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**General Aviation
Preflight Planning to
Reduce Accidents**

Preliminary Data

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16. Abstract Accident analysis reveals that preflight planning is often inadequate or entirely ignored. This report addresses the question, "How can the FAA empower the General Aviation (GA) community to minimize the number of accidents resulting from inadequate preflight planning and preparation?" In answering this question, a key issue is how best to provide the preflight services needed by GA and how best to encourage a greater percentage of pilots to do adequate preflight preparation. There have been major changes in the preflight/weather briefing market over the last decade. There is a need for a fundamental reexamination of the preflight/weather briefing market and of the roles and responsibilities of the various players: federal, state, commercial vendors, and pilots. Such a reexamination would provide the FAA with a better understanding of the consequence of agency decisions. Thus, it would allow the FAA to take these consequences into account in the agency decision making process.					
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1.0 INTRODUCTION. This report addresses the question, "How can the FAA empower the General Aviation (GA) community to minimize the number of accidents resulting from inadequate preflight planning and preparation?" A key issue is how best to provide the preflight services needed by GA and how best to encourage a greater percentage of pilots to do adequate preflight preparation.

The author developed this document during a six month temporary detail to the Safety Promotion and Special Projects Division of the Office of Safety Information and Promotion. The original tasking for this effort focused specifically on the Pilot Information System (PIC), however, the scope of the effort was subsequently expanded.

1.1 Problem Definition. Accident analysis highlights the need for preflight planning. Such planning is required by Federal Aviation Regulation (see reference 1). Preflight planning provides the foundation from which decisions about a flight can be made. However, accident analysis reveals that preflight planning is often inadequate or entirely ignored.

The list of documents needed for preflight planning is lengthy and many of them are regularly revised and updated. As the volume of air traffic increases and the National Airspace System (NAS) becomes more complex, keeping up with all of this information is an increasingly time-consuming and expensive task. This raises a concern on whether all pilots are keeping up with the increasing level of sophistication required for safe operation in the NAS.

Inadequate preflight planning is not a new problem. This has been a common cause/factor in GA accidents for decades (see Appendix B, Correlation - Accidents and Inadequate Preflight Preparation). While the GA accident rate has improved significantly over the last several decades, flight crew preflight planning/preparation continues to be cited regularly by the National Transportation Safety Board (NTSB) as a cause/factor in GA accidents.

1.2 Inadequate Preflight Preparation - Accident Statistics. NTSB tabulations of accident data show accidents declining during the 1978 - 1986 time period. However, there has been an increase in the percentage of accidents related to preflight planning. During the 1982 - 1986 time period, 70 percent of the cause/factors of accidents could be attributed to improper preflight planning¹.

Common sense indicates that GA accidents could be reduced and lives could be saved if a greater percentage of pilots did proper preflight planning and preparation. Qualitative research supports this perspective (see reference 2 as well as discussion

in Appendix B). Research shows that a fatal weather-involved accident is about 2 1/2 to 3 times as likely if a flight did not have a weather briefing². This research also shows that an increased use of weather briefings could reduce fatal weather accidents. ("... a 3 percent increase in the population use of weather briefings is projected to reduce fatal weather accidents by about six accidents per year for single-engine piston airplanes (best estimate). Depending on the true population use of weather briefings, the reduction in accidents could range from 1.5 to 22.2 per year... the maximum reduction possible occurs when all flights are briefed.... This level would reduce fatal weather accidents in multiengine piston airplanes by 7.2 in the upper-bound case.... For single-engine piston airplanes, 100 percent use of weather briefings is estimated to reduce fatal weather accidents by 57.7 per year.")³

TABLE 1. ESTIMATED CHANGE IN FATAL WEATHER ACCIDENTS FROM A 3 PERCENT INCREASE IN THE USE OF WEATHER BRIEFING SERVICES*

	Lower Bound	Best Estimate	Upper Bound
Single Engine Piston Aircraft	-1.5	-6.0	-22.2
Multiengine Piston Aircraft	-0.9	-2.4	-6.1

Some of the Gellman data is shown in Table 1 above. The best estimate is that a 3 percent increase in the percentage of pilots obtaining a preflight briefing would prevent 8.4 fatal GA weather accidents on a yearly basis. In the 1985-89 time period, there were an average of 1.9 fatalities per fatal GA accident.⁴ Using the FAA benefit/cost methodology, the value of life is assumed to be \$2.5 million. Thus, preventing these accidents would give a benefit of roughly \$40 million annually (8.4 x 1.9 x \$2.5 M).

1.3 Relationship with NASA and RTCA Efforts. The RTCA Special Committee SC-169, Flight Information Services, is developing minimum operational performance standards (MOPS) for avionics. These avionics would provide pilots services such as the graphical display of weather information in the cockpit for use during flight. NASA has proposed a Government/industry consortium to develop an Advanced General Aviation Transport Experiment (AGATE). It is anticipated that the AGATE aircraft

will make use of the types of avionics that would be developed to meet the RTCA MOPS.

Both of these efforts are directed toward what can be done to assist pilots during flight. This document is directed toward what can be done to assist pilots during preflight planning. These efforts are complementary. However, the RTCA and NASA efforts are outside the scope of this effort and will not be further addressed in this document.

2.0 BACKGROUND.

2.1 Direct User Access Terminal (DUAT). One of the approaches that the FAA has taken, as a way to minimize accidents resulting from inadequate preflight planning and preparation, is the development and implementation of a Direct User Access Terminal. This section discusses the information content and costs of DUAT.

2.1.1 DUAT - Services Available. DUAT is available to licensed civil pilots and provides the following free services:

- a. Flight plan filing, amendment, and cancellation
- b. Severe weather forecasts and alerts
- c. Significant meteorological information (SIGMETs) and convective SIGMETs
- d. Airmen's meteorological information (AIRMETs)
- e. Center weather advisories
- f. Areas forecasts, including hazards and synopsis icing and turbulence, significant clouds and weather
- g. Surface observations and trends
- h. Terminal forecasts
- i. Pilot reports (PIREPs)
- j. Radar summaries
- k. Notices to airmen (NOTAMs) (L, D, and FDC)
- l. Winds and temperatures aloft forecasts

In addition to the free services listed above, DUAT also provides the following "value-added" services available for a pay-per-view charge:

- m. Satellite images
- n. Weather depictions
- o. Weather radar

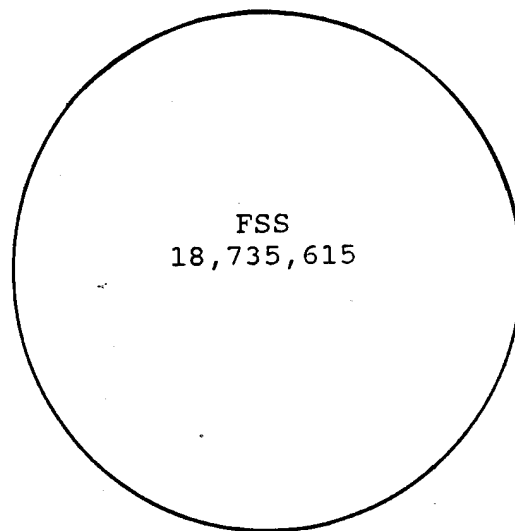
2.1.2 DUAT - Usage and Costs. DUAT usage and costs are shown in Table 2. The average cost per transaction provides a means of comparing DUAT costs with Flight Service Station (FSS) costs per preflight briefing. (A first-order industry cost estimate of \$9.50 per FSS briefing has been reported in the trade publications. The FAA has not conducted a cost analysis to confirm or refute this estimate. One should also recognize that not all pilots are capable and/or interested in using DUAT. Thus, FSS briefings reach a portion of the pilot audience who probably can not be reached any other way. Recognizing these considerations, this comparison does provide an estimate of relative cost.)

FSS preflight briefings have steadily declined from a peak of 18,735,615 in FY 1979⁵ to 10,683,101 in FY 1992⁶. The DUAT transaction numbers indicate that this program has brought about an increase in preflight planning (DUAT grew from zero to 4.4 million annual transaction in the first four years of implementation during a time period when the total annual FSS preflight briefings declined by only 0.7 million). Thus, DUAT has helped to reduce the number of GA accidents. It is also encouraging to see that the cost per transaction has decreased significantly. Perhaps this cost would drop further if the FAA chooses to recompute these contracts.

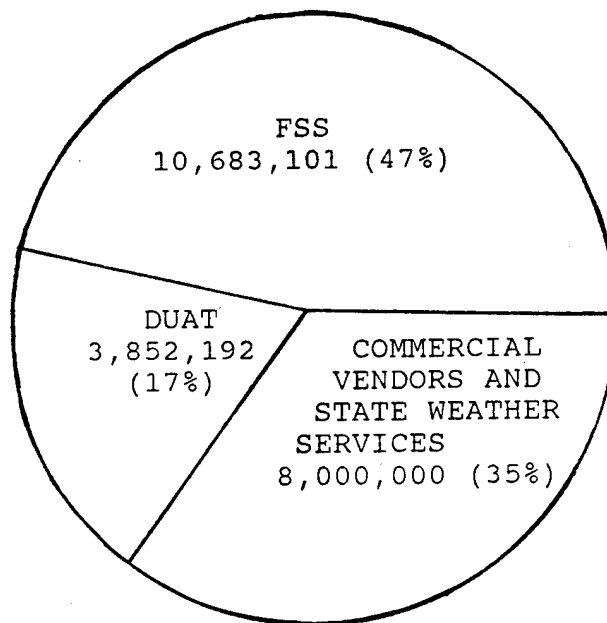
In spite of its success, DUAT is not perfect. Many pilots have commented that the system is not nearly as "user-friendly" as what it could be. Making the system easier to use could increase the annual transactions and decrease the cost per transaction.

TABLE 2. DUAT - TOTAL COSTS AND COSTS PER TRANSACTION ⁷			
Contract Year Time Period	Total Number of Transactions	Total Cost	Average Cost Per Transaction
Feb 1989-90	0*	\$1,120,001	N/A
Feb 1990-91	2,196,818	\$7,634,089	\$3.48
Feb 1991-92	3,076,410	\$8,738,329	\$2.84
Feb 1992-93	4,460,817	\$8,536,383	\$1.91
Feb 1993-94	TBD	\$8,000,000	TBD
Fiscal Year Time Period	Total Number of Transactions	Total Cost	Average Cost Per Transaction
FY 1992	3,852,192	\$8,061,598	\$2.09
FY 1993	5,383,864	\$9,647,652	\$1.79

* The first year was spent setting up the system. No transactions were processed. (In the various transaction/briefing costs given in this report, the costs discussed are operating costs and capitol investment costs are considered as "sunk costs".)



FY 1979 PREFLIGHT BRIEFINGS



FY 1992 PREFLIGHT BRIEFINGS

Figure 1. Comparison of GA Preflight Briefings in FY 1979 and FY 1992

2.2 Pilot Information Center (PIC). One of the approaches that the FAA has considered, as a way to minimize accidents resulting from inadequate preflight planning and preparation, is the development of a "pilot information center". This section discusses history and information content of PIC.

2.2.1 Definition - What is PIC? The PIC was envisioned as a system that would promote general aviation safety by making available a comprehensive and readily available base of information to assist pilots in pre-flight planning. The PIC was also intended to simulate pilot awareness of safety issues. The PIC involved both hardware and software that would provide weather and a host of other information data bases.

2.2.2 Brief History of the PIC. In the late 1980's, state aviation directors (via the National Association of State Aviation Officials (NASAO)) approached the FAA Safety Office with a request for assistance in implementing a preflight briefing system. The FAA wanted to expand the scope of this proposed system by providing additional safety information intended to mitigate accidents. This expansion was developed first as a conceptual idea called Pilot Information Center (PIC) (see reference 3). The information content was based on work documented in a NASAO report done under contract to the FAA (see reference 4). Later, the FAA (via a contract with the University of Maryland) developed a breadboard demonstration model and took it to various aviation shows including Oshkosh where it was well received.

At one point, FAA and NASAO were actively considering the implementation of PIC at airports. Costs were estimated at \$8,000 for PIC acquisition/installation and \$300/month for maintenance. The intentions were to fund acquisition costs under the Airport Improvement Program (AIP) and to pay for the maintenance by selling advertisements to businesses that pilots would patronize.

Several objections were raised to this proposal. Aircraft Owners and Pilots Association (AOPA) personnel commented that PIC should be available to the pilot before arrival at the airport. (Their argument was that, by the time the pilot arrives at the airport, the decision to fly may have already been made.) FAA Airports personnel objected to the use of AIP funds for the purchase of PIC.

While discussions on PIC continued, the FAA introduced DUAT, making some of the PIC menu options available to pilots for free. The FAA shelved the PIC concept when industry voiced concerns that it would be a competitor to DUAT.

2.2.3 PIC Performance Guidelines. The NASAO Center for Aviation Research and Education (CARE) recommended the following guidelines for PIC. The capabilities of guidelines 1 through 8 were strongly recommended as the minimum essential elements of any PIC. The capabilities of guidelines 9 through 14 were recommended as optional. (The information shown below is a condensation. See reference 4 for greater detail.)

Capabilities recommended as a minimum, Guidelines 1-8:

Guideline 1, General Provisions: Turnkey system, user friendly, minimum response times, remote modem access, expandable, automatic fail detector/restart capability, automatic detection and annunciation of interruptions, archived system data, complete user access while maintaining system security, and weather information integration capability.

Guideline 2, Preflight Weather Information System: Alphanumeric data (surface observations, radar reports, terminal forecasts, area forecasts, state forecasts, extended state forecasts, pilot reports, AIRMETS, weather watches, SIGMETS and convective SIGMETS, radar narrative summary, winds aloft, en route data, certified weather data) and graphics data.

Guideline 3, Airport Information: Latitude/longitude, telephone numbers, services, city served, State, elevation, runway information, type of NAVAID and frequency, magnetic variation, and other information.

Guideline 4, Notices to Airmen (NOTAMs): updated NOTAMs including NOTAM (D) or distant, NOTAM (L) or local, and Flight Data Center (FDC) NOTAMs, and data archival capability.

Guideline 5, Flight Planning: heading and distance calculations; time calculations; flight planning worksheet and calculation system; route planning using RNAV routes, NAVAIDs, and/or latitude/longitude points; automatic attachment of weather data; and applicable NOTAMs.

Guideline 6, Flight Plan Filing: Flight plan acceptance and processing, error recognition and easy user correction, and acknowledgement of flight plan receipt by vendor.

Guideline 7, Airman's Information Manual (AIM): Text and image retrieval, quick/user friendly, and ready reference highlighting recent changes.

Guideline 8, AWOS/NADIN Interface: Capability to enter AWOS data into NADIN.

Optional Capabilities:

Guideline 9, Terminal and Special-Use Airspace Information: Accessible in multiple ways, airspace boundaries, frequencies and telephone numbers of controlling agencies, graphic depiction, disclaimer - "Not for Navigational Use".

Guideline 10, Weight and Balance Calculation: Weight and balance calculations, maximum center of gravity (CG) and gross weight limitations calculations, disclaimer.

Guideline 11, Aircraft Operational Information: Cataloging of selected aircraft flight manual data including V speeds, endurance (range/hours), service ceiling, maximum allowable weights (ramp, takeoff, landing), standard empty weight, baggage allowance, fuel capacity, take-off tables, disclaimer.

Guideline 12, Selected Federal Aviation Regulations: Quick/user friendly, and ready reference highlighting recent changes.

Guideline 13, Preferred Routing: FAA preferred routing based on pilot's selection of NAVAIDS and departure/arrival airport.

Guideline 14, Airworthiness Directives and Service Bulletins: FAA-issued airworthiness directives and manufacturer-issued service bulletins, accessible by make and model of aircraft, engine, and/or component.

2.2.4 PIC - Impact on Preflight Briefing Services. PIC was envisioned as an enhanced version of what was implemented by DUAT. DUAT has not provide the full range of menu items envisioned for PIC. However, the evolution of DUAT appears to have been influenced by the PIC concept. The PIC concept introduced and publicized some new ideas on what could be done via a computer-supported preflight briefing system. Various state aviation officials also considered the NASAO PIC guidelines when they developed (or considered developing) a network of weather systems for their state.

The PIC concept also influenced other preflight briefing services. A number of vendors implemented some, but not all, of PIC's menu features. (See Appendixes D for a listing of vendors and the services that they provide). Many of the PIC menu items were not implemented due to a combination of cost and a perception of low marketability.

2.3 State Weather Information System Programs (WISP). State aviation departments provide a wide range of airport services. This section discusses the weather information service programs provided by eleven states.

2.3.1 State WISP Implementation. For roughly a decade, the FAA has been involved in a transition from FSS's to Automated FSS's (AFSS's). (As of August 1993, the FAA had commissioned 59 of the 61 AFSS's planned and had gone from a high of 319 FSS's down to 76 FSS's, 30 of which have been designated as "auxiliary sites" by Congress.) During this lengthy transition, many state aviation officials saw unmet needs for aviation weather information. In response, eleven states have implemented weather information system programs (WISP) with several hundred computer terminals and several hundred AWOS's installed and operational. These states include California, Iowa, Minnesota, Montana, Nebraska, New Mexico, North Dakota, Pennsylvania, Virginia, Washington, and Wisconsin. A significant number of additional states (well over a dozen) are planning to provide a WISP.

The vast majority of these programs have been funded by the states. (Virginia has implemented what may be the most advanced system with what is probably the most innovative source of funds to cover their operational costs. At a number of locations, advertizing revenue pays for the monthly computer maintenance and operational charges.) Many of the state programs began due to dissatisfaction with the FSS automation program. State funding has been based on the argument that the state benefits justify the associated costs. FAA Airport Improvement Program (AIP) funding has been used in a number of states for capital investments such as automated weather observing systems (AWOS).

There is diversity in how the states have implemented WISPs. Ten states have installed computer terminals so that airports and fixed base operators (FBO's) could subscribe to weather services. Some states have provided both the terminals and the subscriptions. Most provide telephone access, although only Minnesota currently provides an 800 number for pilot access from within the state. Some state aviation departments have installed AWOS throughout the state (roughly 300 systems of which about 250 are AWOS III's, see Table 3) (See also Section 5.2 which discusses the weather sensors that constitute the various classes of AWOS facilities). In many cases, these AWOS weather observations are sent to the FAA for national distribution via the National Airspace Data Interchange Network (NADIN).

There is also diversity in the state's choice of commercial vendors. Eight states have chosen Pan Am Services as their weather/flight planning service vendor. Minnesota chose Kavouris for reasons involving the low cost of an 800 number in that state. (Kavouris used an 800 telephone service to distribute

**TABLE 3. NUMBERS OF NON-FEDERAL AWOS
BY FAA REGION AND STATE (PART 1)⁸**

FAA REGION	STATE	COMMISSIONED AWOS	TEST STATUS	PLANNED AWOS
AAL	AK	0	0	0
ACE	IA	30	0	0
	MO	1	0	0
	NB	8	0	0
	ACE Subtotal	39	0	0
AEA	MD	6	0	7
	NJ	0	1 (FAATC)	0
	NY	5	2	1
	PA	10	0	3
	VA	21	0	0
	WV	3	0	0
	AEA Subtotal	44	3	11
AGL	IL	6	2	1
	MI	1	0	20
	MN	37	0	3
	ND	2	0	0
	OH	4	0	1
	WI	2	0	0
	AGL Subtotal	52	0	25
ANE	MA	0	1 (FAA)	1
	ANE Subtotal	0	1 (FAA)	1
ANM	CO	2	0	0
	ID	1	0	2
	OR	1	0	0
	UT	3	0	0
	WY	4	0	0
	ANM Subtotal	11	0	2

**TABLE 3. NUMBERS OF NON-FEDERAL AWOS
BY FAA REGION AND STATE (PART 2)⁸**

FAA REGION	STATE	COMMISSIONED AWOS	TEST STATUS	PLANNED AWOS
ASO	AL	0	1	0
	FL	2	1	0
	GA	10	0	0
	KY	2	0	11
	MS	1	0	0
	NC	6	0	0
	SC	2	0	1
	TN	22	0	11
	ASO Subtotal	45	2	23
ASW	AR	2	0	0
	LA	9	0	0
	NW	4	0	0
	OK	5	0	0
	Gulf of Mexico	0	1	0
	ASW Subtotal	20	1	0
AWP	AZ	4	1	1
	CA	10	0	2
	NV	0	0	2
	AWP Subtotal	14	1	5
All Regions	Grand Total	226	10	67

data while Pan Am uses a satellite link.) Iowa has installed AWOS III's and computers at 30 locations and tied them together with a host computer using a state-owned telephone system. Rather than contracting with a weather/preflight vendor, they have written their software in a way that allows their users to access the FAA DUAT. New Mexico has chosen no vendor. They simply provide telephone access to a number of stand-alone AWOS facilities.

While many states are providing or plan to provide weather information systems, none have implemented a PIC (as it was envisioned several years ago). PIC is a more expensive, more complicated system. It attempted to satisfy all needs at a one-stop location. Whether the services provided by the states will evolve from a WISP into a PIC network remains to be seen.

Federal funding could certainly encourage them to do so. Federal funding could also encourage other states to implement a WISP or to install additional AWOS facilities.

2.3.2 Individual State Weather Information Systems - Usage and Costs. Since eleven states are providing a Weather Information System for pilot preflight preparation, it would be informative to compare their annual usage and their costs per transaction with both DUAT and the FSS briefings. These data are available for some of the eleven states, however, the data do not lend themselves to an easy "apples-to-apples" comparison. Most of the states are not principally interested in the cost of their system per pilot briefing. Generally, they measure the value of the system by the pilot support that it generates and many states have found that their WISP is their most popular program. Often, the states are interested in the relative usage from site to site and month as a way of judging whether sites should be added or deleted. Many do not collect the data needed to estimate total annual usage and cost per transaction. The following sections provide data from those states where such data are available.

(In the various transaction/briefing costs given in this report, the costs discussed are operating costs and capital investment costs are considered as "sunk costs". This is the case for the state WISP transaction costs shown below.)

NASAO has recently done a survey of what the various state aviation departments are doing with regard to weather information systems. (A similar survey, done in about 1990, is published in reference 3.) Publication of the updated NASAO survey is expected in late 1993. Additional cost data may be available as part of this NASAO survey report.

2.3.2.1 Montana - WISP Usage and Costs. Estimated usage and costs per person/contact are shown in table 4. Montana state aeronautical personnel have a precise monthly count of 1993 modem users and an estimated monthly count of 1993 "walk-up" users. Using these figures, they have made a rough estimate of the 1992 users.

TABLE 4. MONTANA - ESTIMATED TOTAL USAGE AND COST PER CALL IN 1992 ⁹	
Estimated Total Annual Calls	Estimated Average Cost per Call
182,177	\$0.34

2.3.2.2 Nebraska - WISP Usage and Costs. Estimated usage and costs per person/contact are shown in table 4. Nebraska does not keep a complete count of all data requests. Instead, they keep

data on only four use categories: surface aviation observations (SA's), terminal forecasts, radar reports, and flight plan filings.

**TABLE 5. NEBRASKA -
ESTIMATED TOTAL USAGE AND COST PER CALL IN 1992¹⁰**

Estimated Total Annual Calls	Estimated Average Cost per Call
182,177	\$0.34

2.3.2.3 North Dakota - WISP Usage and Costs. Estimated usage and costs per person/contact are shown in tables 6A and 6B. North Dakota appears to have a reasonably accurate estimate of the total items requested annually. However, a request for one item does not constitute a preflight briefing. North Dakota state aviation officials estimate that the average caller asks for ten items. (Discussion indicates that the assumption of ten items requested per contact is based on limited analysis.) They use this number as a way to estimate the total annual persons/contacts made and the average cost per person/contact.

TABLE 6A. NORTH DAKOTA - ESTIMATED TOTAL USAGE IN 1992¹¹

Estimated Total Items Requested	Estimated Average No. of Items Requested per Person/Contact	Total Estimated Persons/Contacts
496,000	10	49,600

TABLE 6B. NORTH DAKOTA - ESTIMATED AVERAGE COST PER CONTACT¹¹

Estimated Average Cost per Item Requested	Estimated Average No. of Items Requested per Person/Contact	Estimated Average Cost per Person/Contact
\$0.063	10	\$0.63

2.3.2.4 Virginia - WISP Usage and Costs. Estimated usage and costs per person/contact are shown in tables 6A and 6B. Virginia appears to have a reasonably accurate estimate of the total items requested annually. However, a request for one item does not constitute a preflight briefing. Virginia state aviation officials estimate that the average caller asks for four items. (Discussion indicates that the assumption of four items requested per contact is based on limited analysis; it could be higher.) They use this number as a way to estimate the total annual persons/contacts made and the average cost per person/contact.

TABLE 7A. VIRGINIA - ESTIMATED TOTAL USAGE IN 1992 ¹²		
Estimated Total Items Requested	Estimated Average No. of Items Requested per Person/Contact	Total Estimated Persons/Contacts
1,505,825	4	376,456

TABLE 7B. VIRGINIA - ESTIMATED AVERAGE COST PER CONTACT (ESTIMATE OVER A FIVE YEAR PERIOD) ¹²		
Estimated Average Cost per Item Requested (Over Five Years)	Estimated Average No. of Items Requested per Person/Contact	Estimated Average Cost per Person/Contact (Over Five Years)
\$0.15566209	4	\$0.63

2.3.2.5 Wisconsin - WISP Usage and Costs. Estimated usage and costs per person/contact are shown in tables 7A and 7B. As with Virginia, Wisconsin aviation officials have estimated the average number of requests per caller. Discussion indicates that this number (five) is soft; it could be higher. They have used this number as a way to estimate the total annual persons/contacts made and the average cost per person/contact.

TABLE 8A. WISCONSIN WISP - ESTIMATED TOTAL USAGE IN 1992 ¹³		
Estimated Total Items Requested	Estimated Average No. of Items Requested per Person/Contact	Total Estimated Persons/Contacts
2,700,000	5	540,000

TABLE 8B. WISCONSIN WISP - ESTIMATED AVERAGE COST PER CONTACT IN 1992 ¹³		
Estimated Average Cost per Item Requested	Estimated Average No. of Items Requested per Person/Contact	Estimated Average Cost per Person/Contact
\$0.086	5	\$0.43

2.3.3 State Weather Information Systems - Summary of Usage and Cost Data. Table 8 provides a summary of the available data. These numbers should be viewed as rough estimates. Many of these states do not make a complete count of all their data requests. A state WISP briefing is not necessarily identical to a DUAT briefing. Neither the state WISP briefing nor the DUAT briefing are identical to a standard FSS briefing. None the less, these data do provide a first order approximation of the annual usage and the cost of some of the state systems.

2.4 Commercial Vendors - Preflight and Weather Briefings. Over the last dozen years, the preflight/weather briefing market has grown significantly both in the numbers of providers and in the diversity of services they provide. In discussions within the agency, many FAA personnel appear to be relatively uninformed of the magnitude of this commercial market.

Table 9 below shows the changes in the number of commercial vendors over the last dozen years. The topic of commercial vendors is addressed in greater detail in Appendixes C and D.

**TABLE 9. SUMMARY OF STATE WISPs -
ESTIMATED TOTAL ANNUAL USAGE AND COSTS PER BRIEFING IN 1992**

STATE	ESTIMATED TOTAL ANNUAL USAGE	ESTIMATED COST PER BRIEFING
California	N/A	N/A
Iowa	N/A	N/A
Minnesota	N/A	N/A
Montana	16,000	\$0.25
Nebraska	182,177	\$0.34
New Mexico	N/A	N/A
North Dakota	49,600	\$0.63
Pennsylvania	N/A	N/A
Virginia	376,456	\$0.63
Washington	N/A	N/A
Wisconsin	540,000	\$0.43

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**TABLE 10. GROWTH AND CHANGES IN THE NUMBER OF
COMMERCIAL VENDORS - FLIGHT PLANNING AND WEATHER¹⁴**

Date	Total Number of Vendors	Flight Planning Vendors	Weather Vendors
April 1981	5	*	*
April 1982	16	*	*
April 1984	16	11	16
April 1986	19	12	19
April 1988	23	16	20
May 1990	20	12	13
May 1991	22	14	15
May 1993	22	19	15

*Note: In the 1981 and 1982 surveys, B&CA did not specify whether the vendors provided flight planning services, weather services, or both types of services.

3.0 GOVERNMENT AND VENDOR RESPONSIBILITIES - WEATHER, NOTAMS, AND FLIGHT PLANS.

3.1 Government Responsibilities.

3.1.1 FAA Statutory Responsibilities. FAA's primary mission, as stated in the Federal Aviation Act of 1958, as amended, is to assure safe and efficient use of airspace. In fulfilling this mission, FAA is responsible for providing aviation weather information to pilots. The act directs the FAA to develop, procure, operate, and maintain equipment for disseminating weather information. In addition, the act directs the National Weather Service (NWS) to provide FAA with reports, forecasts, and warnings for aviation use.¹⁵ (This issue is the subject of ongoing discussion. The FAA recently announced its intentions to award a contract to the National Academy of Sciences and the National Research Council for a 20-month study of the roles played by the various federal agencies in providing aviation weather services. This effort is also planned to address what near- and long-term improvements can be made to the system.)

3.1.2 FAA Air Traffic Controller Responsibilities. Air traffic controllers currently disseminate hazardous weather information to pilots. According to FAA's "Air Traffic Control" handbook - FAA 7110.65D - the controllers' first priority is separating aircraft. However, additional duties, such as providing pilots with weather information, are to be accomplished "to the extent possible" contingent on other, higher priority duties. In addition, each of the major terminal facilities has similar orders and policies governing controller responsibilities for disseminating aviation weather hazards information to pilots.¹⁶

3.1.3 Distribution of Weather Information. Continuous access to weather information is available to anyone who has access to Service A. Service A is available to anyone willing to pay the associated fees. The NWS places no constraints on the use of the data. Vendors are free to sell weather information.

3.1.4 FAA Distribution of NOTAMS. Continuous access to NOTAMS is available to anyone on the Aeronautical Fixed Telecommunications Network (AFTN). AFTN access is available to anyone willing to pay the access fee. The FAA places no constraints on the use of the data. Vendors are free to sell NOTAM information.

3.1.5 FAA Acceptance of Domestic Flight Plans from Vendors. The ability to file domestic flight plans directly is available to anyone on the FAA National Airspace System Inter-facility Communications System (NICS). Currently, there are approximately 69 users including airlines, commuters, and vendors. In accepting a request for NICS access, the FAA accepts certain responsibilities. These include the following:

(a) The FAA will pay for all non-recurring and recurring leased communications costs associated with providing a backbone circuit for multiple access or node for vendor access at a point of connectivity designated by the FAA.

(b) The FAA assumes financial responsibility for all costs incurred by the FAA in the development and maintenance of the NICS side of the interface.

3.2 Vendor Responsibilities.

3.2.1 Vendor Receipt of Weather Information. The FAA places no constraints on the use of these data. Vendors are free to sell weather information.

3.2.2 Vendor Receipt of NOTAM Information. The FAA places no constraints on the use of these data. Vendors are free to sell NOTAM information.

3.2.3 Vendor Filing of Flight Plans. Vendors must accept certain responsibilities in order to gain the ability to file domestic flight plans directly (rather than filing through a Flight Service Station (FSS)). These are as follows:

a. Obtain access to the FAA National Airspace System Inter-facility Communications System (NICS) via a memorandum of agreement (MOA) with the FAA. This MOA is consistent with the policy of FAA order 1830.1A, Access Policy for Non-FAA Users and Foreign Correspondents to the NICS.

b. Obtain a three letter designator by complying with FAA Advisory Circular AC120-26H, International Civil Aviation Organization Three-Letter and Radiotelephony Designators.

c. Pay all non-recurring and recurring leased communications costs associated with the transport of data/information from or to the connection point of the NICS as designated by the FAA.

d. Assume financial responsibility for all costs incurred in the development and maintenance of the interface to the designated NICS node.

4.0 ALTERNATIVES. In the interest of reducing accident rates associated with inadequate preflight preparation, the FAA has a variety of alternatives from which to choose. These are briefly discussed below. (The alternatives listed below should not be viewed as an all inclusive list. In addition, inclusion on this list should not be viewed as an indication that the FAA Office of Aviation Safety favors an included alternative over other alternatives not discussed below.)

4.1 Study the Preflight/Weather Briefing Services Market. FAA and NWS do not have a monopoly on preflight briefing services. Appendix C provides a listing of preflight/weather briefing services and shows how the numbers of such vendors has grown over the last twelve years. In May 1993, there were 22 vendors (including the 2 DUAT vendors). For a variety of reasons, many users are prepared to pay for commercial services even though the FAA provides similar services for free. The large number of vendors indicates a very definite market for such services.

While the FAA has a statutory responsibility to provide preflight services, the agency does not need to provide ALL preflight services to ALL users. In many cases, private industry is better at responding to customer needs than the Federal Government. The state aviation departments have also taken a growing interest in providing such services in recent years. In the interest of controlling federal spending while still ensuring that user needs are being met, the FAA should consider what actions the agency can take in order to influence this market.

For reasons discussed in Appendix D, the preflight briefing market is not well understood at this time. Even basic questions on the size of the various non-federal components of this market can not be answered with precision. The FAA has an obvious interest in being able to influence this market. Better knowledge is required to do this wisely. It would be wise to first come to a better understanding of this market segment. The following questions are suggested as a starting point:

- a. Who are the vendors of preflight briefing services and what types of service does each provide? (Appendix D answers this question as of May 1993. However, The FAA should stay in touch with the continued evolution of this market.)
- b. Who are the customers of the various preflight briefing service vendors?
- c. What is it about these services that induces customers to pay for them rather than using FAA/NWS services available for free?

d. What percentage of the market does each of these vendors have? (One way to estimate this would be to keep track of the number of flight plans filed by each of vendor, something that the FAA does not currently do. A second way to do this would be to solicit this information from the vendors. Under our current memorandums of understanding with these vendors, they are required to provide this information to the FAA upon request at no cost to the Government. However, the FAA office of primary interest (ATM) has never requested this information.

e. If FAA funding of DUAT were discontinued, what change would be seen in the percentage of pilots doing each of the following:

- (1) no preflight planning
- (2) preflight planning via FSS
- (3) preflight planning via commercial vendor
- (4) other options

f. What are the accident rates of the users of the various preflight briefing services and how do these rates compare with others in industry flying the same mission categories?

g. When an accident (related to weather/preflight planning) occurs during a flight for which the pilot used a particular preflight briefing service, does the vendor participate in the after-accident analysis? Does the vendor even know that an accident has occurred?

h. How can the FAA work with these vendors to improve aviation safety?

4.2 Study What the Various States Have Implemented. Eleven states have implemented weather/preflight briefing systems on a statewide basis. Over a dozen additional states are planning to implement such systems. Where an industry estimate of the FSS briefing cost is \$9.50 per contact and DUAT costs were \$1.79 per contact in FY 1993, the state systems are substantially less expensive (well under a dollar). State weather briefing systems have been heavily used and many state aviation departments have found that this is their most popular program.

A number of states have taken the lead in the deployment of AWOS (see Table 2). Some states have made use of AIP funding but many have paid for these systems with state funds. (In some of the FAA regions, FAA Airports officials have given state aviation officials the impression that the FAA is reluctant to spend AIP funds on AWOS, preferring instead to assign higher priority to

projects such as runway construction.) In many states, weather data from state-owned and operated AWOS are provided to the FAA via NADIN. In some cases, the NWS has also requesting access to such data.

The FAA should study what has been done at the state level and consider whether their approaches could be applied nationally or encouraged in other states. In addition, the FAA should reconsider the roles and responsibilities of the national and state agencies with regard to the distribution of weather information. The states have been gradually accepting a larger responsibility for the distribution of weather information. As FAA funding gets tighter, perhaps it is time to consider a formal partnership between FAA and NASAO in order to guide future progress in this area. In addition, the FAA could analyze the progress that the states have made in reducing their accident rates by introducing various state aviation programs.

a. What are the GA weather-related accident rates in the various states that have implemented preflight/weather briefing services and/or AWOS systems and how do these rates compare (singly and jointly) with other states that have not implemented such systems?

b. In the various states that have implemented preflight/weather briefing services and/or AWOS systems, have their weather-related accidents rates improved since these installations? How do these rate improvements compare (singly and jointly) with the other states that have not implemented such systems?

c. How can the FAA work with the state aviation departments to improve aviation safety?

d. In view of the ever-present budgetary limitations, how can the FAA and the state aviation departments work together on a more cooperative basis?

4.3 Provide "Seed Money" for one or More Vendors to Start a Service Similar to PIC. This alternative has already been implemented. The service is called DUAT. Initially, the FAA signed contracts with three vendors to provide DUAT services. Two of these vendors have been funded for a full five years (one year of development, four years of operation (February 1990 through February 1994)). Current plans are to extend these contracts for one additional year.

DUAT provides certain minimum preflight services to GA pilots via an "800" number at no direct cost to the pilot. The FAA pays the vendors a fee for each briefing provided. DUAT vendors are allowed to charge pilots for "value added" services provided above and beyond the "core DUAT services" funded by the FAA. Of

the total annual GA flight plans filed either via DUAT or through the FSS's, the percentage of these flight plans filed via DUAT increased from 2.8% in FY 1990 to 9.6% in FY 1992. Roughly 14% of all DUAT transactions involved flight plan filings via the DUAT vendor.

4.4 Conduct a Formal Benefit/Cost Analysis of DUAT. In looking for ways to reduce the FY 1994 budget, the FAA proposed to discontinue federal funding of DUAT. Various arguments have been made concerning the consequences of this action. However, no rigorous analysis of the costs and benefits of DUAT has been published. (Congress subsequently chose to fund DUAT in FY 1994.)

Reference 2 ("Weather Briefing Use and Fatal Weather Accidents") documents an analysis showing that even a small increase in the percentage of pilots who do thorough preflight planning would result in a significant reduction in GA accidents and fatalities. It could be argued that DUAT has brought about an increase in preflight planning and a reduction of GA accidents and fatalities. The FAA should conduct a benefit/cost analysis of DUAT taking into account the analysis of reference 2. If the results show that DUAT services are cost/beneficial, the FAA should consider how these benefits might be retained.

One of several alternatives to be considered would be to continue federal funding of DUAT. Another alternative would be to restructure DUAT along the lines of what has been done by some of the state aviation authorities so as to provide similar services for less money. Still another alternative would be to recompet the DUAT contracts with the expectation that competition would bring down the price. Considering that there are over a dozen vendors in this market and considering that the DUAT program has been a growing success, competition could bring down the price significantly.

4.5 AWOS - Complete Implementation and Distribution of Weather Observations. AWOS has been well received as indicated by the number of systems being installed by many different government entities. State aviation officials alone have installed over 200 AWOS (see Table 2) and planned AWOS installations are expected to increase this total to about 300 facilities. AWOS and ASOS are less expensive than staffing a site with weather observers on a 24-hour basis. Thus, such systems can be justified by federal or state governmental agencies at locations where weather information would otherwise be unavailable.

(While ASOS is very similar to AWOS, it has been less well received in aviation circles. A large number of ASOS facilities have been installed but not commissioned because money has not been available to distribute their observations via NADIN. Weather sensors facilities are of limited value to aviation if

their observations are not readily available via a distribution system. Thus, a significant number of ASOS facilities are uncommissioned and relatively unused.)

Weather information is needed by industry and government for many different reasons. State DOT's need to move the people and materials required to keep the roads open in the winter. The trucking industry needs to know when roads will be icy or snow covered. The farming industry needs weather information to manage their efforts. The list of needs is very long.

All of this can lead to duplication of efforts. One state aviation official has spoken of a case where the NWS and a state DOT highway department both installed automated observation systems roughly 100 yards apart. The agencies involved subsequently realized that either facility could have satisfied both agencies' needs for weather information at that location. Steps have now been taken to avoid such duplication in this state but similar duplication could still take place in other states.

Weather observations from many of the non-federal AWOS's are provided to the FAA for national distribution. Although this is not universally the case, steps are being taken to link some of the current stand alone systems. As an example, Virginia state aviation officials have obtained AIP funding to cover the capital investment required to set up a satellite link that sends AWOS weather observations to the FAA via NADIN. Since this has happened recently and many other state aviation departments are not yet aware of this. Many FAA regional AIP officials may not be aware of it either.

In cooperation with state and federal level government agencies, the FAA should work to fill in the holes in AWOS/ASOS coverage nationally and to link stand alone AWOS/ASOS stations for national distribution via NADIN. Using the same cooperative process, it may also be appropriate to replace the older AWOS I's and AWOS II's with AWOS III's and, eventually (where required, when they become available), with AWOS IV's.

4.6 Encourage the States to Implement Preflight Briefing Systems. About eleven states have implemented a weather information system programs (WISP). Over a dozen additional states are currently planning to provide such a system at some time in the future. These appear to be popular, cost-effective systems. In view of the safety benefits involved, the FAA should encourage more states to implement WISPs. The FAA should also cooperate more fully with NASAO in order to encourage a higher degree of standardization from state to state.

4.7 Expand DUAT by Adding the Additional Menu Items Proposed in PIC. Of the "capabilities recommended as a minimum" proposed for the PIC menu, many but not all of these items were provided by

DUAT. While the other PIC menu items would certainly be nice to offer to pilots, it might be difficult to justify them individually on a basis of benefits versus costs. This might particularly be the case for the "optional capabilities" (see guidelines 9 through 14 in section 2.2.3).

If a decision is made to provide DUAT funding on a long term basis, the FAA might conduct a test on this issue. In part of the country (say a selected FAA region), the FAA could add a single selected PIC menu item to DUAT. In the rest of the country, this item would not be available so as to provide a control group. Benefit/cost analysis would be used to determine if it makes sense to provide such services nationwide. While this alternative may be attractive from a safety perspective, the issue of cost can not be ignored. If the FAA finds DUAT expensive as it is, adding additional services would not make it more affordable. Perhaps the DUAT contractors could be encouraged to add PIC menu items to DUAT as "value-added" services.

4.8 Restructure and Recompete DUAT to Reduce Costs. During the first three years of service, DUAT costs have declined from \$3.48 to \$1.79 per contact. With an increase in usage, costs per contact can be expected to continue to decline. While this is encouraging, there are alternatives available to further reduce these costs while still continuing the present level of service.

A number of state aviation agencies are providing preflight briefing services similar to DUAT but at costs that are significantly less. (Costs per contact for the state systems vary are well under \$1.00 and can be expected to decline with greater usage.) The lower cost does not mean that these systems are less popular with pilots. Several of the state aviation departments have stated that their weather information system is their most popular program and that it enjoys broad pilot support.

The state systems are less expensive than DUAT because they distribute information in a different way. DUAT distributes information directly to the pilot using an 800 number. In contrast, the state systems distribute information to computer terminals located throughout the individual states. Pilots use the system at the airport or via modem and a telephone line but, except in Minnesota, no 800 number is provided. (Montana also provided an 800 number for a period of less than one year.) While the state systems receive many long distance calls from pilots, long distance costs are borne by the pilot (except in Minnesota). The FAA could consider restructuring DUAT to reduce its cost while still providing essential services.

Restructuring would best be done as part of a recompetition of DUAT. With the success of the DUAT program, it is possible that

competition would bring about a significant drop in the price per briefing provided.

4.9 Restructure the GA Preflight Briefing Service Market. This has already been done via the implementation of DUAT. Will further FAA actions be required to bring about additional restructuring? By studying the preflight briefing market (alternatives 4.1 and 4.2) and conducting a benefit/cost analysis on DUAT (alternative 4.4), the FAA would acquire much of the information necessary to answer this question.

4.10 Implement PIC as an FAA Preflight Briefing Service and Provide it to Pilots via Phone Lines and the Pilot's PC. One of the reasons that the PIC was shelved by the FAA was the concern that PIC would compete with DUAT. This concern has not disappeared and there are other concerns that must also be addressed. If the FAA were to provide PIC services for free, would this discourage industry creativity and limit the introduction of innovative new services? If the FAA were to provide PIC services at prices comparable to industry, would this distort the preflight briefing market? Would it provide a good value to the users for the money spent on it? Should the FAA set up PIC as a competitor to commercial vendors?

In many cases, industry is better able to finance, develop, and implement such a service. Industry is also better able to respond to the constantly changing environment, state-of-the-art technology, and the evolving user needs. Would it not be better for the FAA to confine itself to providing those basic services that industry can not economically provide?

4.11 Publish and Distribute the Various Reports on PIC. The FAA has done a significant amount of work on the PIC concept. Much of this effort has not been documented in a form that is suitable for publication and it would not be worthwhile to allocate resources to do so. However, some of this information has been documented although it has not been formally published and made available to the aviation community.

The PIC concept has not been implemented by the FAA and this appears unlikely to happen soon. None the less, the effort has been of value and both FAA and some components of the aviation community have learned from this effort. A number of state aviation departments have implemented preflight briefing systems. Other states may choose to do so in the future. Material developed under the FAA's PIC efforts might be of value to them. It might also encourage some states to add PIC menu items to their weather information systems.

In the interest of information dissemination, the FAA should publish and distribute the reports that have been developed on the PIC. Specifically, this should include references 3 and 4.

The report distribution should include state aviation directors, preflight vendors, and the National Technical Information Center (NTIS). While there is not a universal consensus that PIC should be implemented, these publication should encourage genuine discussion, particularly on the issue of what services are required.

4.12 Encourage Competition Among Providers of Preflight/Weather Briefing Services with Regard to Safety Improvements. GA accidents could be avoided and lives could be saved if preflight/weather briefing services were improved and/or if a higher percentage of GA pilots made use of such services (see reference 2 as well as discussion in Appendix B). Thus, the FAA could improve aviation safety by encouraging safety improvements by all providers of preflight/weather briefing services.

Private industry attracts customers by looking for unmet needs and then providing a service that meets those needs. In a market with many providers, competition is inevitable, focusing on issues such as cost, convenience, and responsiveness to unique requirements. The FAA could encourage vendors to add safety to this list of issues by taking one or more of the following actions:

- a. Solicit ideas from pilots, user groups, state aviation officials, and the preflight briefing industry on ways to encourage safety improvements in preflight/weather briefing services.
- b. In cooperation with industry safety organizations and state aviation officials, develop a list of categories where significant safety improvements have occurred in the area of preflight/weather briefing services over the last ten years. Solicit nominations from pilots, user groups, state aviation officials, and the preflight/weather briefing industry for awards recognizing those responsible for developing or implementing these improvements. Publicize the winners in each category as well as the "honorable mention" nominees.
- c. In cooperation with industry safety organizations and state aviation officials, develop a list of categories where significant safety improvements are needed in the area of preflight/weather briefing services over the NEXT ten years. Publicize this list and encourage the market (industry and government providers) to meet these challenges.
- d. Make a list of the preflight briefing menu items that have a positive effect on safety and develop a matrix showing which menu items fall within the services of each provider. Provide this information to the users by publicizing this matrix. Update this information on a periodic basis as needed to keep it current.

e. Rank the various providers on the basis of which are providing the best services from a safety perspective. (This could be done using a criteria developed in cooperation with pilots, user groups, state aviation officials, and the preflight/weather briefing industry.)

4.13 Place Conditions on the Use of FAA Data by Preflight Vendors. The FAA has a statutory responsibility to provide aviation weather information to pilots. The Federal Aviation Act of 1958, as amended, directs the FAA to develop, procure, operate, and maintain equipment for disseminating weather information. Is the agency required to provide aviation weather and other preflight briefing information to all vendors without any limitation of the use of this data? Can the FAA set conditions on the use of this information? Could the FAA require, as a condition of providing preflight briefing information, that a vendor provide certain minimum services to their customers at no cost?

Could the FAA define a minimum standard for the content of basic preflight briefing services (see section 5.0) and require that vendors meet these standards, at no cost to their low end customers or to the Government, as a condition for obtaining FAA data/information/acceptance of flight plans? Should the FAA place different obligations on commercial vendors who obtain this information for resale, airlines who obtain this information for their own use, and others who use this information for reasons that are not immediately obvious? Should the FAA place different obligations on large commercial vendors and small commercial vendors?

The FAA should consider these questions while pursuing this approach. A legal opinion from General Counsel would probably be required and, at some point, legislation may be necessary. Roughly two dozen commercial vendors base their businesses on the sale of FAA/NWS data and FAA acceptance of flight plans. Many of these are large businesses with customers nationwide. Currently, the FAA is, in effect, subsidizing these businesses. Perhaps these business should be required to provide a DUAT-type service without Government funding in return for FAA/NWS data and FAA acceptance of flight plans. Under such a system, basic preflight services would be provided to all customers for free and vendors would be allowed to charge customers only for "value added" services.

Vendors would undoubtedly raise objections to this proposal. In recent years, vendors costs for weather data from non-government sources has risen significantly. While the FAA charges only access fees for weather information, non-government sources charge access fees, plus fixed fees, plus variable revenue-dependent fees. This may be part of the reason why the number of commercial vendors has dropped from 19 to 15 in recent years (see

Appendix C). If the FAA places additional requirements on these vendors, it may push additional vendors out of this market.

5.0 MINIMUM PREFLIGHT PLANNING REQUIREMENTS AND NEEDS. Accident analysis reveals that preflight planning is often inadequate or entirely ignored. What is it then that pilots ought to do before they decide to take off on a particular flight? What are the minimum requirements for preflight planning? The answer varies depending on a number of factors: the FAR under which the flight would take place (examples: 91, 135, or 121), whether the flight would be VFR or IFR, whether the flight would be local or cross country, domestic or international, and a host of other considerations. The following sections address this question from a variety of perspectives in the interest of identifying the minimum requirements.

5.1 Minimum Weather-Related Preflight Planning as Required by FAR 91. Some of the most important references to be considered, in any attempt to define minimum planning requirements, are the Federal Aviation Regulations (FARs). (This section relies heavily on reference 1. Only weather related planning requirements are addressed. Under contract to the FAA, MITRE analyzed the FARs to identify the weather-related regulations. This analysis was done for Parts 91, 135, and 121. Since we are interested in minimum requirements, this section only addresses Part 91.) While the FAR's tend to be broad rather than specific in defining such requirements, the following are specifically mentioned:

a. General weather conditions (weather reports and forecasts), current and forecast, at the takeoff and destination airports and over the entire route of flight (91.103(a), 91.151, 91.167(a), 91.167(b), 91.319(d)(2), 91.527(d), 91.611(a)(4)(ii)).

b. Wind, current and forecast, at all airports of intended use (91.103(b)(2), 91.151, 91.605(b)(3)).

c. Temperature, current and forecast, at all airports of intended use including alternate airports (91.103(b)(2), 91.605(b)(1), 91.605(b)(2), 91.605(b)(3), 91.611(b)(5), 91.611(b)(6)).

d. Visibility, current, over the entire route (91.155, 91.157, 91.303)

e. Visibility, current and forecast at the destination airport (91.167(b)(2)(ii), 91.169(b)(2)).

f. Visibility, forecast, at the alternate airport (91.169(c)).

g. Ceiling, current, over the entire route (91.155).

- h. Ceiling, current and forecast at the destination airport (91.167(b)(2)(i), 91.169(b)(1)).
- i. Ceiling, forecast, at the alternate airport (91.169(c)).
- j. Clouds, current, over the entire route of flight (91.155 and 91.157).
- k. Icing conditions (91.527).

5.2 Minimum Non-Weather-Related Preflight Planning as Required by FAR 91. In addition to defining minimum weather-related planning requirements (discussed in paragraph 5.1), the FARs also address non-weather-related planning requirements including those listed below. (Since we are interested in minimum requirements, this section only addresses Part 91.) The FAR's tend to be broad rather than specific in defining such requirements. However, the following are specifically mentioned as things with which the pilot must be familiar before beginning a flight:

- a. fuel requirements (any flight under VFR: 91.151) and (any flight under IFR: 91.103(a) and 91.167).
- b. alternatives available if the planned flight can not be completed (any flight under IFR: 91.103(a)).
- c. any known traffic delays of which he has been advised by ATC (any flight under IFR: 91.103(a)).
- d. runway length at airports of intended use and ... takeoff and landing distance data (91.103(b)).

In addition to the above, the following are specifically mentioned in the FAR's as things that the pilot must do before beginning a flight:

- e. preflight briefing of passengers on the use of safety belts, shoulder harnesses (91.107).
- f. compliance with the operating limitations specified in the Flight Manual, markings, and placards (91.xx31)

In addition to the above, the FAR's also require that pilots do certain things in flight. A significant number of these things would require that pilots prepare themselves during preflight. These include preflight planning such as the following:

- g. review NOTAMS (91.139)

5.3 Automated Weather Observing System (AWOS) Weather Information. Another perspective on minimum preflight weather planning requirements can be gained by looking at what is provided by AWOS. These real-time systems are operationally classified into four levels: AWOS A, AWOS 1, AWOS 2, and AWOS 3. These systems provide the following weather information:

- a. Altimeter setting (AWOS A, AWOS 1, AWOS 2, AWOS 3).
- b. Wind direction, speed, and character (AWOS 1, AWOS 2, AWOS 3).
- c. Temperature and dew point (AWOS 1, AWOS 2, AWOS 3).
- d. Automated remarks (AWOS 1, AWOS 2, AWOS 3):
Precipitation accumulation, variable wind direction, variable visibility, and density altitude (included when more than 1000 feet above the airport elevation).
- e. Visibility (AWOS 2, AWOS 3).
- f. Sky conditions and ceiling (AWOS 3).
- f. Manual input remarks: Present weather and obstructions to vision. (Reported only when a weather observer is available.)

There is a recognized need for weather information in addition to what is presently available from an AWOS III. An AWOS IV is expected to provide all the AWOS III observations plus the additional observations listed below. (To date, an AWOS IV system has not yet been certified. Of the following sensors, only the precipitation sensor has been certified. Thus, an AWOS IV is not expected to be available any time soon.)

- g. Precipitation occurrence, type, and accumulation.
- h. freezing rain.
- i. thunderstorms.
- j. runway surface conditions.

5.4 Preflight Preparation as Recommended by the Airman's Information Manual (AIM). The AIM is designed to provide basic flight information and ATC procedures for use in the NAS. It contains recommendations rather than directives. However, it is an excellent reference on the subject of preflight preparation. The following are excerpts from the AIM:

- a. Every pilot is urged to receive a preflight briefing and to file a flight plan. This briefing should consist of the

latest or most current weather, airport, and en route NAVAID information.... Consult an FSS or a Weather Service Office (WSO) for preflight weather briefing.... FSS's are required to advise of pertinent NOTAMS if a **standard** briefing is requested....(AIM 5-1a)

b. Time-critical aeronautical information which is of either a temporary nature or not sufficiently known in advance to permit publication on aeronautical charts or other operational publications receives immediate dissemination via the National Notice to Airman (NOTAM) System. Note - NOTAM information is that aeronautical information that could affect a pilot's decision to make a flight. It includes such information as airport or primary runway closures, changes in the status of navigational aids, ILS's, radar service availability, and other information essential to planned en route, terminal, or landing operations. (AIM 5-3a)

c. NOTAM information is classified into three categories. These are NOTAM (D) or distant, NOTAM (L) or local, and Flight Data Center (FDC) NOTAMS. (AIM 5-3b1)

d. Airport/Facility Directories and supplements. The AIM is complemented by other operational publications including the Airport/Facility Directory, the Alaska Supplement, and the Pacific Chart Supplement. (AIM Preface 3) These publications contain information on airports, communications, navigation aids, instrument landing systems, VOR receiver check points, preferred routes, FSS/Weather Service telephone numbers, Air Route Traffic Control Center frequencies, part-time control zones, and various other pertinent special notices essential to air navigation.

5.5 Preflight Planning as Recommended by the FAA Advisory Circulars. The following FAA advisory circular both have several pages of detailed recommendations on what a pilot should do as part of preflight preparations.

a. AC61-21A Flight Training

b. AC61-23B Pilot's Handbook of Aeronautical Knowledge

5.6 Minimum Preflight Planning Needs as Recommended by NASAO. (This section relies heavily on reference 4. A broad range of planning needs are addressed.) Under contract to the FAA, NASAO CARE developed a set of 14 recommended guidelines (capabilities) for a pilot information center (PIC). Of these 14 guidelines, guidelines 1 through 8 were strongly recommended as the minimum essential elements of any PIC. Of these 8 guidelines for PIC capabilities, guidelines 1 and 8 pertain to PIC capability only and not to elements of pilot preflight preparation. However, the

remaining 6 NASAO guidelines do pertain to the various data bases used by pilots during preflight preparation. Thus, these 6 guidelines (guidelines 2 through 7 shown below) could be viewed as a NASAO CARE recommendation on the minimum pilot needs for preflight planning. (The information shown below is a condensation. See reference 4 for greater detail.)

Guideline 2, Preflight Weather Information System: Surface observations, radar reports, terminal forecasts, area forecasts, state forecasts, extended state forecasts, pilot reports, AIRMETS, weather watches, SIGMETS and convective SIGMETS, radar narrative summary, winds aloft, en route data, and certified weather data.

Guideline 3, Airport Information: Latitude/longitude, telephone numbers, services, city served, State, elevation, runway information, type of NAVAID and frequency, magnetic variation, and other information.

Guideline 4, Notices to Airmen (NOTAMs): updated NOTAMs including NOTAM (D) or distant, NOTAM (L) or local, and Flight Data Center (FDC) NOTAMs.

Guideline 5, Flight Planning: heading and distance calculations; time calculations; flight planning worksheet and calculations; and route planning using RNAV routes, NAVAIDS, and/or latitude/longitude points.

Guideline 6, Flight Plan Filing: Flight plan filing and acceptance.

Guideline 7, Airman's Information Manual (AIM): Review of applicable portions for the flight being planned and review of recent changes.

5.7 Weather-related Accidents and Incidents. One very valuable way to determine minimum preflight weather requirements is to look at the causes of weather-related accidents and incidents. A team from the Office of Aviation Safety looked at such aviation data from a variety of sources including NTSB accident data, FAA accident/incident data, FAA near mid-air collision (NMAC) data, ATC flight assist data, and NASA Aviation Safety Reporting System (ASRS) data. In each set of data, the examination focused on weather-related issues. (This section is based on a Special Review entitled "Aviation Safety" dated November 24, 1993.) The following is a summary of the findings:

- a. Between 1988 and 1992, there were 12,391 aircraft accidents. Weather was a contributing/causal factor in 2,683 (22 percent) of these accidents.

b. 2,347 accidents (88 percent of the 2,683 weather-related accidents) involved general aviation (GA).

c. The weather factor cited varies depending on the category of operator:

(1) 1,649 weather-related accidents (70 percent of the GA weather-related accidents) were in the "Personal" category. Of these, the major weather factors were:

- Winds (42 percent)
- Visibility/Ceiling (25 percent)

(2) 296 weather-related accidents (13 percent of the GA weather-related accidents) were in the "Instructional" category. Of these, the major weather factors were:

- Winds (59 percent)
- Icing (13 percent)

(3) 223 weather-related accidents (10 percent of the GA weather-related accidents) were in the "Business" category. Of these, the major weather factors were:

- Visibility/Ceiling (35 percent)
- Winds (26 percent)

(4) 18 weather-related accidents (approximately 1 percent of the GA weather-related accidents) were in the "Corporate/Exec" category. Of these, the major weather factors were:

- Visibility/Ceiling (53 percent)
- Precipitation (20 percent)

(5) 30 weather-related accidents (approximately 2 percent of the weather-related accidents) involved FAR 135 operations. Of these, the major weather factors were:

- Visibility/Ceiling (35 percent)
- Winds (25 percent)
- Precipitation (21 percent)

(6) Approximately 2 percent of the weather-related accidents involved FAR 121 operations. Of these, the major weather factors were:

- Turbulence (43 percent)*
- Precipitation (18 percent)

* All but one of the FAR 121 turbulence accidents involved injuries to passengers and flight attendants. There was only one FAR 135 turbulence accident.

d. NTSB data indicate that approximately 55 percent of all weather-related accidents show no record of weather briefing. (The lack of data about pilot weather briefing suggests study in other areas such as pilot training and ease of obtaining weather information.)

e. Over the 1988 to 1992 time period, the annual number of weather-related accidents has declined. However, the annual number of weather-related accidents has remained roughly constant as a percentage of total accidents. The annual number of weather-related incidents has also declined.

f. The most prevalent cause factors in fatal accidents were as follows:

Visibility/Ceiling:	cited 672 times
Icing:	cited 45 times
Thunderstorms:	cited 41 times

g. A review of weather-related incidents tends to confirm what is seen in the accident data.

5.8 NTSB - Accidents Due to Inadequate Preflight Planning/Preparation. One very valuable way to determine minimum preflight planning/preparation requirements is to look at the specific causes of accidents where the NTSB has identified preflight planning/preparation and/or related subject codes as the accident causes or factors. Table 11 shows the numbers of accidents that occurred during the five year period 1988 - 1992 in these selected subject codes. Roughly 11 percent of the GA accident in this 5 year time period are associated with these 6 subject codes.

TABLE 11. NUMBERS OF PART 91 ACCIDENTS BY SELECTED NTSB SUBJECT CODES							
YEAR	TOTAL PART 91 ACCIDENTS	SELECTED NTSB SUBJECT CODES*					
		24000	24001	24002	24004	24006	24013
1988	2239	23	205	100	1	27	5
1989	2098	92	115	81	3	22	5
1990	2083	62	61	82	3	24	1
1991	2049	32	92	69	4	17	2
1992	1955	11	98	48	4	17	2
Total	10424	220	571	380	15	107	15

*Note: The NTSB Subject Codes are defined as shown below:

NTSB Subject Code	Specification
24000	Planning-decision
24001	Preflight planning/preparation
24002	Aircraft preflight
24004	Ice/frost removal from aircraft
24006	Aircraft weight and balance
24013	NOTAMS

Typically, the NTSB assigns multiple subject codes as probable causes/factors in a given accident. By reviewing and counting these codes and by reviewing accident narratives for 1991, the author attempted to define quantitatively the major issues that are leading to FAR Part 91 accidents associated with inadequate preflight planning and preparation. This analysis made use of the Natural Language analytical tool of the National Aviation Safety Data Center (NASDC) using the "short NTSB tape". The steps involved in this analysis were as follows:

Step 1. Select the 1988 - 1992 NTSB accidents that have one of three NTSB subject codes (24000, 24001, 24002) as cause or factors. (Subject code 24013 was not included in the first step of this analysis since table 11 shows that the numbers of accidents involving this code were not large. Subject codes 24004 and 24006 were not included in the first step of this analysis since these codes are largely self-explanatory and do not require the detailed analysis needed to decipher codes such as 24000, 24001, and 24002.)

Step 2. Eliminate the NTSB findings that are meaningless (eg. subject code (0) with modifier type (0)). Count the remaining findings associated with each subject code (24000, 24001, and 24002).

Step 3. Combine the counts of the NTSB findings that say the same thing via different combinations of subject code/modifier type [eg. review of the narrative of selected 1991 accidents indicates that the following combinations of NTSB subject code/modifier type all mean that the pilot flew the aircraft out of fuel:

- (1) fluid fuel (17001) exhaustion (1131)
- (2) fuel system (15100) exhaustion (1131)
- (3) fluid (17000) exhaustion (1131)
- (4) fuel supply (22204) inadequate (3115)
- (5) fuel supply (22204) misjudged (3120)]

Step 4. Count the findings that occurred in significant numbers under each of the subject codes 24000, 24001, and 24002.

Step 5. List the findings with the largest counts for each of the subject codes 24000, 24001, and 24002. (If a finding has a large count under subject code 24000, the count is also calculated under subject code 24001 and 24002 even though it may not have been significant in either of those subject codes.)

Step 6. Combine the three subtotal lists obtained in steps 1 through 5 and calculate for each of the findings its percentage of the total meaningful findings (4188) for the subject codes 24000, 24001, and 24002.

The five year counts developed in steps 1 through 5 are shown in Tables 12A through 12C. The results of step 6 are shown in Table 13.

Table 12A. Number of Findings Associated with Planning-decision (24000) Accidents	
Cause/Cause Factors	Number
Aircraft Maintenance/Mechanical	36*
Fuel Contamination	3
Fuel Exhaustion	112
Fuel Starvation	7
Light Conditions	24
Object (collision)	52
Terrain Conditions	60
VFR Flight into IMC	10
Weather Conditions	<u>93</u>
Subtotal:	397

Table 12B. Number of Findings Associated with Preflight Planning/Preparation (24001) Accidents	
Cause/Cause Factors	Number
Aircraft Maintenance/Mechanical	119*
Fuel Contamination	22
Fuel Exhaustion	292
Fuel Starvation	34
Light Conditions	59
Object (collision)	122
Terrain Conditions	179
VFR Flight into IMC	56
Weather Conditions	<u>197</u>
Subtotal:	1080

Table 12C. Number of Findings Associated with Aircraft Preflight (24002) Accidents	
Cause/Cause Factors	Number
Aircraft Maintenance/Mechanical	67*
Fuel Contamination	123
Fuel Exhaustion	161
Fuel Starvation	46
Light Conditions	11
Object (collision)	66
Terrain Conditions	100
VFR Flight into IMC	0
Weather Conditions	<u>14</u>
Subtotal:	588

Note: *With the methodology used, this number is probably significantly understated.

Table 13. Combined Total Number of Findings Associated with Selected Accidents (Subject Codes: 24000, 24001, 24002)		
Cause/Cause Factors	Number	Percentage
Aircraft Maintenance/Mechanical	222*	5.3%*
Fuel Contamination	148	3.5%
Fuel Exhaustion	565	13.5%
Fuel Starvation	87	2.1%
Light Conditions	94	2.2%
Object (collision)	240	5.7%
Terrain Conditions	339	8.1%
VFR Flight into IMC	66	1.6%
Weather Conditions	304	7.3%
Subtotal:	2065	49.3%

Note: *With the methodology used, both the number and the percentage of aircraft maintenance/mechanical accidents are probably significantly understated. For a preflight perspective, one would like to quantify the number of accidents, due to maintenance/mechanical issues, that could have been/should have been identified by the pilot during preflight preparation. In a large number of cases, the NTSB accident records do not provide this information.

In considering the results of Tables 11 and 13, it would be well to first reflect on the intent of this research effort. This effort addresses the question, "How can the FAA empower the General Aviation (GA) community to minimize the number of accidents resulting from inadequate preflight planning and preparation?" A key issue is how best to provide the preflight services needed by GA and how best to encourage a greater percentage of pilots to do adequate preflight preparation. With these thoughts in mind, Tables 11 and 13 can be interpreted as follows:

- a. In this 5 year time period, roughly 11 percent of the GA accident are associated with these 6 subject codes. Thus, if a significant number of these accidents could be prevented, it would make a noticeable improvement in the GA accident rate.
- b. Fuel mismanagement appears to be the area of greatest problems, accounting for 19 percent of the findings associated with subject codes 24000, 24001, and 24002 (approximately 222 accidents in the five year time period). Fuel exhaustion alone accounts for 13.5 percent of the meaningful NTSB findings (approximately 158 accidents in the five year time period). In the long run, perhaps more

effort should be given to solving the difficult problem of how to provide a more accurate estimate of the remaining usable aircraft fuel. In the mean time, however, pilots need to exercise greater vigilance on the issues involved with fuel management.

c. Weight and balance appears to be the second biggest problem, accounting for 107 accidents over the five year period. This also is an area where pilots need to exercise greater vigilance.

d. Terrain conditions, light conditions, and object (collision) constitute 16 percent of the findings associated with subject codes 24000, 24001, and 24002. However, the vast majority of these findings simply reflect the results when pilots made forced landings.

e. Weather conditions show up as an issue in Table 13. However, since this issue was addressed in much greater depth in paragraph 5.6, it will not be further addressed here.

f. Of the problems identified in this portion of the analysis, it is not clear that any of them would be mitigated via the provision of additional services from the FAA.

5.9 Minimum Preflight Planning Preparation - Summary. From a variety of perspectives, section 5 has addressed minimum preflight planning requirements. The list of requirements is long and it appears to have grown over the last decade. Over the next decade, as technology and economics permit, it is likely to grow still longer. In constantly striving to improve safety, both pilots and safety officials regularly consider whether accidents could be avoided by providing the pilot with additional information. For a set of very narrowly defined circumstances, one could certainly develop a minimum preflight planning requirements. As the circumstances are defined more broadly, however, this task becomes more difficult. When the circumstances include all GA flights, the "minimum list of preflight planning requirements" could easily include all of the items addressed in the various paragraphs in section 5. Under such broad circumstances, safety argues against the deletion of any of these items.

6.0 CONCLUSIONS.

6.1 Size of the Preflight/Weather Briefing Market. Between the state aviation departments and the commercial vendors, the non-federal portion of the preflight/weather briefing market is large. It has grown considerably over the last decade and it now appears to be much larger than what most FAA officials realize. (Although accurate figures are NOT readily available, the non-federal portion of the market appears to be on the order of 8 million pilot briefings annually.)

The total annual number of DUAT briefings has also grown over the four years it has been available (4.4 million transactions in the Feb 1992 to Feb 1993 time period). By contrast, the total annual number of FSS briefings has declined (from 18.7 million in FY 1979 to 10.7 million in FY 1992) and the total number of FSS flight services has also declined significantly since 1980¹⁷.

Although the FAA makes decisions that affect this market, many mid-level FAA managers do not appear to have a clear understanding of the entire market and of the effect of agency decisions on the non-federal portion of this market. While many mid-level FAA managers appear uninterested in the non-federal portion of the market, there are growing indications that top level FAA management is starting to pay more attention to this market segment.

6.2 Cost of Preflight/Weather Briefing Services. There are significant differences in the costs associated with the various services available to the GA pilot. The traditional FSS briefing cost about \$9.50 (per AOPA; FAA has not studied this issue in detail and can not provide their own cost estimate). The cost of a DUAT briefing has declined from \$3.48 to \$1.91 (see Table 1). The cost of state briefing systems vary and accurate data are not available in many cases. However, for those state from whom such costs have been obtained, the cost per briefing appears to be well under \$1.00 (see Table 7).

6.3 DUAT - Success and Shortcomings. DUAT has been a highly successful program. During the four years when DUAT operation grew from nothing to 4.4 million annual transactions, FSS briefings decreased from 11.4 to 10.7 million per fiscal year. Thus, DUAT has brought about an increase in preflight planning and, in so doing, has helped to reduce the number of GA accidents. It is also encouraging to see that the cost per transaction has decreased significantly. Perhaps this cost would drop significantly further if the FAA chooses to recompetete these contracts.

In spite of its success, DUAT is not perfect. In specific, many pilots have commented that the system is not nearly as "user-friendly" as what it could be.

6.4 AWOS/ASOS - Success and Shortcomings. The broad implementation of AWOS has been well received by the aviation community and by many other sectors. Many different government entities are involved in this implementation including FAA, NWS, state aviation departments, state highway departments, Department of Agriculture, and others.

All of this can lead to duplication of efforts. One state aviation official has spoken of a case where the NWS and a state DOT highway department both installed automated observation systems roughly 100 yards apart. The agencies involved subsequently realized that either facility could have satisfied both agencies' needs for weather information at that location. Steps have now been taken to avoid such duplication in this state but similar duplication could still take place in other states.

There are still some holes in AWOS/ASOS coverage. Cooperation among state and federal agencies could do much to fill these holes and make this information available on a national basis.

Weather observations from many of the non-federal AWOS's are provided to the FAA for national distribution. Although this is not universally the case, steps are being taken to link some of the current stand alone systems. As an example, Virginia state aviation officials have obtained AIP funding to cover the capital investment required to set up a satellite link that sends AWOS weather observations to the FAA via NADIN. Since this has happened recently and many other state aviation departments are not yet aware of this. Many FAA regional AIP officials may not be aware of it either.

(While ASOS is very similar to AWOS, it has been less well received in aviation circles. A large number of ASOS facilities have been installed but not commissioned because money has not been available to distribute their observations via NADIN. Weather sensors facilities are of limited value to aviation if their observations are not readily available via a distribution system. Thus, a significant number of ASOS facilities are uncommissioned and relatively unused.)

7.0 RECOMMENDATIONS.

7.1 Reexamine the Paradigm and the Roles/Responsibilities of the Various Players. The FAA should reexamine the paradigm of preflight/weather briefings. Preferably this should be done by an independent entity outside the FAA and the effort should be managed by an FAA official who is outside the traditional FSS complex. This effort should look at all portions of the market (federal, state, and commercial vendors) and should consider the respective roles of the various players in this market.

7.2 Commercial Weather/Preflight Briefing Services. The FAA should study the commercial preflight briefing services market and use this information as an input in their decision making. For reasons discussed in Appendix D, the preflight briefing market is not well understood by FAA personnel at this time. Even basic questions on the size of the various non-federal components of this market can not be answered with precision. The FAA has an obvious interest in being able to influence this market. Better knowledge is required to do this wisely.

7.3 State Weather/Preflight Briefing Services. The FAA should study the state-implemented preflight briefing systems and use this information as an input in their decision making. A number of states have implemented weather briefing systems on a statewide basis. These systems are both inexpensive and popular. The FAA should study what has been done at the state level and consider whether any of their innovative approaches could be applied nationally and/or whether similar efforts should be encouraged in other states.

7.4 Influencing the Preflight Briefing Market. In the interest of controlling federal spending while still ensuring that user needs are being met, the FAA should consider what actions the agency can take in order to influence the preflight briefing market (both commercial and state-implemented). FAA may have a statutory responsibility to ensure that adequate preflight services are provided, however, the agency does not need to provide ALL preflight services to ALL users.

Private industry is often better at responding to customer needs than the Federal Government. State aviation departments have also implemented some innovative services. The FAA should encourage both industry and the states to satisfy user needs and should cooperate with them in this regard. The FAA should also consider whether federal/state partnerships could provide better, more cost-effective weather information services.

7.5 DUAT Modifications. The FAA should consider recompeting these contracts in the interest of reducing the cost per briefing. The FAA should also consider what can be done to make DUAT more user-friendly. (Time constraints may dictate that the

FAA first negotiate sole source extensions of the current DUAT contracts. At the same time, however, if DUAT is to be retained, the FAA should consider starting procurement of long term replacement contract(s) for an additional five years of DUAT services.

7.6 AWOS/ASOS Implementation and Linkage. In cooperation with both state-level and federal-level government agencies, the FAA should work to fill in the holes in AWOS/ASOS coverage nationally and to link stand alone AWOS/ASOS station for national distribution via NADIN. Using the same cooperative process, the FAA should replace the older AWOS I's and AWOS II's with AWOS III's and, eventually (where required, when they become available), with AWOS IV's.

7.7 Discussion with the Aviation Community. This has been a limited research effort and did not include significant discussion with many segments of the aviation community. The FAA should initiate extensive discussion prior to making any decisions that could result in a fundamental restructuring of the preflight briefing market.

7.8 Regional Aviation Weather User's Forums. The FAA should consider hosting regional forums modelled after the National Aviation Weather User's Forum held November 30 - December 2, 1993.

7.9 Cooperation Among Weather Information Providers. The FAA and the NWS should look to establish more effective cooperation between governmental entities at the federal and state levels. Many different departments need weather information. Cooperation could lead to better funding arrangements and could eliminate duplications of efforts.

7.10 Pilot Information Center (PIC). Currently, PIC does not appear to have an internal FAA sponsor and there is no strong support for such a system from the users. Thus, the FAA should not implement the PIC at this time. Industry is better able to finance, develop, and implement such a service. Industry is also better able to respond to the constantly changing environment, technology, and the changing needs of their customers. State aviation officials have also demonstrated their ability to implement preflight/weather information systems. With FAA encouragement, either state or vendor systems might be expanded to include PIC menu items that have not yet been implemented. (In some cases, the FAA might contract for the development of the software required to support a particular PIC menu item and let others (states and/or vendors) cover the implementation and operations costs.)

8.0 ENDNOTES.

- ¹ "Pilot Information Center (PIC) Initiative", pg 15, unnumbered letter report, Catherine A. Adams, Advanced Aviation Concepts, FAA Office of Safety Information and Promotion, Washington, DC.
- ² "Weather Briefing Use and Fatal Weather Accidents", pg 21, Golaszewski, R., Gellman Research Associates, Transportation Research Record 1158, Aviation Papers, Transportation Research Board, National Research Council, Washington, DC., 1988.
- ³ "Weather Briefing Use and Fatal Weather Accidents", pg 27, Golaszewski, R., Gellman Research Associates, Transportation Research Record 1158, Aviation Papers, Transportation Research Board, National Research Council, Washington, DC., 1988.
- ⁴ "National Transportation Safety Board, Annual Review of Aircraft Accident Data, U.S. General Aviation Calendar Year 1989." PB93-160687, NTSB/ARG-93/01, NTSB, Washington, DC.
- ⁵ "FAA Air Traffic Activity - FY 1979", table 15, pg 174. FAA Office of Aviation Policy and Plans, Washington, DC, 1980.
- ⁶ "FAA Air Traffic Activity - FY 1992", table 15, pg 142. FAA Office of Aviation Policy, Plans, and Management Analysis, Washington, DC, 1993.
- ⁷ "Direct User Access Terminal (DUAT) Service, Summary Sheet - February 1989 to February 1993," FAA, Washington, DC, 1993.
- ⁸ "Directory of Non-Federal Automated Weather Observing Systems (AWOS)", listing obtained from Kenneth Kraus, July 1, 1993.
- ⁹ Telephone discussions with Montana state aeronautical personnel, October 1993.
- ¹⁰ Telephone discussions with Nebraska state aeronautical personnel, October 1993.
- ¹¹ Telephone discussions with North Dakota state aeronautical personnel, October 1993.
- ¹² Telephone discussions with Virginia state aeronautical personnel, October 1993.
- ¹³ Telephone discussions with Wisconsin state aeronautical personnel, October 1993.
- ¹⁴ "Business and Commercial Aviation" Magazine, various issues: April 1981, April 1982, April 1984, April 1986, April 1988, May 1990, May 1991, May 1993.

¹⁵ "Aviation Weather Hazards - FAA System for Disseminating Severe Weather Warnings to Pilots", pg 11, General Accounting Office briefing report to Congressional requesters, GAO/RCED-86-152BR, April 1986.

¹⁶ "Aviation Weather Hazards - FAA System for Disseminating Severe Weather Warnings to Pilots", pg 11, General Accounting Office briefing report to Congressional requesters, GAO/RCED-86-152BR, April 1986.

¹⁷ "FAA Air Traffic Activity - FY 1992", table I-4, pg I-6, and table 15, pg 142. Total FSS flight services have declined from a peak of 69,597,566 in FY 1979 to 39,734,200 in FY 1992. FAA Office of Aviation Policy, Plans, and Management Analysis, Washington, DC, 1993.

APPENDIX A: REFERENCES

1. "Weather Related Federal Aviation Regulations: General Aviation, Air Carrier, and Air Taxi and Commercial Operations", Graham K. Glover, draft MITRE report No. MTR 93W0000069, June 1993.
2. "Weather Briefing Use and Fatal Weather Accidents", Golaszewski, R., Gellman Research Associates, Transportation Research Record 1158, Aviation Papers, Transportation Research Board, National Research Council, 1988, FOB10A TE5.3.H5A31.
3. "Pilot Information Center (PIC) Initiative", unnumbered letter report, Catherine A. Adams, Advanced Aviation Concepts, FAA contract DTFA01-88-R-00059, Federal Aviation Administration, Office of Safety Information and Promotion, Washington, DC, July 1990.
4. "Performance Guidelines for Pilot Information Centers", NASAO document FAA Contract DTFA01-90-P-01286, April 1991.
5. "Aviation Weather Hazards - FAA System for Disseminating Severe Weather Warnings to Pilots", General Accounting Office briefing report to Congressional requesters, GAO/RCED-86-152BR, April 1986.
6. "Special Study, U.S. General Aviation Takeoff Accidents: The Role of Preflight Preparation", NTSB-AAS-76-2, 10 March 1976, FOB10A TL504.A3.
7. "Special Study, Nonfatal, Weather-Involved General Aviation Accidents", NTSB-AAS-76-3, 27 May 1976, FOB10A TL504.A3.
8. "Special Study of Fatal, Weather-Involved, General Aviation Accidents", NTSB-AAS-74-2, 28 August 1974, FOB10A TL504.A3.
9. "Safety Report - General Aviation Accidents Involving Visual Flight Into Instrument Meteorological Conditions", NTSB/SR-89/01, 8 February 1989, Government Accession No. PB89-917001, FOB10A TL720.5.U85.
10. "Joseph T. Nall General Aviation Safety Report - 1992 Accident Trends & Factors", Aircraft Owners and Pilots Association Air Safety Foundation, Frederick, MD, 1993.
11. "Access Policy for Non-FAA Users and Foreign Correspondents to the NICS", FAA Order 1830.1A, September 16, 1986, Washington, DC.
12. Draft "Memorandum of Agreement Between FAA and Alaska Airlines", undated, Washington, DC.

13. "International Civil Aviation Organization Three-Letter and Radiotelephony Designators", FAA Advisory Circular AC120-26H, June 21, 1991, Washington, DC.
14. "Business and Commercial Aviation" Magazine, various issues: April 1981, April 1982, April 1984, April 1986, April 1988, May 1990, May 1991, May 1993.
15. "FAA Air Traffic Activity - FY 1992," Nancy Trembley, FAA Office of Aviation Policy, Plans, and Management Analysis, Washington, DC, 1993.
16. "Airman's Information Manual," FAA, Washington, DC, September 16, 1993.
17. "Special Review - Aviation Safety," FAA Offices of Integrated Safety Analysis and Safety Information and Promotion, Washington, DC, November 24, 1993.

APPENDIX B: CORRELATION - ACCIDENTS AND INADEQUATE PREFLIGHT PREPARATION

This Appendix quotes heavily from a variety of documents in order to show the correlation between accidents and poor preflight planning.

1. **"Special Study, U.S. General Aviation Takeoff Accidents: The Role of Preflight Preparation", NTSB-AAS-76-2, 10 March 1976, FOB10A TL504.A3.** This study involved a review of GA accidents from 1970 to 1974 and an in-depth examination of takeoff accidents in 1974. The Safety Board expressed its concern that pilots may not be fulfilling their responsibilities to ensure safe takeoffs. Accident data indicate that too little preparation is made for the actual takeoff of the aircraft.

While the number of GA accidents has shown a downward trend in recent years, the accident and fatality/serious injury statistics indicate an increase in the percentage of accidents during takeoff. From 1970 through 1974, 822 people died and 741 were seriously injured in 386 takeoff accidents. The most disturbing aspect of the takeoff problem is the high ratio of fatal accidents to total accidents. From 1970 through 1974, 10 in every 100 takeoff accidents were fatal. By comparison, only 4.4 in every 100 approach and landing accidents were fatal.

The Safety Board's statistics clearly indicate that most takeoff accidents are operational (accidents where the pilot can exercise a high degree of control over the causal factors). The primary cause/factor was the pilot, which was cited in 87 percent of all takeoff accidents and in 90 percent of all fatal takeoff accidents.

The Safety Board divides the broad pilot cause/factor category into 51 detailed cause/factors. In the accidents reviewed during this study, **"inadequate preflight preparation and/or planning"**, **"failed to maintain/obtain flying speed"**, **"failed to maintain directional control"**, **"failed to abort takeoff"**, **"selected unsuitable terrain and lack of familiarity with aircraft"** were cited as cause/factors more than any others, and represented over 50 percent of all fatal takeoff accidents. The fact that **"inadequate preflight planning and/or preparation"**, **"selected unsuitable terrain"**, and **"lack of familiarity with aircraft"** are a result of a lack of pilot preparation further emphasizes the need for better preflight planning.

2. **"Special Study, Nonfatal, Weather-Involved General Aviation Accidents", NTSB-AAS-76-3, 27 May 1976, FOB10A TL504.A3.** This study involved a review of GA accidents from 1964 to 1974. Of 54,039 accidents during these 11 years, 47,093 were nonfatal, 10,471 involved weather, and 7,856 were nonfatal weather-involved

accidents. This study concentrated on those 7,856 nonfatal weather-involved accidents.

From 1964 to 1974, the GA nonfatal accident rate dropped from 30 per 100,000 aircraft hours to slightly under 12 per 100,000 aircraft hours. However, from 1965 to 1968, the weather-involved nonfatal GA accidents grew from 10 percent to 19 percent of all GA nonfatal accidents. (From 1968 to 1974, this percentage has remained relatively constant.)

During the 11-year period, "inadequate preflight planning preparation and/or planning" was the most frequently cited cause in which both pilots and weather were involved. Statistics reveal that most of the nonfatal, weather involved GA accidents occurred during the landing regime, i.e., either during the landing roll or during leveloff and touchdown, when unfavorable wind conditions existed, and the weather was VFR. Unfavorable winds were cited five times more frequently as a cause or a factor than were low ceilings, and 16 times more frequently than was thunderstorm activity. Statistics also reveal that a pilot was 12 times more likely to encounter weather as predicted than to encounter weather worse than predicted.

3. "Special Study of Fatal, Weather-Involved, General Aviation Accidents", NTSB-AAS-74-2, 28 August 1974, FOB10A TL504.A3. Weather is the most frequently cited causal factor in fatal, GA accidents. This study examines weather-involved, fatal GA accidents during 1964 through 1972. Of 45,321 total GA accidents, 8,471 involved weather and 2,026 were both fatal and involved-weather.

Of the major types of pilot involvement during the 9 years studied, the most frequently cited cause was: "continued VFR flight into adverse weather conditions". The next most frequently cited causes, by order of frequency were: "inadequate preflight preparation and/or planning", "attempted operation beyond experience/capacity level", and "failure to obtain/maintain flying speed".

4. "Weather Briefing Use and Fatal Weather Accidents", Golaszewski, R., Gellman Research Associates, Transportation Research Record 1158, Aviation Papers, Transportation Research Board, National Research Council, 1988. This paper examines the qualitative reduction in risk associated with the use of a weather briefing. It examines fatal accidents during 1964 through 1981 where weather is cited as a cause or factor. Statistics show that pilots of these flight had a lower incidence of use of weather briefing use than the pilot population overall. Weather accidents represent almost 40 percent of all fatal GA accidents. They are characterized as being related most often to flight in low ceilings or when fog or rain is present. The types of pilot error in fatal weather-involved accidents include

continued visual flight into adverse weather conditions, improper preflight planning, and improper inflight decision making. Results show that a fatal weather-involved accident is about 2 1/2 to 3 times as likely if a flight did not have a weather briefing. The study also showed an increased use of weather briefings could reduce fatal weather accidents. For example,... a 3 percent increase in the population use of weather briefings is projected to reduce fatal weather accidents by about six accidents per year for single-engine piston airplanes (best estimate). Depending on the true population use of weather briefings, the reduction in accidents could range from 1.5 to 22.2 per year. ... the maximum reduction possible occurs when all flights are briefed.... This level would reduce fatal weather accidents in multiengine piston airplanes by 7.2 in the upper-bound case. (For single-engine piston airplanes, 100 percent use of weather briefings is estimated to reduce fatal weather accidents by 57.7 per year.

5. "Safety Report - General Aviation Accidents Involving Visual Flight Into Instrument Meteorological Conditions", NTSB/SR-89/01, 8 February 1989, Government Accession No. PB89-917001, FOB10A TL720.5.U85. Between 1975 and 1986, accidents involving VFR flight into instrument meteorological conditions (IMC) accounted for 4 percent of all GA flights but produced 19 percent of the resulting fatalities. While the GA accident rate was reduced 37 percent over the 12 year period, the VFR flight into IMC accident rate decreased by 64 percent. Seventh-two percent of the VFR flight into IMC accidents were fatal which was substantially higher than the corresponding 17 percent of all GA accidents.

This report presents a statistical compilation of data from the NTSB's Aviation Accident Data System. The data include 361 GA accidents that occurred between 1983 and early 1987. In all of these accidents, VFR flight into IMC was listed as a probable cause or a related factor. There were 276 fatal accidents that resulted in 583 fatalities. Ninety-four percent of the aircraft involved in these accidents were airplanes; the remainder were helicopters.

For the 361 GA accidents reviewed, 1,121 "probable causes" and 1,714 "related factors" were cited. About 40 percent of these causes were attributed to "Flightcrew - Obtaining and Using Weather Information". About 14 percent were attributed to "Flightcrew - Planning and Decision Making". Roughly 29 percent of the "Planning and Decision Making" causes were attributed to "Preflight planning/preparation".

6. "Joseph T. Nall General Aviation Safety Report - 1992 Accident Trends & Factors", Aircraft Owners and Pilots Association Air Safety Foundation, Frederick, MD, 1993. "Weather continues to play a significant role in the serious accident picture, affecting single-engine retractables and multi-

engine aircraft used in cross-country flight. The leading weather-related cause in all classes continues to be 'VFR flight into IMC.'" pg. 21

"Accidents in the takeoff and approach phases of flight were greatest in the multi-engine class. Class-specific causes such as engine failure, V_{mc} loss of control, etc. did not seem to significantly affect these statistics. **Poor takeoff planning and preparation appear to have been more of a factor in takeoff accidents in all classes. (Bold emphasis added.)** Weather played a large role in multi-engine approach accidents." pg. 22

APPENDIX C: GROWTH AND CHANGES IN THE NUMBER OF VENDORS

This appendix contains information showing growth and changes in the number of commercial vendors providing aviation weather and other data bases for preflight planning. Over the last dozen years, this market has grown significantly both in the numbers of providers and in the diversity of services they provide.

The information shown below is based on surveys published in Business and Commercial Aviation (B&CA) magazine in the following issues: April 1981, April 1982, April 1984, April 1986, May 1991, and May 1993. Material in this appendix is a condensation. Review of the May 1993 and/or the May 1991 issues of B&CA would provide a more complete view of the broad diversity of services available.

In addition to the vendors shown in this appendix, there is also a larger and rapidly growing number of vendors who provide a wide variety of aviation computer services. These are not included in the totals shown below because they are outside the focus of this effort.

TABLE C-1. GROWTH AND CHANGES IN THE NUMBER OF COMMERCIAL VENDORS - FLIGHT PLANNING AND WEATHER			
Date	Total Number of Vendors	Flight Planning Vendors	Weather Vendors
April 1981	5	*	*
April 1982	16	*	*
April 1984	16	11	16
April 1986	19	12	19
April 1988	23	16	20
May 1990	20	12	13
May 1991	22	14	15
May 1993	22	19	15

*Note: In the 1981 and 1982 surveys, B&CA did not specify whether the vendors provided flight planning services, weather services, or both types of services.

April 1981 Issue, Flight Planning

Air Routing International
Aircraft Owners and Pilots Association
Lockheed Aircraft Service Company
National Weather and Aviation Corporation
Universal weather and Aviation

April 1982 Issue, Flight Planning/Weather Service

Air Routing International
Aircraft Owners and Pilots Association
Aviation Information Services
Aviation Safety Institute
CompuServe
Craig Research
Engineering Management Information
Flight Research, Inc.
Global Weather Dynamics
Heath Co.
Kavouris, Inc.
Lockheed Data Plan, Inc.
National Weather Corporation
SynSat Communications
Universal Weather and Aviation
Weather Services International

April 1984, Weather Services

Alden Electronics (weather charts)
Air Routing International (flight planning, weather)
Compuflight (weather, flt. planning, regs., safety info.)
Craig Research (weather charts)
Engineering Management Information (flt. planning, weather)
Flight Ops (flight planning, weather, maint.)
Global Weather Dynamics (weather, flight planning)
Jet Services (flight planning, weather, maint.)
Kavouris (weather radar, flight planning)
Lockheed DataPlan (flight planning, weather, mgmt, maint.)
National Weather Corp. (flight planning, weather)
R-SCAN Corp. (satellite weather maps)
Southern Marine Research (weather charts)
Universal Weather & Aviation (flight planning, weather)
Weather Network Inc. (weather)
WSI (weather)

April 1986 Issue, **Weather Services**

Air Routing International (international flight planning, weather)
Alden Electronics (weather radar graphics)
Aviotex (weather, flight planning)
Compuflight (weather, flight planning, regulations, safety information)
CompuServe (flight planning, weather)
Craig Research (weather charts)
Daniel Systems (weather, maintenance, management)
EMI Aerodata (flight planning, weather)
Flight Ops (flight planning, weather, maintenance)
Global Weather Dynamics (weather, flight planning)
Kavouras (weather radar, flight planning)
Lockheed DataPlan (international flight planning, weather, management, maintenance)
National Weather Corp. (international flight planning, weather)
Noetic Systems Inc. (weather, flight planning)
R-SCAN Corp. (weather)
Universal Weather & Aviation (international flight planning, weather)
Weather Network (weather)
WeatherTalker (auto. ATIS)
WSI Corp. (weather)

April 1988 Issue, Service Bureau Weather Vendors

Accu-Weather Inc.
Aero Software
Air Routing International Corp.
Aviation Time Management Inc.
Aviotex
CompuServe
Flight Data Center
Global Weather Dynamics, Inc.
Global Wulfsberg Systems
International Aero Lease Inc.
Kavouras, Inc.
Lockheed DataPlan
Micro Aviation Weather System
Multi Service Corp.
National Weather Corp.
Pan Am Weather Systems
R-Scan Corp.
Satellite Information Services Corp.
Universal Weather and Aviation
WSI Corp.

April 1988 Issue, Service Bureau Flight Planning Vendors

Accu-Weather Inc.
Air Routing International Corp.
Aviotex
Compuflight
CompuServe
EMI Aerocorp, Inc
Flight Data Center
Global Wulfsberg Systems
International Aero Lease Inc.
Lockheed DataPlan
Multi Service Corp.
National Weather Corp.
Pan Am Weather Systems
RMS Technology, Inc.
Universal Weather and Aviation
WSI Corp.

April 1990 Issue, Aviation Weather Providers

Accu-Weather Inc.
Air Routing International Corp.
Contel Federal Systems
CompuServe
Data Transformation Corp.
Global Weather Dynamics, Inc.
Global-Wulfsberg Systems
Jeppesen DataPlan
Kavouras, Inc.
Lasertrak Corp.
Universal Weather and Aviation, Inc.
Weather Network, Inc.
WSI Corp.

April 1990 Issue, Flight Planning System Vendors

Ac-U-Kwik Navpak
Aviation Software and Analysis, Inc.
Compuflight
Contel Federal Systems
Data Transformation Corp.
EMI Aerocorp, Inc
Global-Wulfsberg Systems
Jeppesen DataPlan
Lasertrak Corp.
Multi Service Corp.
RMS Technology, Inc.
System One Corp.

May 1991 Issue, Flight Planning Service Providers

AC-U-Kwik Navpak
Aviation Software and Analysis
Compuflight
Contel Federal Systems
Data Transformation Corp.
EMI Aerocorp, Inc
Global Wulfsberg Systems
Jeppesen DataPlan
Kavouras, Inc.
Lasertrak Corp.
Multi Service Corp.
Pan Am Weather Systems, Inc.
RMS Technology, Inc.
System One Corp.

The May 1991 issue of B&CA contains a two page matrix showing the service available from each provider: Their flight planning areas (US, Canada/Alaska, global), their navigation database elements (airways/navaids, intersections, SIDs/STARs), supplemental databases (vendor provided, FBOs, Hotel/Motel), aircraft performance databases (vendor provided, user biasing, operating costs), tracks provided (direct, airways, RNAV), flight optimization planning, and distribution channel/remarks.

May 1991 Issue, Aviation Weather Vendors

Accu-Weather
Air Routing International Corp.
Baseops International
Contel Federal Systems
CompuServe
Data Transformation Corp.
Global Weather Dynamics, Inc.
Global Wulfsberg Systems
Jeppesen DataPlan
Kavouras, Inc.
Lasertrak Corp
Pan Am Weather Services, Inc.
Universal Weather and Aviation, Inc.
Weather Network, Inc.
WSI Corp.

The May 1991 issue of B&CA contains a two page matrix showing the services available from each vendor: ARINC/SITA/AFTN, service coverage (US, Canada/Alaska, Mexico/Caribbean, Int'l), meteorologist on duty, voice briefings, Int'l transmissions, Satellite imagery, DIFAX imagery (raw/custom), radar (live/composites), user required graphic capability, Int'l NOTAMs, flight plan filing, ARO filing, optimized flight plans, local access number, flight following.

May 1993 Issue, Flight Planning Service Providers

Ac-U-Kwik Navpak	GTE Federal Systems
Air Routing Int'l Corp.	Jeppesen DataPlan
Aviation Software and Analysis	Mentor Plus Software
BaseOps International	MultiService Corp.
Compuflight	Pan Am Systems
Data Transformation Corp.	RMS Technology, Inc.
EMI Aerocorp, Inc.	Spectrum Air Services, Inc.
Excel Software Corp.	Universal Weather & Aviation
Flight Data Centers, Inc.	WSI Corp.
Global Wulfsberg Systems/Sundstrand Data Control	

The May 1993 B&CA contains a one and one half page matrix showing the services provided by each of the above vendors: geographic coverage (US & Canada, Europe, Global), access (direct, network, FBO), supplemental databases (SIDs/STARs, Airports, FBOs/Hotels), performance data (aircraft optimization, operating costs), handling services (flight plan filing, ARO filing, flight following, overflight permits, message forwarding), prices, and remarks.

May 1993, Aviation Weather Vendors

Accu-Weather
Air Routing International Corp.
Baseops International
Data Transformation Corp.
EMI Aerocorp Inc.
Flight Data Centers Inc.
Global Weather Dynamics, Inc.
Global Wulfsberg Systems/Sundstrand Data Control
GTE Federal Systems
Jeppesen DataPlan
Kavouras, Inc.
Pan Am Services Inc.
Universal Weather and Aviation, Inc.
WSI Corp.

The May 1993 B&CA contains a one page matrix showing the services provided by each weather vendor: geographic coverage (US & Canada, Europe, global), access (direct, network FBO), voice briefings, FAX downloads, flight plan filing, ARO filing, optimized flight plans, Int'l NOTAMS, satellite imagery, user required graphics capability, price, and remarks.

APPENDIX D: VENDORS - PREFLIGHT BRIEFING SERVICES

In early 1993, the FAA proposed to terminate the funding of DUAT effective not later than February 1994 (the expiration date of the FAA's contracts with the two DUAT vendors). This precipitated a large volume of mail from pilots, user organizations, and Members of Congress. This appendix contains information developed by FAA personnel in response to one particular Congressional letter. Other than formatting, no changes have been made to this information. However, the author of this report would take exception to the following statements made later in this appendix:

STATEMENT: "According to a survey in the May 1993 issue of Business and Commercial Aviation, there are 21 private sector companies that provide aviation weather and flight plan services to pilots via computer terminals."

AUTHOR'S RESPONSE: There are 22 vendors that provide aviation weather and/or flight plan services to pilots. (In its response to Congress, the FAA did not include Aviation Software and Analysis (a flight planning vendor) in their list of vendors, because they are a Canadian firm and their system is not compatible with DUAT.)

Of these 22 vendors, 19 provide flight planning services and 15 provide aviation weather services. Many provide both types of services. It is important to recognize that not all vendors provide all services. Otherwise, it can lead one to mistaken conclusions (see next statement below).

STATEMENT: "For the past six years the number of computer weather briefing companies has remained fairly static with more than 20 vendors providing some or all aspects of this type of service. There have been some entries and exits, but these have resulted in a zero net effect."

AUTHOR'S RESPONSE: For the past seven years, the number of vendors providing aviation weather and/or flight plan services to pilots has increased from 19 to 22. However, the number of computer weather briefing companies has decreased from 19 to 15 (see Appendix C). In its original context, the statement above would lead readers to assume that the introduction of DUAT had not had an effect on the other vendors who were providing preflight weather services. However, closer analysis leads one to wonder why four vendors dropped out of this business between 1986 and 1991. (Determining the reasons was outside the scope of this research effort.)

DUAT SERVICE QUESTIONS/ANSWERS

QUESTION 1: How many private sector companies provide aviation weather services to pilots via computer terminals?

According to a survey in the May 1993 issue of Business and Commercial Aviation, there are 21 private sector companies that provide aviation weather and flight plan services to pilots via computer terminals. Attachment A lists these vendors and their services.

QUESTION 2: How much do weather briefings and flight plans cost from each vendor?

The cost for weather briefings and flight plan filing services from each vendor varies. Several vendors sell software packages which allows the pilot to access vendor databases via communication link. The cost for this s/w ranges from \$39.95 to \$3,090. Some vendors also charge an additional fee per minute for user connection time. The maximum cost per minute is \$2.50. In other cases, the pilot has access to weather briefing and flight plan filing via toll free numbers (800 numbers). Finally, other vendors pilots via voice or facsimile requests. See Attachment B for the listing of vendors and their associated fee for s/w, communication access time, and voice weather briefing and flight plan filing capability.

QUESTION 3: Are there trend data that show how fast the computer weather briefing industry is growing?

For the past six years the number of computer weather briefing companies has remained fairly static with more than 20 vendors providing some or all aspects of this type of service. There have been some entries and exits, but these have resulted in a zero net effect. An increase in the volume of transactions can be attributed to the two vendors available to indicate that this trend has followed suit in private companies. Additionally, there does not appear to exist a trade association for this industry.

QUESTION 4: What is the size of their business in dollars?

Many of the companies providing these services are privately held and not required to disclose this information. We have requested this information in the past, but have been unable to obtain it because the companies indicate that this is proprietary. We have no requirement or charter to obligate these companies to disclose this information.

QUESTION 5: How many flight plans are being filed through these other vendors?

the FAA does not presently maintain a separate breakout of flight plans filed by individual private vendors. Our system is programmed to count aggregate flight plans per ARTCC only. We have requested this information from some of the private vendors, but have been unable to obtain the information for the reasons cited above. It would take time and be costly to write the software necessary to collect these statistics internally.

QUESTION 6: What other services do they provide?

Eleven of the twenty-one vendors offer full "fixed based operator (FBO)" services, which include car rentals, hotel reservations, fueling services, and maintenance support. Many of the vendors provide international weather and coordinate airport handling activities (customs, fuel, etc.) at foreign airports.

QUESTION 7: How much does a pilot spend each year on computer weather briefings?

Because of the various methods of charging for services, it is not possible to cost pilot expenditures for computer weather briefings. However, based on the number of pilots registered on the DUATS system, the average usage is approximately 13 transactions per pilot per month. This number does not factor out the transactions that may actually be the result of "guest" users who are not required to be licensed pilots and, although they obtain weather briefings, do not actually file flight plans.

QUESTION 8: What percentage of the total transactions is for flight plan filing?

We have requested this information from several vendors not under contract with the FAA, but have been unable to obtain it. However, the percentage of DUATS transactions that was flight plan filing is listed below:

FY 1990 - 13.45% of transactions were flight plans
FY 1991 - 14.97% of transactions were flight plans
FY 1992 - 13.85% of transactions were flight plans

Also, the percent of total flight plans filed via DUATS increased from 2.8% in FY 1990 to 9.6% in FY 1992.

ATTACHMENT A TO APPENDIX D

LISTING OF VENDORS AND SERVICES

1. Accu-Weather, Inc. State College, PA
 - o provide flight plan filing/AROs and satellite imagery
 - o full color graphics and weather maps available via personal computer or DC DUAT and Flight Data Centers, Inc.
2. Air Routing International Corp. Houston, TX
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
 - o worldwide maps and data available at own personal computer (PC) through AirMet II program 24 hours a day; information updated daily
3. BaseOps International, Inc. Houston, TX
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
4. Data Transformation Corp. Turnersville, NJ
 - o provide FAX downloads, flight plan filing/ARO, optimized flight plans, and satellite imagery
 - o value-added services include Accu-Weather graphics and EAASY Sabre
5. EMI Aerocorp, Inc. St. Louis, MO
 - o provide FAX downloads, flight plan filing/ARO and optimized flight plans
 - o Autobrief en route briefings can be customized; access via Compuserve (modem) or voice phone for fax service

6. Flight Data Centers, Inc. Wilkes-Barre, PA
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
 - o Flightplanner provides access to multiple services; no minimum fees, time-triggered dispatch; NWS radar site database access
7. Global Weather Dynamics, Inc. Monterey, CA
 - o provide FAX downloadings, flight plan filing/AROs, optimized flight plans, and international NOTAMS
 - o feeds to customer mainframe; dedicated line "FCS: and satellite available; live color radar added to G*WISS.
8. Global Wulfsberg Systems/Sundstrand Data Control Redmond, WA

provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, and international NOTAMS
9. GTE Federal Systems Chantilly, VA
 - o provide FAX downloadings, flight plan filing/AROs, and international NOTAMS
 - o DUAT program provider-basic services free. Value-added weather graphics available; free software from GTE; EGA required for color; PC and MAC versions available.
10. Jeppesen DataPlan Englewood, CO
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
 - o worldwide weather also available through interactive fax (JeppFax)

11. Kavouras, Inc. Minneapolis, MN
 - o provide FAX downloadings, optimized flight plans, and international NOTAMS
 - o Access to real-time NWS radar; high-speed communications
12. Pan Am Services Minneapolis, MN
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
 - o FBO-based stations; Mexican flight information system
13. Universal Weather & Aviation Houston, TX
 - o provide voice briefings, FAX downloadings, flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
14. WSI Corp. Billerica, MA
 - o provide flight plan filing/AROs, optimized flight plans, international NOTAMS, and satellite imagery
 - o available through ASTROBrief and PILOTBrief workstations or WEATHER-view Software and Weather for Windows and WEATHERmac software
15. AC-U-KWIK NAVPAK Omaha, NE
 - o provide flight plan filing/following, AROs
16. Compuflight Port Washington, NY
 - o provide flight plan filing/following, AROs
17. Excel Software Corp. Saratoga, CA
 - o provide flight plan filing/following, AROs
 - o Graphical flight planner; integrated with DUATS for automated weather briefings/filings

18. Mentor Plus Software Aurora, OR
 - o provide flight plan filing/following, AROs
 - o FAA/ICAO flight plans. PC/mac compatible
19. MultiService Corp. Overland Park, KS
 - o provide flight plan filing/following, AROs
 - o Aerosoftware WeatherBrief 4.01 weather retrieval system
20. RMS Technology, Inc. Molalla, OR
 - o provide flight plan filing/following, AROs
21. Spectrum Air Services, Inc. Houston, TX
 - o provide flight plan filing/following, AROs

ATTACHMENT B TO APPENDIX D

LISTING OF VENDORS AND SERVICE FEES

1. Accu-Weather, Inc. State College, PA
 - o s/w packages for weather briefing: \$39.95
 - o shipping & handling charges: \$9.95
 - o connection time fees:
 - 12:00 p.m. - 5:00 a.m. - \$.31/min.
 - 5:00 p.m. - 7:00 p.m. - \$1.21/min.
 - 7:00 p.m. - 12:00 p.m. - \$.59/min.
 - o minimum monthly charge: \$9.95/month
2. Air Routing International Corp. Houston, TX
 - o cost of s/w packages for weather briefings: \$295
 - o connection time fees: \$.95/min.
 - o no minimum/monthly fees
3. BaseOps International, Inc. Houston, TX
 - o weather briefings/flight plans are done verbal or with text
 - o weather briefings: \$15 domestic, \$17.50 international
 - o flight plan filing: \$30 + \$2.00/page
4. Data Transformation Corp. Turnersville, NJ
 - o free
5. EMI Aerocorp. Inc. St. Louis, MO
 - o EMI does not sell s/w packages, but s/w/ is needed to access CompuServe.
 - o CompuServe access fee: \$9/month
 - o Connection time fees: \$.08 to \$.21/min.
 - o Additional charges: \$1.50 to \$10 for briefings and filing flight plans

6. Flight Data Centers, Inc. Wilkes-Barre, PA
 - o cost of s/w packages for weather briefing and flight plans: \$99.95
 - o connection time fees for flight plans: free (access via 800 services)
 - o no minimum fees
7. Global Weather Dynamics, Inc. Monterey, CA
 - o s/w packages for weather briefings: free
 - o connection time fees: \$.60 to \$1.10/min.
8. Global Wulfsberg Systems/Sundstrand Data Control Redmond, WA
9. GTE Federal Systems Chantilly, VA
 - o free
10. Jeppesen DataPlan Englewood, CO
 - o cost of s/w packages for weather briefing and flight plan: \$160 (maximum cost)
 - o connection time fees: \$.20 to \$.30/min.
 - o minimum charges: \$3.50 month
11. Kavouras, Inc. Minneapolis, MN
 - o cost of s/w packages for weather briefing: \$150
 - o connection time fees: free (access via 800 services)

12. Pan Am Services Minneapolis, MN
 - o cost of s/w packages for weather briefings - \$185
 - o cost of s/w packages for weather briefings and flight plans (available 8/93) - \$195
 - o connection time fees: free (access via 800 services)
13. Universal Weather & Aviation Houston, TX
 - o cost of s/w packages for weather briefings and flight plans: \$150
 - o connection time fees: \$1.00/min
 - o Verbal weather briefings and flight plans:
 - o Domestic flight plans - \$5
 - o International flight plans - \$7.50
 - o Weather briefings - cost varies on the length of the route
14. WSI Corp. Billerica, MA
 - o cost of s/w packages for flight plans - \$195 to \$495
 - o connection time fees - maximum \$2.50/min.
15. AC-U-KWIK NAVPAK Omaha, NE
 - o cost of s/w packages for flight planning: \$350
 - o connection time fees: free (access via 800 services)
16. Compuflight Port Washington, NY
 - o minimum 10 flight plans per month; \$12 domestic, \$15 international; includes filing
17. Excel Software Corp. Saratoga, CA
 - o cost of s/w packages for flight plans: \$199
 - o connection time fees: free (access via 800 services)

18. Mentor Plus Software Aurora, OR

- o cost of s/w packages which access Jeppesen NavData: \$295 to \$2,000
- o connection time fees: \$.20 to \$.30/min.
- o minimum charge: \$3.50/month

19. MultiService Corp. Overland Park, KS

- o cost of s/w packages for flight plans and weather briefings: \$1,595-\$3,090
- o lease service: \$150/month (annual contract)
 - o allows unlimited access

20. RMS Technology, Inc. Molalla, OR

- o s/w packages for flight plan: \$188-\$388

21. Spectrum Air Services, Inc. Houston, TX

- o Domestic and international flight plans \$25 each.
- o No minimum fees.

APPENDIX E: ACRONYMS

AAL	FAA Alaskan Region
ACE	FAA Central Region
AEA	FAA Eastern Region
AFTN	Aeronautical Fixed Telecommunications Network
AGATE	Advanced General Aviation Transport Experiment
AGL	FAA Great Lakes Region
AIM	Airman's Information Manual
AIP	Airport Improvement Program
AIRMET	Airmen's meteorological information
ANE	FAA New England Region
ANM	FAA Northwest Mountain Region
ARO	airport reservation office
ASO	FAA Southern Region
ASOS	automated surface observing system
ASRS	Aviation Safety Reporting System
ASW	FAA Southwest Region
AWOS	automated weather observing system
ATC	air traffic control
ATIS	Automatic Terminal Information Service
AVCOMPS	aviation computer software
AWP	FAA Western Pacific Region
B&CA	Business and Commercial Aviation magazine
CARE	Center for Aviation Research and Education (NASAO)
CG	center of gravity
DOT	Department of Transportation

DUAT	Direct User Access Terminal
DVFR	Defense visual flight rules
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBO	fixed base operator
FDC	Federal Data Center
FSS	Flight Service Station
GA	general aviation
GAO	General Accounting Office
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
ILS	instrument landing system
IMC	instrument meteorological conditions
MOPS	Minimum Operational Performance Standards
N/A	not available
NADIN	National Airspace Data Interchange Network
NAS	National Airspace System
NASAO	National Association of State Aviation Officials
NASDC	National Aviation Safety Data Center
NAVAID	navigational aid
NICS	National Airspace System Interfacility Communications System
NMAC	near mid-air collision
NOTAM	notice to airmen
NTIS	National Technical Information Center
NTSB	National Transportation Safety Board
NWS	National Weather Service

PC	personal computer
PIC	Pilot Information Center
PIREP	pilot report
RCL	Radio Communications Link
RNAV	area navigation
RTCA	RTCA Inc. (formerly Radio Technical Commission for Aeronautics)
SA	surface aviation observations
SID	standard instrument departure
SIGMET	Significant meteorological information
STAR	standard terminal arrival
s/w	software
TBD	to be determined
U.S.C.	United States Code
VFR	visual flight rules
WISP	weather information system programs
WSO	Weather Service Office