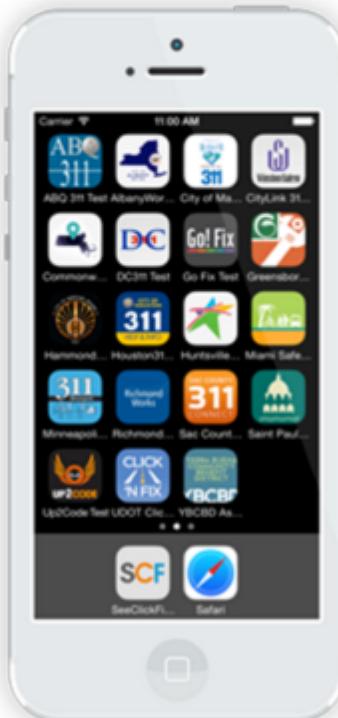
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Graffiti on bus station is OPEN

There is 6 foot high black spray painted graffiti tag on the back wall of this bus stop.

1 Person want this fixed... [I want this fixed too!](#)
Opened: 263 day(s) ago Viewed 10 times
Last Updated: 74 day(s) ago
Address: 836 Ulloa St, San Francisco, CA 94127

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