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RESTRUCTURING PLANS FOR THE CWSUs
A Vision for Improved Weather Forecast Services

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1. INTRODUCTION

The current agreement (FAA, 1998) between the FAA and the National Weather Service (NWS) that authorizes the Center Weather Service Units (CWSUs) was initiated about 25 years ago (NTSB, 1977). The mission of the CWSUs is to serve the needs of the Air Route Traffic Control Centers (ARTCCs) for operational weather services and nowcasting (FAA Orders 7210.38A, 1990). Each Unit operates with a detachment of 4 NWS employees, working 2 shifts per day, 7 days per week, at 20 sites in the CONUS (Figure 1) and at one site in Alaska. The NWS operates and manages the program on a reimbursable basis under the terms of an Interagency Agreement (FAA, 1998) that is renewable every 3-5 years.

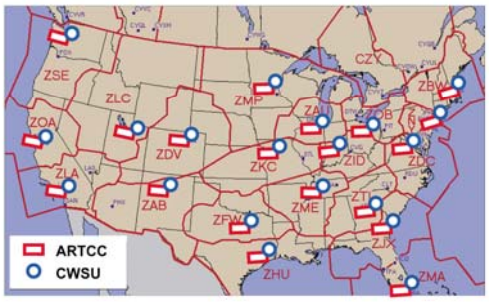

Figure 1 – The current locations of ARTCCs and CWSUs in the CONUS>

In the early 1990s the reimbursable agreement came under intense scrutiny (FAA, 1993, 1994). About the same time the WARP weather display system was being prepared for installation. These factors led the FAA to initiate a proposal to consolidate the CWSUs (ATM, 1993). The delay in fielding the WARP system was a factor in the eventual decision to maintain the *status quo.*

Subsequently, the CWSUs were reviewed by the National Research Council (NRC, 1995) soon after the FAA decision to maintain the *status quo*. Consequently, the NRC directed their recommendations towards improving NWS management. About the same time hazardous weather contributed to aircraft accidents that drew the NTSB into an examination of the functions of the CWSUs. Their recommendations have remained "open" and unsatisfied (FAA1995, 2001).

Shortly afterwards the NWS (1996) also considered restructuring the CWSU program, but decided to maintain the *status quo* and leave improvements to the initiative of the FAA.

In spite of the investment of energy and time at 4 agencies, they were unable to meet the emphatic need for improved weather information and forecasts at ARTCCs, TRACONs, ATCTs and Flight Watch offices of the AFSSs (Fig. 2). All these facilities make decisions that depend critically on weather information and forecasts. Furthermore, weather hazards are intimately tied to capacity issues.

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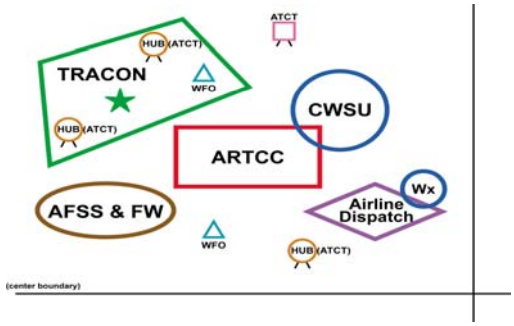

Figure 2 – A schematic identification of potential users of CWSU products and services. The Weather Service Forecast Office (WFO) is a point of coordination.

This is a status report on the FAA and NWS plans to reject the *status quo*, change the mission, and design a new concept of operations for the CWSUs. Not only will these changes meet the objections and recommendations of the NRC and the NTSB, but they are also intended to radically improve the current delivery of weather services and forecasts to FAA operational field sites.

2. FUNCTIONAL AUDIT and ASSESSMENT

By 2002 it was abundantly clear to the FAA, the NWS, the NTSB, and the aviation community that the CWSUs had dropped even further below expectations for delivery of modern aviation weather services. A series of studies were funded to assess the needs of one user of CWSU services (ARS, 1999, 2001, 2002a,b, 2003a)

These issues were addressed by site visits and a functional audit (ARS 2003a,b) and by an Assessment of Current Operations (ATT, 2003b). The objectives of those efforts were to assess current operations, the mission, the services and the value. But the assessment was also motivated by a more fundamental problem in the operation of the national airspace: *How shall weather services be utilized most effectively to maximize the benefits to traffic management while maintaining the highest standards of safety and security?*

3. MISSION NEEDS

The needs for regular and routine weather support to the ARTCCs, TRACONs, ATCTs and FSS-Flight Watch facilities were established as a result of recommendations from the NTSB (1977). This requirement is detailed by FAA Orders 7210.38a (FAA, 1990, Revised). In addition to the documentation referenced above, a Mission Needs Statement #339 (FAA, 2002) documents the need for meteorological observations and forecasts.

4. NWS PARTNERSHIP

Consideration of CWSU restructuring was initiated in late 2002, and *Guidelines for Restructuring the CWSUs* (ATT, 2003a) was distributed early in the following year. Several meetings of the NWS Vision Team were held, but no tangible results were accepted (NWS, 2003a). By the end of the year (2003), however, the NWS convened a Tiger Team who produced a report on *An Integrated Concept for Enhancing Support to the National Airspace System* (NWS, 2003b). This was a substantial turning point in FAA-NWS cooperation, replacing the traditional adversarial and contractual relationship with a commitment to partnership and cooperation on aviation weather services. This was affirmed by correspondence (ATT, 2004). In particular, the ATT Program and the NWS accepted a new mission for the current CWSUs:

> *The future mission of the CWSU program is defined by the needs of the national system of traffic flow management to meet the objectives of safety, security, and capacity in the National Airspace System (NAS). This mission requires the CWSU to be cognizant of hazardous weather information covering all phases of flight, and to support the transition from strategic decisions to tactical operations.*

Based on this mission, a concept of operations will be built around the following concepts:

- Acknowledge national traffic flow management of the NAS, and translate this perspective consistently into weather support covering all phases of flight for regions of the national airspace that are the responsibility of the center(s);
- Responsible for collecting hazardous weather information, applying it in the context of strategic planning of traffic flow management, and as time evolves, guiding the transition to short range products that are useful for tactical decisions;
- Work as an operational and technical extension of the national centers (ATCSCC and the AWC (in Alaska: the AAWU).

5. DEFICIENCIES AND USER NEEDS

The *Assessment of Current Operations* (ATT, 2003b) identified 11 deficiencies, and these were translated into user needs in a subsequent description of *Mission and Conops* (SysOps, 2004c). This report has the force of requirements for a new network of Joint Aviation Weather Sites (JAWS) for delivery of aviation weather forecast services to the FAA.

5.1 Redesign the Mission and a Conops
5.2 Operate Continuously (7x24)
5.3 Set National Standards
5.4 Redesign Weather Briefings for Air Traffic Managers
5.5 Develop Products for User Needs
5.6 Improve and Integrate Weather Displays
5.7 Improve Intramural Collaboration
5.8 Improve Extramural Products and Services
5.9 Commitment to Training
5.10 Conduct Project Management
5.11 Maintain Financial Control

The success of any plan to restructure the CWSUs depends on the commitment of the FAA and the NWS to implement these user requirements. To meet these objectives within current resources it will be necessary to consolidate. The proposed national configuration is shown in Fig 3.

Figure 3 – Proposed national configuration for the JAWS areas of responsibility.

6. INTERACTIVE WEATHER BRIEFING

A critical element of the JAWS CONOPS is a capability to perform remote briefings through teleconferencing. This capability, coupled with the briefing itself and a recommitment to the concept of using weather information to forecast capacity, is the basis for an Interactive Weather Briefing (IWB), Figure 4.

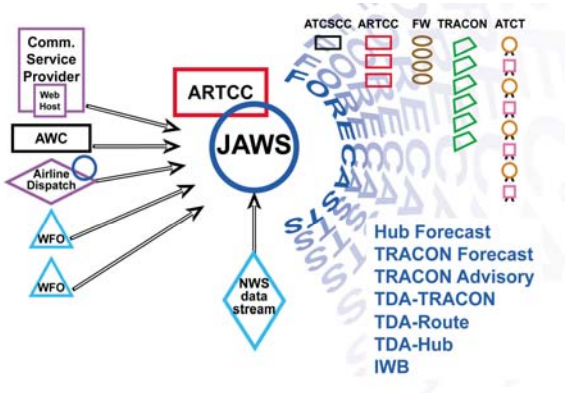

Figure 4 – A schematic vision for the JAWS at the central point of distribution for aviation weather products (lower right) to FAA users (upper right). Inputs are received for en route products (AWC), and for hourly Hub Forecast and a Tactical Decision Aid (TDA) from a commercial service provider.

With a new mission and a substantial increase in users (Table 1), the JAWS must also integrate their forecast into the national context, as well as be consistent with local, terminal forecasts. Thus, the JAWS must maintain a close connection with the other elements of the NWS; eg, the AWC, the Severe Storms Center (SSC), and WFOs.

An estimate has been made of the workload to meet the mission requirements and produce the required products (SysOps, 2004a, 2004b): For full service, 7x24, including operational TRACON forecasting, met watch, product development, IWB. CCFP, training and administration, the workload is estimated to be 50.4 shifts per week. An average federal employee is available about 4.2 shifts per week, and thus the personnel requirement for full service is about 12 FTEs.

REGION	ARTCC TMUs	Major TRA-CONS	Hubs	Flt Watch	TOT Facs
North-East	4	7	9	4	***24***
South East	4	5	7	4	***20***
North Central	3	3	4	3	***13***
South Central	3	3	3	3	***12***
Mountain	3	3	3	3	***12***
Pacific	3	4	4	3	***14***
Wx Off	6	---	---	---	***6 + NWS***

Table 1 – The estimated number of facilities within each JAWS area of responsibility.

7. PROJECT MANAGEMENT

In order to remedy the deficiencies that arose in the past there are 3 *essential* requirements (items 5.9, 10, 11, above) that must be addressed:

- Training
- Project Management
- Budget Control

For this purpose a small Weather Office is designed with a mission:

- Weather Operations Monitor: monitor the provision of national weather services and provide operational feedback from the users to the producers;

- Weather Forecasting Advisor: advise on operational weather forecasting and its application to traffic management, both at the JAWS and at the ATCSCC;

- Project Management: perform the functions of a project office for the JAWS network, including the services of COTR: monitoring performance and providing feedback to the Contracting Officer, NWS management, private sector service providers, and Systems Operations management.

8. PROTOTYPE TESTING

To prove the concept of an Interactive Weather Briefing (IWB), several independent Prototype Tests are planned:

- **Terminal –** to develop and test the production of hourly Hub Forecasts by a commercial service provider, including a Tactical Decision Aid (TDA) for Hubs that predicts capacity, consistent with the forecast.

- **En Route –** to develop and test TRACON Forecasts, the weather briefing for the IWB, and related NWS products**.**

- **System –** to develop and test an interactive conferencing system (including display and bandwidth) between centers and other centers and TRACONS; passive viewing is designed for the FAA intranet.

9. INVESTMENT ANALYSIS

Although the objective of this project is to radically improve the delivery of weather services, including forecasts, to FAA field sites, there is a required investment cost. That investment must lead to reduced costs after the completion of the restructuring. An initial Investment Analysis for CWSU Restructuring (SysOps, 2004a) was completed that estimated a cost savings of $1.6 M per year, or approximately 16% per year in annual operating costs. However, an investment of about $2.8 M was needed to complete the transition. The payback period for the differential costs of $840K was estimated to be 16 months.

There are a number of limitations to this estimate. This restructuring plan would require additional changes at the ATCSCC, and the differential cost estimates are based on conditions that are not well known. Furthermore, there is no consideration of advanced weather systems (a WARP replacement), nor an advanced remote teleconferencing system.

Nevertheless, a more sophisticated and complete analysis has confirmed the cost savings and the basic restructuring design (August 2004).

10. BENEFITS AND VALUE

It might appear that satisfying the recommendations of the NTSB and the FAA operational users would be sufficient authority to proceed with restructuring. However, an engineering study would be more desirable to quantify the benefits of the future JAWS services, as compared to the present CWSU current operations. Lacking that, it is still possible to list the benefits of that would be provided, following the priorities of the FAA Flight Plan (FAA, 2004).

10.1 Increase Safety

10.2 Greater Capacity

10.3 Organizational Excellence

10.4 Value

However, it is more substantial to discuss the *value* of restructuring. Value equals the benefits divided by the cost.

Consider, $\mathbf{V_0}$ = the current value of CWSU services,

$\mathbf{B}$ = the relative (fractional) increase in benefits due to restructuring,
$\mathbf{S}$ = relative (fractional) cost savings due to restructuring,
$\mathbf{V_1}$ = the future value of JAWS services.

Then, $\mathbf{V_1 = V_0\,(B+1)/(1-S)}$

The Transition Value of the investment ($\mathbf{V_T}$) is determined by

$$\mathbf{V_T = (V_1 - V_0) \times C_0 \div Investment}$$

where $\mathbf{C_0}$ = the current cost of CWSU services,

and $\mathbf{F}$ = the investment as a fraction of the current cost,

then, $\mathbf{V_T = V_0\,(B+S)/F(1-S)}$

The results for a traditional case where an additional investment will bring increased benefits, even though the cost also increases (Fig. 5).

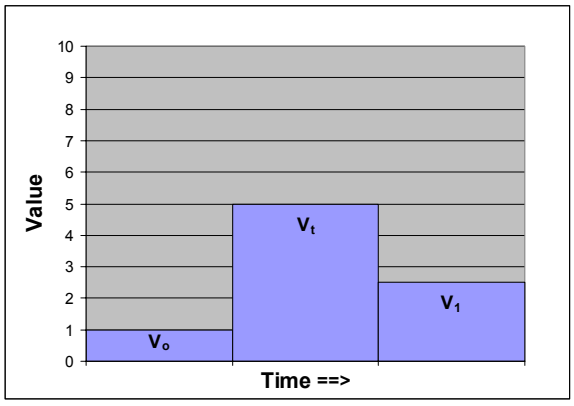

Figure 5 – Example of value for a *Traditional Case* where V0=1; B=2.0; F=0.3; and where the benefits are achieved in stage 1 at an additional cost: S=-0.2. The results indicate that substantial value is achieved.

On the other hand, for the case of CWSU restructuring, the cost reductions finance the increase benefits, following a contemporary dictum from private industry: "do more with less". Although an investment is required to achieve a lower annual cost, the *value* is considerably higher (Fig. 6).

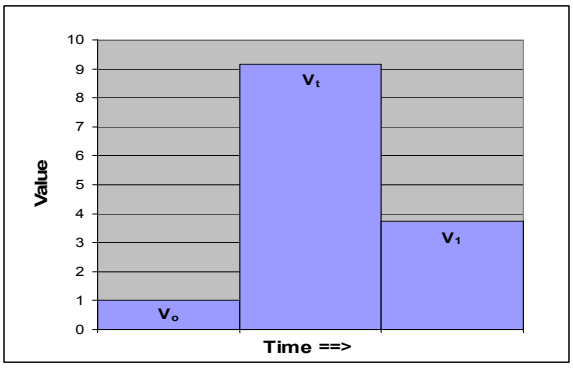

Figure 6 – Example of the value for case of *CWSU Restructuring.* The same parameter values are used as in Figure 1, except *both* benefits and cost savings are achieved: S=0.2. The results indicate a substantial increase in value for both the transition and in the long-term.

A conservative estimate for the restructuring of CWSU into JAWS leads to:

$$V_2 = 3.8 \qquad V_T = 9.1$$

11. CONCLUSIONS

The foundation has been laid to respond to the recommendations and concerns of the FAA, the NTSB, and the NRC. A major accomplishment is the greatly improved cooperation between the FAA and the NWS regarding aviation weather services.

At this time (August, 2004) the details of the planning are still under consideration by the FAA, and the NWS has not yet had an opportunity to fully respond to these user requirements. When this plan is approved and implemented, it holds the promise for CWSU personnel to accept full forecasting responsibilities and be the center of service delivery for the FAA operational units.

The immediate challenge is the Prototype Test that must be conducted to prove the concept of the Interactive Weather Briefing (IWB). The results of the test will further refine the implementation that is planned.

Acknowledgements

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