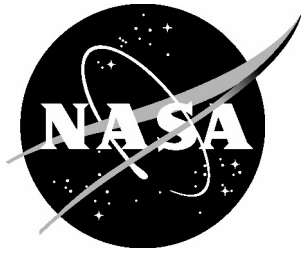NASA/CR-2005-212993

Advanced Weather Awareness and Reporting Enhancements

Corinne Clinton Ruokangas and Wallace E. Kelly III
Rockwell Scientific, Thousand Oaks, California

March 2005

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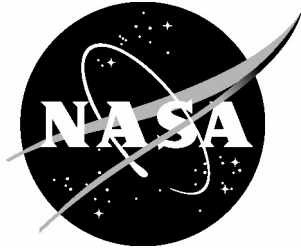
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National Aeronautics and
Space Administration

Langley Research Center
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1   Summary of Technical Accomplishments

We are completing the final year of a four-year project with NASA, who initiated a large multi-year safety program to develop technologies that will eventually reduce aviation accidents and fatalities attributable to weather. AWARE (Aviation Weather Awareness and Reporting Enhancements) is a NASA Cooperative Research and Development program conducted jointly by Rockwell Scientific, Rockwell Collins, and NASA.

AWARE is an enhanced weather briefing and reporting tool designed to integrate graphical and text-based aviation weather data to provide clear situational awareness <u>in the context of a specific pilot, flight and equipment profile</u>. We initially implemented AWARE as a web-based preflight planning tool, specifically for general aviation pilots, who do not have access to support such as the dispatchers available for commercial airlines. Initial usability tests showed that for VFR (Visual Flight Rules) pilots, AWARE provided faster and more effective weather evaluation. In a subsequent formal usability test for IFR (Instrument Flight Rules) pilots, all users finished the AWARE tests faster than the parallel DUAT tests, and all subjects graded AWARE higher for effectiveness, efficiency, and usability. The decision analysis basis of AWARE differentiates it from other aviation safety programs, providing analysis of context-sensitive data in a personalized graphical format to aid pilots/dispatchers in their complex flight requirements.

The fourth year of the AWARE program began October 2001. The primary goal of AWARE for this year was changed from supporting in-cockpit tests to development of a prototype tool for dispatchers or weather briefers who must monitor the weather situation for multiple flights. The in-cockpit integration being performed on the AHAS project motivated this shift in focus. The new milestones for year four (FY'02) include the following:

> Milestone 14: AOC/FSS (Weather Briefer) Architecture Design
> Milestone 15: Weather Briefing Summary Display
> Milestone 16: Weather Briefer Integration
> Milestone 17: Integrated Demonstration

In this last year, we have extended AWARE for use by dispatchers tracking multiple flights. This final effort, AWARE Dispatcher, is documented in this document, with both implementation details and user-evaluation of AWARE by dispatchers in tracking multiple flights and receiving automated hazard alerts for weather. We also maintained and upgraded the previously released web-based demonstration for GA and AT pilots. The primary goal this year was to produce a prototype system that could support commercial airline dispatchers in the planning and monitoring of multiple parallel flights. The initial years focused on development of a web-based pre-flight weather briefing tool for VFR and IFR pilots, initially for general aviation and last year for commercial transport.

New accomplishments for the year include
- Upgrades to the web-based system for robustness, speed, and usability

- Knowledge acquisition to determine weather briefers' goals for hazard reporting for multiple flights
- Design of an architecture to support weather briefer personnel for multiple flights
- Initial prototype of AWARE Dispatcher including user interface and an underlying multiple-client session-manager.
- Implementation of AWARE Dispatcher, incorporating groundstation, data collector, and a new client to support dispatchers, including the setup for multiple flights.
- Evaluation of AWARE Dispatcher by commercial dispatchers representing United Airlines, American Airlines, and Universal Weather.

1.1 Conclusions for FY2002

The objective of this year's study was to determine the relevance of an AWARE-like display and analysis system for commercial dispatchers, who track as well as plan multiple flights. Previous studies have shown the effectiveness of both AWARE as a pre-flight briefing system for GA pilots and of AHAS for in-cockpit use by pilots.

Flight dispatchers have different requirements than either pre-flight planning GA pilots or Commercial Pilots in-cockpit:
- Dispatchers are responsible for 5-50 flights per day, and usually work the same region of the country each day
- They may monitor 6-30 on-going flights at once, and
- They consider it a challenge to determine and communicate all possible weather hazard alerts, preferring an automated system to support them.

We addressed these requirements, and then tested the system with commercial dispatchers. The goals included determining our completeness in demonstrating that we had addressed the defined limits of AWARE for dispatchers, provided here in order of importance:
- ✓ The display and hazard evaluation must support more than a single flight.
- ✓ Weather data sources within AWARE would ideally be augmented by more elevation based values (ex: winds aloft), and lightning (also NEXRAD echo tops and static satellite infrared cloud cover display, and text-indicators of NOTAMs.)
- ✓ The display area should be reorganized to present primarily the region of the dispatcher, with zoom in and zoom out ability; navigation controls could be available from menus or popups, and text displays could be presented in (dismissable) dialog overlays.
- ✓ The dispatcher should be able to set preferences for his requirements, rather than for each pilot.
- ✓ Coloration within AWARE should more strictly adhere to the VFR/IFR/LIFR standard colors.
- AWARE could provide notification of significant wind changes versus forecast values.
- Ideally, the speed of storms (NEXRAD/EchoTop) should be available via graphics.

The strength of our system, the underlying decision analysis, allows us to tailor alerts to specific situations, to allow the user to have overall control over both the alerts reported, and the level at which the alerts should be shown. We are using a "universal" model, representing all possible alerts, and then pruning it during execution based on mode switches, for accessing appropriate parameters and execution of appropriate subsets of the model.

1.2 Tasks: Milestone and Reporting Tasks

While this report details the activities and accomplishments in the six technical areas that are defined in the original AWARE proposal, the actual tasks completed and the corresponding reporting task areas are as follows:

Milestone 14:
> Implementation of usability-study based enhancements (1, 2 and 3 below)
> Knowledge Acquisition from Weather Briefers (5 below)
> Design of Weather Briefer software, communications, and system architecture (6 below)
> Design of Weather Briefer User Interface (UI) (5 below)
> Design of Weather Briefer Decision Support (DS) (4 below)

Milestone 15:
> Improve weather data collection mechanisms (1, 2 below)
> Data flow implementation and testing (1, 2 and 3 below)
> Prototype Weather Briefer UI (5 below)
> Implement Weather Briefer Decision Support (4 below)
> Overall architecture prototype (5 and 6 below)

Milestone 16:
> AWARE Dispatcher System Integration (6 below)
> Usability Studies of AWARE Dispatcher (5 below)
> Lab test of complete system (6 below)

Milestone 17:
> Implement enhancements from Usability Study (5 below)

2 Background Projects

This section provides background on the earlier parts of the AWARE project as it has developed for varying needs over the life of the project. It discusses the existing web-based pre-flight briefing architecture and the in-cockpit architecture, as well as the architecture that supports dispatchers in using AWARE.

2.1   AWARE – Web-Based Pre-Flight Presentation of Weather

AWARE consists of a context sensitive presentation of graphical and textual displays, augmented by decision-analysis based hazard analysis for each leg of the flight. It is tailored to the specific pilot's preferences for visibility, ceiling, proximity to thunderstorms and other parameters, as well as the aircraft type, and the specific flight plan including a corridor around the path. Since the presentation is context-sensitive, it is limited to the areas of interest to the pilot, and the hazard analysis is specific to the pilot's preferences.   The AWARE system is comprised of

- Acquisition and interpretation of text-based weather data, both from the Internet and from satellites.
- Acquisition and interpretation of graphical weather data, presently primarily for radar-based data.
- A temporal-spatial database to support queries specific to flight times and locations
- Bayesian network-based decision support for analysis of weather hazards.
- A user-centered display of weather hazards.

AWARE was initially built as a web-based system, in support of GA pilots. Instead of dealing with inordinate amounts of always cryptic and sometimes irrelevant data, the GA pilot can use AWARE to specify his preferences for flight parameters (visibility, ceiling…) and can view a graphical evaluation as shown below in Figure 1 including an analysis of hazards specific to his preferences and aircraft along the expected flight.
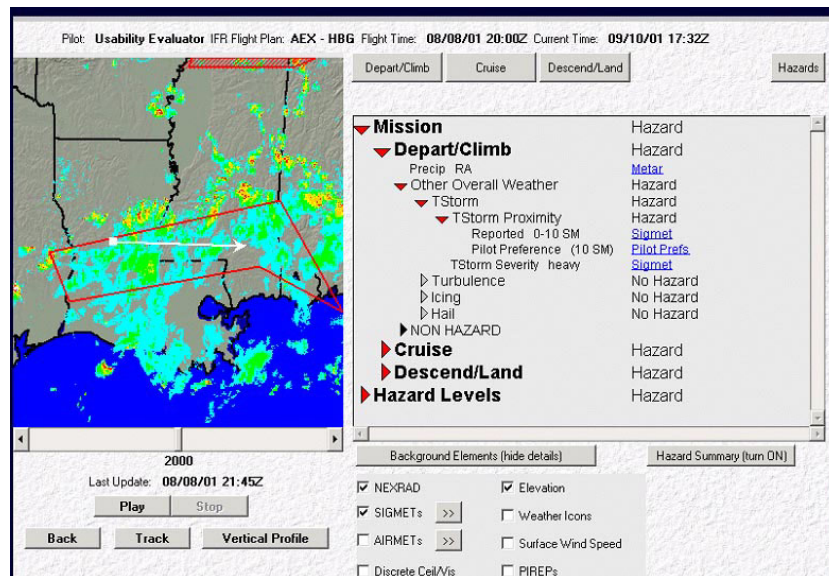

Figure 1: AWARE graphical and hazard analysis display

2.2   AHAS - In-cockpit version of AWARE

As the AWARE project progressed, the parallel project AHAS for displaying both tactical and strategic data in the cockpit was implemented. AWARE technology was incorporated into the cockpit, to provide strategic analysis to pilots during flight. AHAS

not only presents graphical weather information to the pilot, from both on-board sensors and datalinks, but also can automatically evaluate hazards in the weather data stream and alert the pilot to them. A screenshot from a demonstration to NASA is shown in **Figure 2**. The primary display, similar to AWARE, displays Nexrad, metar-based and Sigmet data, with mouse-overs for details. The real-time flight path, updated with the position of the aircraft, is indicated. Hazards are indicated as alerts along the right side of the screen, with textual details available at the bottom.
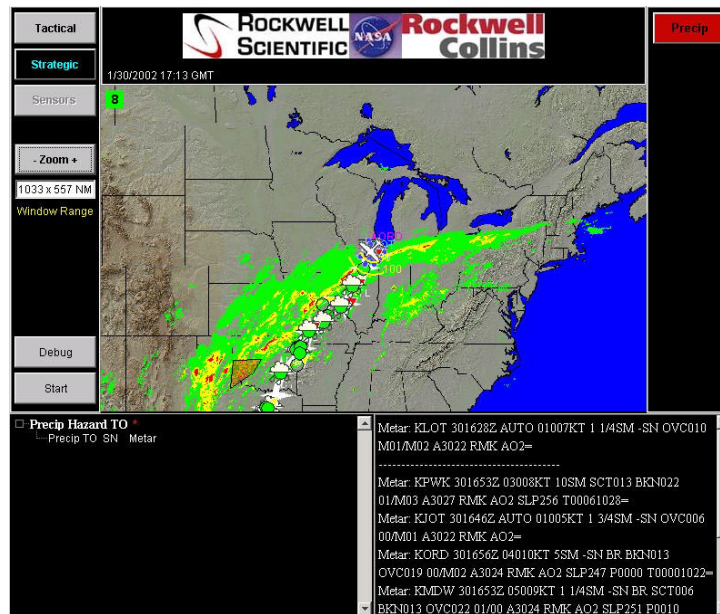
Figure 2: AWARE in-cockpit, a strategic evaluation of data during flight

3   Task 1. Interpretation of Text-Based Data

In the usability tests performed at the completion of FY'01, we identified several problematic areas for weather data acquisition. Where speed issues are primary, we have determined that database access is the primary bottleneck; for our work solving this problem, please see Task 3 below. In addition, several parsing issues were addressed.

Metar data was on occasion received with inaccurate dates from the generators; the dates are now more completely parsed and validated. Sigmets are often reported with updates; at this time we have designed a technique for limiting the display of replicating data items. Our Pirep parsing has been improved to accurately represent icing data. Winds Aloft data was being parsed for incorrect valid-to times; that has been corrected. Winds Aloft data is now being parsed more completely, handling comments in the input stream, such as those identifying the data as incomplete or questionable.

In addition, the acquisition of Metar data is now accomplished in multiple steps (per CONUS state, rather than groups of states) providing a higher degree of dependability and speed.

4 Task 2. Interpretation of Graphical Weather Data

4.1 NEXRAD Storm Kinetics

The AWARE preprocessing system extracts storm information from NEXRAD data as it comes into the system. The extracted storm characteristics are then stored in the temporal spatial database as polygons. Additionally, we have developed tools to correlate NEXRAD Attribute Data for storms with the polygons in the database, which essentially allows us to determine the height of a particular storm cell. These tools are currently being used for the EWxR program, and we expect to incorporate them into AWARE in the future.

4.2 Additional data sources

We have evaluated additional data sources, including Icing, Turbulence, Cloud Cover, and Lightning. All except for Lightning are still feasible, and we plan to include additional overlays for the Dispatchers from this set of data. Lightning was priced at nearly $2K per month. This is considered to be a price relevant for a commercial package, but not at this time for AWARE Dispatcher.

We have evaluated ADDS icing and turbulence GRIB files, but were limited in our success by the variations in GRIB file formats. We are instead continuing to concentrate our efforts on NCWF data.

5 Task 3. Databases for Storing and Retrieving Aviation Weather Information

Based on the speed/robustness issues determined during usability tests, we have modified the contents and methods of database access. Initially, out-of-date data was kept in the active database; three years of data, excluding the demonstration dates, was archived, and the tables were downsized. New tables and spatial indexes were implemented. With these two steps the access time for Metars alone was decreased by nearly a factor of four. We are still evaluating additional query formatting for increasing the speed of Airmet and Winds Aloft queries.

The speed improvements based on decreasing the database size alone are included in Figure 3. The usability tests for FY'01 for specific flights were repeated, and were timed both prior to and after database modifications.

6

Flights	Timing Improvement Factor
AEX-HBG	3.5
BTR-NEW	2.9
TUP-BNA	1.9
MIA-JAX	2.4
JAX-NEW	3.8

Figure 3: Speed Improvement based on database modifications

The proportion of time spent in specific weather type queries currently is shown in Figure 4, where for each flight, the timing per query is identified both by weather type and by phase of flight. As indicated, the most significant portion of time is spent in querying the database for Winds Aloft and Airmet data.

	aex-hbg			btr-new			tup-bna		
	takeoff	cruise	land	takeoff	cruise	land	takeoff	cruise	land
Metar	-	-	-	1	-	-	1	-	-
Taf	-	-	-	-	-	-	1	1	1
sigmet	-	2	-	2	3	-	1	2	1
airmet	7	12	1-	9	10	6	12	21	16
pirep	-	-	-	-	-	-	-	5	-
winds aloft	18	16	17	14	15	11	10	12	11

Figure 4: Current timing per weather data type & phase for 3 flights

Subsequent modifications to other database tables led to speed improvements varying from a factor of 6 to a factor of 190 (Pireps).

This indicates that it would be beneficial to limit the data stored in the "permanent" database tables to that referenced only by known flight tests. The updated architecture of the groundstation has taken this into account.

6   Task 4. Decision Support Systems for Interpretation of Weather Hazards

We updated the AWARE Decision Analysis model and system to include Sigmets and Metars in the determination of thunderstorm proximity and severity. In addition, each hazard node of the decision tree now includes a "short name" appropriate for displaying on the multiple alert buttons displayed in the Dispatcher format. We also corrected the algorithm for Winds Aloft to be based on headwinds rather than general winds.
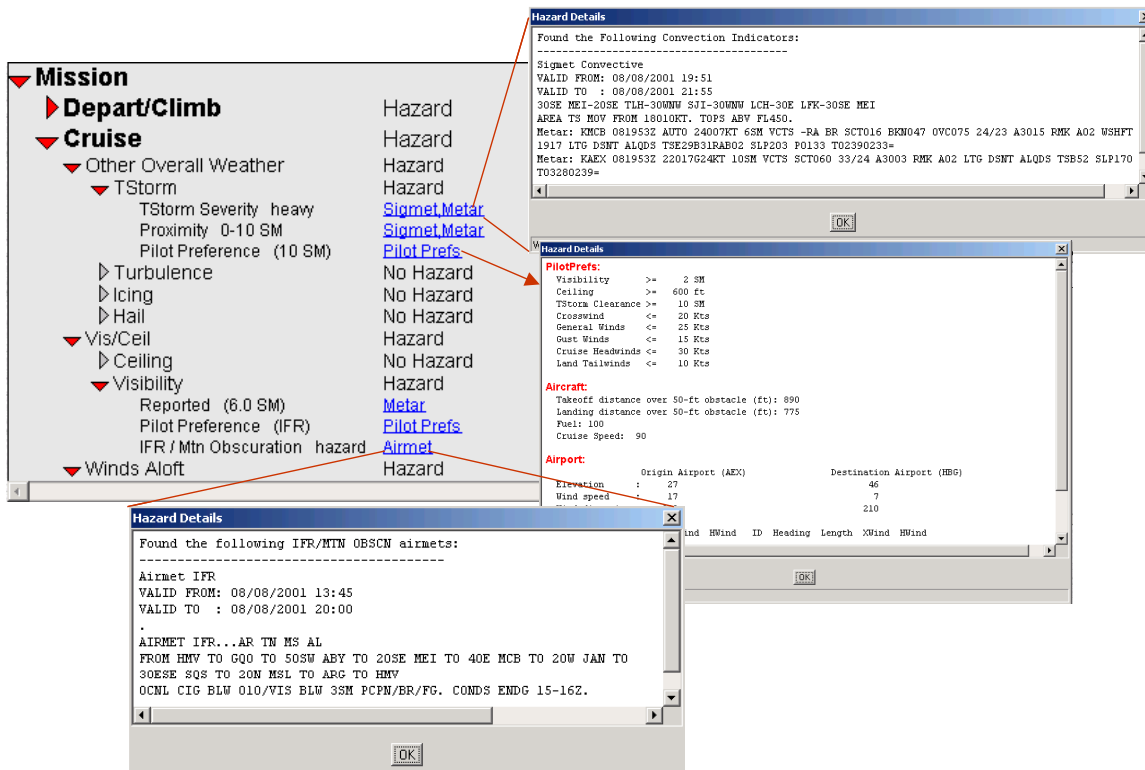
▼ **Mission**	
▶ **Depart/Climb**	Hazard
▼ **Cruise**	Hazard
▼ Other Overall Weather	Hazard
▼ TStorm	Hazard
TStorm Severity heavy	Sigmet,Metar
Proximity 0-10 SM	Sigmet,Metar
Pilot Preference (10 SM)	Pilot Prefs
▷ Turbulence	No Hazard
▷ Icing	No Hazard
▷ Hail	No Hazard
▼ Vis/Ceil	Hazard
▷ Ceiling	No Hazard
▼ Visibility	Hazard
Reported (6.0 SM)	Metar
Pilot Preference (IFR)	Pilot Prefs
IFR / Mtn Obscuration hazard	Airmet
▼ Winds Aloft	Hazard

Hazard Details

Found the Following Convection Indicators:

Sigmet Convective
VALID FROM: 08/08/2001 19:51
VALID TO : 08/08/2001 21:55
30SE MEI-20SE TLH-30WNW SJI-30WNW LCH-30E LFK-30SE MEI
AREA TS MOV FROM 18010KT. TOPS ABV FL450.
Metar: KMCB 081953Z AUTO 24007KT 6SM VCTS -RA BR SCT016 BKN047 OVC075 24/23 A3015 RMK A02 WSHFT
1917 LTG DSNT ALQDS TSE29B31RAB02 SLP203 P0133 T02390233=
Metar: KAEX 081953Z 22017G24KT 10SM VCTS SCT060 33/24 A3003 RMK A02 LTG DSNT ALQDS TSB52 SLP170
T03280239=

OK

Hazard Details

PilotPrefs:
    Visibility   >=   2 SM
    Ceiling   >=   600 ft
    TStorm Clearance >=   10 SM
    Crosswind   <=   20 Kts
    General Winds   <=   25 Kts
    Gust Winds   <=   15 Kts
    Cruise Headwinds <=   30 Kts
    Land Tailwinds   <=   10 Kts

Aircraft:
    Takeoff distance over 50-ft obstacle (ft): 890
    Landing distance over 50-ft obstacle (ft): 775
    Fuel: 100
    Cruise Speed: 90

Airport:
                     Origin Airport (AEX)   Destination Airport (HBG)
    Elevation   :   27   46
    Wind speed   :   17   7
                                                           210

ind HWind   ID Heading Length XWind HWind

OK

Hazard Details

Found the following IFR/MTN OBSCN airmets:

Airmet IFR
VALID FROM: 08/08/2001 13:45
VALID TO : 08/08/2001 20:00
.
AIRMET IFR...AR TN MS AL
FROM HMV TO GQO TO 50SW ABY TO 20SE MEI TO 40E MCB TO 20W JAN TO
30ESE SQS TO 20N MSL TO ARG TO HMV
OCNL CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS ENDG 15-16Z.

OK

Figure 5: The web-based AWARE Hazard Analysis window(s)

7 Task 5. User-Centered Design of Aviation Weather Hazard Displays

7.1 Initial Design and Evaluation

The first pass of knowledge acquisition was completed by presenting AWARE in its web-based format to dispatchers and flight service specialists from two separate dispatcher companies. The goals were to evaluate the utility of and determine enhancements for AWARE for dispatchers, by demonstrating AWARE to them and by observing them in the process of performing their activities. Both groups had interest in AWARE for providing "automatic" alerts, especially if AWARE were augmented with some additional decision analysis and some additional weather sources.

In summary, based on knowledge acquisition from dispatchers, the areas of primary interest are

- Automatic notification of hazards for multiple flights, per flight
- Integration with additional data sources
- Ease of interactions
- Dependability of hazard analysis

Changes were required to the data acquisition, decision analysis and graphical user interface components to demonstrate an effective system for use by dispatchers.

8

In discussing AWARE with dispatchers, it became clear that some basic requirements of dispatchers differ from those of single pilots running AWARE, whether in pre-flight or in-cockpit mode. A single dispatcher is responsible for a specific region, i.e. a portion of the Continental US, a trans-con view of the US, or an international segment. Each dispatcher is responsible for a specific set of flights in their region, from takeoff through landing; they are in charge of flight planning and monitoring, and updating the pilots with weather (and other) information determined during monitoring. Hence, for dispatchers, the client will be displaying multiple flight paths on a known region. The dispatchers need to be alerted to any weather hazards within their region, and the flights that are affected by those hazards must be identified. Alerts affecting multiple aircraft within a session are displayed once as a "common" alert, with indications of all flights involved.

Based on the knowledge acquisition, both an architecture and a user interface were designed, including modifications that may be appropriate for the decision analysis.

The initial prototype for data presentation is shown in Figure 6. Dispatchers must be able to view multiple flights, with the associated hazards. Flights must include color and activity attributes, and the dispatcher must be able to zoom in on flights by choice.
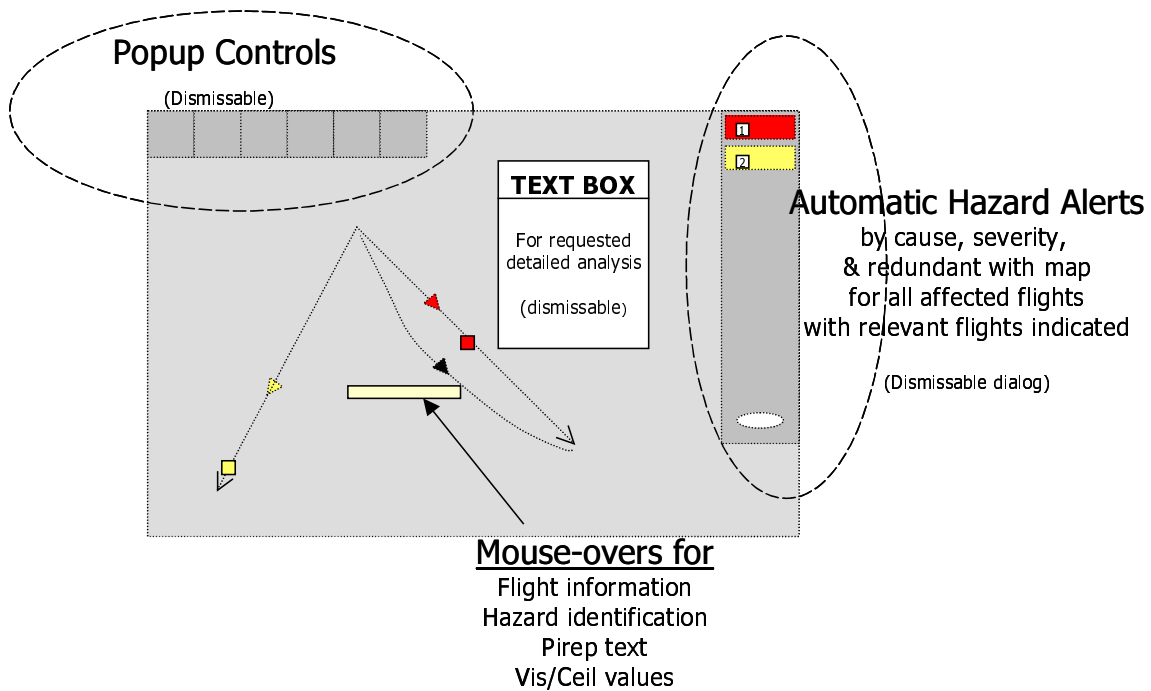

Figure 6: Prototype design for hazard display for dispatchers

7.2 Implementation

AWARE Dispatcher was built as an extension around the real-time architecture of the in-cockpit system, augmenting it to support multiple flights for a dispatcher. The display is more similar to the in-cockpit than to the original web-based design, due to the requirements of the dispatchers (larger graphical display area, working in a dark area, real-time data requirements). Decision analysis is instantiated for each active flight of a dispatcher.

As shown in Figure 7, AWARE Dispatcher supports an entire region of flights; flights can be colored by the choice of the dispatcher, and the dispatcher may add/remove flights from his display. The text area is minimized, and in fact may be implemented as dismissible pop-up displays in the future. The display layout was reorganized to represent the dispatchers' interests, including a larger display of the flight routes themselves and the ability to zoom to any point on the screen. Mouse-overs were provided for detailed information that could not be displayed at all times, eliminating some of the complexity of the layout.
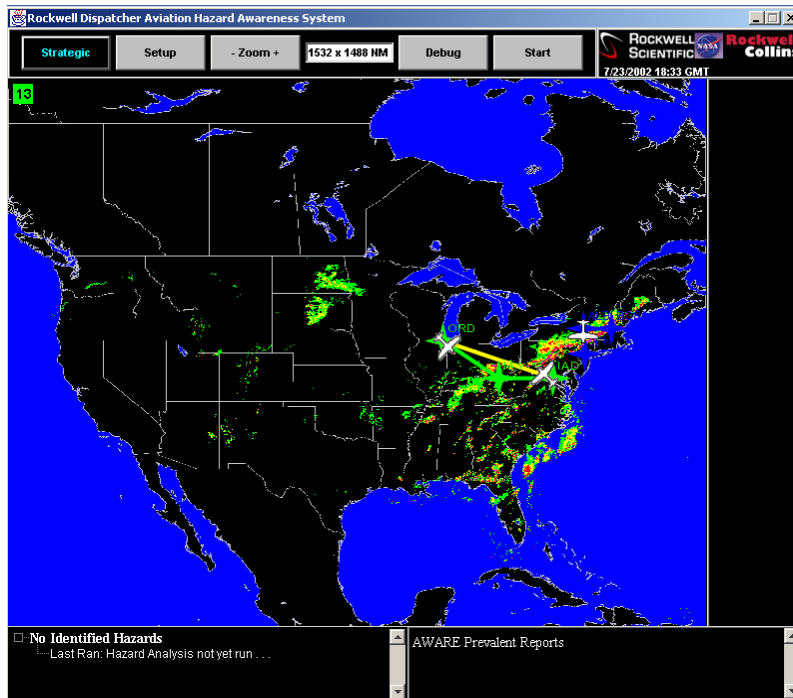
Figure 7: AWARE Dispatcher overview screen, having selected NorthEast quadrant and 3 flights; displays multiple routes, weather elements, and has room for alerts and source text.

The user may zoom in on a specific area, and mouse-over a flight to determine its identification.

Constraint control was defined per dispatcher, and includes the ability to switch between regions and select a variety of aircraft.

The user can easily turn on/off various weather elements (NEXRAD, PIREPS, METARS, Winds Aloft.

Elevation based data can be selected for a different elevation by a right-mouse-click. At this time, we present Winds Aloft for varying flight elevations; when icing and turbulence data become available, we will also present the user-defined elevation and allow changes. This allows the dispatcher to determine, real-time, the most appropriate flight level for each flight.

Decision analysis is instantiated for each flight, providing alerts per flight per phase of flight; again, mouse-overs provide identification details.

7.3 Usability Study on Implemented Prototype of AWARE Dispatcher

After implementation was completed, AWARE Dispatcher was again demonstrated to commercial transport dispatchers, with the purpose of acquiring feedback on the implementation's ability to augment their existing display system.   We presented the system to United Airlines dispatchers in May, and to American Airlines dispatchers in September. Due to firewall issues, we were unable to perform live demonstrations on-site. As in the initial user knowledge acquisition, the demos were slideshow based, and were directed by the users. Hence, this usability test was not as formal as the previous web-based AWARE usability tests.

The goals of the test were to determine our completeness in demonstrating that we had addressed the defined limits of AWARE for dispatchers, provided here in order of importance:
  ✓ The display and hazard evaluation must support more than a single flight.
  ✓ Weather data sources within AWARE would ideally be augmented by more elevation based values (ex: winds aloft), and lightning (also NEXRAD echo tops and static satellite infrared cloud cover display, and text-indicators of NOTAMs.)
  ✓ The display area should be reorganized to present primarily the region of the dispatcher, with zoom in and zoom out ability; navigation controls could be available from menus or popups, and text displays could be presented in (dismissable) dialog overlays.
  ✓ The dispatcher should be able to set preferences for his requirements, rather than for each pilot.
  ✓ Coloration within AWARE should more strictly adhere to the VFR/IFR/LIFR standard colors.
  − Ideally, the speed of storms (NEXRAD/EchoTop) should be available via graphics.

We were able to accomplish multiple-parallel flights and the associated hazard alerts, elevation based data, reorganization of the display to represent dispatchers' preferences, dispatcher-based preferences for all flights, and standardized coloration. We continue our work on NCWF for storm speed

As stated earlier, the primary strength of our system is the underlying context-sensitive decision analysis, which allows us to alert the user to hazards specific to his situation. While the visualization work was required to provide a base for the overall dispatcher system, it is acknowledged that it is not our primary goal; dispatchers' existing visualization/interaction systems have evolved over several years, and are based on considerable human factors / user interface conceptual design. While they are limited in some extents (primarily, no specific alerting functions for difficult-to-determine hazards), millions of dollars have been invested in their deployment, including user interface, projection options, focus, zoom/pan, flight display, and data sources (lightning, UAL PIREPS). It is not our goal to supplant these Dispatcher visualization systems; rather we wish to augment them with additional value by our decision analysis effort. However, our visualization display must be complete enough to demonstrate and test our underlying decision analysis-based alert system. In addition, the effort we expend to develop additional data sources and displays can be utilized in partner projects such as AHAS.

Nonetheless, our visualization provided some advantages over the existing displays. Access to winds at varying elevations is more functional/accessible than existing displays. We display PIREPS graphically, in linear as well as point mode. We provide access to data source text (although Dispatchers tend to not utilize it except in gaining confidence with the system's hazard alert output).

Dispatchers are by definition experts (with pride in their situation awareness capabilities), so alerts for nominal hazards such as thunderstorms were often considered redundant. A Dispatcher wants to be alerted to alerts he doesn't notice; by definition he notices visual StormTop / lightning / SIGMET data regarding convective hazards, which overlap our Tstorm (thunder storm) alerts.

However, they do not have good visual access to changes in winds aloft, nor crosswind calculations. Nor do they have ready access to turbulence or icing data, especially with respect to specific flights. They also do not have visual access to combinations of weather events, such as Cat II landings (vis <1/4 mile) combined with crosswinds, nor can they readily determine information about whether takeoff alternates are needed. These are all areas that have been or can be readily addressed using our decision analysis based system.

We also presented AWARE Dispatcher to American Airlines dispatchers; they considered the automatic alerting to be very valuable, especially since it could be tailored to their preferences. They had some user interface suggestions that could help clarify some displays (they prefer all land and water masses to be black, with political outlines for states and blue outline for land-water interfaces). They are in the midst of redefining their future systems, and would very much like this to be available for integration with their current planning/monitoring display technology.

7.4 Summary, User-centered Design

Our visualization efforts met the requirements defined earlier by dispatchers, including
- ✓ Multiple flight tracking, with hazard alerts as appropriate

✓ Additional weather sources, especially by elevation
✓ A display layout area and navigation designed explicitly for dispatchers
✓ Coloration to more strictly adhere to the VFR/IFR/LIFR standard colors.

Our decision analysis was modified to
✓ Incorporate dispatcher-based constraints for decision analysis.

Alerts should be based on additional data sources, single or multiple-parameter calculations, or requirements for alternate data. Our decision analysis system addresses these needs effectively.

8 Task 6. System Integration and Demonstration

8.1 Architecture

For dispatchers, the client displays multiple flight paths on a known region. The dispatchers need to be alerted to any weather hazards within their region, and the flights that are affected by those hazards must be identified. This requires AWARE to support parallel execution of multiple decision analysis models, one per active flight plan, as well as real-time updates of weather data as designed into the in-cockpit system. Each client is associated with a session; a session is defined by a region of interest and the aircraft and flight plans within that region. Alerts affecting multiple aircraft within a session are shown once as a general alert, with indications of the specific flights affected.

To accommodate a dispatcher with multiple flights using AWARE, a Dispatch-Server was created. The Dispatch-Server will more effectively handle multiple clients (each dispatcher is considered to be a client) and more aircraft than the current in-cockpit server. It includes a Session-Manager, as well as the decision analysis and local database, plus the communications to the GroundStation for acquiring relevant data. The Session-Manager will assign a session to each dispatcher; within that session, multiple aircraft will be represented. The Session Manager will be responsible for updating all relevant weather data and hazards to the dispatcher client(s).

As an overview, the client(s) will
- Handle displays to the dispatcher(s)
- Communicate the required flights/current positions/dispatcher preferences
- Ask the Dispatch-Server for relevant data and decision analysis results
- Provide a mechanism for the dispatcher to define his region / preferences.

Again, as an overview, the Dispatch-Server, will
- Include the Session Manager to differentiate clients and their requests
- Execute decision analysis for all flights
- Maintain state and data cache for all clients
- Send relevant data and decision analysis results to clients
- Interact with the Wx Data System database

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14. ABSTRACT

AWARE (Aviation Weather Awareness and Reporting Enhancements) was a NASA Cooperative Research and Development program conducted jointly by Rockwell Scientific, Rockwell Collins, and NASA. The effort culminated in an enhanced weather briefing and reporting tool prototype designed to integrate graphical and text-based aviation weather data to provide clear situational awareness in the context of a specific pilot, flight and equipment profile. The initial implementation of AWARE was as a web-based preflight planning tool, specifically for general aviation pilots, who do not have access to support such as the dispatchers available for commercial airlines. Initial usability tests showed that for VFR (Visual Flight Rules) pilots, AWARE provided faster and more effective weather evaluation. In a subsequent formal usability test for IFR (Instrument Flight Rules) pilots, all users finished the AWARE tests faster than the parallel DUAT tests, and all subjects graded AWARE higher for effectiveness, efficiency, and usability. The decision analysis basis of AWARE differentiates it from other aviation safety programs, providing analysis of context-sensitive data in a personalized graphical format to aid pilots/dispatchers in their complex flight requirements.

15. SUBJECT TERMS

Weather awareness; Pre-flight planning; DUAT; VFR/IFR; Weather hazards; Aviation weather hazard analysis; Bayesian networks; Datalink; Nexrad

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