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Naturalistic Driving Studies

- Instrument volunteer drivers vehicles and continuously collect data while they go about their normal activities. Why?...
  - What do drivers really do? Speeding, tailgating, cell phone, alcohol …
  - What were they doing just before they crashed?
    - Usual crash studies we can only guess because we are surmising after the fact.
    - We can see fraction of second by second what happened.
    - What were other possible causal factors
  - How does the roadway, vehicle and environment impact driving?
- Several previous smaller naturalistic driving studies
  - 100-car: Northern Virginia, one year, 100 vehicle-years, 10 years old and still being used
- SHRP 2 Naturalistic Driving Study: 40 times larger
  - SHRP 2 data will be used for 20 years or more

2

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NDS Example Data From InSight Website
(not an actual participant)

3

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SHRP2 NDS Study Design

- Largest Naturalistic Driving Study Ever Undertaken
  - 3,147 drivers, all age/gender groups.
  - 3,958 data years; 5 M trip files; 49.7 M vehicle miles
  - 3 years of data collection
    - Most participants 1 to 2 years
  - Vehicle Types: All light vehicles
    - Passenger Cars
    - Minivans
    - SUVs
    - Pickup Trucks
  - Six data collection sites
- Integration w/ detailed roadway information

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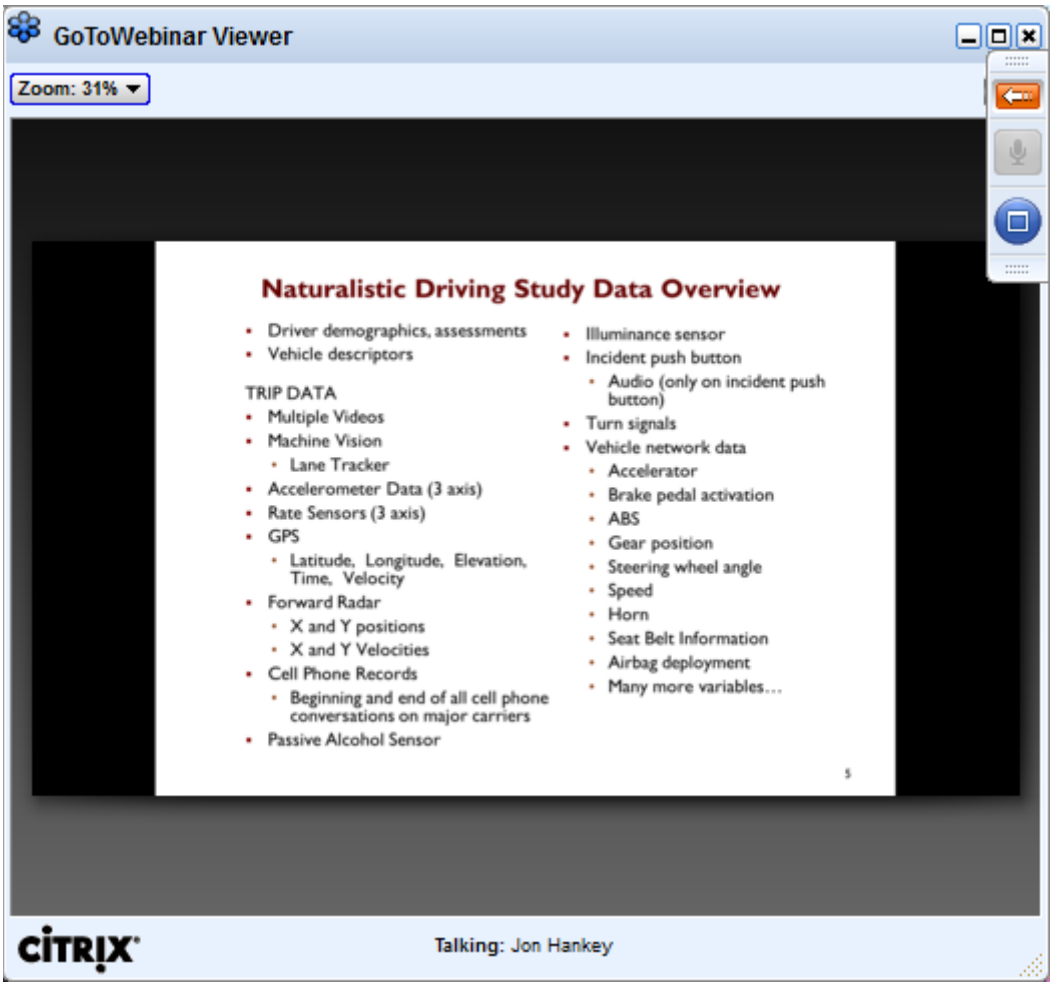
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Naturalistic Driving Study Data Overview
Driver demographics, assessments
Vehicle descriptors
TRIP DATA
Multiple Videos
Machine Vision
Lane Tracker
Accelerometer Data (3 axis)
Rate Sensors (3 axis)
GPS
Latitude, Longitude, Elevation, Time, Velocity
Forward Radar
X and Y positions
X and Y Velocities
Cell Phone Records
Beginning and end of all cell phone conversations on major carriers
Passive Alcohol Sensor
Illuminance sensor
Incident push button
Audio (only on incident push button)
Turn signals
Vehicle network data
Accelerator
Brake pedal activation
ABS
Gear position
Steering wheel angle
Speed
Horn
Seat Belt Information
Airbag deployment
Many more variables…
5
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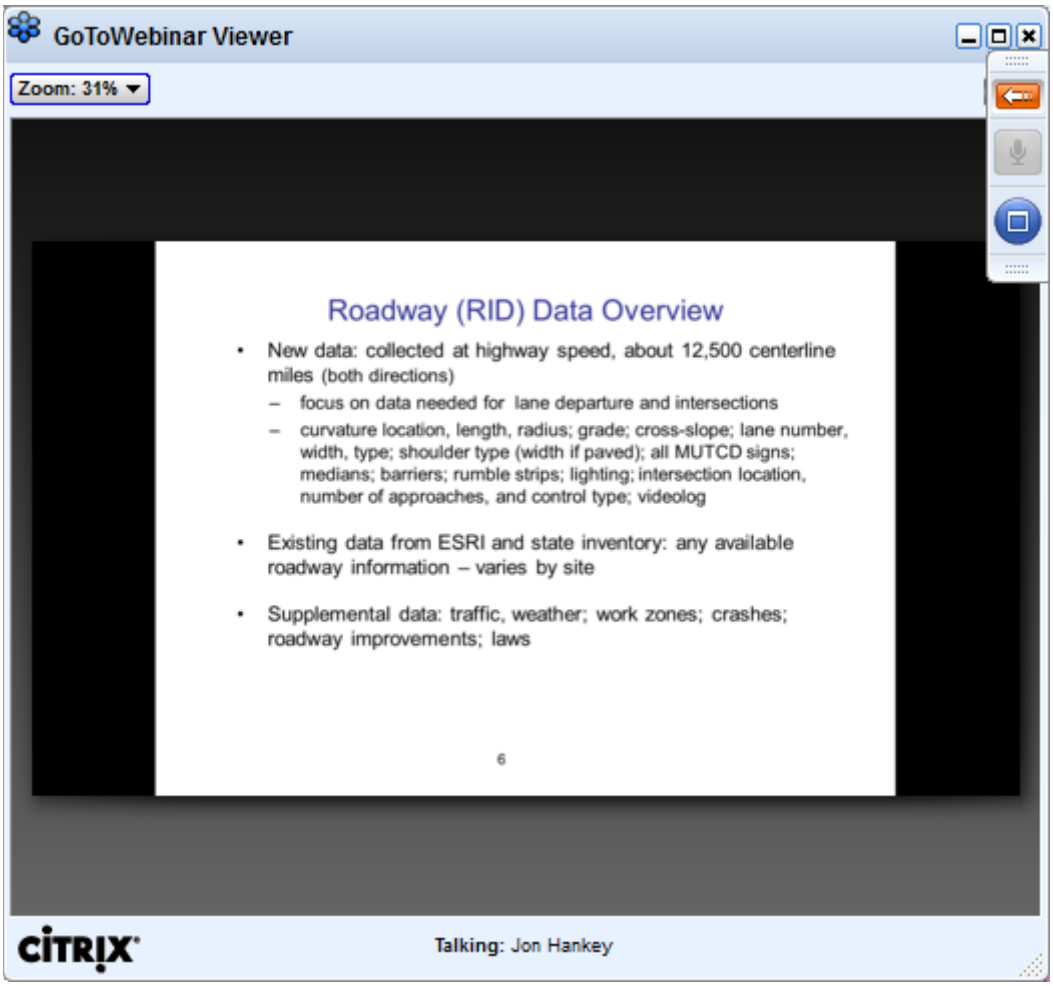
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Roadway (RID) Data Overview
New data: collected at highway speed, about 12,500 centerline miles (both directions)
focus on data needed for lane departure and intersections
curvature location, length, radius; grade; cross-slope; lane number, width, type; shoulder type (width if paved); all MUTCD signs; medians; barriers; rumble strips; lighting; intersection location, number of approaches, and control type; videolog
Existing data from ESRI and state inventory: any available roadway information – varies by site
Supplemental data: traffic, weather; work zones; crashes; roadway improvements; laws
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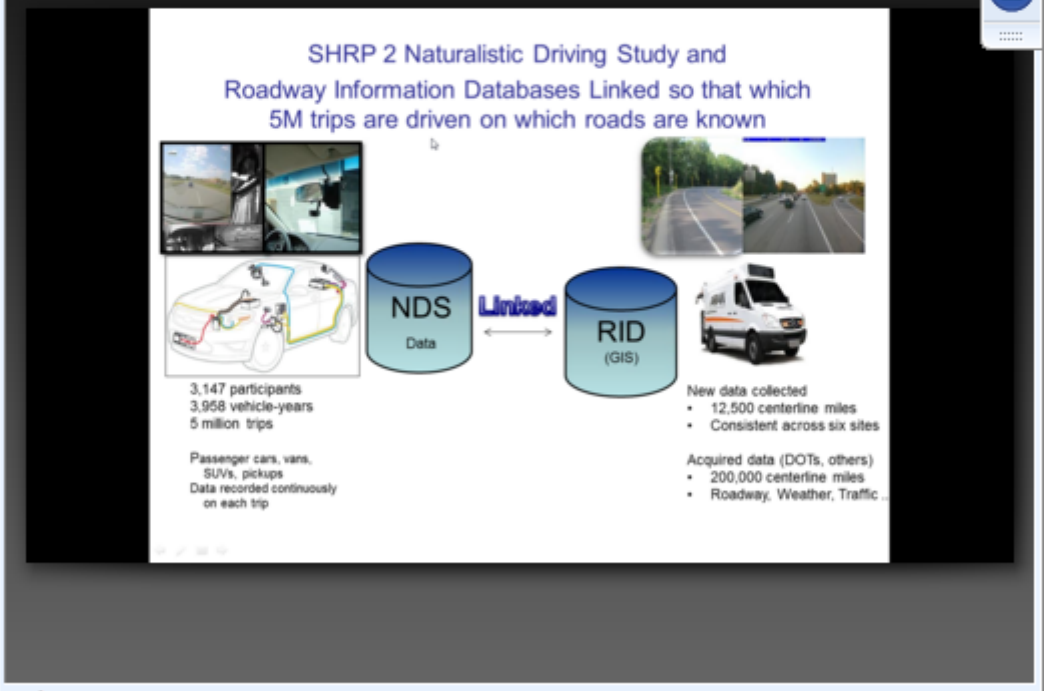

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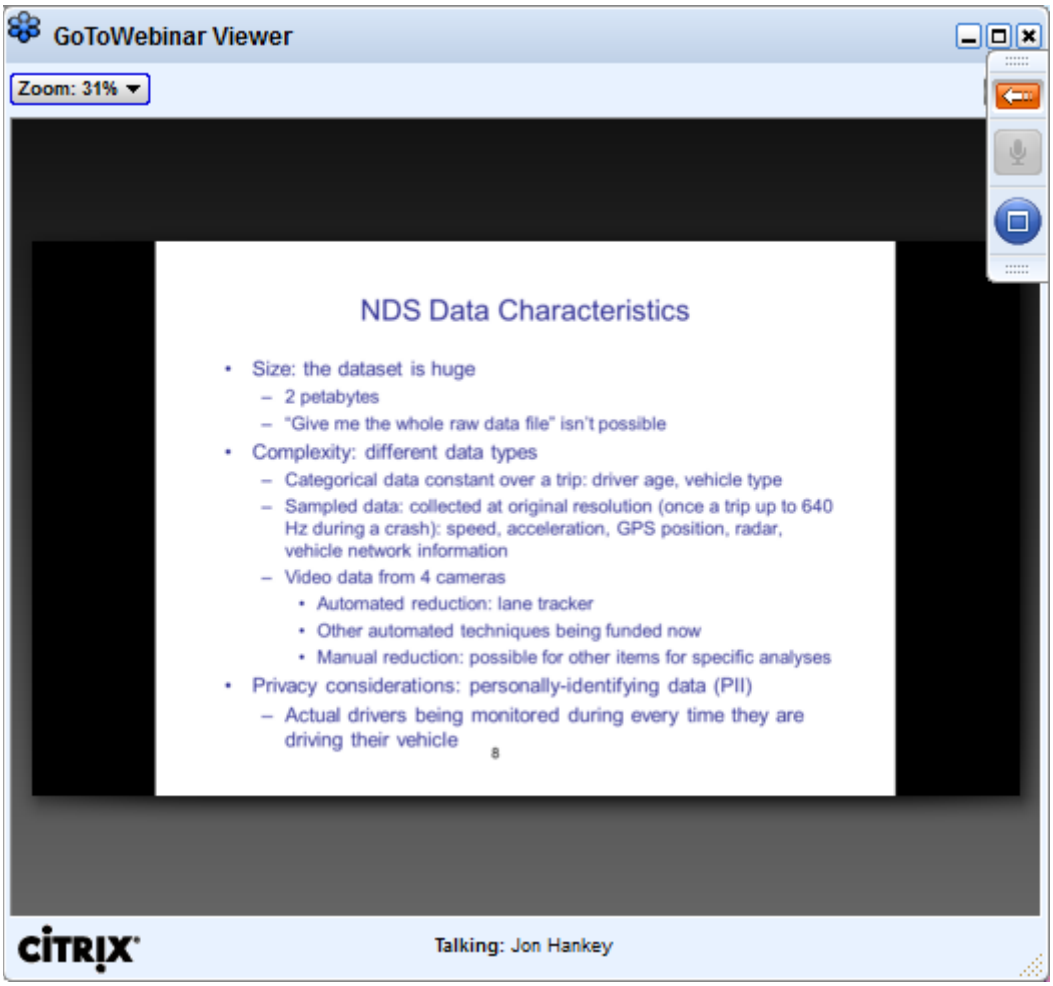
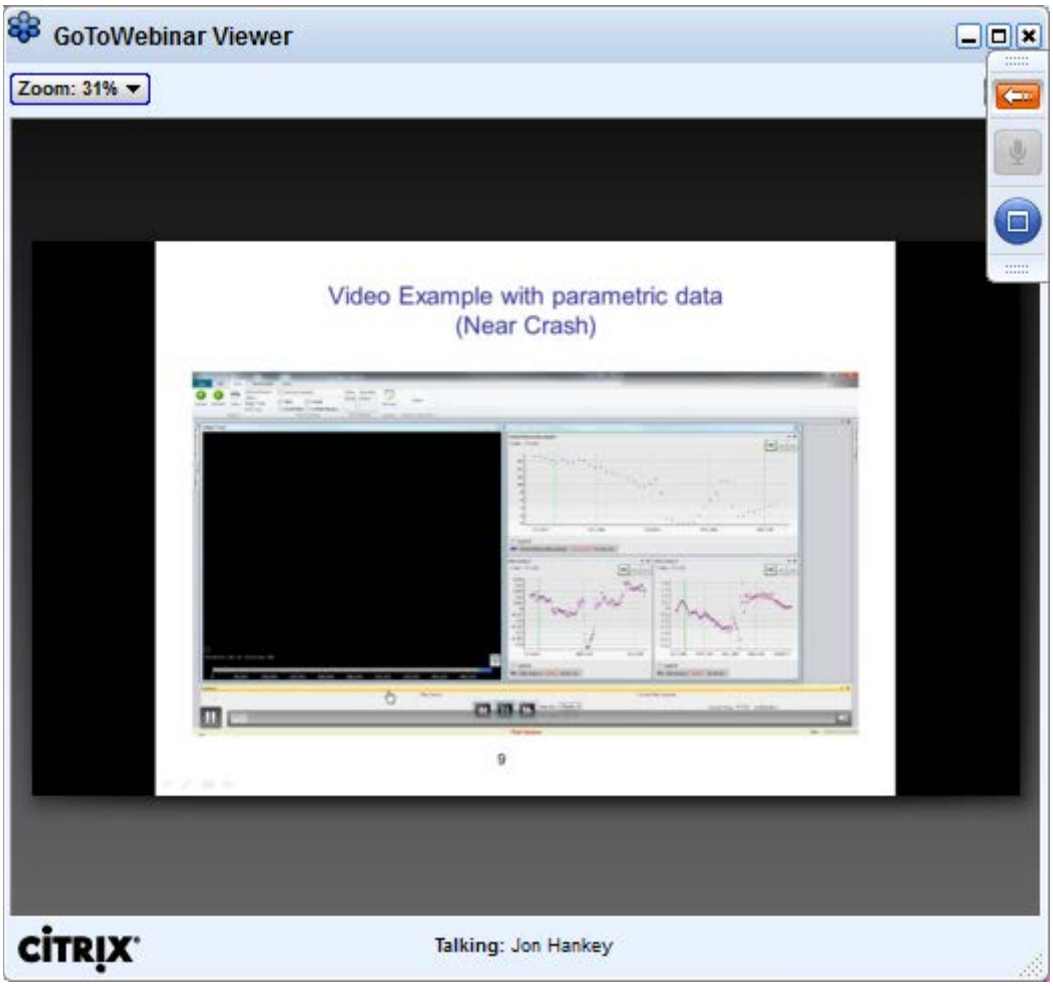


2000 Terabytes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Video Example with parametric data
(Near Crash)
9
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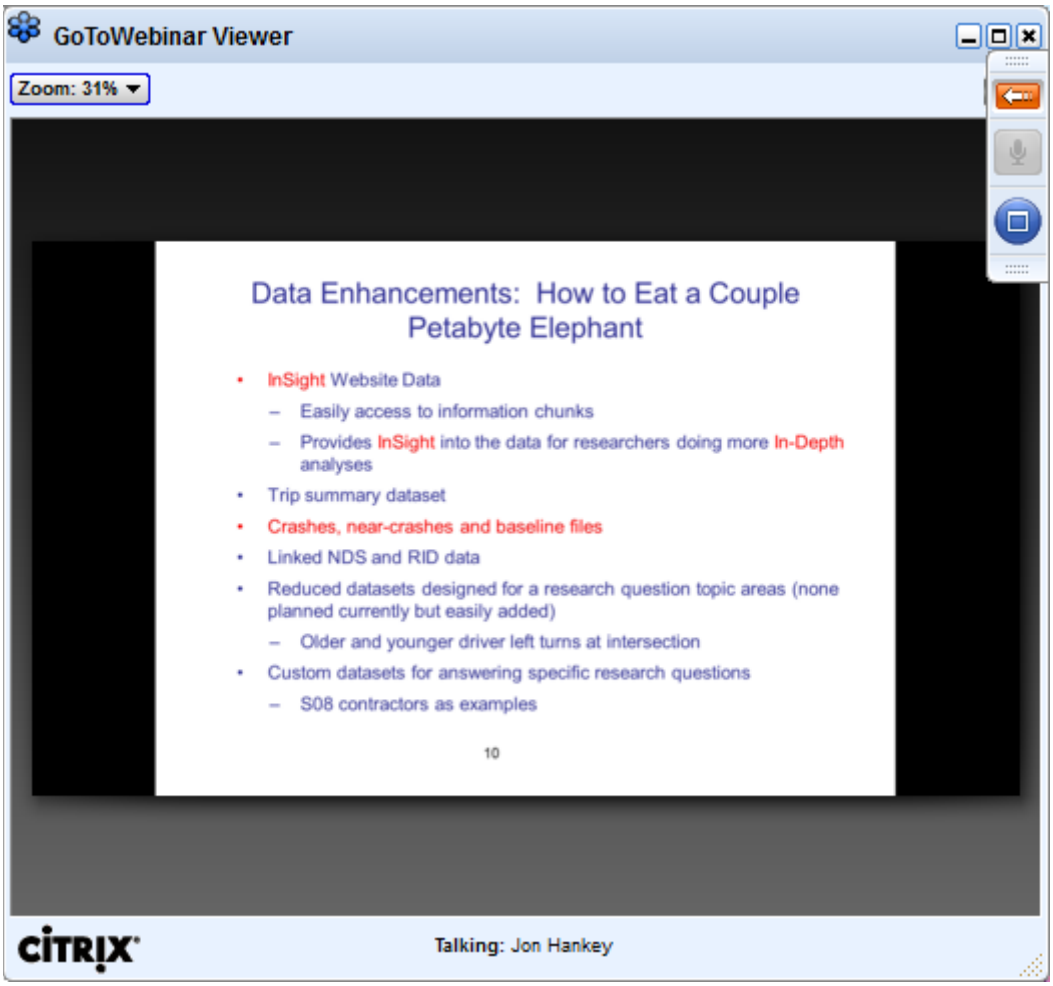
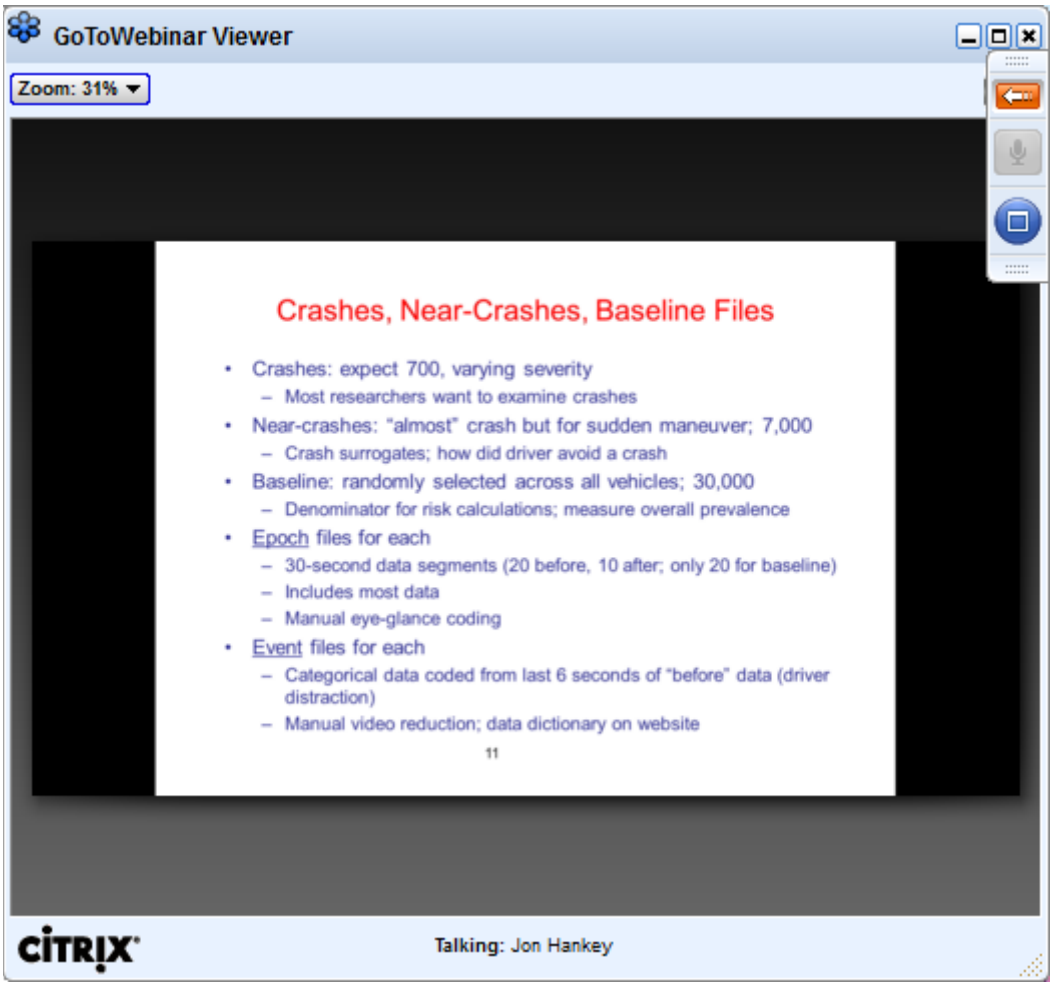


Insight web site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Crashes, Near-Crashes, Baseline Files
• Crashes: expect 700, varying severity
– Most researchers want to examine crashes
• Near-crashes: "almost" crash but for sudden maneuver; 7,000
– Crash surrogates; how did driver avoid a crash
• Baseline: randomly selected across all vehicles; 30,000
– Denominator for risk calculations; measure overall prevalence
• Epoch files for each
– 30-second data segments (20 before, 10 after; only 20 for baseline)
– Includes most data
– Manual eye-glance coding
• Event files for each
– Categorical data coded from last 6 seconds of "before" data (driver distraction)
– Manual video reduction; data dictionary on website
11
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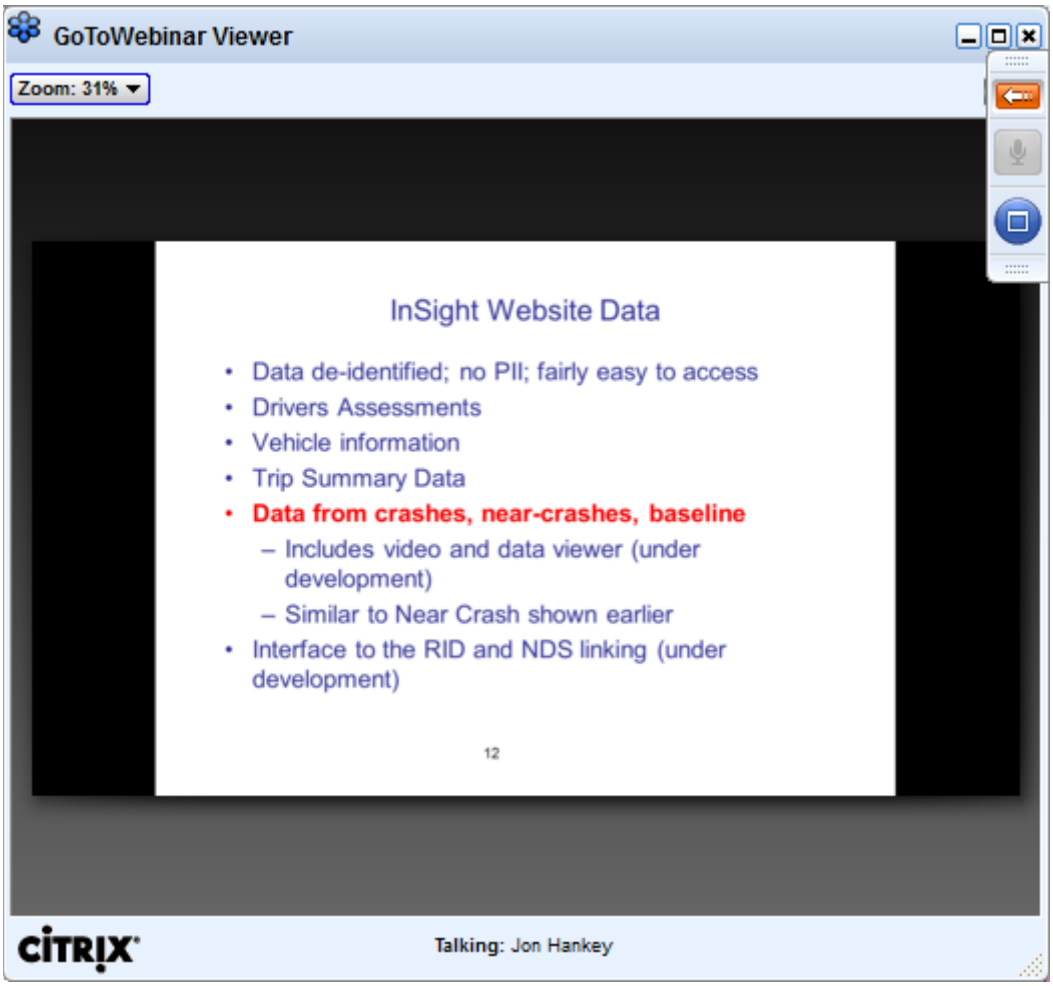
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InSight Website Data
• Data de-identified; no PII; fairly easy to access
• Drivers Assessments
• Vehicle information
• Trip Summary Data
• Data from crashes, near-crashes, baseline
– Includes video and data viewer (under development)
– Similar to Near Crash shown earlier
• Interface to the RID and NDS linking (under development)
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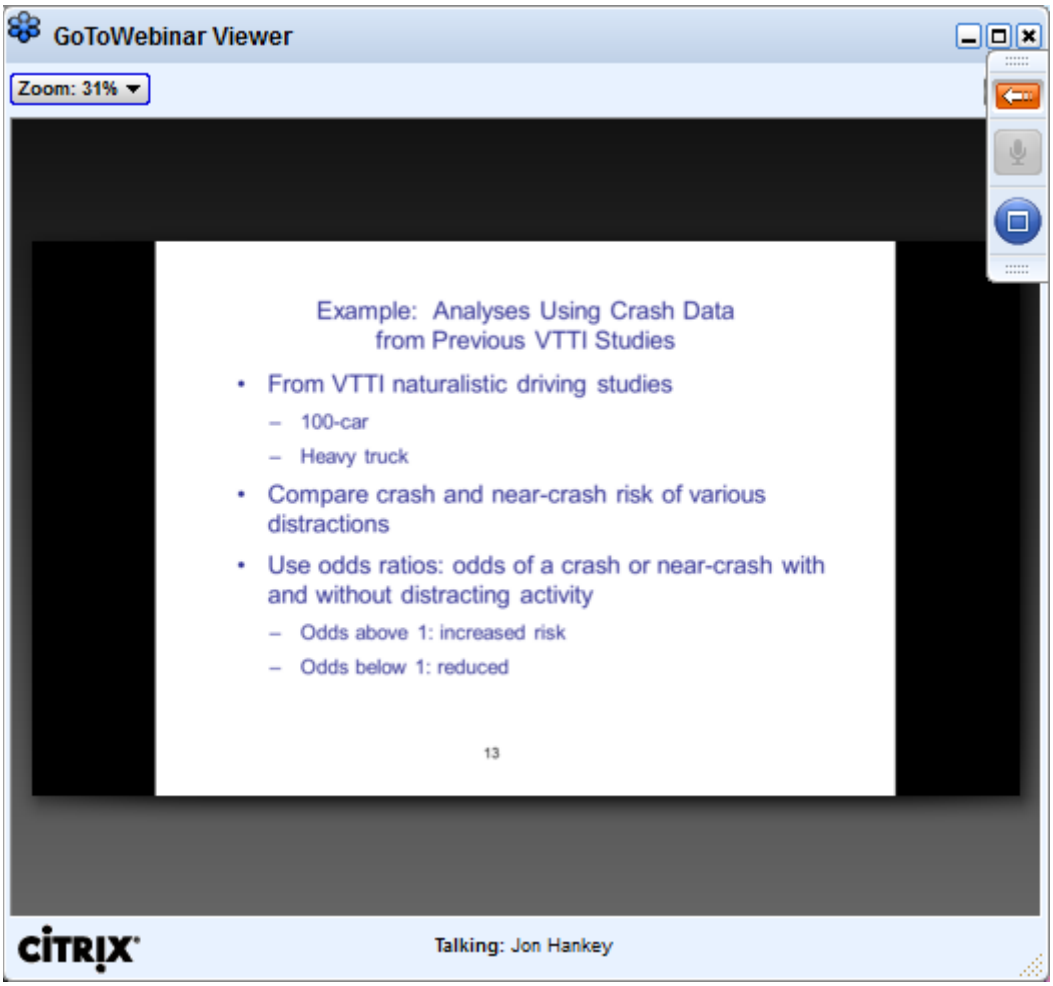
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Example: Analyses Using Crash Data from Previous VTTI Studies
• From VTTI naturalistic driving studies
– 100-car
– Heavy truck
• Compare crash and near-crash risk of various distractions
• Use odds ratios: odds of a crash or near-crash with and without distracting activity
– Odds above 1: increased risk
– Odds below 1: reduced
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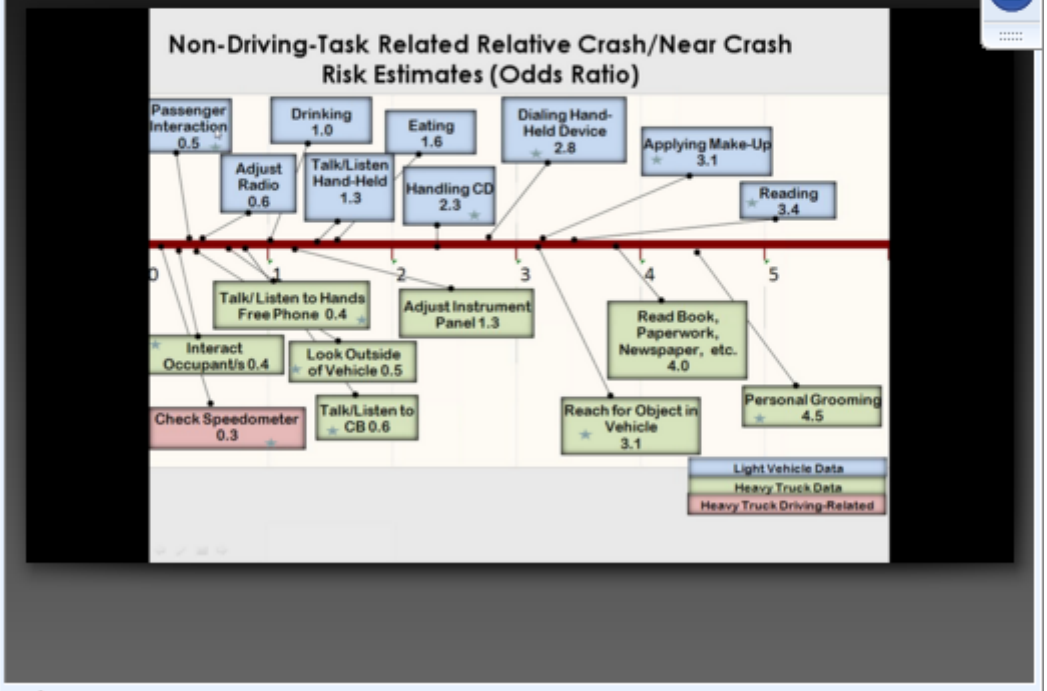

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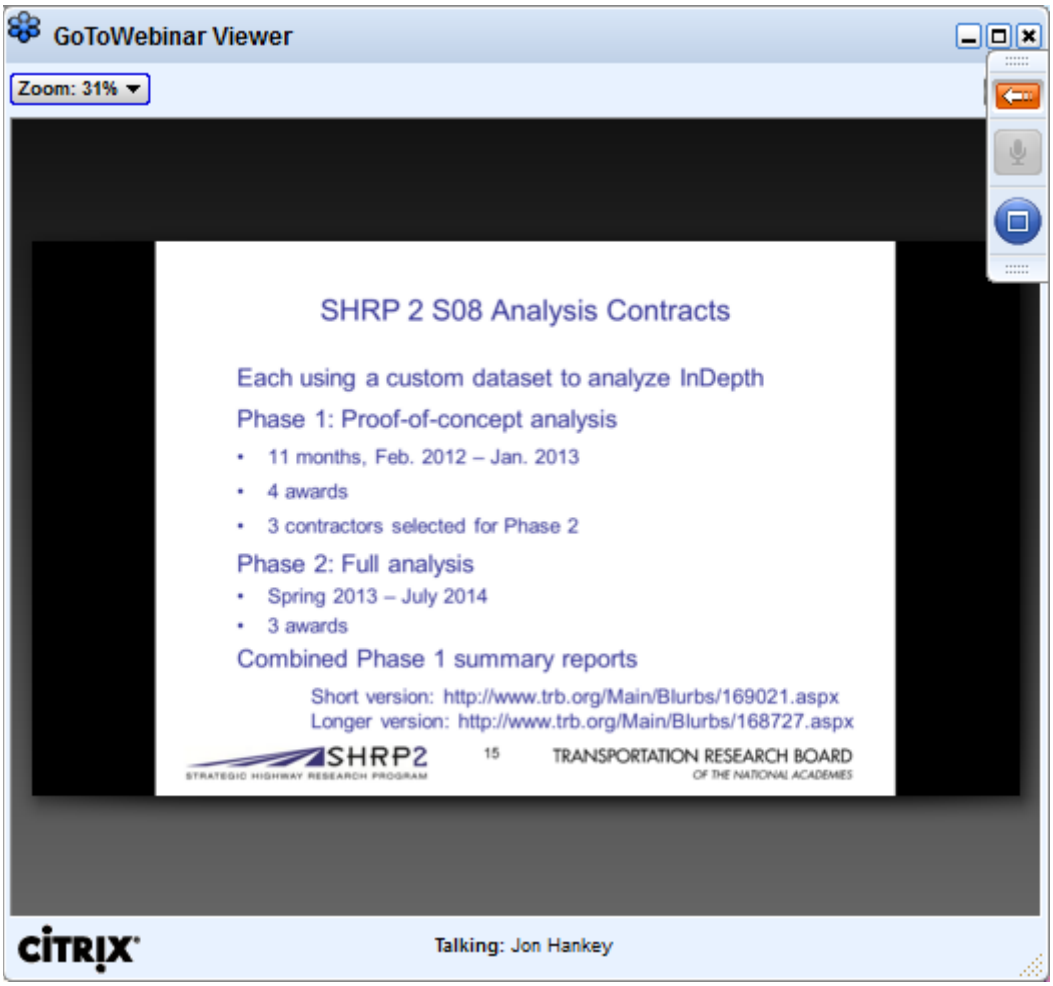
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SHRP 2 S08 Analysis Contracts
Each using a custom dataset to analyze InDepth
Phase 1: Proof-of-concept analysis
• 11 months, Feb. 2012 – Jan. 2013
• 4 awards
• 3 contractors selected for Phase 2
Phase 2: Full analysis
• Spring 2013 – July 2014
• 3 awards
Combined Phase 1 summary reports
Short version: http://www.trb.org/Main/Blurbs/169021.aspx
Longer version: http://www.trb.org/Main/Blurbs/168727.aspx
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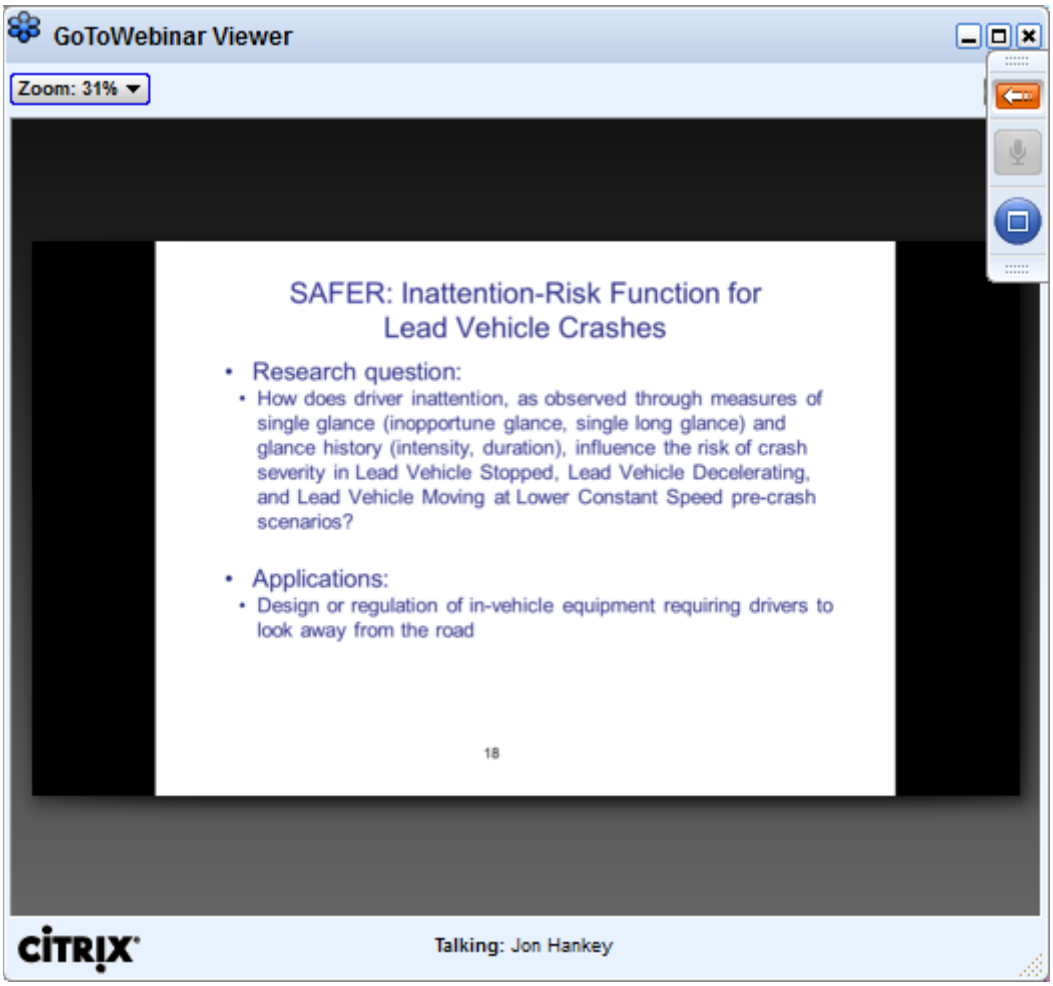
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SAFER: Inattention-Risk Function for Lead Vehicle Crashes
• Research question:
• How does driver inattention, as observed through measures of single glance (inopportune glance, single long glance) and glance history (intensity, duration), influence the risk of crash severity in Lead Vehicle Stopped, Lead Vehicle Decelerating, and Lead Vehicle Moving at Lower Constant Speed pre-crash scenarios?
• Applications:
• Design or regulation of in-vehicle equipment requiring drivers to look away from the road
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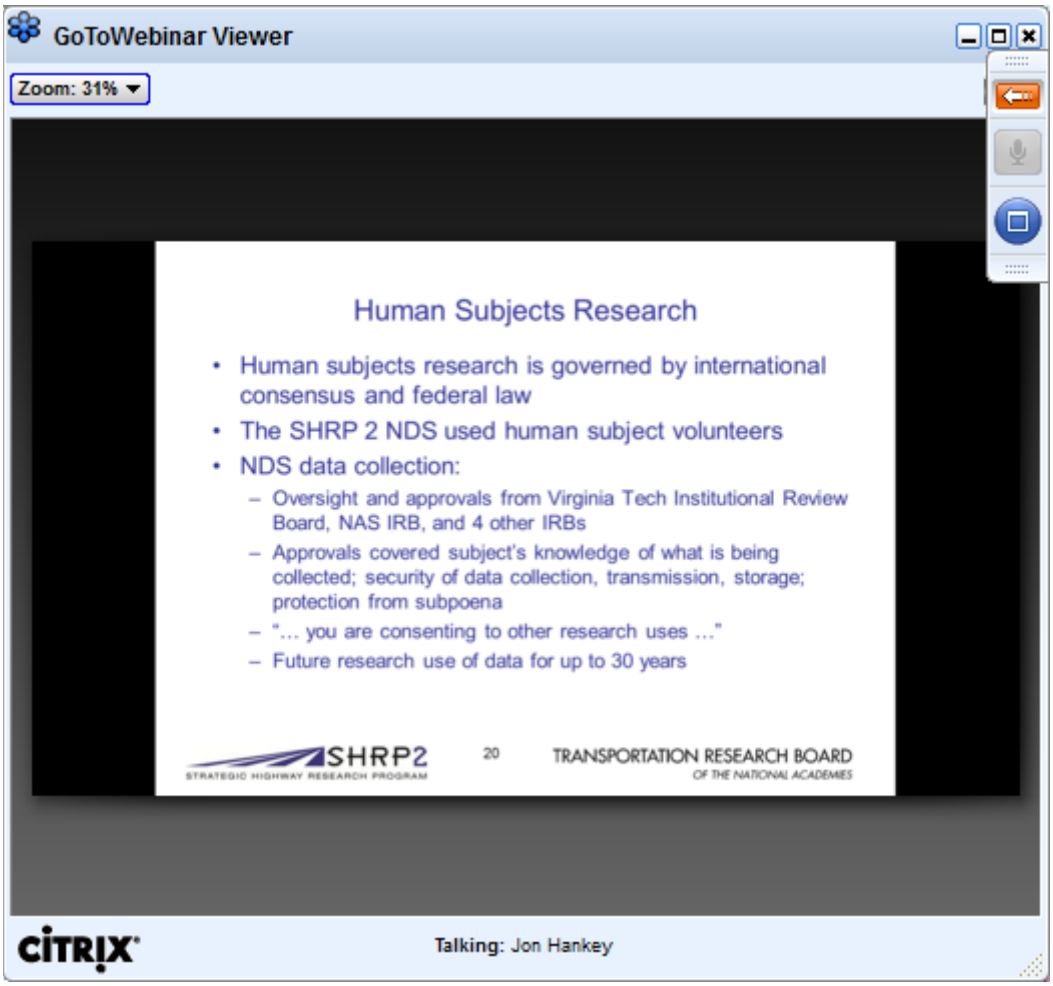
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Human Subjects Research
• Human subjects research is governed by international consensus and federal law
• The SHRP 2 NDS used human subject volunteers
• NDS data collection:
– Oversight and approvals from Virginia Tech Institutional Review Board, NAS IRB, and 4 other IRBs
– Approvals covered subject's knowledge of what is being collected; security of data collection, transmission, storage; protection from subpoena
– "… you are consenting to other research uses …"
– Future research use of data for up to 30 years
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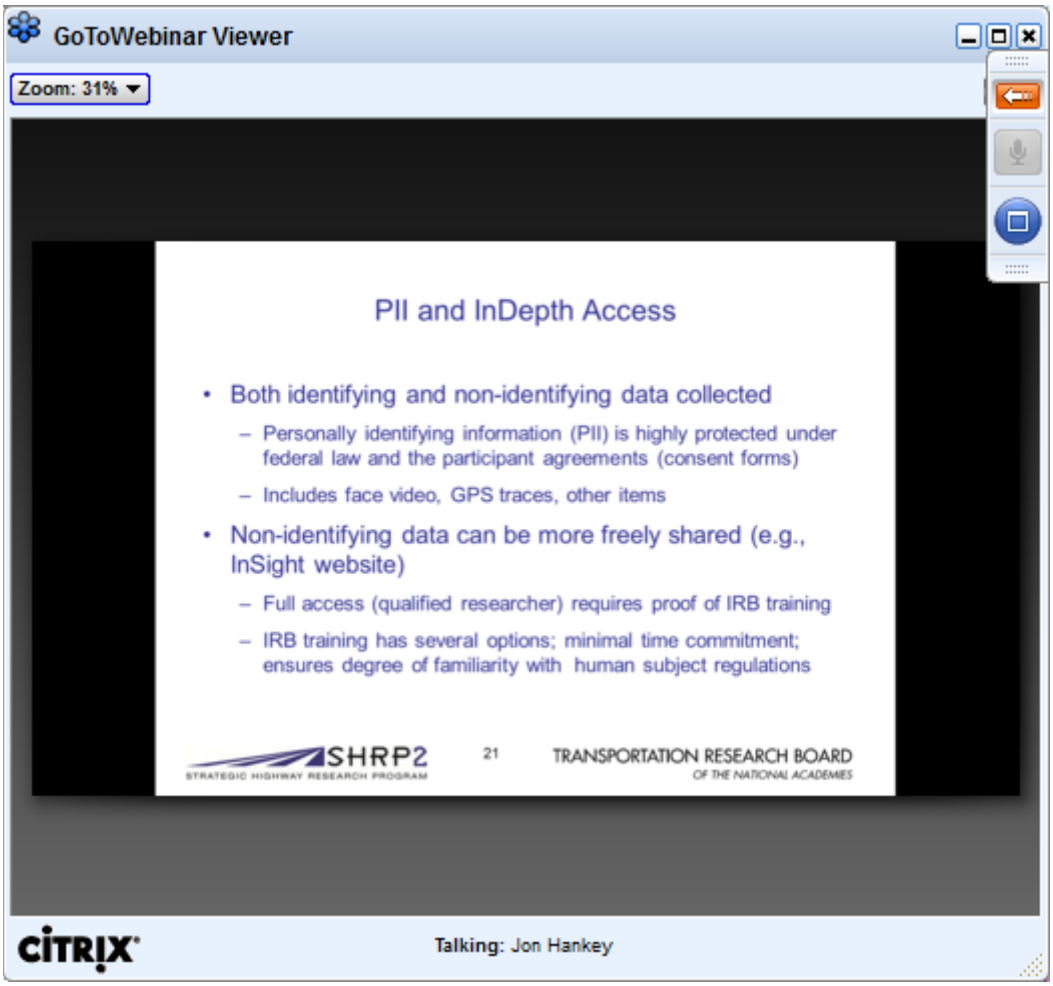
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PII and InDepth Access
• Both identifying and non-identifying data collected
– Personally identifying information (PII) is highly protected under federal law and the participant agreements (consent forms)
– Includes face video, GPS traces, other items
• Non-identifying data can be more freely shared (e.g., InSight website)
– Full access (qualified researcher) requires proof of IRB training
– IRB training has several options; minimal time commitment; ensures degree of familiarity with human subject regulations
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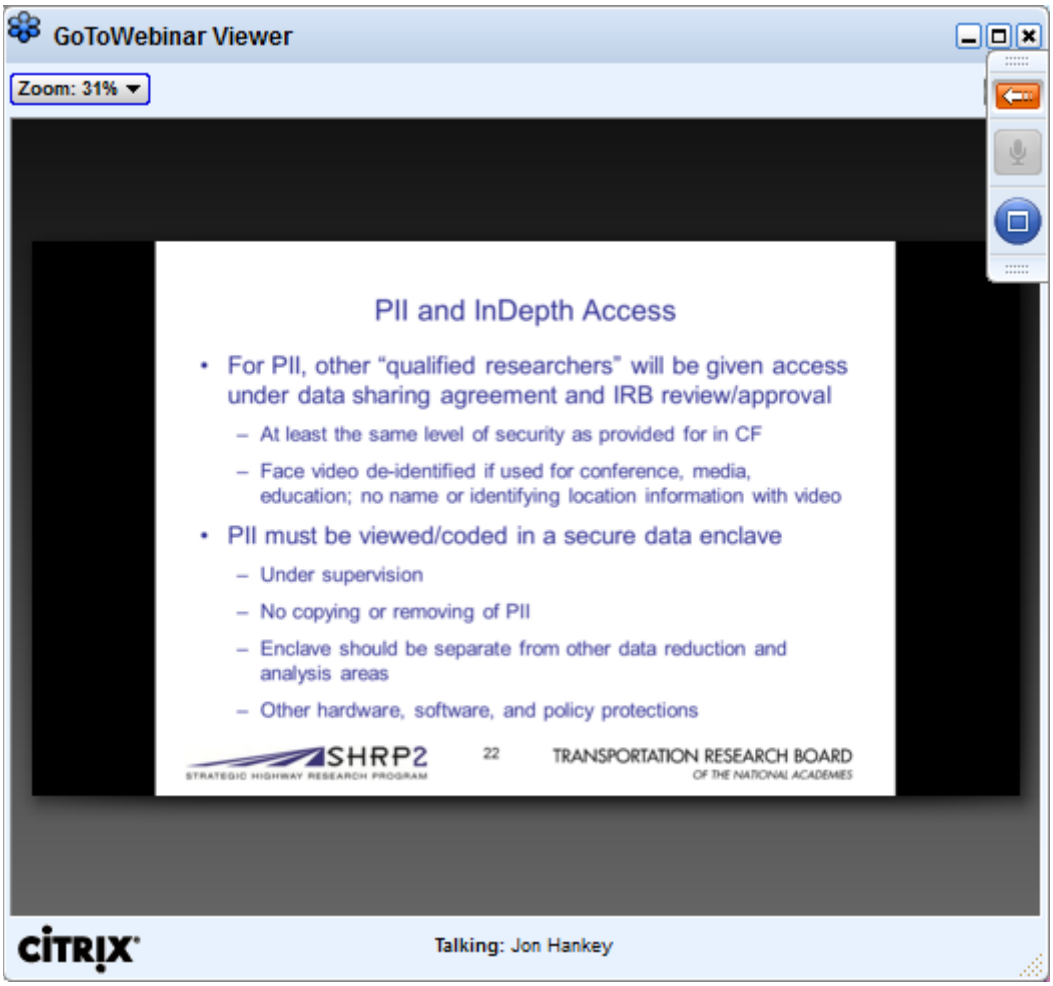
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PII and InDepth Access
• For PII, other "qualified researchers" will be given access under data sharing agreement and IRB review/approval
– At least the same level of security as provided for in CF
– Face video de-identified if used for conference, media, education; no name or identifying location information with video
• PII must be viewed/coded in a secure data enclave
– Under supervision
– No copying or removing of PII
– Enclave should be separate from other data reduction and analysis areas
– Other hardware, software, and policy protections
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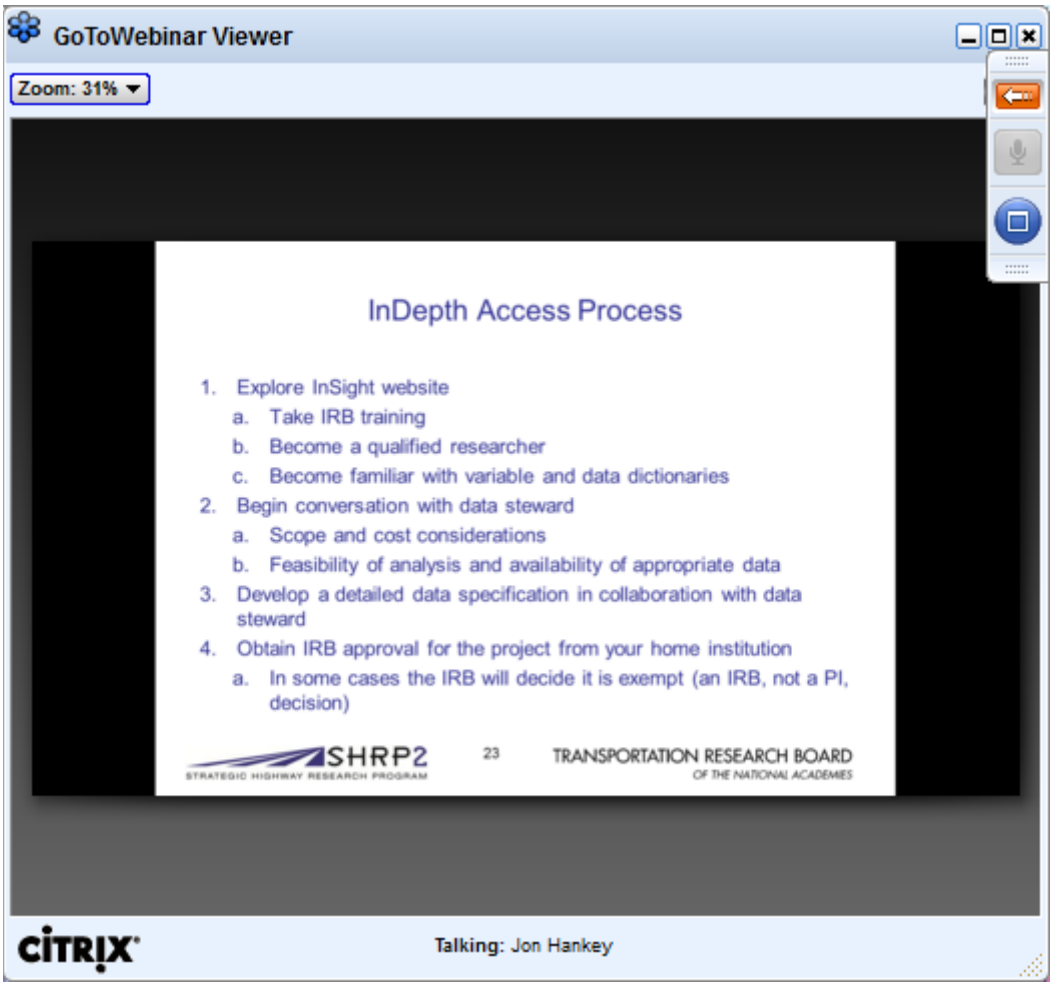
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InDepth Access Process
1. Explore InSight website
a. Take IRB training
b. Become a qualified researcher
c. Become familiar with variable and data dictionaries
2. Begin conversation with data steward
a. Scope and cost considerations
b. Feasibility of analysis and availability of appropriate data
3. Develop a detailed data specification in collaboration with data steward
4. Obtain IRB approval for the project from your home institution
a. In some cases the IRB will decide it is exempt (an IRB, not a PI, decision)
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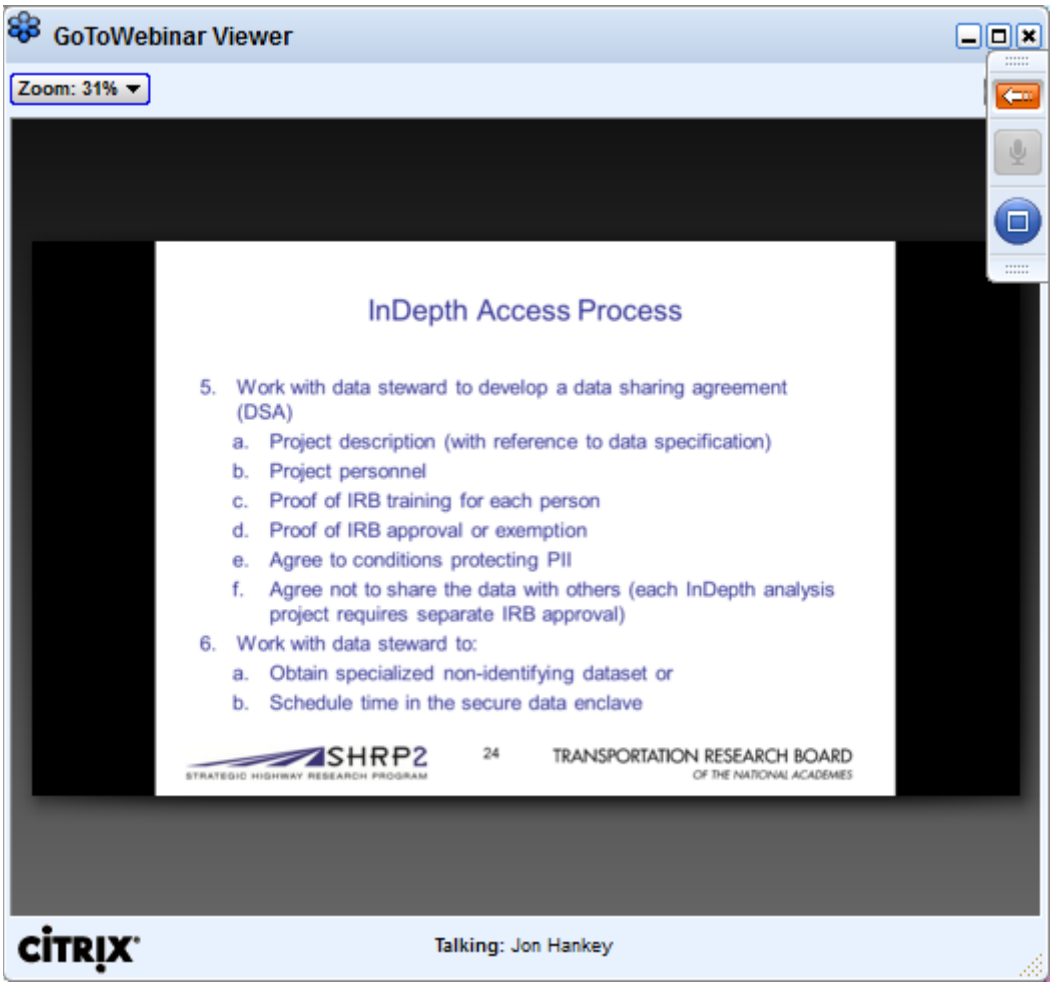
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InDepth Access Process
5. Work with data steward to develop a data sharing agreement (DSA)
a. Project description (with reference to data specification)
b. Project personnel
c. Proof of IRB training for each person
d. Proof of IRB approval or exemption
e. Agree to conditions protecting PII
f. Agree not to share the data with others (each InDepth analysis project requires separate IRB approval)
6. Work with data steward to:
a. Obtain specialized non-identifying dataset or
b. Schedule time in the secure data enclave
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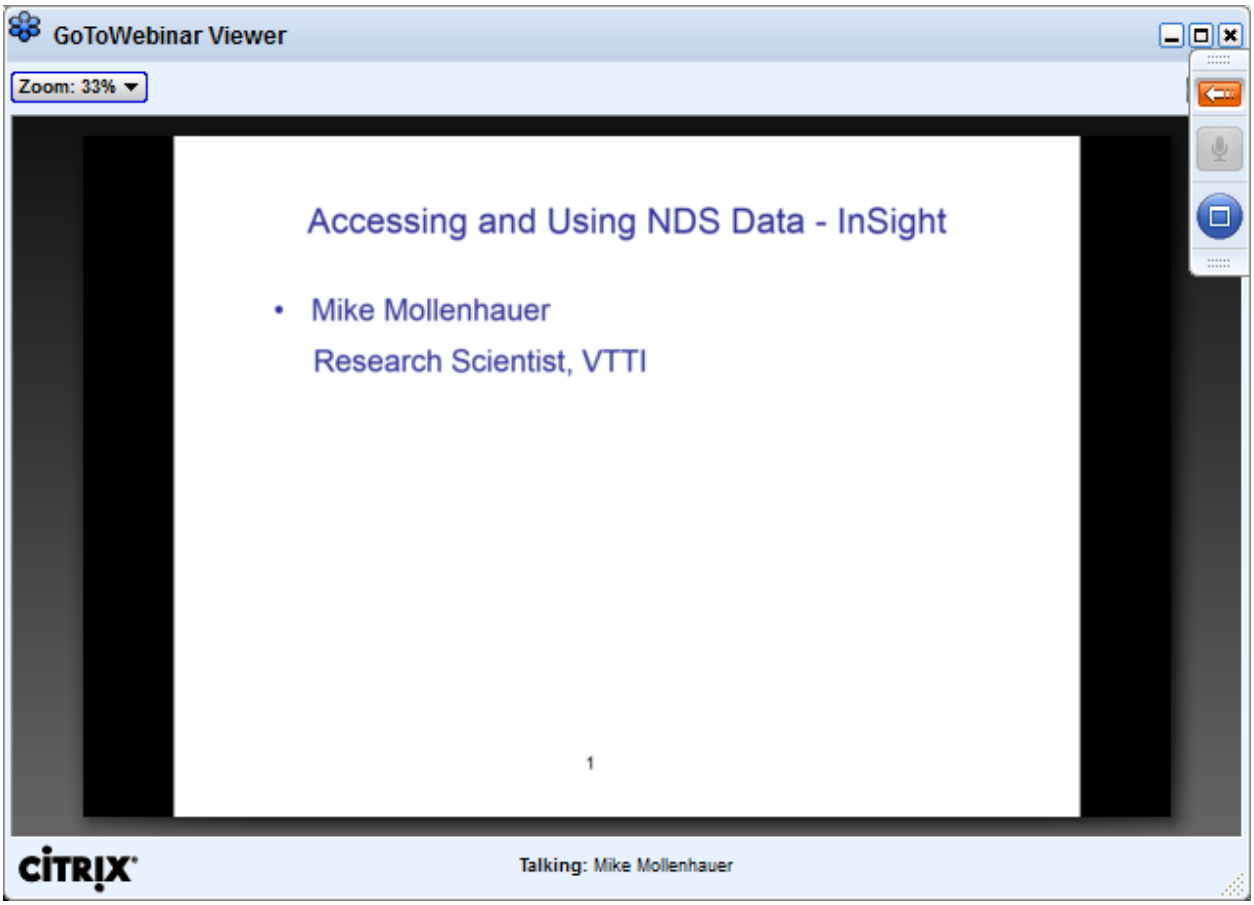
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Accessing and Using NDS Data - InSight
Mike Mollenhauer
Research Scientist, VTTI
1
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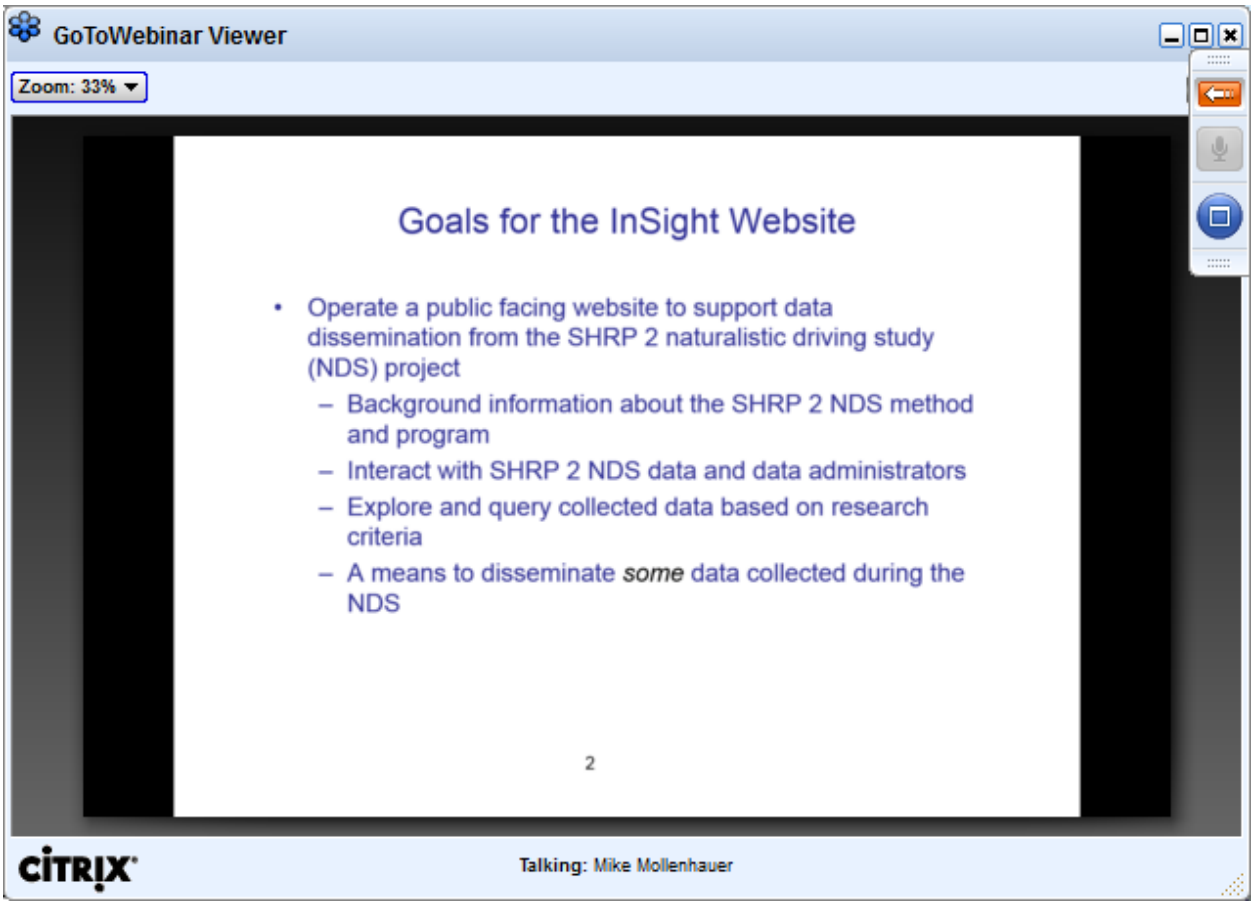
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Goals for the InSight Website
• Operate a public facing website to support data dissemination from the SHRP 2 naturalistic driving study (NDS) project
– Background information about the SHRP 2 NDS method and program
– Interact with SHRP 2 NDS data and data administrators
– Explore and query collected data based on research criteria
– A means to disseminate some data collected during the NDS
2
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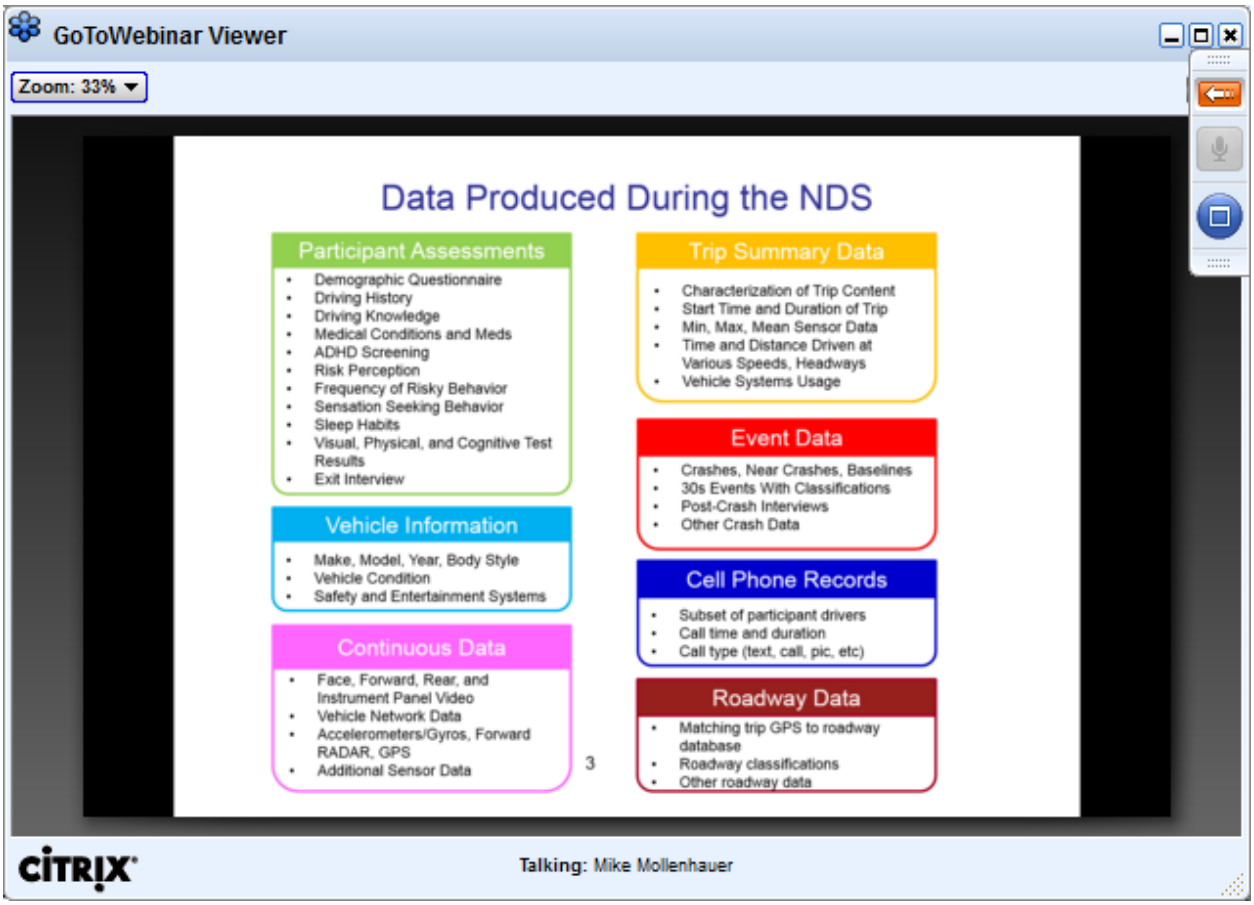
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Data Produced During the NDS
Participant Assessments
Demographic Questionnaire
Driving History
Driving Knowledge
Medical Conditions and Meds
ADHD Screening
Risk Perception
Frequency of Risky Behavior
Sensation Seeking Behavior
Sleep Habits
Visual, Physical, and Cognitive Test Results
Exit Interview
Vehicle Information
Make, Model, Year, Body Style
Vehicle Condition
Safety and Entertainment Systems
Continuous Data
Face, Forward, Rear, and Instrument Panel Video
Vehicle Network Data
Accelerometers/Gyros, Forward RADAR, GPS
Additional Sensor Data
3
Trip Summary Data
Characterization of Trip Content
Start Time and Duration of Trip
Min, Max, Mean Sensor Data
Time and Distance Driven at Various Speeds, Headways
Vehicle Systems Usage
Event Data
Crashes, Near Crashes, Baselines
30s Events With Classifications
Post-Crash Interviews
Other Crash Data
Cell Phone Records
Subset of participant drivers
Call time and duration
Call type (text, call, pic, etc)
Roadway Data
Matching trip GPS to roadway database
Roadway classifications
Other roadway data
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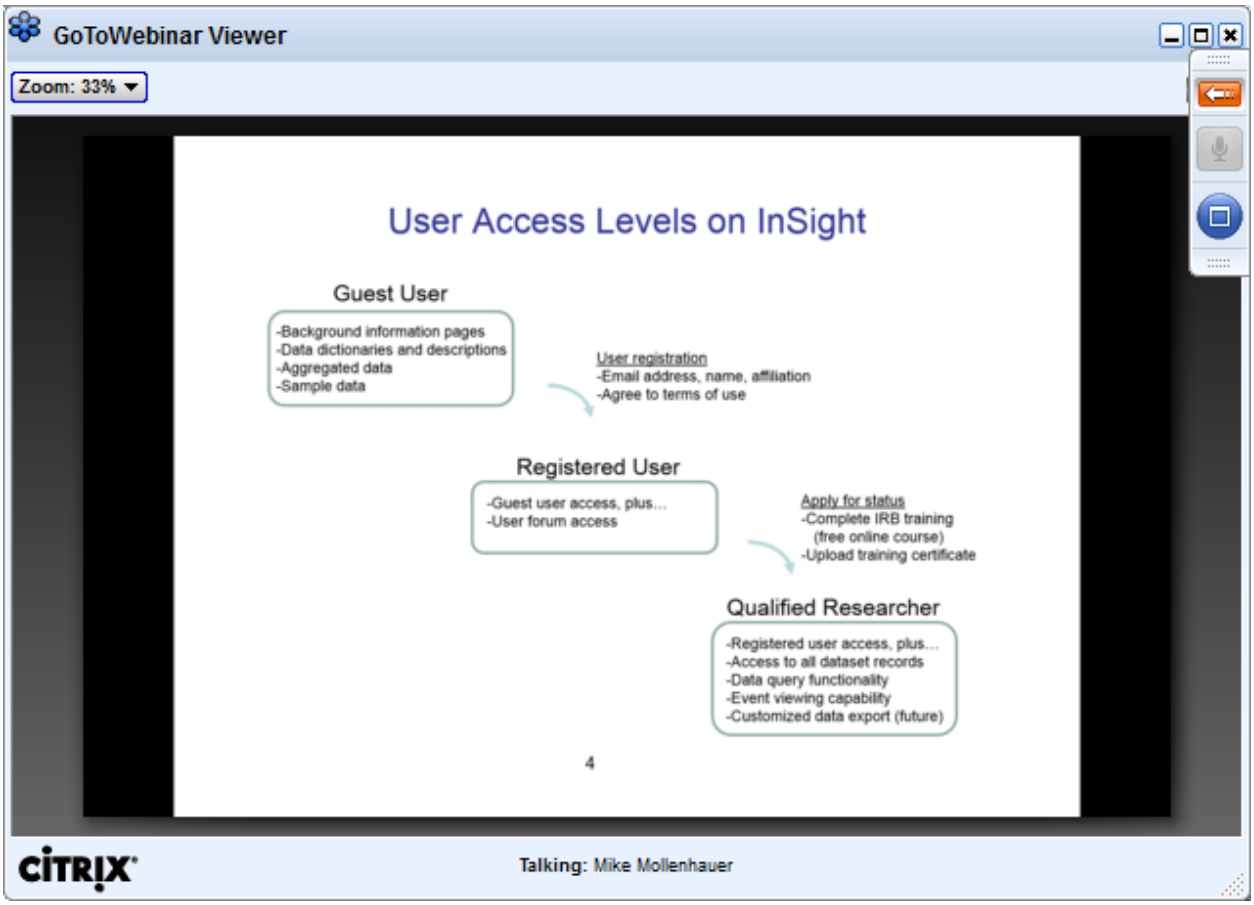
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User Access Levels on InSight
Guest User
-Background information pages
-Data dictionaries and descriptions
-Aggregated data
-Sample data
User registration
-Email address, name, affiliation
-Agree to terms of use
Registered User
-Guest user access, plus…
-User forum access
Apply for status
-Complete IRB training
(free online course)
-Upload training certificate
Qualified Researcher
-Registered user access, plus…
-Access to all dataset records
-Data query functionality
-Event viewing capability
-Customized data export (future)
4
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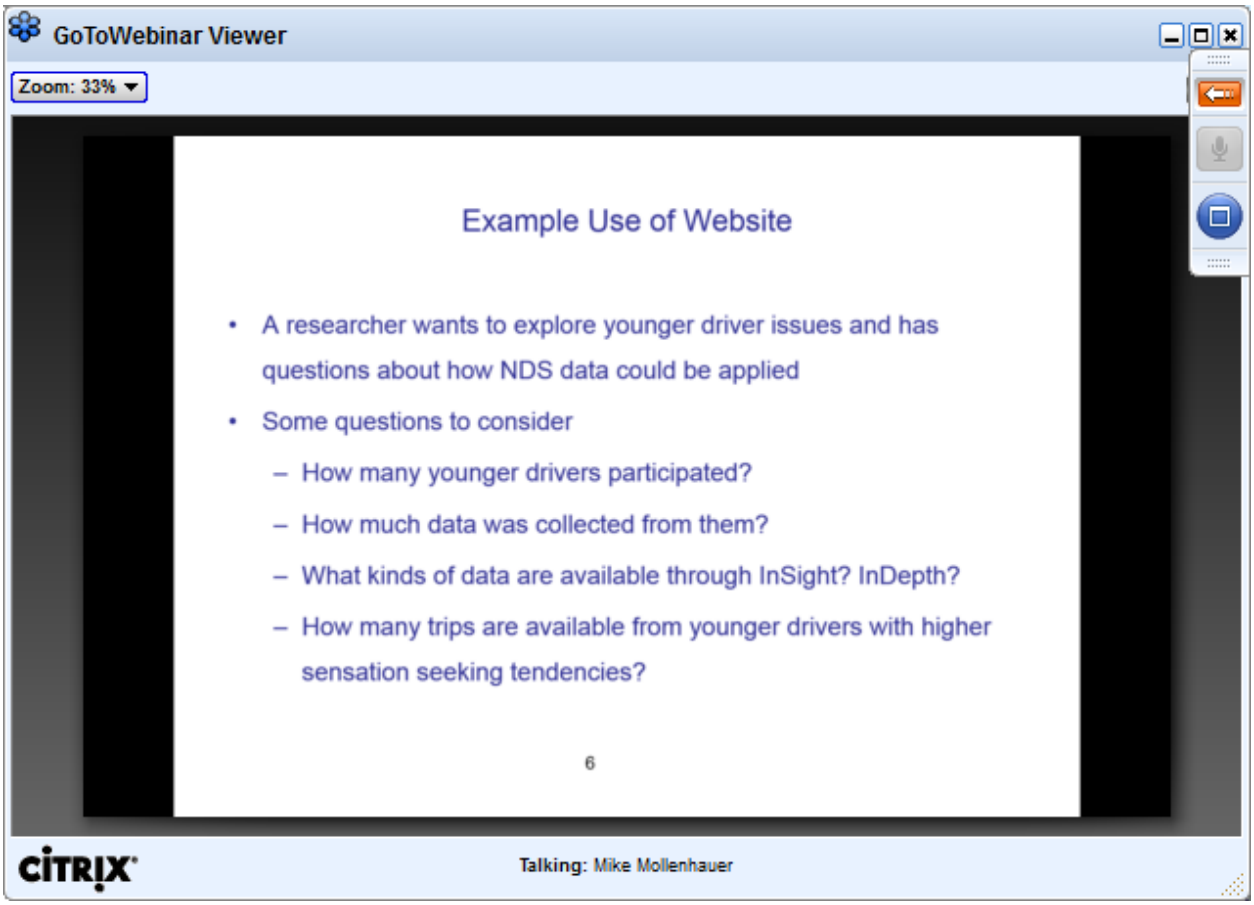
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Example Use of Website
• A researcher wants to explore younger driver issues and has questions about how NDS data could be applied
• Some questions to consider
– How many younger drivers participated?
– How much data was collected from them?
– What kinds of data are available through InSight? InDepth?
– How many trips are available from younger drivers with higher sensation seeking tendencies?
6
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InSight Data Access Website
SHRP 2 Naturalistic Driving Study
Learn More About SHRP2 NDS...
Already Registered?
Username (email)
Password
Sign In
Remember me
Forgot Password?
Need an Account?
You must register to gain access to the available data.
About User Access Levels
Register Now
What Is Available on This Website
Information describing the 3,400+ drivers and vehicles that participated in the naturalistic driving study
SHRP 2 NDS status information including data collection and processing progress
Background information about the project and data being collected
500,000+ Trip summary records that describe individual trips recorded during the study
30,000+ Crash, near crash, and baseline driving events. (Coming Soon!)
Discussion forums for questions about the project and available data
What You Can Do on This Website
View Background information about the SHRP 2 NDS
View detailed data collected from driver assessments, vehicles, trip summaries, and critical driving events
Query the database of detailed data, create cross tabulations, and assess NDS database content
Privacy Policy · Terms of Service · © 2013 Virginia Tech Transportation Institute · v0.33.0
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InSight
SHRP 2 NDS
Data
Forums
Background
Michael Mollenhauer
Welcome to InSight
InSight provides access to data collected during the SHRP 2 Naturalistic Driving Study (NDS).
What's Available on This Website
Driver Descriptions and Assessments
Summary graphs and detailed records of driver assessments are provided addressing driver demographic background, physical, psychological, and medical condition.
Custom Query Capability
Build custom queries to search for records matching criteria that span multiple datasets.
Summary of Continuous Naturalistic Data Collected
Graphs and detailed records describe data collection progress and characteristics of trips collected during the study.
Naturalistic Driving Study Background Information
Access an overview of the SHRP 2 naturalistic Driving Study project, data collection procedures, data dictionaries, and sample data.
Vehicle Descriptions
Summary graphs and detailed records describe the types of vehicles involved in the study.
Access to SHRP 2 NDS Forums
Join a community of SHRP 2 NDS Forum members to discuss available data, website functionality, and related topics.
What's New
9/10/2013 - New data released! New data include the Barkley's Quick Screen results and over 45,000 trip summaries.
7/8/2013 - SHRP 2 inSight forum website is now available for technical support and general discussion.
7/7/2013 - Query page expanded to include an initial crosstab table configuration tool.
View More...
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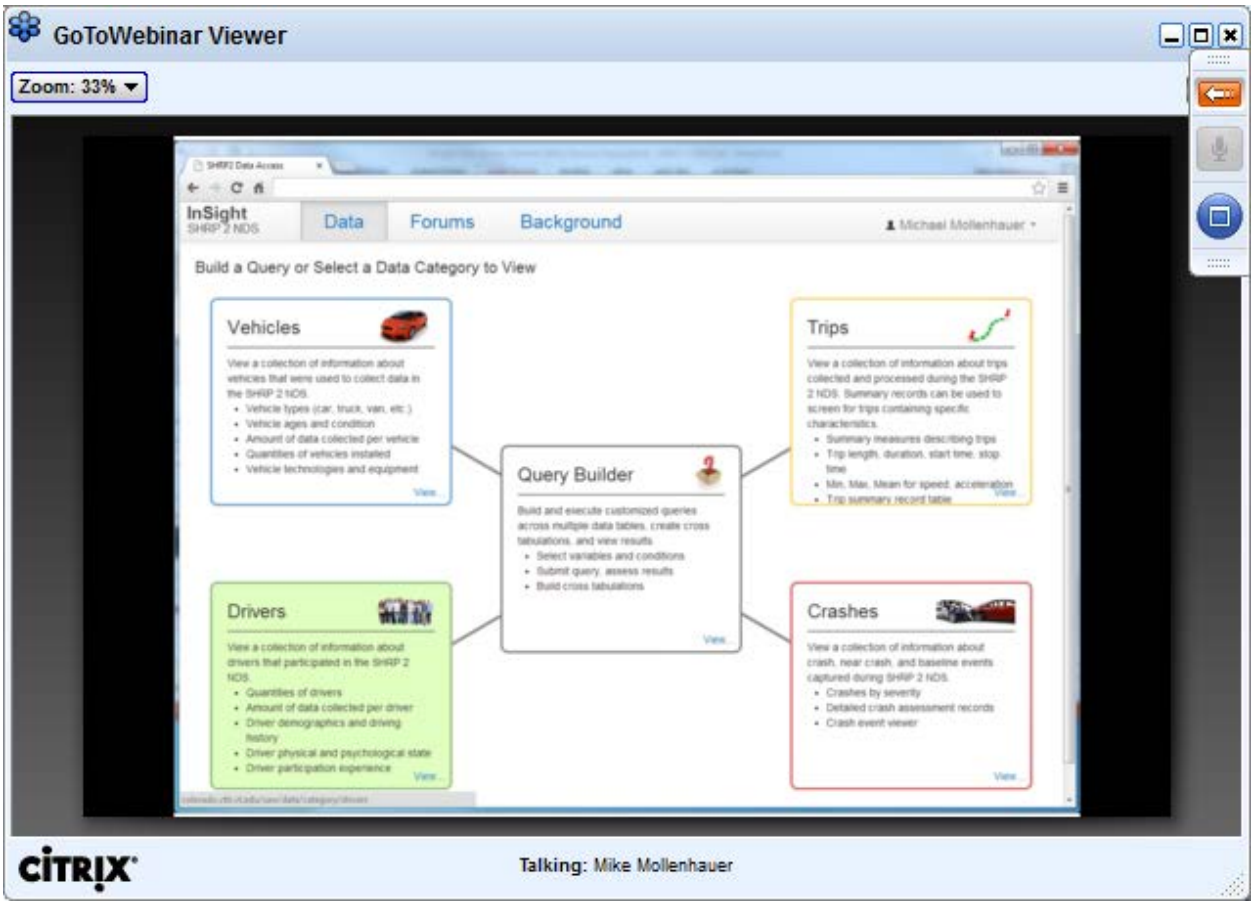
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InSight
SHRP 2 NDS
Data
Forums
Background
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Build a Query or Select a Data Category to View
Vehicles
View a collection of information about vehicles that were used to collect data in the SHRP 2 NDS.
Vehicle types (car, truck, van, etc.)
Vehicle ages and condition
Amount of data collected per vehicle
Quantities of vehicles installed
Vehicle technologies and equipment
Query Builder
Build and execute customized queries across multiple data tables, create cross tabulations, and view results.
Select variables and conditions
Submit query, assess results
Build cross tabulations
Trips
View a collection of information about trips collected and processed during the SHRP 2 NDS. Summary records can be used to screen for trips containing specific characteristics.
Summary measures describing trips
Trip length, duration, start time, stop time
Min, Max, Mean for speed, acceleration
Trip summary record table
Drivers
View a collection of information about drivers that participated in the SHRP 2 NDS.
Quantities of drivers
Amount of data collected per driver
Driver demographics and driving history
Driver physical and psychological state
Driver participation experience
Crashes
View a collection of information about crash, near crash, and baseline events captured during SHRP 2 NDS.
Crashes by severity
Detailed crash assessment records
Crash event viewer
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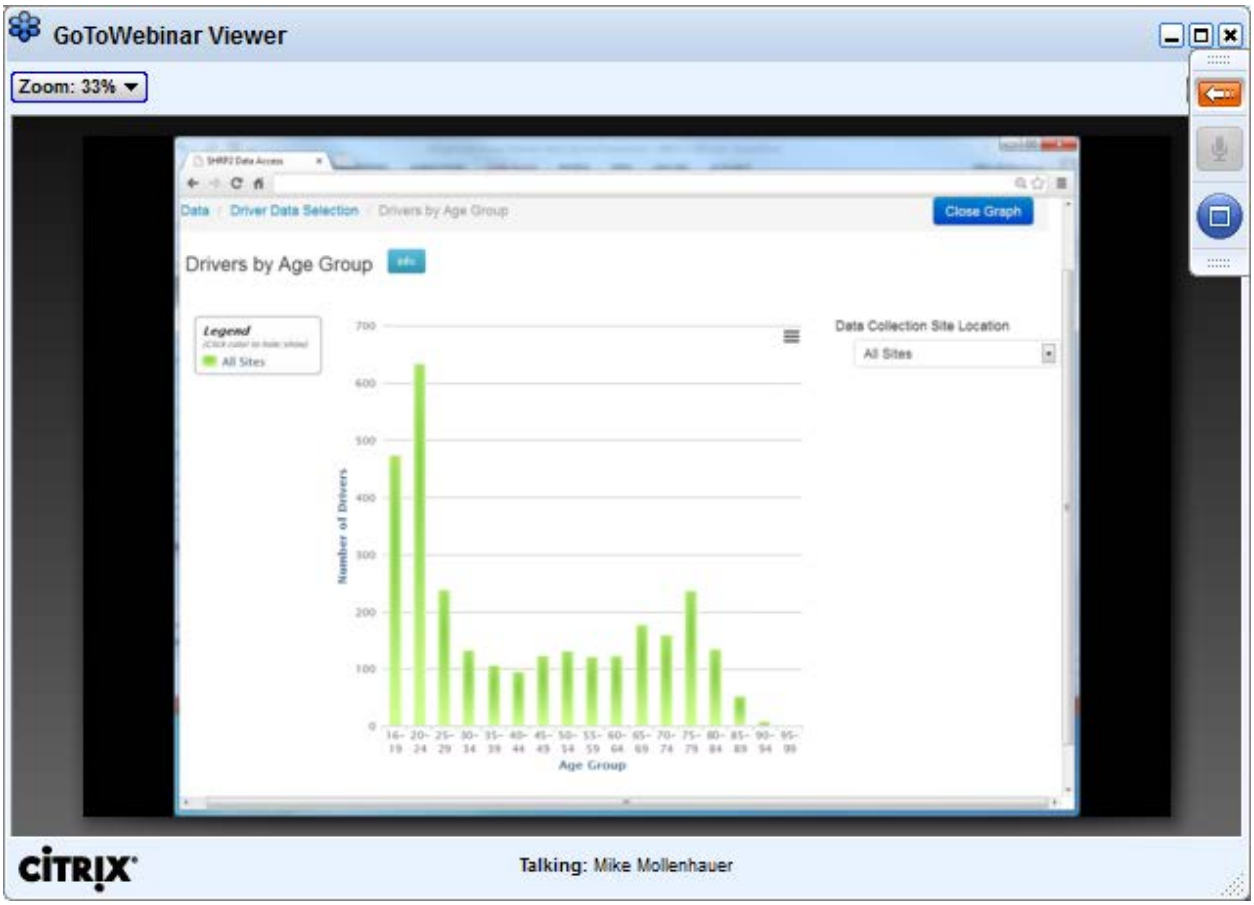
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Data / Driver Data Selection / Drivers by Age Group
Close Graph
Drivers by Age Group
Legend
All Sites
Data Collection Site Location
All Sites
Number of Drivers
Age Group
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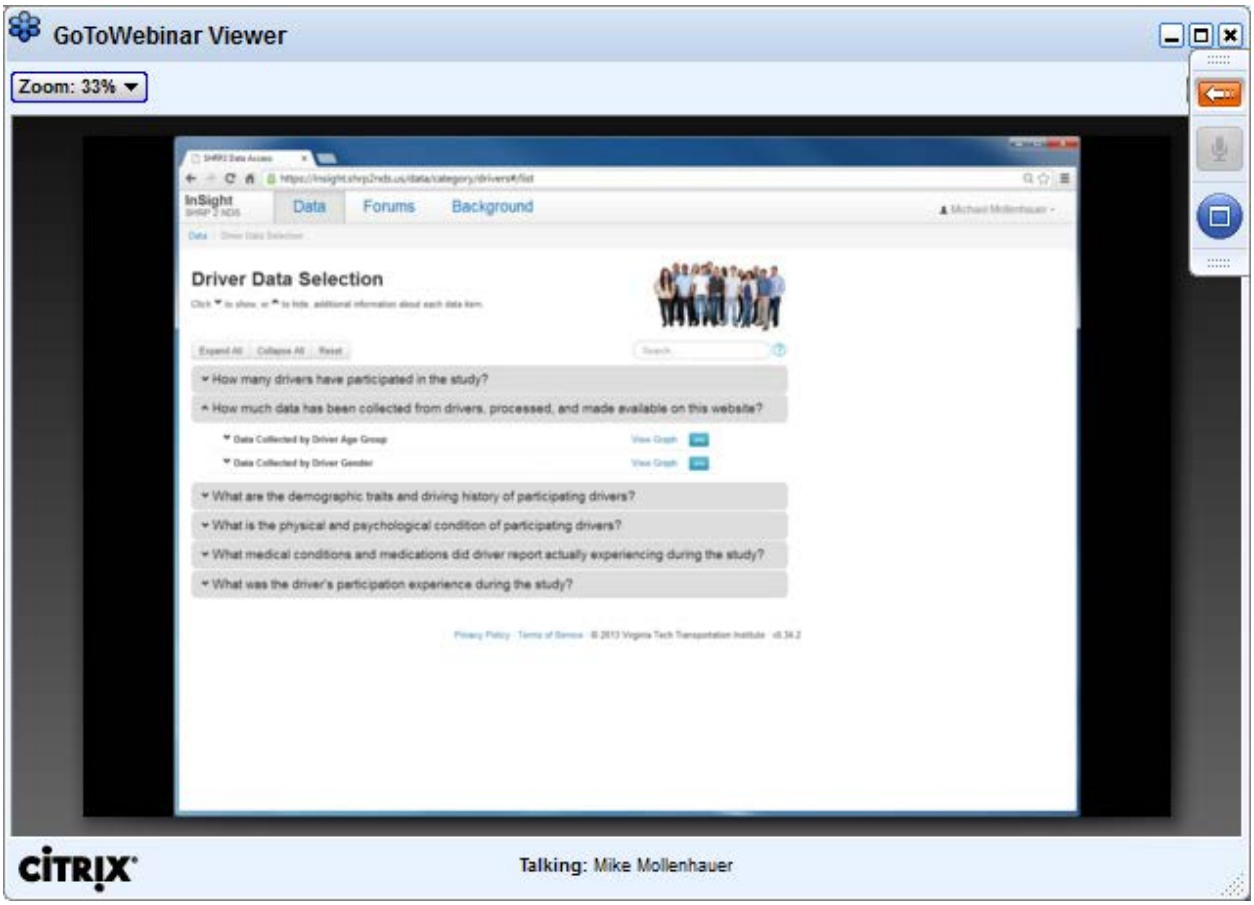
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InSight
Data
Forums
Background
Driver Data Selection
How many drivers have participated in the study?
How much data has been collected from drivers, processed, and made available on this website?
What are the demographic traits and driving history of participating drivers?
What is the physical and psychological condition of participating drivers?
What medical conditions and medications did driver report actually experiencing during the study?
What was the driver's participation experience during the study?
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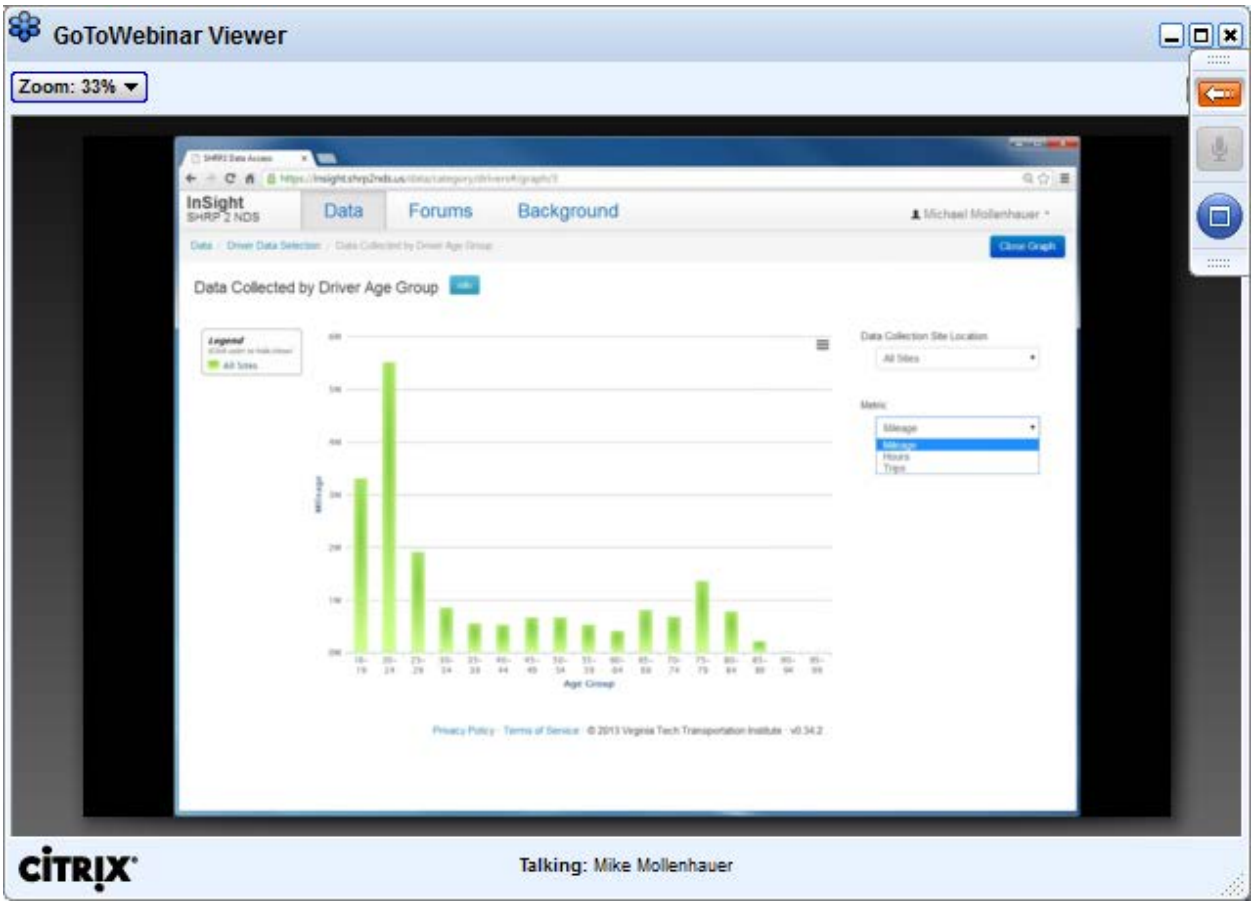
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InSight
SHRP 2 NDS
Data
Forums
Background
Michael Mollenhauer
Close Graph
Data Collected by Driver Age Group
Legend
All Sites
Data Collection Site Location
All Sites
Metric
Mileage
Hours
Trips
Age Group
Privacy Policy
Terms of Service
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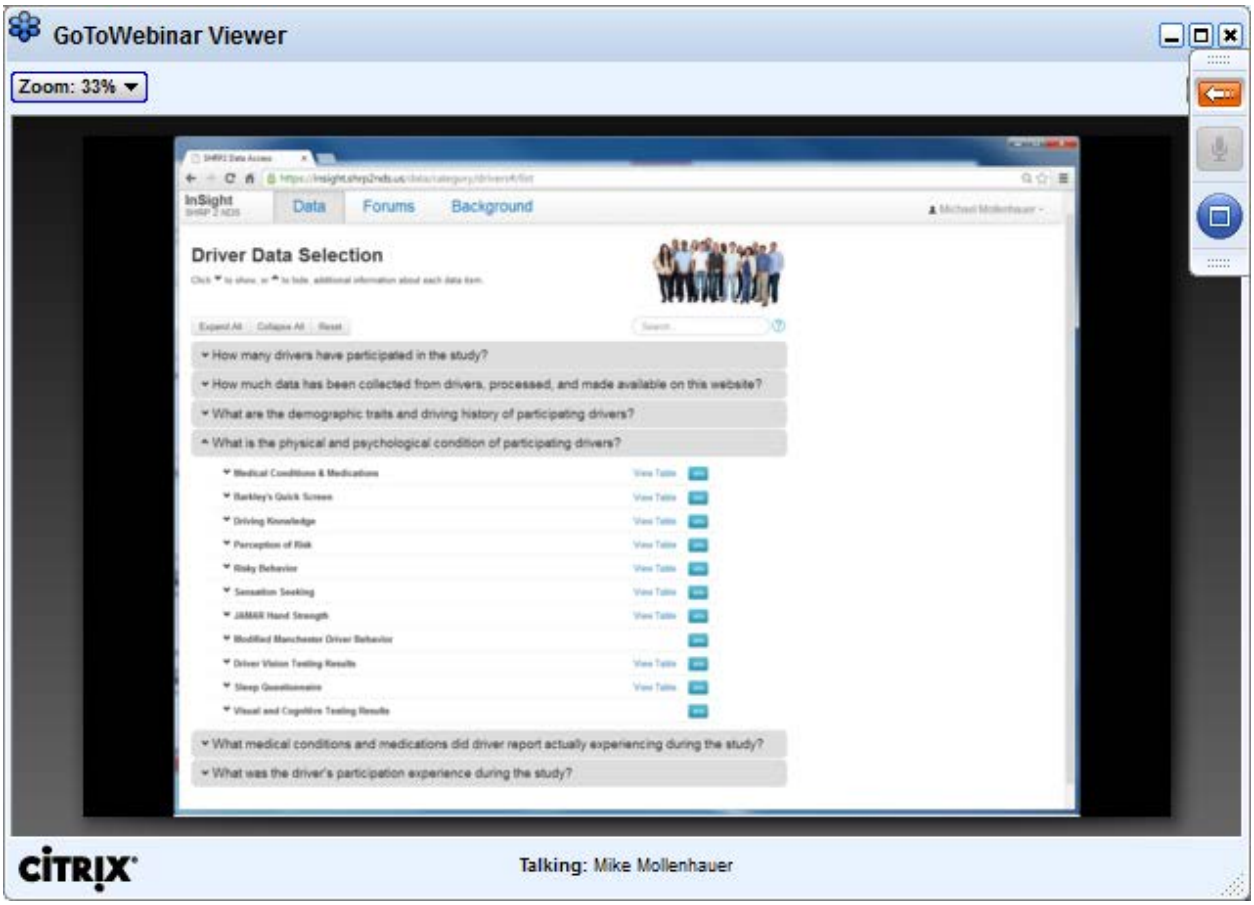
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InSight
Data
Forums
Background
Driver Data Selection
How many drivers have participated in the study?
How much data has been collected from drivers, processed, and made available on this website?
What are the demographic traits and driving history of participating drivers?
What is the physical and psychological condition of participating drivers?
What medical conditions and medications did driver report actually experiencing during the study?
What was the driver's participation experience during the study?
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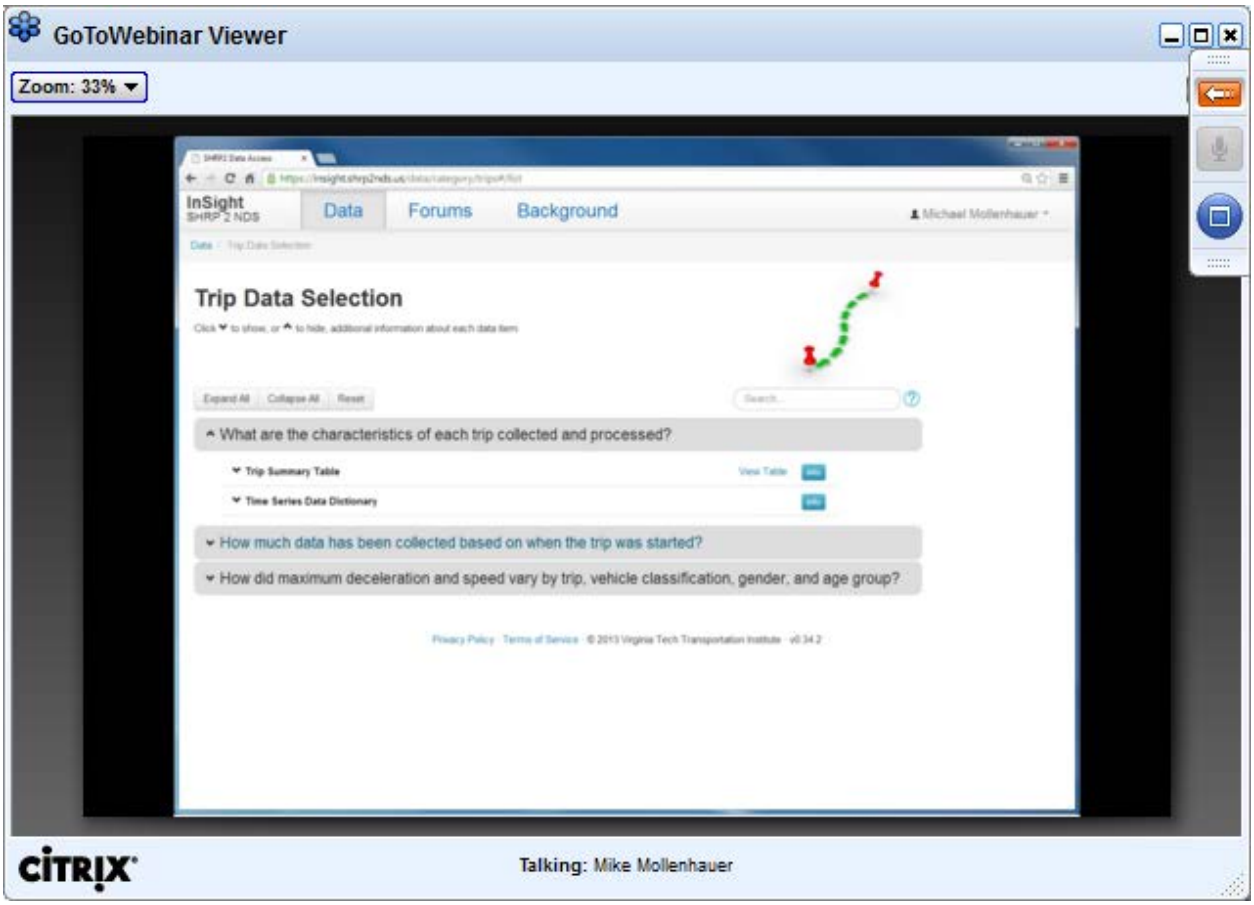
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InSight
SHRP 2 NDS
Data
Forums
Background
Michael Mollenhauer
Trip Data Selection
Expand All
Collapse All
Reset
What are the characteristics of each trip collected and processed?
Trip Summary Table
Time Series Data Dictionary
How much data has been collected based on when the trip was started?
How did maximum deceleration and speed vary by trip, vehicle classification, gender, and age group?
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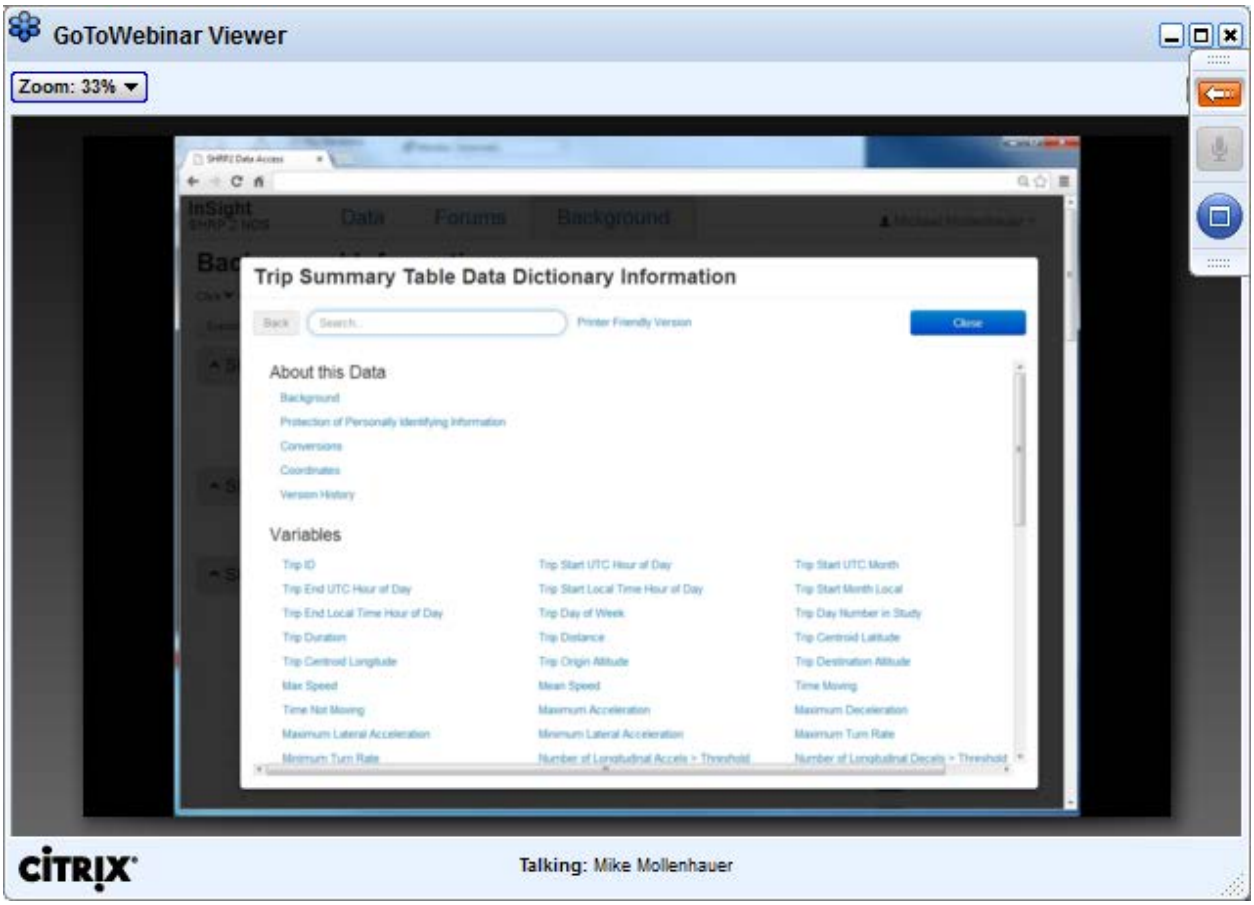
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Trip Summary Table Data Dictionary Information
About this Data
Variables
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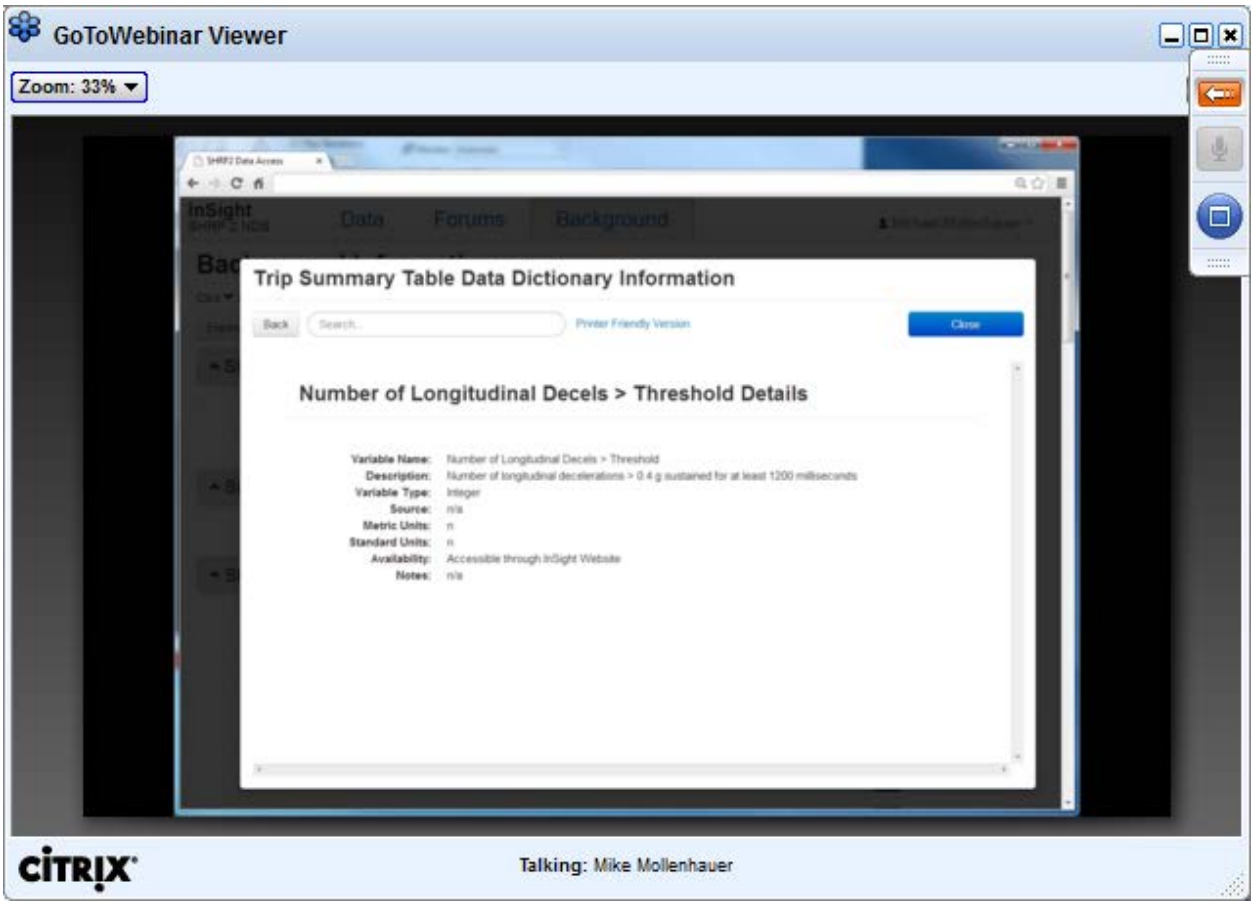
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Trip Summary Table Data Dictionary Information
Back
Printer Friendly Version
Close
Number of Longitudinal Decels > Threshold Details
Variable Name: Number of Longitudinal Decels > Threshold
Description: Number of longitudinal decelerations > 0.4 g sustained for at least 1200 milliseconds
Variable Type: Integer
Source: n/a
Metric Units: n
Standard Units: n
Availability: Accessible through InSight Website
Notes: n/a
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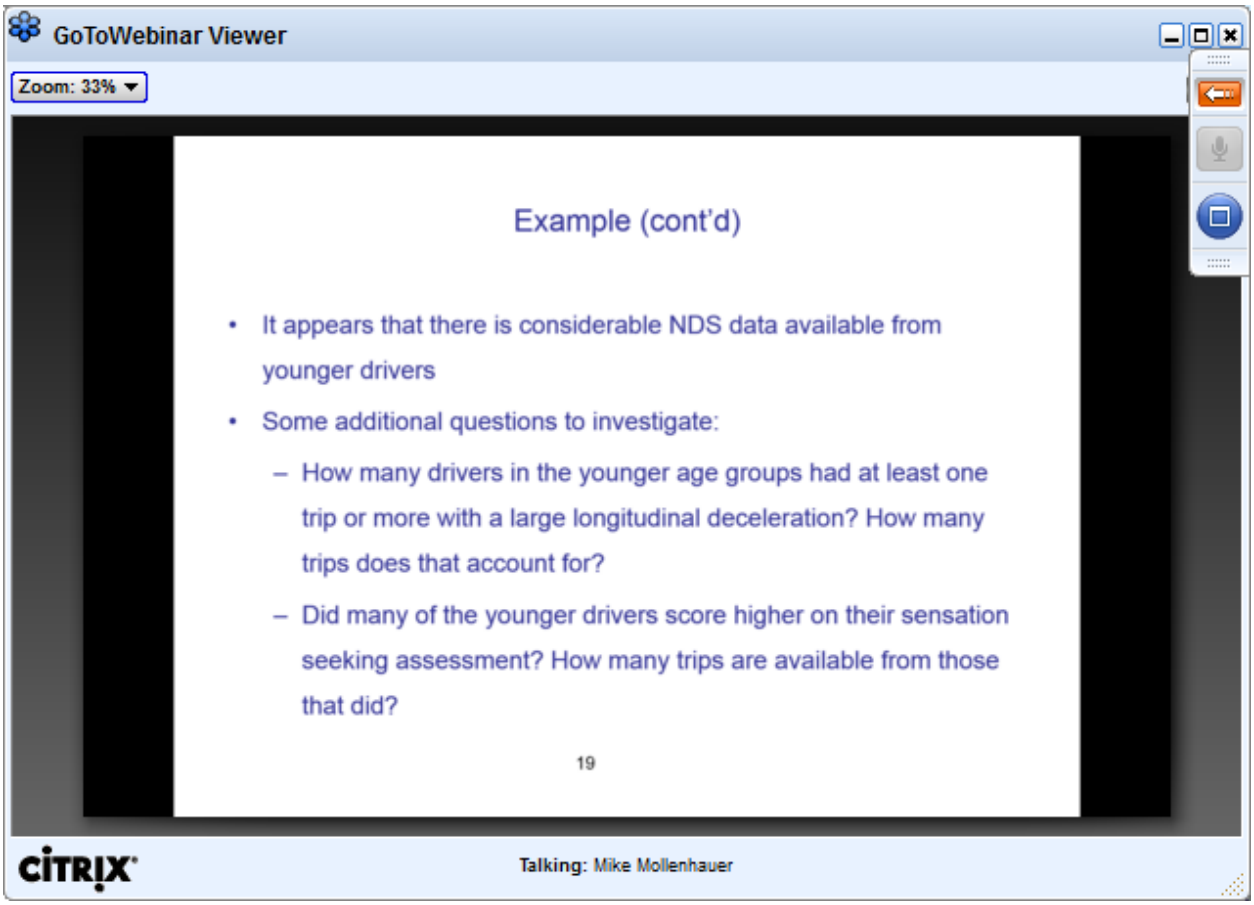
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Example (cont'd)
• It appears that there is considerable NDS data available from younger drivers
• Some additional questions to investigate:
– How many drivers in the younger age groups had at least one trip or more with a large longitudinal deceleration? How many trips does that account for?
– Did many of the younger drivers score higher on their sensation seeking assessment? How many trips are available from those that did?
19
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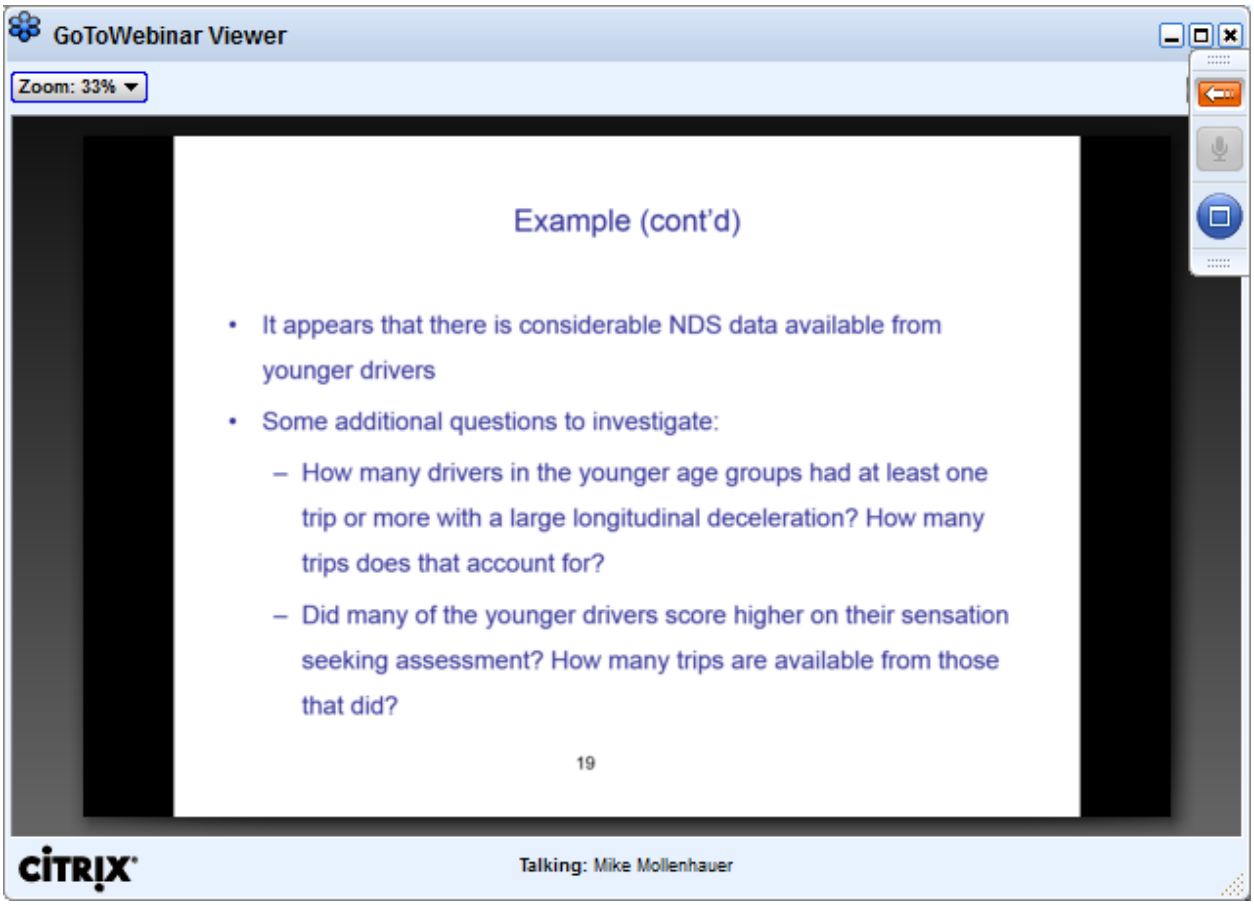
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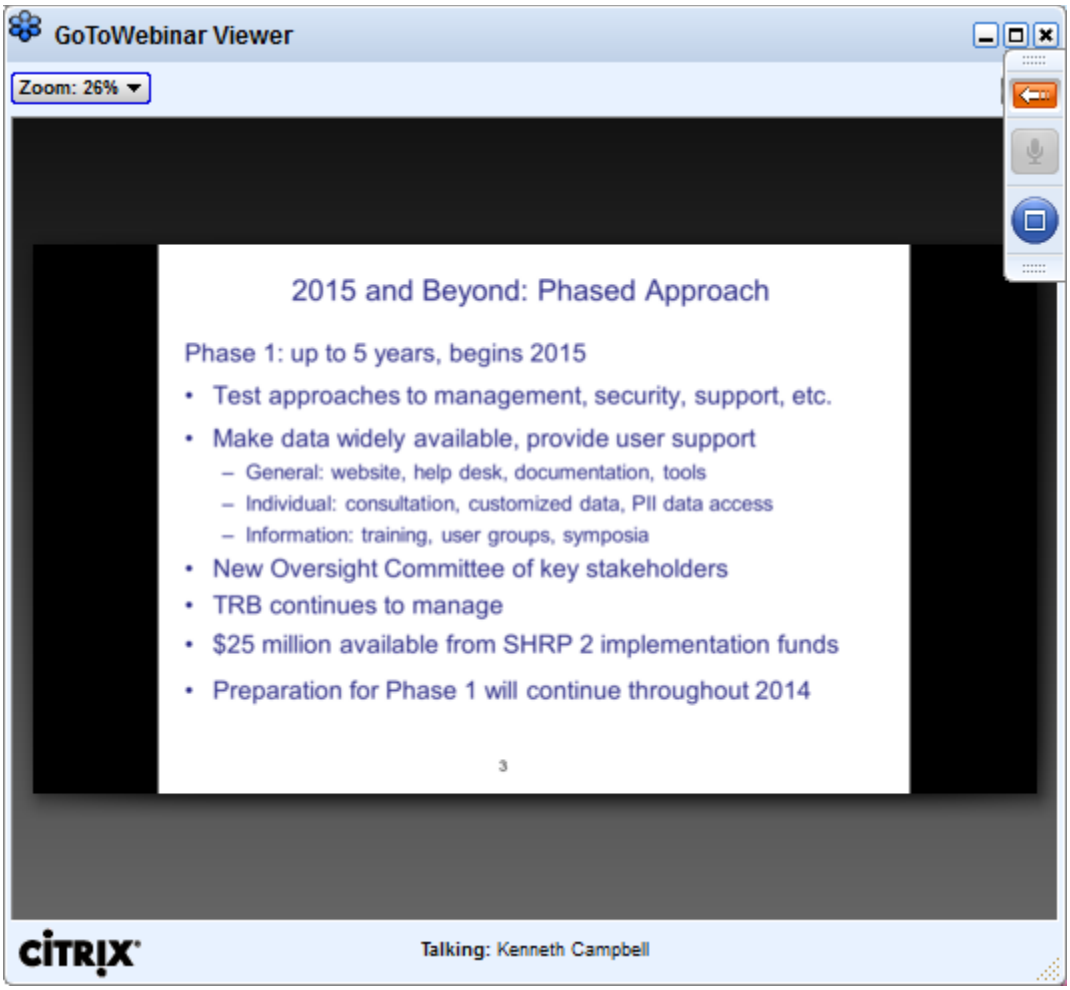
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2015 and Beyond: Phased Approach
Phase 1: up to 5 years, begins 2015
• Test approaches to management, security, support, etc.
• Make data widely available, provide user support
– General: website, help desk, documentation, tools
– Individual: consultation, customized data, PII data access
– Information: training, user groups, symposia
• New Oversight Committee of key stakeholders
• TRB continues to manage
• $25 million available from SHRP 2 implementation funds
• Preparation for Phase 1 will continue throughout 2014
3
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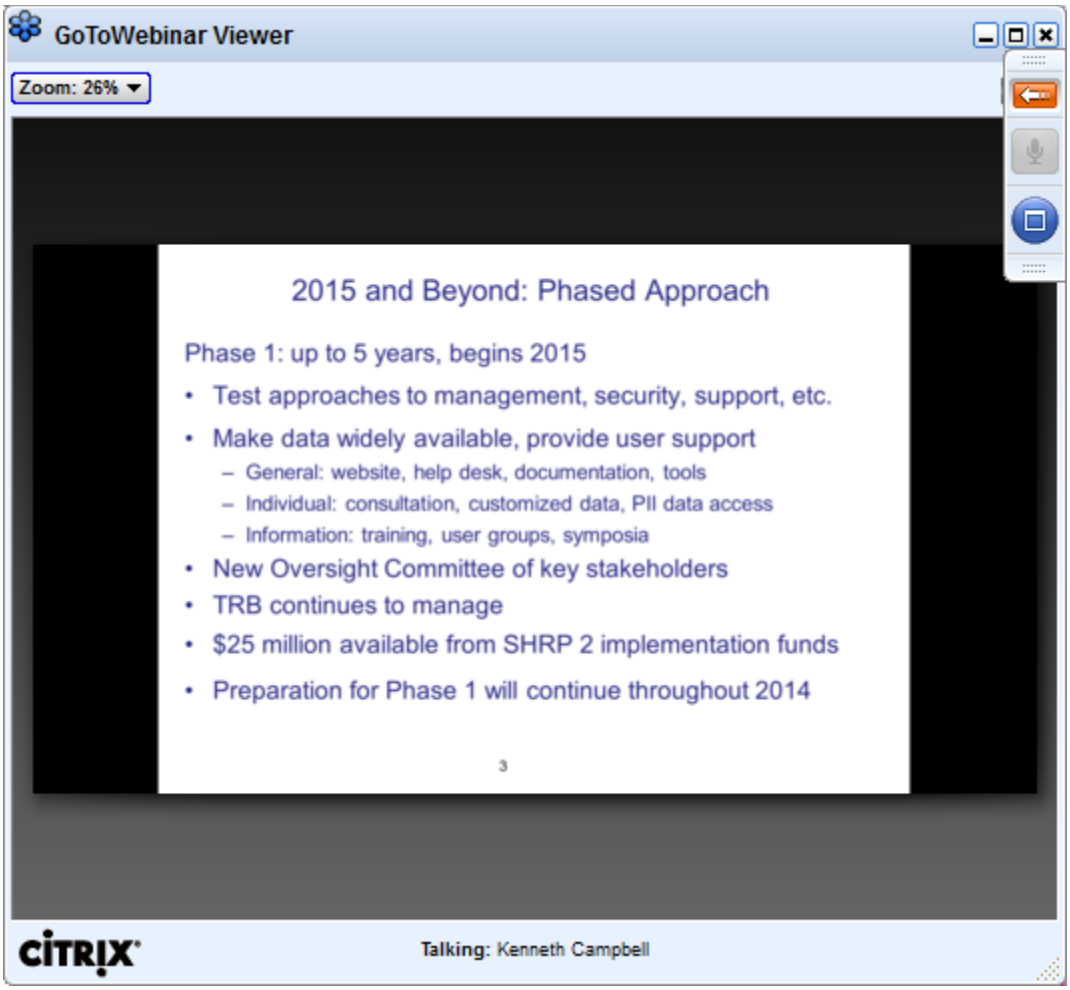
Talking: Kenneth Campbell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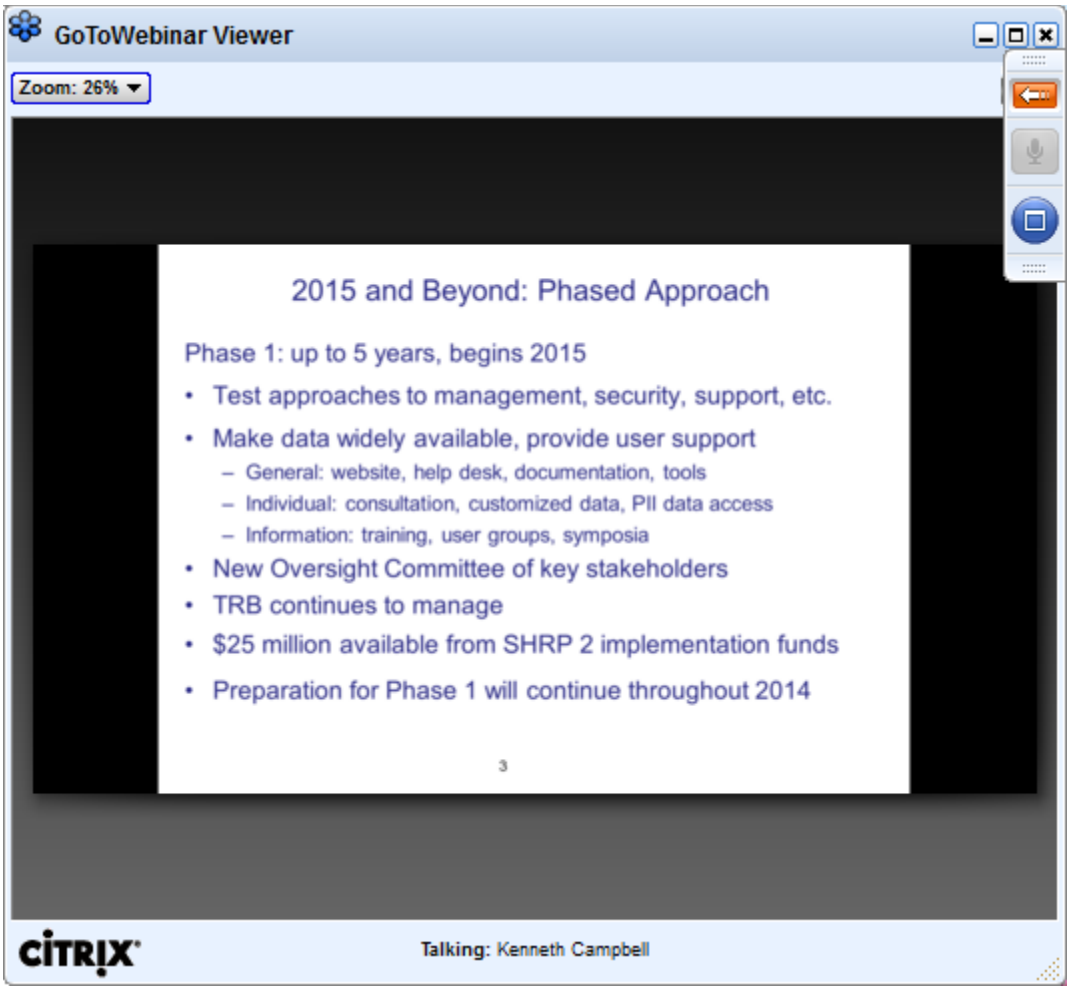
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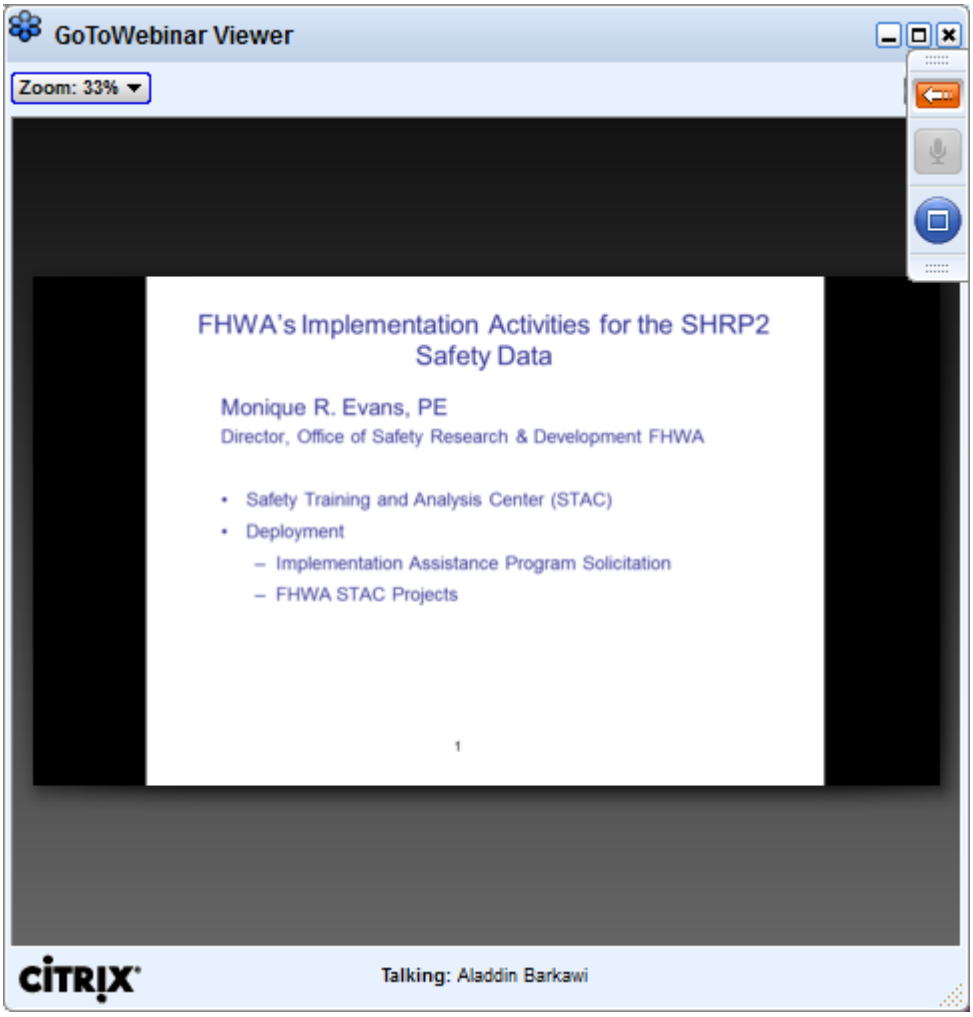
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FHWA's Implementation Activities for the SHRP2 Safety Data
Monique R. Evans, PE
Director, Office of Safety Research & Development FHWA
• Safety Training and Analysis Center (STAC)
• Deployment
– Implementation Assistance Program Solicitation
– FHWA STAC Projects
1
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Talking: Aladdin Barkawi

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Safety Training and Analysis Center (STAC)

Why establish a STAC at TFHRC?

To accelerate and proliferate use of the data… to improve safety.

FHWA Turner-Fairbank Highway Research Center (TFHRC)

2

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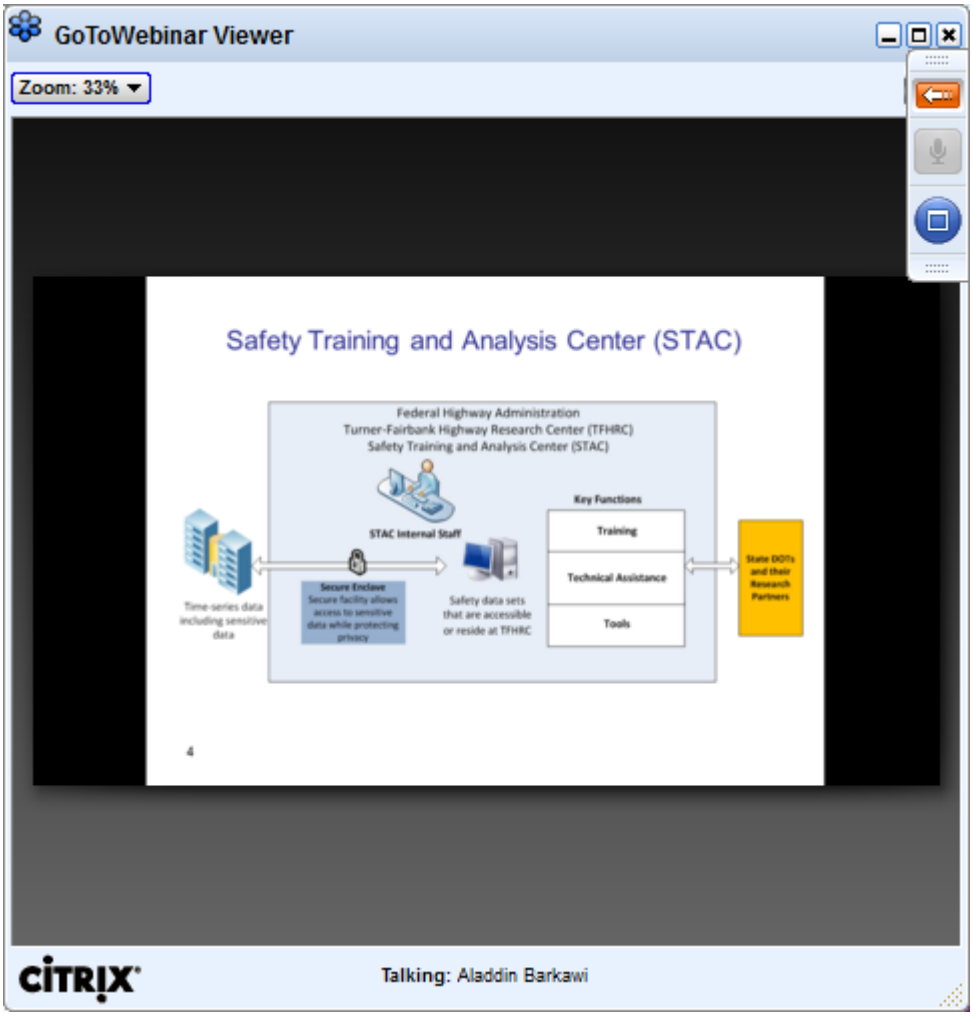
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Safety Training and Analysis Center (STAC)
Federal Highway Administration
Turner-Fairbank Highway Research Center (TFHRC)
Safety Training and Analysis Center (STAC)
STAC Internal Staff
Key Functions
Training
Technical Assistance
Tools
Secure Enclave
Secure facility allows access to sensitive data while protecting privacy
Safety data sets that are accessible or reside at TFHRC
Time-series data including sensitive data
State DOTs and their Research Partners
4
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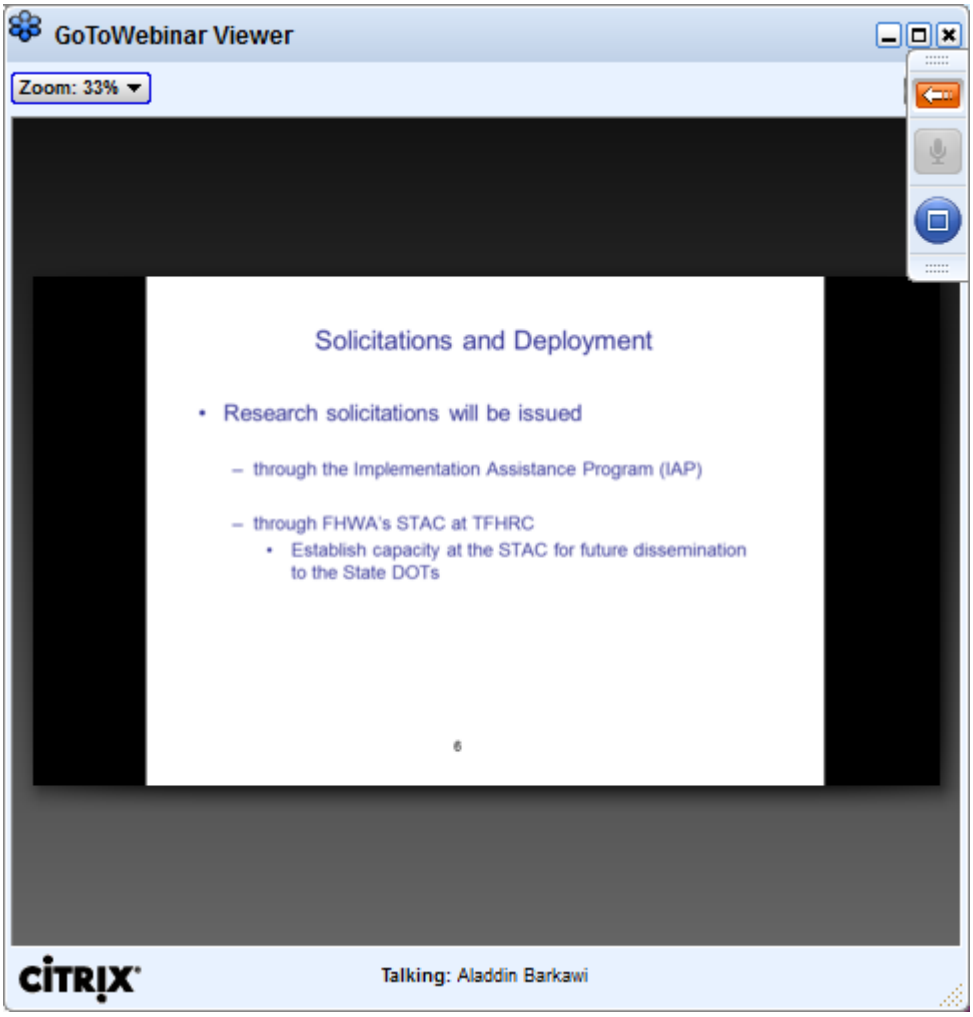
Talking: Aladdin Barkawi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Solicitations and Deployment
• Research solicitations will be issued
– through the Implementation Assistance Program (IAP)
– through FHWA's STAC at TFHRC
• Establish capacity at the STAC for future dissemination to the State DOTs
6
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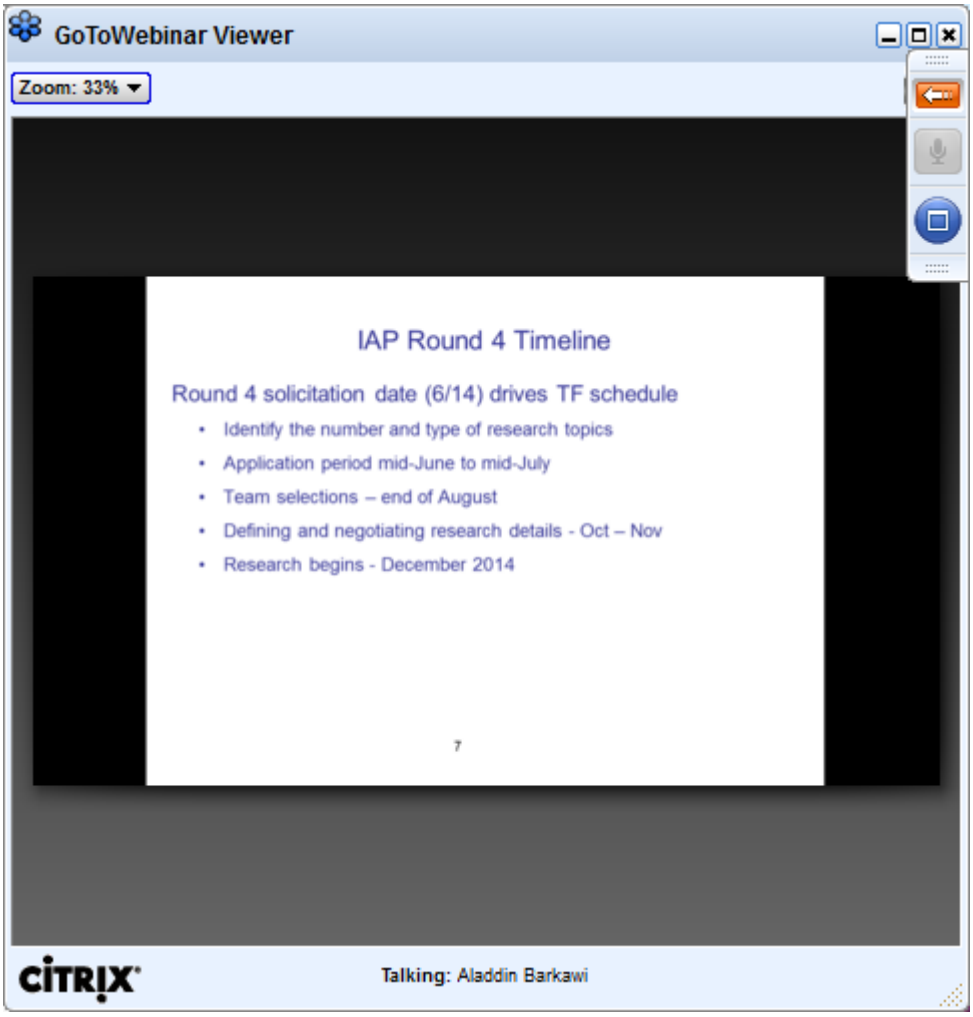
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IAP Round 4 Timeline
Round 4 solicitation date (6/14) drives TF schedule
• Identify the number and type of research topics
• Application period mid-June to mid-July
• Team selections – end of August
• Defining and negotiating research details - Oct – Nov
• Research begins - December 2014
7
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Virginia Tech (data) and Iowa State (roadway)