

GENERAL AVIATION DATA LINK SURVEY ANALYSIS
NATIONAL BUSINESS AIRCRAFT ASSOCIATION

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16. Abstract The Federal Aviation Administration (FAA) is interested in integrating Data Link communications technology into the General Aviation (GA) community. But, how much does the GA community know about the Data Link concept, the services that are possible, and the advantages of Data Link? This report contains an analysis of a survey that was conducted at the 1992 National Business Aircraft Association (NBAA) convention.					
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EXECUTIVE SUMMARY

The Federal Aviation Administration (FAA) is interested in implementing alternatives to the current voice communication between pilots and air traffic management. One alternative is Data Link. The use of Data Link is expected to enhance flight safety and to decrease pilot workload in commercial, air transport, and General Aviation (GA).

In order to obtain information from the potential end users of the proposed Data Link System, a survey was produced to determine the user's preferences for services that can be presented through Data Link. Information regarding the pilot's experience and type rating was also collected.

The survey was distributed at the 1992 National Business Aircraft Association (NBAA) meeting in Dallas, Texas. The results of this survey indicate that the GA pilot's current knowledge about Data Link was limited, and therefore, they were unable to determine what services would be useful to them. The wide variation of responses regarding the types of potential services indicates that the GA community is skeptical and reluctant to "buy into" Data Link without a greater understanding of the cost/benefit question.

1. INTRODUCTION.

The Federal Aviation Administration (FAA) is interested in integrating Data Link communication technology into the General Aviation (GA) community. This interest is driven by a desire to enhance GA flight safety and to decrease pilot workload.

In order to ensure that the Data Link system developed is “needs driven,” the FAA went to the user community to obtain input from GA pilots regarding the type of information, either air traffic control (ATC) or related flight services that the GA pilot would like to have presented through a Data Link system. Potential users of the system were asked to participate in a survey that was developed to collect this information. The first data collection effort was conducted at the Experimental Aircraft Association (EAA) Airshow in Oshkosh, Wisconsin. The second survey effort was conducted during the September 1992 National Business Aircraft Association (NBAA) Convention in Dallas, Texas. The third survey effort targeted GA pilots at five different flight schools. Surveying GA pilots was directed as an initial step in the development of system requirements.

In addition, in order to obtain information regarding the pilot population responding to the survey (background and experience), pilots were requested to provide information regarding their current involvement in aviation, certifications/ratings, flight experience, and current use of ATC and related services.

This report presents the findings of responses to the GA pilot survey distributed at the NBAA convention. A copy of the survey is provided in appendix A.

2. PURPOSE.

The purpose of this paper is to respond to the following:

- a. What air traffic services do GA pilots need over Data Link?
- b. How could the desired services be presented to the pilot?

3. METHODOLOGY.

The survey was developed to collect information from GA pilots regarding the type of ATC and related services they would like provided through Data Link. In order to stratify the data, the survey requested respondents to provide data describing: current involvement in aviation, certificates and ratings, and flight experience.

In addition, data was collected to obtain information regarding ATC and related services currently utilized and regarding ATC and related services pilots would prefer if Data Link were provided. Due to the low awareness of Data Link among GA pilots at EAA, the questionnaire distributed at the NBAA airshow remained largely unchanged for this data collection effort.

Therefore, the need for Data Link was derived once again from the pilot's desire and preference for Data Link.

When pilots were asked what services they would prefer Data Link to provide, pilots had the option of responding that they would “like” the service provided with Data Link, “dislike” the service provided with Data Link, or have a “neutral” preference for Data Link. The “neutral” preference allows pilots to choose an alternate option that does not indicate a like or dislike of the service with Data Link. It should be noted that many pilots responding to question 6 left one or more services categories blank, and that all of these blanks were interpreted to be “neutral” responses and are included in the statistics as such.

4. RESULTS.

Findings are addressed in two areas: quantitative analysis and qualitative analysis. The quantitative analysis section presents the results from pilot responses to questions 1-7 of the survey. This section also presents three comparative assessments between ATC and related services with the current system and with a Data Link system. The qualitative analysis section contains comments that pilots provided in the survey. Of the 56 pilots surveyed, there were 22 flight department managers. Their responses were incorporated with the responses of the 34 full-time pilots.

4.1 QUANTITATIVE ANALYSIS.

This section will present an overview of the quantitative survey results. There were a total of 56 pilots that responded to the survey. Findings from questions 1, 2, 3, and 4 present results for full-time pilot/flight department manager distinction, level of pilot certification/rating, and flight experience. Questions 5, 6, and 7 requested responses to the type of ATC and related services the pilots currently use, their desired use of ATC and related services with Data Link, and the desired format display type.

Questions 1 and 2 requested pilots to provide information regarding whether they were a pilot, flight department manager or both. Of the 56 pilots that responded to the survey, the findings indicated:

Pilot	100 percent
Flight Department Manager	39 percent

Question 3 requested pilots to provide information regarding their certificates and ratings (see figure 1; appendix C). The following are the pilot certifications:

Private Pilot	12.5 percent
Commercial Pilot	17.9 percent
Airline Transport Pilot (ATP)	69.6 percent

The following are the pilot ratings:

Single engine	100 percent
Multiengine	79 percent
Sea plane	12 percent
Rotorcraft	5 percent
Instrument rated/airplane	73 percent
Instrument rated/rotorcraft	2 percent

Question 4 requested pilots to provide information regarding their flight experience. This question was divided into two parts. The first part requested pilots to provide information regarding their total flight experience. The categories were 0-500, 500-2000, and 2001+. These categories were recorded to represent Low, Medium, and High flight experience levels. The results were: 9 percent for 0-500 hours or Low, 14 percent for 500-2000 or Medium, and 77 percent for 2001-plus or High (see figure 2; appendix C).

The second part of the question requested the amount of flight time logged in the preceding 12 months. Due to the large variance in the response distribution, the best representation of the data is the mode (the most frequently occurring score). The mode for pilot flight time over the past 12 months was 300 hours. When the total flight time for the preceding 12 months was plotted (see figure 3; appendix C) approximately 68 percent flew less than 300 hours.

Question 5 requested pilots to check, “Which of the following FAA ATC and related services do you routinely use?” The findings are listed in table 1 (numbers) and in figure 4 (percentages; see appendix C). Those pilots that responded to the “other” category (a category that gave pilots the option to add a service they use that is not on the list) indicated that three pilots use Direct User Access Terminals (DUAT), one pilot uses High Altitude Weather Service, and one pilot uses Aerodrome Flight Information Service (AFIS). As presented in figure 4, (appendix C) only approximately half of the total pilots surveyed use visual flight rules (VFR) to Controlled Airports and VFR through Controlled Airspace, and even less file VFR Flight Plans or use VFR Flight Following.

TABLE 1. SERVICES CURRENTLY UTILIZED

ATC and Related Services	Used	Unused
IFR Operations	54	2
VFR to Controlled Airports	26	30
VFR through Controlled Airspace	22	34
VFR Flight Plan Filing	13	43
VFR Flight Following	14	42
Flight Watch	45	11
Weather Briefing	49	7
NOTAMS/PIREPS	48	8
ATIS	54	2

This table presents that out of the 56 pilots that responded to this survey, there is high usage of instrument flight rules (IFR) Operations, Flight Watch, Weather Briefing, Notices to Airmen (NOTAMS)/Pilot Reports (PIREPS), and Automated Terminal Information System (ATIS).

Question 6 requested, “If the technology necessary for Data Link communications was available, which of the following ATC and related services would you like Data Link to provide?”

Table 2A (numbers) presents the data from all of the pilots responding in each category of service listed on the survey.

TABLE 2A. DATA LINK SERVICE PREFERENCES (ALL PILOTS)

ATC and Related Services	Like	Neutral	Dislike
IFR Operations	45	4	7
VFR to Controlled Airports	15	37	4
VFR through Controlled Airspace	12	39	5
VFR Flight Plan Filing	19	35	2
VFR Flight Following	12	40	4
Flight Watch	34	18	4
Weather Briefings	46	6	3
NOTAMS/PIREPS	49	7	0
ATIS	54	2	0

It does not appear that pilots dislike Data Link services. Half of the data represents a high “like” preference for Data Link, about half represents a high “neutral” preference for Data link, and the “dislike” data represents a small portion of the responses.

Data Link services for which pilots reported a high preference are ATIS, NOTAMS/PIREPS, Weather Briefings, and IFR Operations, and a fairly high preference was indicated for Flight Watch. Pilots reported a largely neutral response for VFR Flight Following, VFR through Controlled Airspace, VFR to Controlled Airports, and VFR Flight Plans. The following table 2B presents the statistics on all of the “blank” responses under Question 6.

TABLE 2B. NUMBER OF “BLANK” RESPONSES

ATC and Related Service	Total	Users	Non- Users	Full-Time Pilots	Managers
IFR Operations	1	0	1	1	0
VFR to Controlled Airspace	14	1	13	7	7
VFR through Controlled	16	3	13	8	8
VFR Flight Plan Filing	18	2	16	9	9
VFR Flight Following	22	1	21	11	11
Flight Watch	9	5	4	6	3
Weather Briefings	3	3	0	3	0
NOTAMS/PIREPS	3	0	3	2	1
ATIS	0	0	0	0	0

This data is extremely important in order to gain a better understanding and interpretation of the data presented in tables 2A, 3, 4, and 5. Many answers to Question 6, especially from nonusers of services, were left blank probably due to the fact that they were simply unfamiliar with a particular service and chose to not express an opinion. These nonresponses were interpreted as “neutral,” and table 2B allows each reader to analyze the table data for themselves.

Question 7 stated, “What format would you prefer the Data Link information to be “displayed?”

Fifty-five percent responded that they would prefer to have the information displayed on a CRT (panel display), 27 percent preferred printed paper copy, and 2 percent chose voice synthesizer. Data from five subjects were not included in this dataset because these subjects responded twice to this question; four of the subjects chose flat panel display and printed paper copy, and one subject chose flat panel display and voice synthesizer. See appendix B for comments regarding display format.

4.2 COMPARATIVE ASSESSMENT.

4.2.1 ATC and Related Services Currently Used Versus Those That Would Be Preferred With Data Link.

A comparative assessment is presented to determine if there is a difference between the number of services that a pilot currently uses without Data Link versus those services that pilots would use with Data Link. Table 3 below represents the findings:

TABLE 3. CURRENTLY USED SERVICES VERSUS DATA LINK PREFERENCES

ATC and Related Services	Currently Used	Data Link Services		
		Like	Neutral	Dislike
IFR Operations	54	45	2	7
VFR to Controlled Airports	26	13	10	3
VFR thru Controlled Airspace	22	10	9	3
VFR Flight Plan Filing	13	8	5	0
VFR Flight Following	14	7	5	2
Flight Watch	45	30	11	4
Weather Briefing	49	39	7	3
NOTAMS/PIREPS	48	45	3	0
ATIS	54	52	2	0

It appears that there are few users of ATC and related services under VFR (VFR to controlled airports, VFR through controlled airspace, VFR flight plan, VFR flight following). There are also fewer ATC and related services preferred under VFR conditions with Data Link.

The other services (IFR Operations, Flight Watch, Weather Briefings, NOTAMS/PIREPS, and ATIS) are highly used and also highly preferred with Data Link. Specifically, there are three

services that pilots currently use frequently and would like as well as or better than the current system. Pilots currently use ATIS and would like it equally with Data Link. Services pilots prefer with Data Link are VFR flight plans and NOTAMS/PIREPS.

4.2.2 ATC and Related Services Currently Unused Versus Those That Would Be Preferred With Data Link

A comparative assessment is presented to determine if there would be a “like” preference for ATC and related services currently not being used but would be used if a Data Link system were available. Table 4 below presents the findings:

TABLE 4. CURRENTLY UNUSED SERVICES VERSUS DATA LINK PREFERENCES

ATC and Related Services	Currently Used	Data Link Services		
		Like	Neutral	Dislike
IFR Operations	2	0	2	0
VFR to Controlled Airports	30	2	27	1
VFR thru Controlled Airspace	34	2	30	2
VFR Flight Plan Filing	43	11	30	2
VFR Flight Following	42	5	35	2
Flight Watch	11	4	7	0
Weather Briefing	7	7	0	0
NOTAMS/PIREPS	8	4	4	0
ATIS	2	2	0	0

There are four ATC and related services largely unused by the pilots surveyed: VFR to Controlled Airports, VFR through Controlled Airspace, VFR Flight Plan, and VFR Flight Following. Preference for these services (with Data Link) is largely neutral across all services. Due to the many neutral responses for VFR-type services, an increase of pilot usage of VFR services, if a Data Link were available, is difficult to predict.

4.2.3 Non-Manager Versus Flight Manager Preferences for Data Link.

A comparative assessment is presented to determine if there is a difference between the Data Link preferences for ATC and related services of the 34 full-time pilots versus the 22 flight department managers. All of the flight department managers are also licensed pilots. Table 5 below represents the findings:

Figure 5 (full-time pilots) and figure 6 (flight department managers) show the corresponding percentages (see appendix C). The data indicates a strong correlation between full-time pilots and flight department managers responses in all categories of ATC and related services (except one) as well as in all choices of “like,” “neutral,” and “dislike.” Particularly, both groups indicate a high neutral preference for services such as VFR to Controlled Airports, VFR through Controlled Airspace, VFR Flight Plan, and VFR Flight Following. The exception mentioned above is that full-time pilots express twice the neutral preference than flight department managers do for Flight Watch.

TABLE 5. FULL-TIME PILOT VERSUS MANAGER PREFERENCES

ATC and Related Services	Full-Time Pilots				Managers			
	Users	Data Link Service			Users	Data Link Service		
		Like	Neu-tral	Dis-like		Like	Neu-tral	Dis-like
IFR Operations	32	27	3	4	22	18	1	3
VFR to Controlled Airports	16	7	23	4	10	8	14	0
VFR thru Controlled Airspace	14	6	23	5	8	6	16	0
VFR Flight Plan Filing	8	10	23	1	5	9	12	1
VFR Flight Following	9	5	26	3	5	7	14	1
Flight Watch	26	19	14	1	19	15	4	3
Weather Briefing	29	26	6	2	20	20	1	1
NOTAMS/PIREPS	29	29	5	0	19	20	2	0
ATIS	32	32	2	0	22	22	0	0

Full-time pilots and flight department managers both concur that Data Link is well liked for IFR Operations, Flight Watch, Weather Briefinqs, NOTAMS/PIREPS, and ATIS.

4.3 QUALITATIVE ANALYSIS.

The comments received from the survey are presented in the following categories: economically justifiable, practically achievable, display format, and merit comments.

TABLE 6. COMMENTS - BY CATEGORY

=====
Economically Justifiable:

“If you have to have a \$500,000 satellite phone our company will have nothing to do with it.”

“Nice--If you can afford it and it doesn't interfere.”

Practically Achievable:

“I don't like airborne IFR Data Link. Isolates the crew from other traffic. Destroys situational awareness.”

“This system appears to be a one-way communication process. How would the pilot in IFR conditions change flight plans by voice or by keyboard?”

“Nice--If you can maintain situational awareness--which you won't be able to do.”

Display Format:

“A Panel display with an option to print (3 comments).”

“Some panel display Data Link information would be good during IFR operations (re-routes, crossing restrictions, etc.). We already enjoy the benefits of weather and NOTAM displays via AFIS.”

“Items that are most writing intensive, lend themselves to printing. The voice synthesizer might be preferred for short messages only. The printed output, however, should not be text only, it should contain a pictorial description of the new IFR route. If this is not feasible, it should printout a shorthand description instead of all text, e.g.,

ATC CLEARANCE RX 030145 UTC VIA MHT ARTCRBS
N84176 C MIEGS AP AF
LT040 ↗M 30°° (40°° +10)
124.4 MHT DEP 0245.

Sample shorthand large letters:

↗M	- climb and maintain
()	- expect
C	- cleared
AF	- as filed”

“Printed copies of certain information would be preferred such as weather and initial IFR clearances; however, the ability to call up and display stored information may be acceptable.”

Merit Comments:

“Thank you for the opportunity to respond. Data linking of any of this information to airplane cockpits will enhance safety proportionately.”

“Hurry with your development of Data Link.”

“Single pilot IFR is high stress in a busy environment. Trying to go thru a pre-check landing list, rechecking or changing approach plates in addition to communicating with ATC, following directions while trying to catch ATIS in a place like San Francisco or Los Angeles terminal control area (TCA) is almost super human. If ATIS and confirmation of TCA instructions would appear on a panel or printout, I would pay anything for it.”

“Clearance delivery via Data Link would be a plus.”

“IFR Operations--I like the idea of Data Link for IFR flight plans and as a verification of sector frequencies.”

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5. DISCUSSION.

This section will discuss findings from quantitative, comparative, and qualitative assessments. Similarities and differences when compared with the general aviation EAA survey findings are presented in this section, however, it must be understood that this evaluation is purely speculative; no statistical comparison could be conducted due to the differences in sample size between the two populations.

5.1 QUANTITATIVE.

Less than half (40 percent) of the 56 pilots surveyed at NBAA are also flight department managers. Approximately two-thirds of the pilots have Airline Transport Pilot (ATP) ratings and the remaining one-third is split between private and commercial ratings. All are single engine rated and the majority hold multiengine and instrument/airplane ratings. Most pilots surveyed (about two-thirds) have a fairly high level of flight experience, and most pilots have 300 hours or less in the preceding 12 months.

This pilot population is distinctly different from the pilot population at EAA; where the majority of pilots held private pilot certification, approximately one-third held commercial and less than 10 percent held ATP ratings. Given the successive nature of certification attainment, the NBAA pilots hold higher certifications.

The EAA pilots have a minority of multiengine rated pilots and slightly fewer instrument rated pilots than the pilots surveyed at NBAA. The pilots surveyed at EAA represent a low to moderate experience level pilot in comparison to the high experience level of the NBAA pilot. During the preceding 12 months EAA pilots flew less than 100 hours, in contrast to NBAA pilots that flew three times as much. Again, findings indicate that the NBAA survey pilot is a more experienced pilot in comparison to the EAA survey pilot.

All of the ATC and related services in the survey are currently used by some pilots surveyed, however there is less usage of VFR ATC and related services (such as VFR to controlled airports, VFR through controlled airspace, VFR flight plan, VFR flight following). However, these services resulted in fairly high usage among pilots surveyed at EAA.

The EAA pilots fly for pleasure and recreational reasons, therefore, they fly in good weather, such as required under VFR conditions. In contrast, the NBAA pilot is employed to fly; therefore, he flies more often and in all types of weather.

Pilots surveyed at NBAA reported a high usage of IFR Operations, ATIS, Weather Briefings, and NOTAMS/PIREPS. Of the total pilots surveyed, only two pilots did not respond to using IFR Operations or ATIS. The most frequently selected ATC and related services that pilots would like to receive via Data Link are: ATIS, NOTAMS/PIREPS, Weather Briefings, and IFR Operations. Thus, services pilots currently use are the same services that they would like to receive through Data Link. This result is almost identical to findings at EAA, except that pilots surveyed at EAA are not interested in ATC instructions.

Full-time pilots who participated in this survey, due to their advanced experience level, may be more comfortable receiving ATC instructions through Data Link. However, both the NBAA pilot and the less experienced EAA pilot surveyed desire informational data presented through Data Link.

The GA pilot's workload is represented by the amount of information needed to be assimilated during a flight, such as weather, ATIS, and PIREPS/NOTAMS. Data Link would provide pilots with a method of "off-loading" some of that information from their mental working memory to a system such as Data Link, thus reducing pilot mental workload. Data Link would enable the pilot to receive, store, and recall information upon request.

Finally, of the three formats that Data Link information can be provided, the majority of pilots surveyed preferred to have Data Link information presented on a CRT/panel display. This finding is similar to the format preference chosen by pilots surveyed at the 1992 EAA Airshow in Oshkosh. In the EAA survey, pilot responses also indicate a desire for a display format with an option to print.

5.2 COMPARATIVE.

Three comparative assessments were conducted from the NBAA survey responses. The first assessment compared the pilot's use of current ATC and related services with the pilot's desire to have these same services provided through Data Link. There are three services that pilots would prefer at least as much as the current system. These are VFR Flight Plans (the current users of this service represent a small portion of the total sample), NOTAMS/PIREPS, and ATIS. In addition, there appears to be a considerable number of neutral opinions regarding the use of Data Link for all services. In fact, this number exceeds the number for services disliked, with the exception of VFR operations.

Pilots reported neutral opinions for VFR Operations and services (VFR to Controlled Airports, VFR through Controlled Airspace, VFR Flight Plan, VFR Flight Following) except for one service, Flight Watch, which had a fairly high response under "like" with Data Link. Therefore, perhaps the high number of neutral responses for these services is a result of the pilots surveyed not flying under VFR conditions frequently enough to really evaluate, or have an opinion on, Data Link for these services. Table 1 shows the fewer number of users of VFR ATC and related services. Overall, the neutral responses presented here for the ATC and related services are comparable with the findings at the EAA convention.

The next two comparative assessments were not conducted with the responses from pilots at EAA, therefore they cannot be compared/contrasted with findings at EAA. The second comparative assessment is presented to determine if those ATC and related services that are not currently used by pilots surveyed have a "like" preference for Data Link. Given that the pilot would like to have this service provided through Data Link, he probably would use it if a Data Link system were available.

The data indicates that there are four ATC and related services that are not predominately used by NBAA pilots surveyed; VFR to Controlled Airports, VFR through Controlled Airspace, VFR Flight Plan, VFR Flight Following. Pilot responses to Data Link preference with these services resulted in the highest neutral preferences across all listed services. This high neutral response indicates that if these services were available through Data Link, pilots may still not use them.

A third comparative assessment was conducted between full-time pilots versus flight department manager preferences for ATC and related services with Data Link. The issue of interest is whether or not there is a difference between those individuals responsible for flight department finances (flight department managers) versus full-time pilots.

Overall, findings from pilots and flight department managers are similar. They concur that Data Link is well liked for IFR Operations, Flight Watch, Weather Briefings, NOTAMS/PIREPS, and ATIS. Both groups indicate a neutral preference for services such as VFR to Controlled Airports, VFR through Controlled Airspace, VFR Flight Plan, and VFR Flight Following. As reported earlier, NBAA pilots and/or flight department managers use VFR services infrequently, therefore it is understandable that they have a neutral preference for these services with Data Link.

The data indicates that pilots reported slightly higher neutral preferences for use of all services with Data Link than flight department managers. Perhaps pilots are concerned with the technical feasibility of such a system, or with “Heads-Down” time, whereas flight department managers are interested in the added safety and efficiency that can be obtained with this new technology.

5.3 QUALITATIVE.

The qualitative analysis indicated that pilots expressed opinions on economics, practicality, display format and merit of the system. Although issues associated with economic justification were presented, the majority of comments focused around user input into the display format and design. These issues are important in the development and implementation of a Data Link system to the GA business pilot surveyed. The pilots want to be involved in the Data Link design process. This is demonstrated by the specificity of their input. The benefits of integrating the user into the development process is essential to the production of a practical Data Link system. Respondent comments in the survey indicate that ensuring a smooth flow of information and situational awareness are important concerns for pilots.

The comments presented by pilots surveyed at NBAA are quite different in number and type than those expressed by pilots surveyed at Oshkosh. There were fewer comments provided by NBAA pilots than the EAA pilots.

The type of comments provided do not focus as much on the economics of the system as did the EAA pilots. Perhaps this is because Data Link would not represent an “out-of-pocket” expense to those surveyed at NBAA as it would to those pilots that attended the EAA. The cost for the Data Link system would come out of company funds and the expense would be viewed by the company as beneficial if it would add an extra measure of safety for the management of the company.

Two comments that were received regarding economic considerations were made by line pilots (not flight department managers). Education did not seem to represent as large an issue with pilots surveyed at NBAA as the pilots surveyed at EAA. A similarity between both groups is the anticipation for implementation of this emerging technology.

6. CONCLUSION.

Pilot's perceived need for Data Link was derived from the pilot's desire for a Data Link system. Due to an assumed low awareness of Data Link technology the results of this survey led to the following conclusions:

- a. What services do general aviation (GA) pilots need via Data Link?

The services that pilots reported a high preference for Data Link are: Automated Terminal Information Service (ATIS), Notice(s) to Airmen (NOTAMS)/Pilot Reports (PIREPS), Weather Briefings, and instrument flight rules (IFR) Operations. A fairly high preference for Flight Watch was also indicated.

- B. How will these desired services be presented to the pilot?

Pilots reported that they would prefer to have Data Link information displayed on a cathode ray tube (CRT) (panel display) and there was some interest in having an optional print function. It was recommended that writing intensive activities lend themselves to printing, while brief messages lend themselves to a voice synthesizer.

7. RECOMMENDATIONS.

Findings of the survey suggest the following recommendations:

- a. As stated earlier, the comments section of the survey indicates that there is a need to inform pilots on the operational aspects of this emerging technology, i.e.; how the system will work; how the information will flow; how the user is integrated into the system. A demonstration of the functionality of the system would be beneficial.

- b. Comments suggested a need for a cost/benefit analysis. Some pilots are concerned that the benefits of the system will be negated by an astronomical cost.

Although there were few comments received regarding concerns about cost, the comments received indicated a perception of considerably high cost. The cost/benefits analysis will be able to assess the advantages gained for the dollar spent.

It is likely that valuable development criteria could be obtained simply by asking the user community (in a follow-on survey) a question phrased in the following manner: What cost would you consider to be the practical ceiling for the purchase and installation of Data Link equipment?

(1) \$5,000

(2) \$10,000

(3) \$20,000

(4) \$30,000

c. The general aviation (GA) pilots surveyed prefer Data Link information presented on a cathode ray tube (CRT)/flat panel display with an option to print. This, however, is a very general requirement. There are numerous parameters to be determined and specified in order to develop an optimal presentation format such as size, location, color, synthesized voice, etc.

The parameters need to be developed by the Federal Aviation Administration (FAA), avionics and airplane manufacturers, Human Factors experts, and the user community. Having the user in the loop in the design and development process could result in high acceptance and useability. Once an optimal Data Link display is developed, certification will ensure standardization of displays, display formats, and parameter specifications for avionics manufacturers.

APPENDIX A
DATA LINK GENERAL AVIATION SURVEY

information is transmitted via ground-based station or satellite to the aircraft, where it is received and stored in a digital format.

Data link facilitates faster transmission of the information, and eliminates many of the errors inherent in voice communication. Information can be stored in receiver memory and retrieved later on a CRT display, printed paper copy, or voice synthesizer.

If the technology necessary for data link communications was available, how would you rate the desirability of obtaining the following air traffic control and related services by data link?

Check each item [√] by the appropriate box:
Like, Neutral, Dislike

	Like	Neutral	Dislike
IFR Operations			
VFR to Controlled Airports			
VFR through Controlled Airspace			
	Like	Neutral	Dislike
VFR Flight Plan Filing			
VFR Flight Following			
Flight Watch			
	Like	Neutral	Dislike
Weather Briefing			
NOTAMS/PIREPS			
ATIS			

7. Choose the format type you would prefer the Data Link information to be displayed (check [√] one response)

- Panel display
- Printed paper copy
- Potentially voice synthesizer

8. Comments:

APPENDIX B
PILOT COMMENTS

Thank you for the opportunity to respond. Data linking of any of this information to airplane cockpits will enhance safety proportionately.

If you have to have a \$500,000 satellite phone our company will have nothing to do with it.

Nice--if you can afford it and it doesn't interfere and you can maintain situational awareness--which you won't be able to.

Actually, a panel display, option to print.

Clearance delivery via data link would be a plus.

I soon hope to get my instrument rating; my use might increase if available.

IFR Ops--I like the idea of data link for IFR flight plans and as a verification of sector frequencies.

Some panel display data link info would be good during IFR operations (re-routes, crossing restrictions, etc.). We already enjoy the benefits of weather/NOTAM displays via AFIS.

Single pilot IFR is high stress in a busy environment. Trying to go thru a pre-check landing list, rechecking or changing approach plates in addition to communicating with ATC, following directions while trying to catch ATIS in a place like San Francisco or Los Angeles TCA is almost super human. If ATIS, & confirmation of TCA instructions would appear on a panel or printout, I would pay anything for it.

Flight watch is a congested mess.

Don't like airborne IFR datalink. Isolates the crew from other traffic. Destroys situational awareness.

The items checked above were the most writing intensive, which lends itself to printing. The voice synthesizer might be preferred for short messages only. The printed output, however, should NOT be text only, it should contain a pictorial description of the new IFR route. If this is not feasible - it should print out a shorthand description instead of all text, e.g.,

```
ATC CLEARANCE RX 030145 UTC VIA MHT ARTCRBS
N84176 C MIEGS AP AF
LT040 7M 3000 (4000 +10)
124.4 MHT DEP 0245
```

(this comment continued on next page)

B-1

Sample shorthand (in LARGE LETTERS): 7M - climb and maintain
() - expect
C - cleared
AF - as filed

Printed copies of certain information would be preferred such as weather and initial IFR clearances; however the ability to call up & display stored information may be acceptable.

A small panel with a printer option would be nice.

1. Panel display with option of printed paper copy
2. I've used global-wulfsberg AFIS - Its fantastic
3. Hurry with your development of data link

Thank you.

This system appears to be a one-way communication process. How would pilot in IFR conditions change flight plan, by voice, by keyboard in plane?

B-2

APPENDIX C

FIGURES

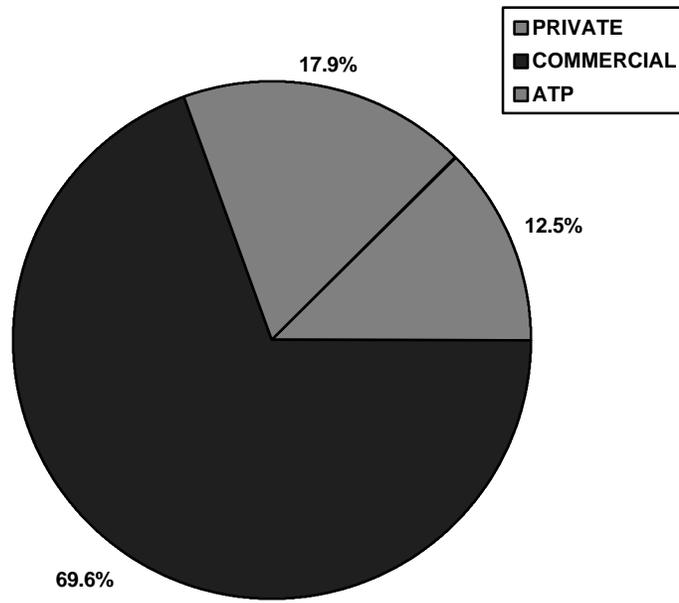


FIGURE 1. PILOT CERTIFICATION

C-1

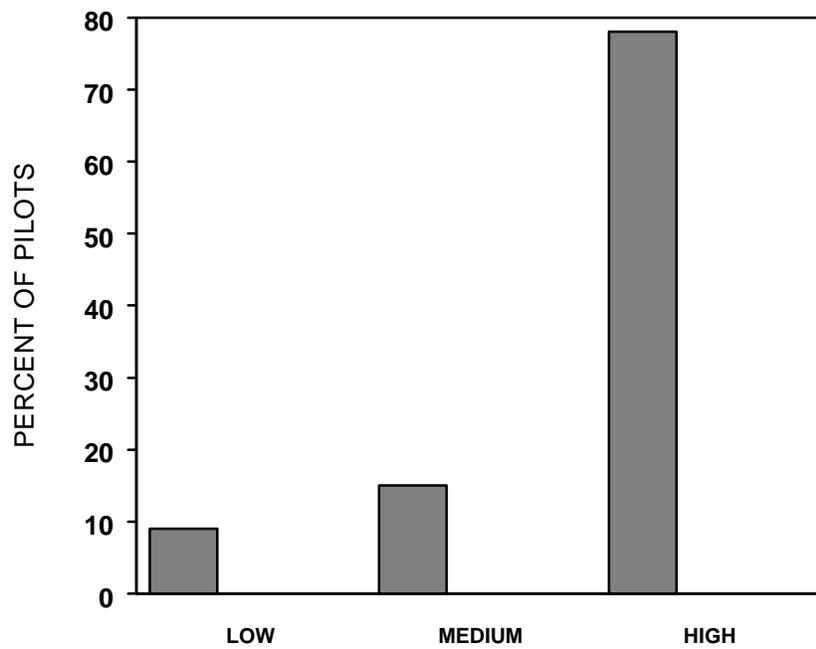


FIGURE 2. PILOT FLIGHT EXPERIENCE

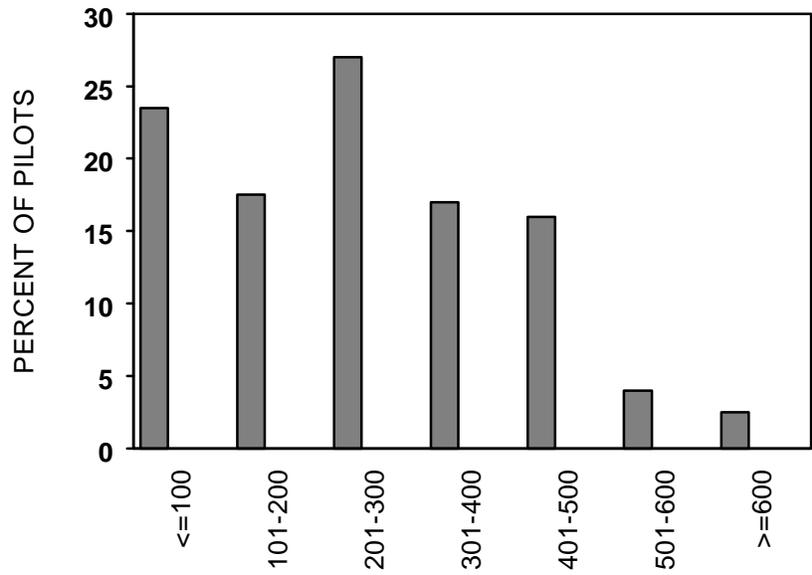


FIGURE 3. FLIGHT TIME DISTRIBUTION

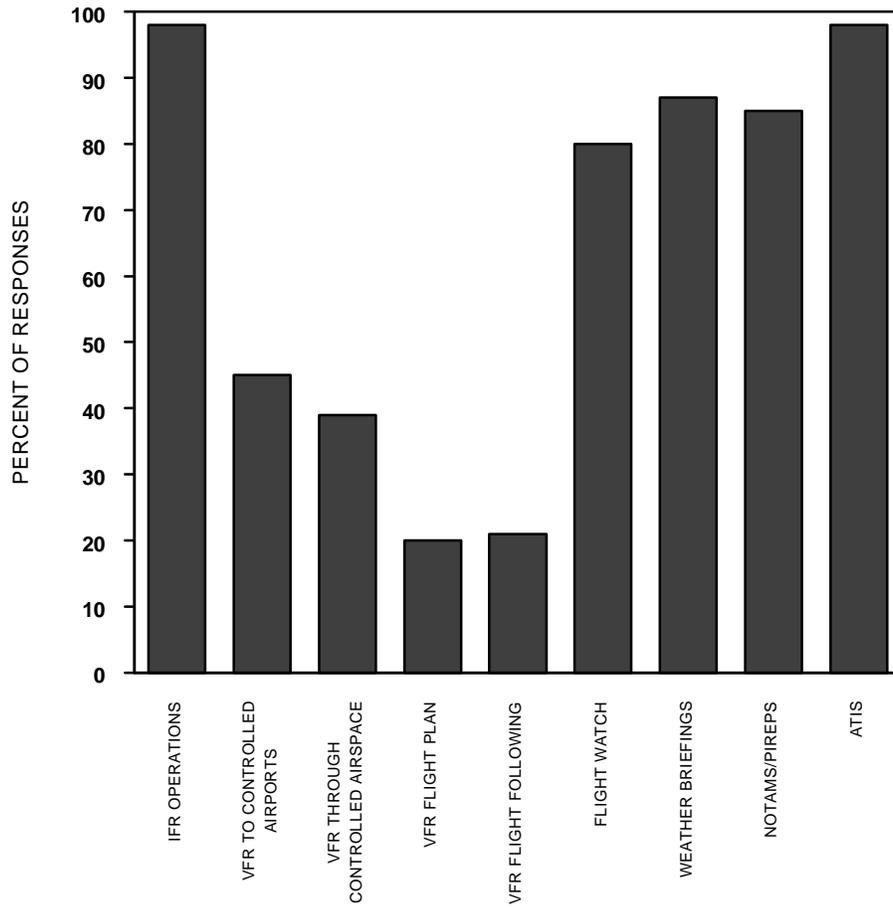


FIGURE 4. CURRENTLY USED ATC AND RELATED SERVICES

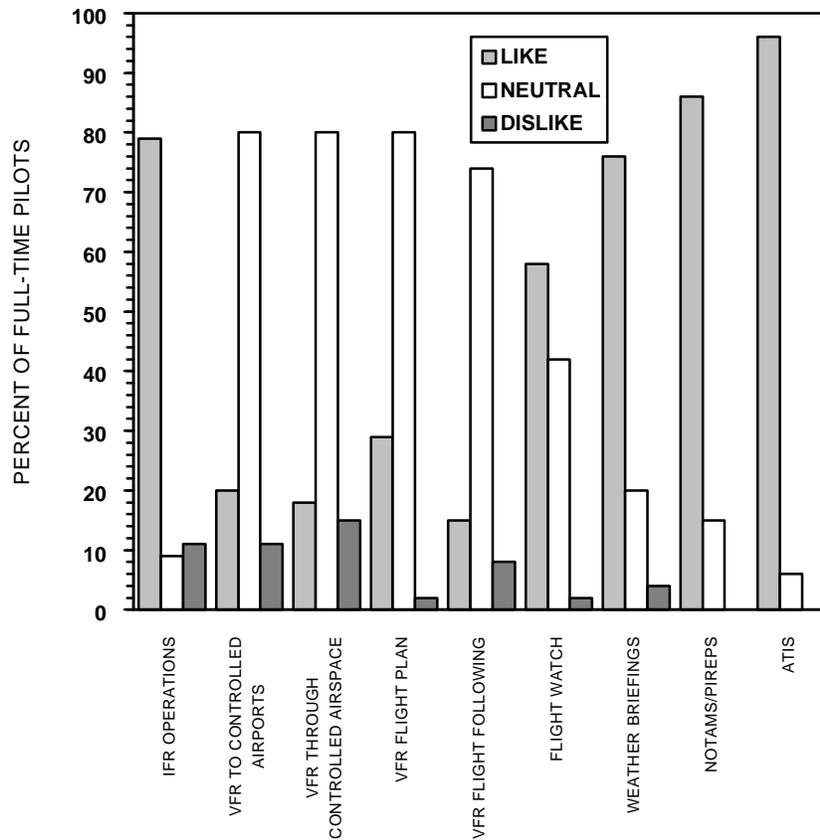


FIGURE 5. FULL-TIME PILOT PREFERENCES FOR DATA LINK

C-5

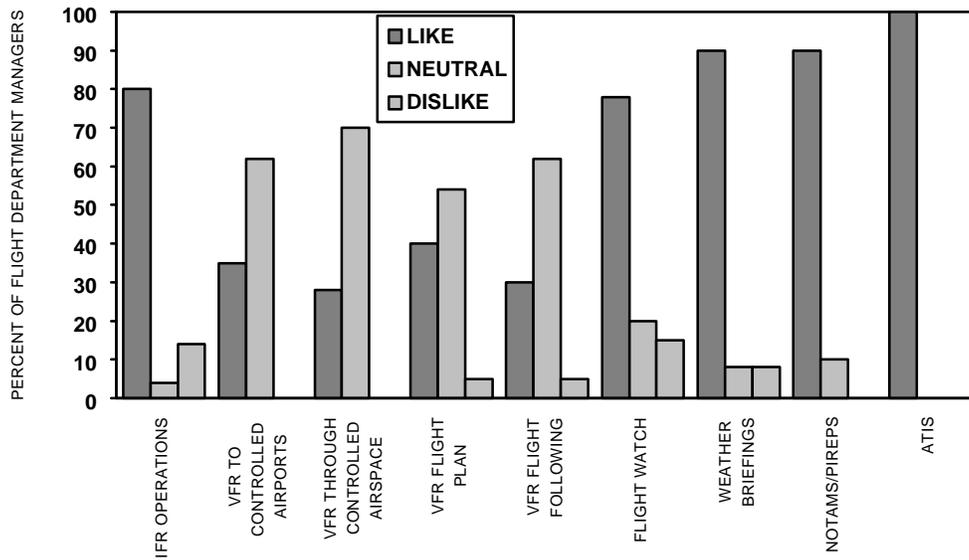


FIGURE 6. FLIGHT DEPARTMENT MANAGERS PREFERENCES FOR DATA LINK