PANEL 1 -- WEATHER INFORMATION NEEDS/REQUIREMENTS RESULTS

Moderator: Mr. Douglas Jonas, Matrix Management Group

Rapporteurs: Mr. Blaine Tsugawa, OFCM
Mr. Christopher Moren, OFCM (STC)

Panelists: Mr. David Whatley, Department of Transportation, Federal Aviation Administration
Mr. Paul Pisano, Department of Transportation, Federal Highway Administration
Mr. Arthur Handman, Greater Hartford Transit Authority (representing Department of Transportation, Federal Transit Administration)
Mr. William Broder, American Association of Railroads (representing Department of Transportation, Federal Railroad Administration)
Trooper Scott Reinacher, National Coalition of State Troopers
Mr. Christopher Moren, OFCM (STC) (addressing Department of Transportation, United States Coast Guard)

Objective: Provide the results of OFCM's efforts, conducted on behalf of the Federal meteorological community, to collect weather needs and identify requirements for roadways, railways (includes transit), waterways, and pipelines.

Synopsis

Moderator's Introductory Remarks

Mr. Jonas described his ten-year association with surface transportation and explained that he had seen an awakening role regarding weather impacts. Over this time, he has observed the developing collaborative efforts of the commercial weather industry and the National Weather Service. He believes each has a role in addressing and satisfying the emerging requirements.

Airport Ground Operations

Mr. Whatley spoke of the evolution of weather information that impacts the efficiency of multi-modal operations on and around the terminal. Airport throughput is very much affected by the efficiency and effectiveness of ground operations. Mr. Whatley identified five key factors that impact airport ground operations: snow removal; deicing operations; refueling operations; equipment protection; and ground support personnel effectiveness. He pointed out that lead-times and event duration were dependent on the nature of the environment, the availability and type of equipment and treatments, and the decision-making policies of each user.

- ***Snow removal*** is a primary concern. Freezing precipitation of any kind is critical along with lead-time, accumulation, and start/stop times. Temperature and moisture forecasts are clearly crucial variables in the forecast equation.

- ***Aircraft deicing operations*** are the responsibility of the Pilot in Command (PIC), air carrier, or the general aviation operator. Forecasts of freezing precipitation are critical for both planning and execution of deicing operations. Deicing constraints include forecast lead-time, duration of the event, type and amount of precipitation, temperature and wind predictions, deicing location, taxi- and holdover-time, and choice of deicing method (fluids).

- ***Refueling Operations*** are most severely impacted by the occurrence of lightning. When lightning is reported within 3 miles of the airport, refueling operations cease.

- ***Ground Support Equipment*** is affected by strong and gusty winds.

- ***Ground Support Personnel*** are impacted by wind chill (forecasts of temperature and wind)--lead-times and event duration are essential.

The list is not all-inclusive. Technology will provide the means for more effective application of weather information to requirements known now, and those yet to be identified -- all designed to improve the effective, efficient and safe throughput at air terminals.

Transit Operations

Mr. Handman presented the road and railway transit requirements and summarized the weather needs and requirements from the Connecticut roadway and railway transit perspective.
Key factors are:

- ***Mesoscale variability*** - One of the key ingredients to the surface transportation weather problem is the ability to apply reasonable, physically consistent weather data to a small scale.

- ***Flooding*** - Local knowledge of flooding is critical to transit operations. The local transit authorities know where urban and rural flooding occurs; but the transit authorities don't know when or where a weather event will generate sufficient rainfall (intensity and duration) to produce flooding. Additionally, once this forecast hurdle is overcome, communicating this information to the traveling public efficiently and effectively becomes critical.

- ***Visibility*** - Visibility thresholds are different for urban bus traffic and light rail. As a rule, city buses are slow and steady movers and, thus, require ¼ mile visibility ($\sim$2 city blocks). Light rail, on the other hand, have other dependent variables, e.g., length of train and the degree of cab control, thus, 1 mile visibility is needed.

- ***Winds*** - Winds can be a factor but pose a customer hindrance more so than an impact to transit's ability to move people and goods. Except for extremes! Sustained winds over 65 mph will suspend operations.

- ***Temperatures*** - Temperatures affect several transit functions. Specifically,
  - Icing - Roadway icing treatment changes with changes in pavement temperature; 32°F is treated differently than 15°F.
  - Wind Chill - Safety and passenger and crew comfort are paramount (~20°F).
  - Heat Stress - Safety and passenger and crew comfort are paramount (~105°F).
  - Catenary wire expansion - Older light rail power wires are susceptible to expansion at and above 85°F.

- ***Lead-times and responsibilities*** - The transit authority needs 12 to 24 hours advance notice; however, reaction time can be as late as 2 hours prior to an event.

Anecdotal **-** Other decisions not within the control of the transportation authority can undo a perfect weather forecast and transportation decision. For example, the insurance and banking industry of Hartford are mindful of the travel difficulty their employees have when it snows. Once snow is falling, regardless of the predicted duration, coverage, or accumulation, they release their employees at 11:00 a.m. without regard to the regularly scheduled transportation slow down during the post-morning and pre-afternoon rush hours. A tremendous demand for service is imposed with resultant delays and overcrowding.

Weather impacts on our operation can be significant. And when the weather event is extreme it can be the most important factor in satisfying or not satisfying our transit mission. The WIST process needs to provide tailored and detailed forecasts with the ultimate goal of providing early and understandable products/services to our customers, not just the surface transportation professionals.

Railway Operations

Mr. Browder is the Director of Operations for the Association of American Railroads (AAR). His presentation summarized the weather needs and requirements for the railway transit system with particular emphasis on heavy rail. AAR is a legislative lobbying agency for railroad standards and practices.

Since 1985, the railroad industry has grown and changed. Boxcars have gone the way of the dinosaurs, yielding to inter-modal containers and trailers. Warehousing is considered a drain on rail customer and goods service. The business operation plan calls for "on-time delivery". In order to remain competitive, the rail industry inspects all 120,000 miles of track twice weekly and considers the impact of weather to be an integral factor in efficient and effective operations. The four major rail carriers either have their own weather forecast staff or contract for weather support services.

- ***Frozen precipitation*** (< 8") generally does not pose a problem for the heavy rail industry. The industry prides itself in being dependable and reliable when other transportation modes are restricted or suspended. The best operating advice is to keep the trains running as a means of keeping the rails clear and the accumulations at a manageable level.

- ***Flooding*** - The rail industry operates under the "fail safe" condition. If there is a reported problem with or on the tracks, a track inspection is required prior to the resumption of operations. In general, the reaction to reports of flooding is "when" and "where". This approach isolates the impacted region, limits suspension of operations to the affected areas, and initiates rail inspections.

- ***Hurricanes and Tidal Surge*** – The industry monitors hurricane trajectories to determine potential effects of storm-force winds, the cumulative effect of tides and storm surge, and inland flooding.

- ***Lightning*** is a concern for the safety of ground crews. When lightning is present, exposed ground operations cease.

- ***Temperatures*** - When the temperature exceeds 90°F, track inspections are prescribed. The major concern is track "kinks" associated with rail expansion and contraction. The biggest concern is not a singular upper or lower threshold but the temperature variation. Temperature gradients of 30-40°F over 24 hours can result in track misalignment, inconsistent expansion and contraction, and possible rail failure.

- ***Visibility***, as a rule, is not a significant factor. The train control system is on autopilot, or instruments, and trains normally run at track speed regardless of the visibility. Visibility becomes a factor when it is not possible to have positive control to stop the train without the engineer. Visibility thresholds are based on the stopping distance, which is a factor of topography and weight. A 10,000 ton train moving at 60 miles per hour requires 1 1/4 miles to stop. Visibility awareness needs to be provided (alerted) at ~ 3 miles.

Weather definitely influences railway operations. Decisions made without weather input reduce efficiencies, increase the operating costs, and decrease industry customer satisfaction. Timely, detailed forecasts will aid in the continuing growth of the rail industry.

Highway Operations

Mr. Pisano, Team Leader for the Weather/Winter Mobility Program at the Federal Highway Administration, summarized the efforts of his group in developing the Surface Transportation Weather Decision Support Requirements (STWDSR), which emphasizes the maturing Winter Decision Support System.

Four-Step Process - The development of the decision support system followed a four-step process:

- Looking at the information needs by road users and operators,
- Creating an Operational Concept Description,
- Gathering external inputs to support the OCD, and
- Testing and evaluating the concepts created.

The information needs focused on the decision-making with the result being a quantifiable outcome, e.g., saving time, money, lives, etc. How do the users and operators respond or cope with weather? These responses create the need statements, which are one of the critical inputs to the decision support system. During FHWA's first effort, 426 information needs across 44 decision-maker categories were produced. In-order-to translate these needs and categories into manageable subsets, the data were segregated into three time-scales:

- Warning (immediate)
- Operational (1-24-hour lead-times)
- Planning (> 24-hours)

The Decision Support System efforts focused on the operational scale. As an aside, focusing on Decision Support is the weak link. The process is really a filtering and fusion of external weather parameters and other road information, Figure 1, to come up with an appropriate decision.

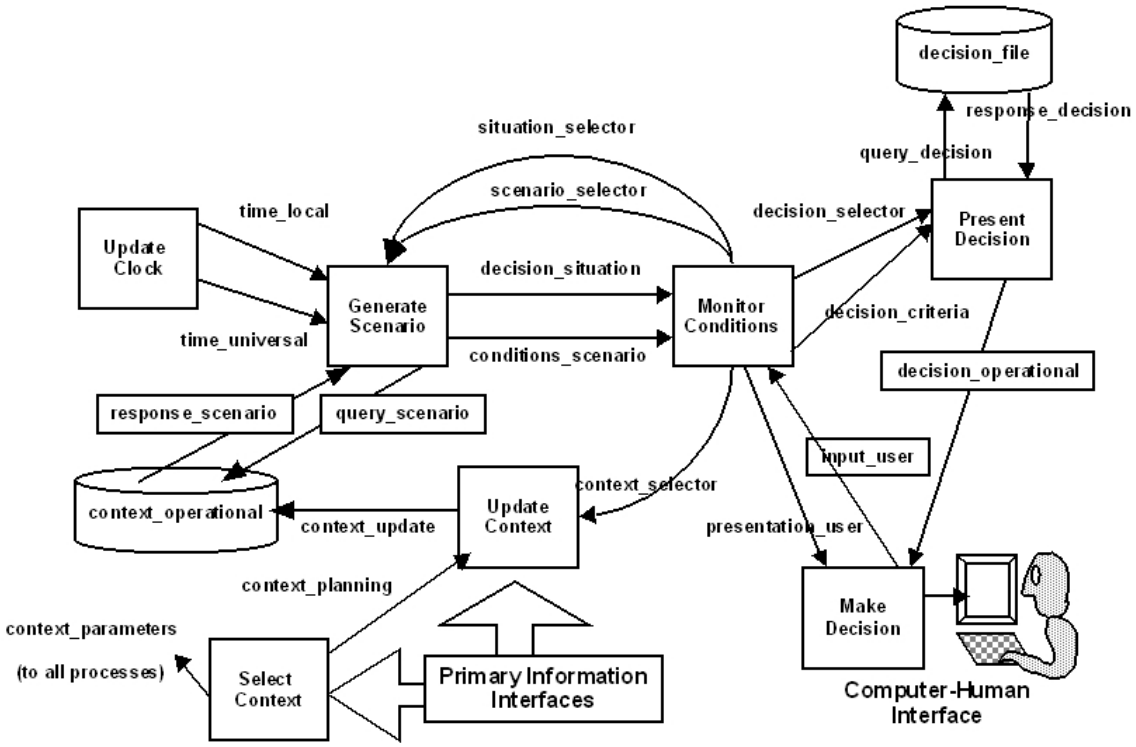

Figure 1. Systems Engineering Diagram

External weather support can be provided by public or private agencies through an appropriate standard interface. In this system design, weather is just one of the inputs to the DSS. Information must be gathered for the transportation system, including treatment options.

- Environmental information-e.g., precipitation, temperature, icing, et al.
- Transportation state-e.g., types of vehicles available, crew rest, etc.
- Treatment information-e.g., chemicals to be used and availability, etc.

In order to effectively accomplish this taxonomy, responses and reactions must be linked to performance threats and synthesize the external inputs.

The result is an iterative development scheme creating a methodology that focuses on the outcome and satisfies the question of "How it makes our systems operate better?"

Emergency Responders

Trooper Scott Reinacher is Chairman of the National Troopers' Coalition (NTC); NTC represents over 45,000 members and 48 state police associations. The NTC is charged with improving police services, improving cooperation between associations, and elevating the standards of police across the association. Trooper Reinacher provided a state trooper's perspective of weather support and information during emergencies.

- ***Support*** **-** Most of the agencies reported that weather support was received via multiple methods with varying quality, e.g., NWS, Internet, private provider, etc. Each has their place but none of them have all the detailed and timely support answers.

- ***Observing Systems*** **–** Often, the troopers provide the first on-scene weather observation and this information is communicated back to the command center for redistribution. The troopers take this responsibility very seriously. The desire is to make the information complete the full cycle back to the weather forecast offices. Some states have on-board observing systems tied into the traffic control center for immediate distribution, e.g., Minnesota Department of Transportation.

- ***Local Effects and Lead-times*** **-** Knowledge of the local effects and variability of weather conditions gives the state troopers an edge in performing their duties. This knowledge coupled with the accurate and timely weather forecast provides the local jurisdictions with the ability to refine staffing and effectively enforce traffic control. Monitoring the environment in a proactive manner increases personnel safety and mission accomplishment.

- ***Traffic Control*** **-** Weather affects their job and creates more work. When the weather is a factor, troopers still have to operate but the public can choose to stay home. When the public does not stay home, state troopers have a much larger accident rate and officers'

duties are consumed by vehicle safety and traffic control rather than other important police activity. Weather factors that impact their mission dramatically and consistently are freezing precipitation, reduced visibility, wind, and extreme cold and heat.

- ***Communications*** **-** Lightning doesn't affect their mission routinely, however, communications have been disrupted and communication towers destroyed by lightning strikes. The state troopers' communications systems are redundant but inefficient when operating at half their potential. In addition, most agencies don't have the resources to replace a $250K communication system.

- ***HAZMAT*** - Hazardous material transport is not part of the state troopers' mission responsibility; however, they have had to deal with the effects of accidents involving HAZMAT carriers. Troopers are often the first responders on-the-scene and they must deal, at great risk, with the effects of downwind dispersion.

Anecdotal **-** Weather also affects police work in cooperative ways. For instance, in January, there was a bank robbery in Holton, Michigan, which became a hostage situation during a vehicle escape attempt. Weather played a major role in the deployment of the response team and, ultimately, the apprehension. When the state agencies were notified of the bank robbery, the response team gathered but was unable to travel to Holton by air because of an intense snowstorm. Eventually, the team was convoyed to Holton by road plow. Because of the storm, the bank robber wasn't going anywhere either. In due course, the suspect was captured when the escape vehicle ran out of gas and the severe cold caused him to seek the warmth of the surrounding police vehicles.

The overwhelming response by a majority of state troopers was for the weather agencies to provide thorough and accurate observations and forecasts. This best-effort support will dramatically improve the troopers' ability to complete their missions.

Waterway Operations - Great Lakes

This presentation summarizes the weather needs and requirements for waterway operations with particular emphasis on the United States Coast Guard (USCG) Great Lakes waterway transit system. LT Nicole Novotny, USCG District 9, provided additional information and specifics. LT Novotny gathered the information by contacting appropriate representatives within the Great Lakes waterway transit system.

Currently, the 9th Coast Guard District cutters receive the majority of their weather information from the National Weather Service (NWS). The NWS support system meets the weather needs of the cutters. The Coast Guard on the Great Lakes also uses NOAA Weather Radio extensively. The National Ice Center (NIC) provides 9th Coast Guard District cutters with information on Great Lakes ice conditions. Accuracy of the weather forecasts and ice conditions is vital to the

Great Lakes Coast Guard cutter mission. Deficiencies exist and should be the focus of future resolution, specifically, the accuracy (timeliness and location) of weather elements and access, readability, and timeliness for ice conditions products. The current product suite includes;

National Weather Service Products

- Marine observations
- Marine forecasts - open water and near shore
- Special marine warnings
- Marine weather statements
- Radar and satellite imagery
- Water temperature analysis
- Surface water temperature
- Ice outlook
- Water levels

National Ice Center Products

- Ice composites - Tuesdays and Fridays
- Seasonal outlook
- 30-day forecast
- RADARSAT imagery

The Great Lake's weather is diverse and volatile; its impact on Coast Guard cutter operations is exponentially diverse and unpredictable. All elements of weather - precipitation, temperature, visibility, wind, waves - are continuously affecting and driving 9th Coast Guard District cutter operations. How these elements impact operations depends on many other factors including the capabilities of the cutter, the mission being conducted, the location of the cutter and the Commanding Officers' overall comfort with the situation. Due to many variables, it is difficult to establish a unified set of criteria reflecting a Coast Guard cutter's reaction to various weather conditions. Furthermore, weather conditions that would be expected to suspend waterway operations usually generate Coast Guard "search and rescue" operations.

Commanding Officers of Coast Guard cutters on the Great Lakes analyze available weather information and adjust their operations as appropriate. Each cutter has various plans in place, such as a "Heavy Weather Bill," to react immediately to deteriorating weather conditions. Additionally, Coast Guard cutters are always assigned a readiness status. That status reflects a period of time the cutter must be ready to proceed to a tasked mission. Great Lakes' cutters are assigned 2-, 12-, and 24-hour statuses; therefore, weather information with similar lead-times is needed.

With all elements of weather, the more severe or intense the more lead-time the Coast Guard needs to prepare for it. Generally, 48-hour to 24-hour notice of severe conditions and 24-hour to 12-hour notice of light or normal conditions is desired. If conditions are predicted to change drastically, immediate to 2-hours notice is desired.

- ***Precipitation*** - No matter the form, precipitation reduces the visibility and clutters the radar of cutters that are underway. Snowfall accumulating on a cutter will affect the cutter's stability and the crew's movement onboard. Snowfall on top of ice-covered waters will slow a cutter's movement through the ice. Flooding caused by ice jams may require icebreaking operations to alleviate the flooding.

- ***Temperature*** **-** Air and water temperatures primarily affect Coast Guard operations on the Great Lakes as they reach the freezing mark. Air temperature of 32°F causes water spraying onto the ship to freeze. This topside icing reduces a cutter's stability. As water temperatures decrease, ice forms on the lakes and Coast Guard small boats are removed from the water. Coast Guard cutters then become a primary search and rescue resource on the Great Lakes. Coast Guard icebreaking operations then commence to perform emergency operations, flood control and facilitate navigation. Both extreme cold and hot temperatures impact the effectiveness of the personnel onboard cutters.

- ***Visibility*** impacts Great Lakes Coast Guard cutters. Commanding Officer's Standing Orders direct the cutter's response to reduced visibility; most Standing Orders take precautions when visibility is reduced to between 2-4 nautical miles.

- ***Wind*** and waves may be the elements of weather that most affect Coast Guard cutter operations. Each class of Coast Guard cutter reacts differently to different wind speeds. Likewise, each Coast Guard operation is affected differently by varying wind speeds.

- ***Seas (waves)*** - The Great Lakes do not experience tides. However, wind driven tides (referred to as "seiching") on the Great Lakes can have an effect on all mariners. As the wind blows, water is pushed from one end of the lake to the other leaving behind low water levels that can prevent Coast Guard cutters from transiting the shallow areas. Additionally, wave periods on the Great Lakes are typically short, can come from various directions and build rapidly. Waves affect port operations differently depending on where a cutter is moored. As with wind, waves of differing heights will affect each cutter and operation differently.

Follow-up Discussion:

In response to Mr. Jonas' question of what additional requirements need to be addressed, Mr. Boselly commented that pavement temperatures and temperature trends drive everything in snow and ice control. In addition, weather and pavement conditions should be considered as an entity

in totality and not just as weather information. Mr. Richard Nelson, Nevada Department of Transportation, reiterated the importance of pavement temperature and that wholesale acceptance of inferred pavement temperature based on an air temperature measurement is likely invalid scientifically. He also pointed out that the temperature trend was critical in the decision process.

On the topic of road conditions, Paul Try asked whether there was a standard vernacular for information exchange, particularly as it applies to the non-meteorologists, e.g., state troopers describing the weather. Trooper Reinacher responded there was no standard phraseology or order language to a central control or dispatch who in-turn shares that information with other safety organizations, such as AAA.

Although the FHWA and some state DOTs, such as Iowa and Wisconsin, are looking into measurements of friction and braking action, the equipment is extremely expensive and, therefore, not widely deployed. Iowa DOT is also deploying less expensive sensors that are calibrated against a standard (expensive equipment) as a means to obtain friction and braking action measurements. In addition to the cost of deploying this equipment, there are also institutional and legal considerations that need to be addressed. Due to the liability issues, these data are not often redistributed or made available to the general consumer. Iowa DOT is examining the use of a disclaimer to address the liability issue. Mr. Kevin Crow, Union Pacific Railroad, agreed with Iowa DOT's concerns regarding data liability. His industry takes rail sensor information (called "hotbox detectors") and uses it internally but feels the need for liability protection.

Discussions also focused on the following statements:

- the weather community needs to be more accurate, particularly with event lead times, start times, and duration.

- the audience and panel members were reminded to NOT forget the waterways, particularly, the ferry systems. Ferry traffic in Washington State carry more passengers than AMTRAK.

- one caution to the group was "…sophistication without regard to practicality serves no useful purpose. How sophisticated do we need to be in order to satisfy the WIST requirement?"

- examining maintenance and supply costs can substantiate the perceived cost of creating a surface transportation weather information support structure; these costs routinely outweigh the cost of purchasing weather support by a 10 to 1 margin.

Links to Presentations:

Mr. David Whatley, DOT/FAA
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/2_FAA_Whatley.ppt

Mr. Paul Pisano, DOT/FHWA
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/5_highwayPisano.ppt

Mr. Arthur Handman, GHTA (representing DOT/FTA)
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/3_transitHandman.ppt

Mr. William Broder, AAR (representing DOT/FRA)
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/4_transitBrowder.ppt

Trooper Scott Reinacher, NCST
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/6_state_trooper.ppt

Mr. Christopher Moren, (addressing DOT/USCG)
www.ofcm.gov/WistII/Presentations/Day1/5_Panel1/7_CoGuard-Waterway.ppt