Assessment of Weather-Related Congestion On Utah's Highways: Investigation of Event Impacts From the Winter of 2008-09’

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Today’s Presentation

- Partnerships
- Motivation for project
- Analysis of weather-related impacts on transportation system
- Moving forward
Unique Collaboration

- America’s Weather Industry (NorthWest Weathernet), State (UDOT), Academia (University of Utah), and Federal (NWS)
- Meteorologists embedded at the UDOT Traffic Operations Center (TOC)
- Multidisciplinary approach
  - Traffic Engineers
  - Communications specialists
  - Psychologist
  - Meteorologists

Photo courtesy UDOT
Increased Demands...Increased Commute Times

- Population growth = Increase demand
  - 22.5% increase this decade

- Congestion results in annual cost of $250 million in Utah
  - Recurring (i.e., AM/PM commute times)
  - Non-recurring congestion (weather, accidents)

- Inclement weather plays a significant role in non-recurring congestion
  - Delays, mobility, productivity, and safety

“Large weather events cause trips to take 40-50% longer”
Weather Impact on Commute

“This is a striking finding – but it seemed intuitive on further consideration. The only things that affect the entire road system around Salt Lake City are snowstorms, or major holidays. Other sources of delay (crashes, thunderstorms, congestion) tend to be more localized.”

(UDOT)
Factors in Event Impact

- Traffic volume...demand on transportation system
  - Time of day
  - Day of week
  - Holidays
  - Public perception/preparedness

- Road Characteristics
  - Mitigation strategies
  - Snowfall rates
  - Snowfall amounts
  - Road temperatures
Goal: Develop an Enhanced Understanding of Winter Storm Impacts

- 11 events from the winter 2008-09
- Focus on Performance Measurement System (PeMS) data
- Examine relationship between meteorological phenomena, road conditions, and resultant impacts
- Determine common factors in events with the greatest impacts
Data Collection

- Observations
  - Crash data
  - Traffic data (PeMS)
  - Snowfall data (NWS)
  - Radar and satellite (NWS)
  - Plow driver reports (TATS)
  - Road Weather Information System (RWIS)

- Forecasts
  - UDOT
  - NWS

- Messaging
  - CommuterLink 511 Travel Information Line, variable message signs, Highway Advisory Radio (HAR), NWS watches, warnings, and advisories
Tracking Impacts

- **PeMS**
  - 240 sensors in the Salt Lake City Metropolitan Area
  - High temporal (5 min) and spatial (1/2 mile) resolution
    - Level of Service (LOS)
    - Vehicle Miles Traveled (VMT)
    - Vehicle Hours Traveled (VHT)
    - Speed
    - Flow
    - Delays
Level of Service

LOS is defined by the density of vehicles on the road (vehicles per lane per mile), and is a measure of a driver's freedom to maneuver.
Winter 2008-09’ – Travel Impacts

- Six cases had significant decrease in flow
- System wide LOS was only significantly impacted on three occasions
- Impacts do vary by corridor

...Multiply “Decrease in Flow” value by 10 to get number of vehicles...
LOS - AM versus PM Commute Windows

- Gross LOS in categories D-E-F for morning and evening commutes
  - More pronounced effect evening commute
A Tale of Two Commutes
5 Jan 2009 and 19 December 2008

Photo courtesy UDOT
5 Jan 2009 Event

- Forecast Information
  - 1-3” forecast for Salt Lake Valley – verified well
  - Winter Weather Advisory issued near onset based on commute impacts
  - Minimal discussion of impact in days leading up to event
  - Significant storms preceded this event
Road Considerations and Impacts

- Road temperatures near 25° F
  - Snow stuck to roads at onset

- Limited mitigation options available prior to event

- Numerous crashes (180) in Salt Lake and Utah Counties

- Worst commute of the season

5 Jan 2009 - Road temperatures ~ 420 p.m.
19 December 2008

- More ramp-up to the event
  - Watch issued 36 hours before onset
  - Winter Storm Warning issued ~21 hours before onset

- Area Forecast Discussion – 442 PM 17 Dec 2008 -
  ...With very cold temps expect snow to rapidly accumulate on area roadways...

- Winter Storm Warning – 302 PM 18 Dec 2008
  ...Snow expected to rapidly accumulate along area roadways and result in treacherous driving conditions...

...Much of this snow may be occurring during the late afternoon and early evening hours which would have a very significant impact on the evening commute...
Road Considerations and Impacts

- Roads temperatures remained near 30° F
  - More effective mitigation
- Level of service remained higher throughout the event
- Aggressive mitigation prior to and during event
- 3-7” storm total

19 Dec 2008 - Road temperatures ~ 400 p.m.
Speed and Flow

- Similarities between the two events
  - Drop in discretionary travel
  - Travel is not displaced in time
  - Speed and flow drop off rapidly right after snow onset

- Differences
  - Speed trough on the 5th was lower
  - More significant impact on the 5th
  - Increase in flow (above normal) prior to snowfall onset on the 19th
So, how was the commute?

5 January 2009 event

- Note the significant difference between Monday and Tuesday
- As flow decreases, high density of vehicles on the roadway

19 December 2008 event

- No space, very difficult to switch lanes, vehicles move in lockstep, frequent stops
- Higher level of service indicates that vehicles are moving (albeit at a reduced speed, in this case)
- Not completely packed on the roads (there is spacing)
- Difference between Thursday and Friday is not that significant
Uncertainty and Impact

Meteorology

Road Conditions

Impact

Public Response
Future Work

- Further correlate weather with road impacts
- Submitted Partners Project
- Collaborative communication strategies

Photo courtesy Bruce Tremper
Submitted Partners Project - Winter of 2009-10’

- Multisector approach

- Targeted surveys via research firm
  - 1200 completed surveys
  - 3 events

- Collection and analysis of:
  - Knowledge
  - Perceptions
  - Decision Making

- Identify effective strategies for communicating critical information

Desired outcome: modified commuter behavior that leads to improved mobility and safety!
Collaborative Communication Strategies

- High confidence in forecast and road impacts may result in common message from NWS, UDOT, NorthWest Weathernet, Media
- 7 December 2009 Decision Support Service
  - Coordinated with UDOT on potential impact prior to storm onset
    - Identified highest impact areas for motorists
  - Coordinated impact based statements
    - Incorporated into Winter Storm Warning
    - Incorporated into CommuterLink 511 Travel Information Line
    - Media
      - Scrolling banner similar to Convective Warnings

“UNNECESSARY TRAVEL IS DISCOURAGED TONIGHT ALONG ALL OF INTERSTATE 70 AND INTERSTATE 15 FROM SANTAQUIN SOUTH TO ST GEORGE.”
Thank you!

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