3A.2 MOBILE TECHNOLOGY AS A GLOBAL DECISION SUPPORT TOOL

Jim Foerster *
Telvent, Minneapolis, Minnesota

1. INTRODUCTION

As more and more of today's workers who grew up in the "technology age" continue to enter the workforce, the public's definition of technology continues to evolve. Increasingly, the definition of technology is not confined to computers or the Internet. In this ever-evolving world, technology is something that must adapt to the needs of the user, not something that requires them to change.

By definition, a Decision Support System (DSS) is a computer-based information system that supports business or organizational decision-making activities. Typically, DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance. While not exclusive to "weather decisions", in organizations where weather safety and cost savings are critical, a well-crafted DSS can provide other critical information to the end user.

A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, rules-of-practice or business models to identify and solve problems and make decisions. Of course, this is nothing new. In fact, for reference at the 2011 AMS Annual Meeting, there were over a dozen papers referencing "DSS" in some context.

Organizations are already experiencing the benefits of a mobile workforce, but what lies ahead? As enterprises expand their global operations, the next generation of DSS products and services must be able to support an expanded mobile workforce, while combining mobile technology advances with advances in science.

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* *Corresponding author address:* Jim Foerster, Telvent, 11400 Rupp Dr., Burnsville, MN 55337; e-mail: jim.foerster@telventdtn.com

2. EVOLUTION OF EXPECTATIONS

Back in 1980, a small company called Kavouras produced the first remote radar weather display and introduced what was previously only available at a NWS office or university synoptic-lab to the public. In the 30+ years since that date, there has been a significant change in the expectation of a typical user of private-sector weather information. We entered the next phase of customer expectation in the mid 90's when the Internet was "commercialized" and allowed to carry commercial traffic, replacing satellite as the primary data delivery mechanism. Companies like DTN, one of the most successful companies during this time at transmitting information via satellite, began to realize the value of weather information and acquired Kavouras in 1998. Now, the weather business was poised to change significantly as sophisticated graphic weather systems were developed in both a hosted as well as a SaaS environment. No longer was it suitable to just provide a "weather display" – customers in the key markets served by DTN and other weather providers were now looking for "value added" services. Examples of these types of value added services included "rain-snow masks", custom warning services and the ability to project the weather on their assets.

As our appetite for technology has continued to advance and in fact embraced by today's workforce, we have now entered into the present phase of customer expectation, which is rooted in the essence of a true decision support system. In effect, over a 30 year period, the evolution of expectations has evolved from:

- "Thanks for the weather display – *it looks just like TV"*
- "I like your weather display, but can you *help me understand* what I am looking at with some new tools?"
- "I am not a meteorologist, I am busier that I have ever been and I have a cool new phone that's supposed to make me smarter – *please tell me what I should do*"

Another 10 years passed, when in 2008 Telvent acquired DTN, largely due to the business model of providing high-quality value added meteorological services to business, and the evolution of expectations has brought us to where we are today.

3. WEATHER SERVICES VALUE CHAIN

It is a basic expectation of our customers today that we are doing more than passing along freely-available weather information. At Telvent, we refer to the Value Chain to present a clear picture of where the value is being added along the way to delivery. Simply put, there are 4 steps in the Value Chain:

- **Observation Networks** – gathering of information related to weather, water, roads, air quality, etc.
- **Data Fusion** – data assimilation, quality assurance, delivery and support.
- **Value Added Services** – forecasting, visualization, alerting, integration, and consultation.
- **Decision Support Tools** – Various solutions in Energy, Aviation, Transportation, Agriculture, Recreation and Hydrology.

The end result of the Value Chain is a series of tools tailored to the weather challenges specific to that given industry. While there is often an accompanying visual component to the solution provided to customers in 2012, the true value comes in these decision support tools layered on top of the value-added services typically provided by the private sector.

4. GLOBAL BUSINESS REQUIREMENTS

It is no longer an option at Telvent to design support tools, software or applications that do not function on a global basis. Global companies like Schneider Electric, the parent company of Telvent, have over 135,000 employees in 25 countries and all require the same solution. Likewise, software and customized solutions must also be designed to operate on mobile devices, and in many cases, must integrate the capabilities that these mobile devices have to further enhance the value of the provided service Over the past decade, wireless networks, devices, and applications were developed to support the most basic enterprise applications, such as voice, email, ordering, and tracking. First came the explosion of Smart Phones, with over 30 million new users in the past 12 months, and anyone who was around this past holiday season noticed the exact same trend with tablets, basically just bigger versions of their smart-phone cousins. New Decision Support tools must be designed to both operate seamlessly on these devices, as well as incorporating location-based capabilities to provide an additional suite of solutions. Applications and solutions in native languages are also critical as DSS goes global, and whenever possible, simple green-yellow-red scheme (Figure 1) must be utilized to provide clear actionable decisions.

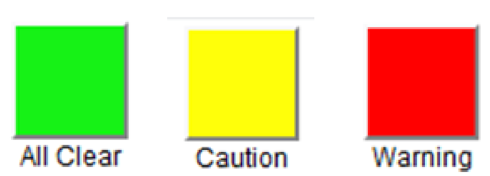


Figure 1: *Example of simple Green-Yellow-Red color scheme that provides the user a clear and actionable decision tool*

5. DSS COMPONENTS

Simply put, an effective DSS can be broken down into the following components:

1. The database or knowledge base
2. The model that the DSS is based on (i.e., the decision context and user criteria)
3. The user interface

With the focus in this paper on the use "Mobile Technology as a Global Decision Support Tool", the User Interface (UI) becomes much more important. By the very nature, this class of user is now mobile and likely away from the traditional support structure an internal user is accustomed to, therefore ease-of-use and clear understanding of the UI is critical. A good example of where we typically fail in this area is in the rental car process. With the focus now on getting in and out of the airport as fast as you can, a typical customer can now just walk up to any car, get in and drive away. It's only when we get to the window to pay, or need the wipers or lights, that we realize we have no idea how the car's "decision support system" is designed and wind up wasting more time that we are saving, as well as potentially making the wrong decision. As a result, the Decision Support Tools that are built around complex meteorological events must provide clear guidance and minimal setup in order to ensure the appropriate end-user decision.

6. DSS EXAMPLES

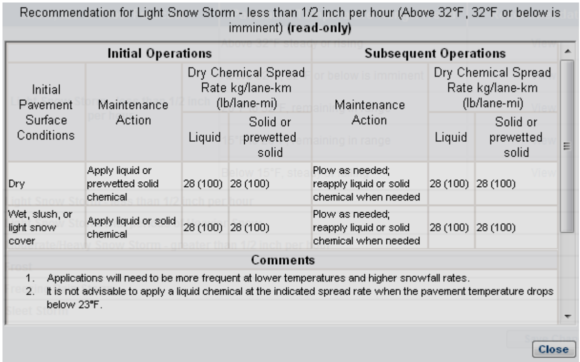
There are several examples of effective and valuable decision support systems in place in the Telvent product portfolio. While these tools are pre-configured for ease-of-use, they all contain admin-controlled user interfaces that allow further customization.

With over 30 State DOT and 1000+ cities and counties as customers, Telvent has had the opportunity to work with industry professionals as well as an internal team of transportation professionals to develop a sophisticated pavement treatment-recommendation DSS that is offered in both online and mobile solutions. These forecasts allow users to make decisions with forecasts down to the road surface and also allow utilization of RWIS observations as input if available. As can be seen in Figure 2, in addition to the standard hourly weather parameters one would expect a State or County DOT to utilize, there are also "truck icons" across the bottom of the forecast screen. These truck images exist for a reason, and draw the users attention to the fact that there is some action needed to be taken. Color-coding of trucks is also utilized, with a red truck indicating immediate action is needed.

Hour (Mountain Standard Time)	Tue 2PM	Tue 3PM	Tue 4PM	Tue 5PM	Tue 6PM	Tue 7PM
Weather Condition						
Weather	Flurries Possible	Snow Possible	Snow Possible	Snow Possible	Snow Possible	Snow Possible
Temperature (°F)	20	21	21	18	17	16
Feels Like (°F)	12	14	14	10	9	8
Wind Direction	N	N	N	NNE	NNE	NE
Wind Speed/Gusts (mph)	6	5	5	6	5	5
Dew Point (°F)	14	14	14	14	14	13
Humidity (%)	77	74	74	84	88	88
Precipitation Chance (%)	20	26	34	33	40	40
Precipitation Type	NRM Snow	NRM Snow	NRM Snow	NRM Snow	NRM Snow	DRY Snow
Precip Amount (Rain:in., Snow:in.)	S: <1/4 L: 0.01			S: <1/4 L: 0.01		
24 Hr Snow/Ice Accum (in.)(11AM-11AM)	1.10	1.20	1.30	1.40	1.50	1.60
Blowing Snow Potential	Medium	Medium	Medium	Medium	Medium	Medium
Bridge Temp (°F)	28	27	25	23	21	20
Road Temp (°F)	34	33	31	29	27	24
Bridge Frost Likely?	No	No	No	No	No	No
Road Frost Likely?	No	No	No	No	No	No
Treatment Recommendation						

Figure 2: *Hourly forecast showing truck icons across the bottom indicating to the user that treatment is either required, or must be changed due to evolving weather conditions*

The result of clicking on these truck images is a detailed recommendation of both initial and subsequent operations (Figure 3), with details down to the actual maintenance action and amount of chemical to be applied for that particular meteorological event and accompanying current/forecast conditions.



Recommendation for Light Snow Storm - less than 1/2 inch per hour (Above 32°F, 32°F or below is imminent) **(read-only)**

Initial Operations				Subsequent Operations		
Initial Pavement Surface Conditions	Maintenance Action	Dry Chemical Spread Rate kg/lane-km (lb/lane-mi)		Maintenance Action	Dry Chemical Spread Rate kg/lane-km (lb/lane-mi)	
		Liquid	Solid or prewetted solid		Liquid	Solid or prewetted solid
Dry	Apply liquid or prewetted solid chemical	28 (100)	28 (100)	Plow as needed; reapply liquid or solid chemical when needed	28 (100)	28 (100)
Wet, slush, or light snow cover	Apply liquid or solid chemical	28 (100)	28 (100)	Plow as needed; reapply liquid or solid chemical when needed	28 (100)	28 (100)

Comments

1. Applications will need to be more frequent at lower temperatures and higher snowfall rates.
2. It is not advisable to apply a liquid chemical at the indicated spread rate when the pavement temperature drops below 23°F.

Close

Figure 3: *Example of treatment recommendations for a light snow situation and temperatures above 32 but falling*

Part of the same suite of solutions, the Blowing Snow Potential graphic (Figure 4) provides the Maintenance Worker a clear picture of when blowing and drifting snow will become a hazard, allowing for proper decisions to be made regarding staffing potential proactive road-closures.

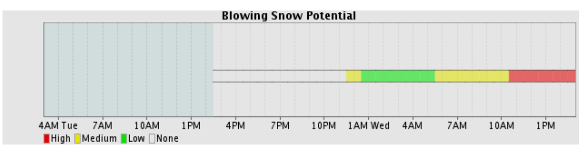


Figure 4: *Hourly blowing snow potential graphic driven by combination of snow character and forecast surface winds*

Together, this suite of Decision Support System products provides the Transportation customer the necessary information to effectively plan and staff for an event as well as ensuring the most cost-effective pre-treatments and treatments are utilized. All elements of an effective DSS are represented, and the result is a powerful addition to the standard display of weather information typically available to this audience.

6. NEW TECHNOLOGIES BRING NEW SOLUTIONS

As new technologies and wireless solutions come on board the sophistication of the DSS tools presented must continue to evolve. New capabilities of Smart Phones have already allowed an extension of standard alerting as the concept of "roaming alerting" has been introduced, allowing alerts to now follow users anywhere ensuring same level of protection is always provided to workers. In addition to alerts being driven by mobile devices, advances in technology now allows these devices to display (and alert on) custom user-assets such as wind farm boundaries, dense road networks or transmission lines, providing clear and actionable DSS to the end users. These trends will need to continue as we move beyond Wi-Fi or cellular connectivity to the always-wired world.