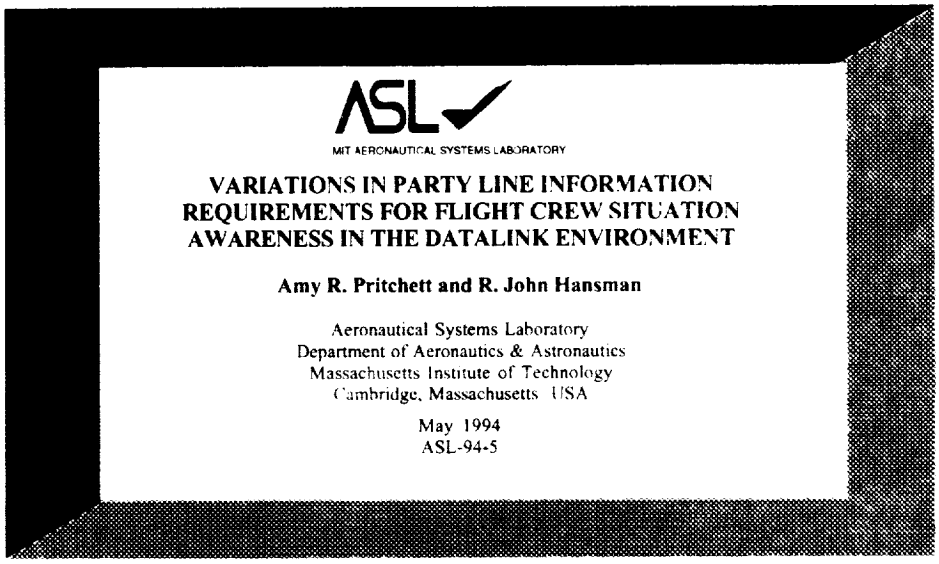

VARIATIONS IN PARTY LINE INFORMATION REQUIREMENTS FOR FLIGHT CREW SITUATION AWARENESS IN THE DATALINK ENVIRONMENT

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Abstract

Current Air Traffic Control communications use shared VHF voice frequencies from which pilots can obtain 'Party Line' Information (PLI) by overhearing communications addressed to other aircraft. A prior study has shown pilots perceive this PLI to be important. There is concern that some critical PLI may be lost in the proposed datalink environment where communications will be discretely addressed. Different types of flight operations will be equipped with datalink equipment at different times, generating a 'mixed environment' where some pilots may rely on PLI while others will receive their information by datalink. To research the importance, availability and accuracy of PLI and to query pilots on the information they feel is necessary, a survey was distributed to pilots. The pilots were selected from four flight operation groups to study the variations in PLI requirements in the mixed datalink environment. Pilots perceived PLI to be important overall. Specific information elements pertaining to traffic and weather information were identified as *Critical*. Most PLI elements followed a pattern of higher perceived importance during terminal area operations, final approach and landing. Pilots from the different flight operation groups identified some elements as particularly important. Pilots perceived PLI to be only moderately available and accurate overall. Several PLI elements received very low availability and accuracy ratings but are perceived as important. In a free response question designed to find the information requirements for global situation awareness, pilots frequently indicated a need for traffic and weather information. These elements were also frequently cited by them as information that could be presented by a datalink system. The results of this survey identify specific concerns to be addressed when implementing datalink communications.

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- The military squadrons who helped in distributing this survey to the appropriate military pilots.

- The many pilots who took the time to complete the survey.

Contents

Chapter One

Introduction

Current Air Traffic Control (ATC) communications use shared VHF voice frequencies . Because each frequency is monitored by the ATC facility and several aircraft, pilots can receive not only their own 'direct' transmissions from ATC, but can also overhear communications addressed to other aircraft. This 'Party Line' effect can provide many types of supplementary information, as shown in Figure 1.1. Therefore, many pilots consider this 'Party Line' Information (PLI) to be a valuable resource (Ref. Midkiff, 1992).

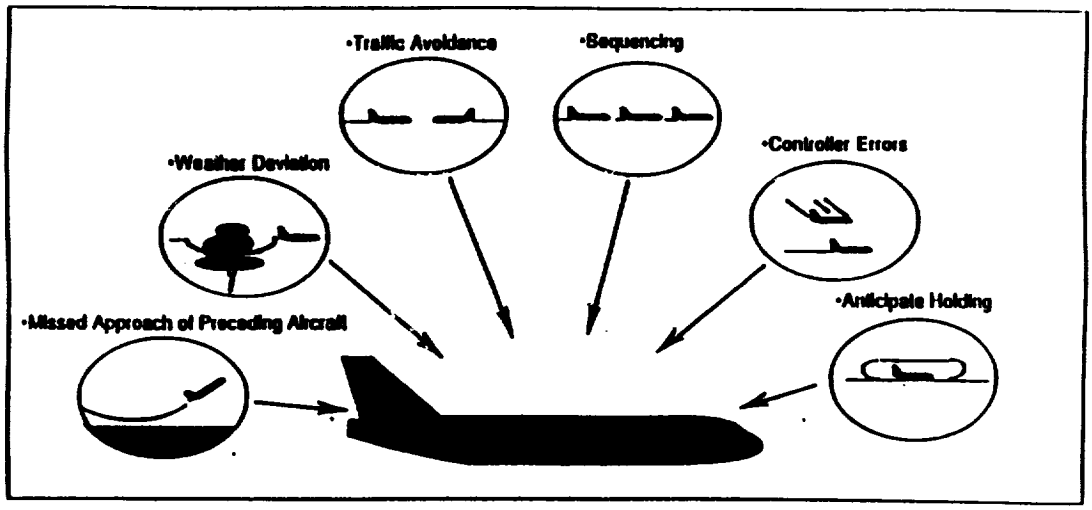

Figure 1.1 Party Line Information

There are, however, significant limitations of the voice system as indicated by the high number of Aviation Safety and Reporting System (ASRS) submissions identifying breakdowns and saturation in VHF voice channels. For example, of the more than 14,000 ASRS reports received in 1985 and 1986, one fourth involved problems in air/ground information transfer (Ref. Lee & Lozito, 1989).

The Federal Aviation Administration's (FAA) National Airspace modernization plan calls for the implementation of digital datalink communications for air/ground information exchange between aircraft and ATC facilities. The Airline Transport Association (ATA) has also recommended as early as possible use of datalink communications between ATC and aircraft and data transmission to an aircraft's flight management system without need for voice communications. (Ref. Aviation Week & Space Technology, 1994)

Datalink communications offer increased system safety and efficiency by reducing transmissions and interpretation errors and by allowing a greater exchange of information. This system of communications may also relieve the overloading of ATC radio frequencies, which hamper efficient message exchanges during peak traffic periods in many busy terminal areas. (Ref. Knox & Scanlon, 1990)

To the pilot, the most obvious datalink system to date has been the ARINC Communication Addressing and Reporting System (ACARS) developed and in use by several major airlines. The ACARS unit in the cockpit is a terminal with which information can be exchanged between the aircraft and airline operations. Pilots can receive digital Automatic Terminal Information System (ATIS) messages, PreDeparture Clearances (PDC), and gate and arrival information. Pilots can downlink messages such as arrival estimates and requests for weather reports. Automatic downlinks of aircraft departure time and engine performance data are also in common use. (Ref. Midkiff, 1992, Ryan, 1992, Armstrong, 1992)

With the advent of satellite voice and digital communications, several other additions to these datalink communications are being proposed and tested. For example, Automatic position reports during oceanic flights are being tested with some airlines on both Pacific and North Atlantic routes, using the Automatic Dependent Surveillance system (ADS). (Ref. Lorge, 1993, Armstrong, 1992, Ryan, 1992)

Because future datalink communications can provide ADS position reports and can transmit a substantial amount of detailed flight path information directly to the aircraft's Flight Management Computers, several other benefits are being analyzed. With better knowledge of aircraft positions outside normal radar coverage, such as on oceanic flights, the possibility of reducing aircraft separations is already being analyzed to allow for more efficient use of the airspace. More efficient use of airspace can also be envisioned in next generation ATC systems which can negotiate direct flight routings

with aircraft flight management computers, allowing for the most direct and efficient flight routes without being constrained to established airways. (Ref. Lorge, 1993, den Braven, 1992, Ryan, 1992)

The pilots' responses to the datalink tests run so far have been positive. However, before datalink ATC communications become more than a supplementary or experimental system, several human factors issues must be examined. For example, the discrete nature of datalink addressing (where each transmission is directed only to specific aircraft) may cause less information to be presented by PLI. However, before any compensation methods for PLI loss can be determined, a solid understanding of current PLI use and importance must be obtained. (Ref. Knox & Scanlon, 1990, Armstrong, 1992, Midkiff, 1992)

The importance of PLI overall and of specific PLI elements was examined in a previous study. This study made several valuable observations based on an airline pilot opinion study and a full mission flight simulation study. PLI was generally identified as important, with some specific traffic or weather PLI elements receiving critical ratings. The PLI elements received the highest importance ratings during the aircraft's arrival; because this phase of flight is the most time critical, the final tower controller frequency was concluded to be a less desirable candidate for initial datalink implementation than other "enroute" operations. Some specific PLI elements were perceived as important but not very reliable, indicating information for which the 'Party Line' is not the best modality of communication. Finally, pilots indicated they were more receptive to the implementation of datalink if compensation is included for any PLI loss. However, this study surveyed only one distinct group of pilots -- current American Airlines aircrew based at Chicago O'Hare -- and therefore may not represent the diverse concerns of the entire aviation community. (Ref. Midkiff, 1992)

This report documents a continuing study of current PLI use and importance. A pilot opinion survey was developed, based upon the survey from Midkiff's study. The distribution of the survey was increased to include additional operational groups with a wide geographic spread. Several PLI elements were expanded into more specific components to better examine the 'Traffic' and 'Weather' elements previously identified as important in the Midkiff study.

This study continues with several objectives with Midkiff's survey in determining the use and importance of Party Line Information:

1) Determine the Importance, Availability and Accuracy of both 'Party Line' Information overall, and of specific PLI elements,
2) Determine how PLI usage varies with different flight regimes, &
3) Solicit pilot opinions on datalink implementation.

The results of Midkiff's study identified several issues requiring further study. Therefore, this survey also had several additional objectives to provide greater detail about the various factors affecting PLI importance and pilot situational awareness:

4) Expand the distribution of the survey to study any variations of PLI usage between pilots from different types of flight operations,
5) Include more specific PLI elements to allow for a more exact determination of the important PLI elements pertaining to weather and traffic information, &
6) Solicit pilot opinions on the information required for situation awareness.

The survey design, distribution and analysis are detailed in Chapter 2. Chapters 3, 4 and 5 discuss the numerical Importance, Availability and Accuracy ratings of specific PLI elements, and Chapter 6 discusses the pilots' subjective responses. Finally, Chapter 7 summarizes the important results and conclusions of the study.

Chapter Two

Survey Design, Distribution and Analysis

The pilot opinion survey was designed to solicit both ratings of PLI Importance, Availability and Accuracy, and pilot opinions on datalink implementation and situation awareness. This survey was based upon the one distributed in the Midkiff study (Ref. Midkiff 1992), with both the content and distribution expanded.

The Midkiff study identified PLI elements pertaining to Traffic and Weather information as being particularly important. Therefore, the content of this survey included several expanded sections requesting more detailed responses about these PLI elements. A free-response question was added asking pilots "What does the 'Big Picture' mean to you?" in an effort to identify information pilots feel is necessary for Global Situation Awareness.

The previous survey specifically focused on airline PLI requirements and was only distributed to American Airline pilots based at the Chicago O'Hare airport. The distribution of this survey was increased to include pilots of additional types of flight operations, including General Aviation, Regional/Commuter Airlines, Major Air Line and Military operations.

This chapter will detail the survey design, distribution and analysis. A copy of the survey is included in Appendix A. A summary of the characteristics of the respondents is included in Appendix B.

2.1 Survey Design

The survey was organized into three sections. The first and largest section requested numerical ratings of the Importance, Availability and Accuracy of specific PLI elements. The second section investigated issues relating to datalink implementation and to the information requirements for global situation awareness. The third section gathered information about the respondents' characteristics and flight experience.

Several other documents accompanied the survey. A cover letter detailed the purpose and importance of the survey as a potential input by pilots into the development of datalink systems. A separate study included at the end surveyed the use and importance of current cockpit displays for providing weather information.

2.1.1 Importance, Availability and Accuracy Ratings

To examine how pilots use PLI, numerical ratings of the Importance, Availability and Accuracy of specific information PLI elements were solicited. These PLI elements were selected for their likely importance to pilots, based upon the original list of elements determined by Midkiff through exploratory studies with active airline air crew. Because the PLI elements relating to Traffic and Weather information were identified as particularly important, this survey included additional PLI elements to provide more detailed ratings about these types of information. For example, in addition to a rating for the information element **Weather Overall**, pilots were also asked to rate the individual factors contributing to weather conditions. Pilots were also requested to provide additional PLI elements in an **Other** category for each phase of flight

PLI usage for many elements has been found to vary throughout the course of a flight (Ref. Midkiff, 1992). Therefore, most of the PLI elements were surveyed in each of the appropriate Phases of Flight, defined in Table 2.1. The elements listed under each Phase of Flight are given in Table 2.2.

Ground Operations (G.Ops)	*Pre-Start, Taxi*
Departure (Dep)	*Takeoff to Top of Climb*
Cruise	*Top of Climb to Top of Descent*
Descent (Des)	*Top of Descent to Approach Control Contact*
Terminal Area (TA)	*Approach Control Contact to Final Approach Fix*
Final Approach (FA)	*Final Approach Fix to Runway Threshold*

Table 2.1 -- Phases of Flight Surveyed

Ground Operations
- Next Communications Frequency
- Weather Situation
  - -Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Surface Winds
- Routing to Runway
- Relative Sequencing of Other A/C
- "Hold Short" Instructions of Other A/C
- A/C Crossing Active Runway While You Are Lined Up for Take Off
- Error or Mistake of the Controller
- Other _____

Departure
- Next Communications Frequency
- Weather Situation
  - -Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Surface Winds
- Traffic Avoidance
  - - Controlled Airports
  - - Uncontrolled Airports
- Relative Sequencing of Other A/C
- Error or Mistake of the Controller
- Other _____

Cruise
- Next Communications Frequency
- Weather Situation
  - -Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Surface Winds
- Traffic Avoidance
- Relative Sequencing of Other A/C
- Error or Mistake of the Controller
- Other _____

Descent
- Next Communications Frequency
- Weather Situation
  - -Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Surface Winds
- Traffic Avoidance
  - - Controlled Airports
  - - Uncontrolled Airports
- Relative Sequencing of Other A/C
- Holding Situations / EFC Validity
- Error or Mistake of the Controller
- Other _____

Terminal Area
- Next Communications Frequency
- Weather Situation
  - - Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Surface Winds
- Traffic Avoidance
- Relative Sequencing of Other A/C
- Holding Situations / EFC Validity
- Terminal Routing / Runway Assignments
- Approach Clearance
- Error or Mistake of the Controller
- Other _____

Final Approach
- Next Communications Frequency
- Weather Situation
  - - Overall
  - - TRW Buildups & Deviations
  - - Visibility & Ceiling
  - - Icing Conditions
  - - Ride Reports / Turbulence
  - - Winds Aloft
  - - Windshear
  - - Surface Winds
- Traffic Avoidance
  - - Controlled Airports
  - - Uncontrolled Airports
- Missed Approach - Weather Induced
- Missed Approach - Other
- Aircraft On Your Landing Runway
- Braking Action
- Taxiway Turnoff/Planned Runway Exit
- Relative Sequencing of Other A/C
- Error or Mistake of the Controller
- Other _____

Table 2.2 -- PLI Elements Listed With Each Phase of Flight

A separate section requested the ratings for the General PLI elements that do not vary significantly with phase of flight, such as **Navaid Problems**, and for the Prosodic PLI elements made available by voice inflection or phraseology, such as **Controller's Experience Level**. These elements are listed in Table 2.3.

Sector Congestion (As Indicated by Frequency Congestion)
Controller's Experience Level (Inferred From Tone of Voice and Speech Patterns)
Pilot's (Of Other Aircraft) Experience Level (Inferred From Tone of Voice and Speech Patterns)
Controller's "Level of Urgency" (Inferred From Tone of Voice and Speech Patterns)
Pilot's (Of Other Aircraft) "Level Of Urgency" (Inferred From Tone Of Voice And Speech Patterns)
Background ATC Transmissions Used as Reassurance of Being "In Contact" With the Controller. ("Anybody Out There?")
Call Sign Confusion (Other Aircraft Accepting Your Clearance or Vice Versa)
ATC Facility Problems / Lost Communications
Navaid Problems
Other _____

Table 2.3 -- General and Prosodic PLI Elements

This expanded list of PLI elements contained some elements that may not be relevant to all the pilots given the survey with their differences in flight operations. For example, the PLI element **Traffic -- Uncontrolled Airports** may not be relevant to Major Airline pilots accustomed to flying into only large, controlled airports. Therefore, pilots were asked to only rate those elements applicable to their accustomed flight operations.

A small sample of the rating section, shown in Figure 2.1, illustrates the format that allowed pilots to simultaneously rate the Importance, Availability and Accuracy of each PLI element. The Importance ratings were on a scale from 1 (Trivial) to 5 (Critical)with Importance defined at the beginning of the survey as 'How important is each item?' The Availability ratings were on a scale from 1 (Non-Existent) to 5 (Common-Place), with availability defined as 'How available is the information when you need it?'. The Accuracy ratings were on a scale from 1 (Unreliable) to 5 (Reliable), where accuracy was defined as 'Is Party Line Information a good indication of the actual situation?'

PHASE OF FLIGHT	Importance					Availability					Accuracy				
	Trivial				Critical	Non-Existent				Common-Place	Unreliable				Reliable
Descent: *Top Of Descent To Approach Control Contact*															
Next Communications Frequency	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Weather Situation															
- Over-All	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- TRW Buildups & Deviations	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Visibility & Ceiling	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Icing Conditions	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Ride Reports/Turbulence	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Winds Aloft	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Surface Winds	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Traffic Avoidance - Controlled Airports	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Uncontrolled Airports	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Relative Sequencing Of Other A/C	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Holding Situations/EFC Validity	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Controller Error	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Other_____	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

Figure 2.1 -- Sample Rating Section (Descent Phase of Flight)

2.1.2 Datalink Implementation Questions

Pilot opinions were solicited on several issues associated with the information required for situation awareness, datalink implementation, and current cockpit displays.

First, pilots were asked for free responses to the three subjective questions. The first question, which asked about the concept of the "Big Picture" in an attempt to identify the specific information elements which pilots require for global situation awareness, was:

There is a concern that, without "Party Line" Information, pilots may lose a sense of the "Big Picture." What does the "Big Picture" mean to you?

The next two questions asked for pilot input about the specific information content suitable for datalink systems, possible methods of displaying this information, and possible mechanisms to compensate for any PLI loss caused by datalink communications. They were:

Is there any particular information or images which you feel should be datalinked to aircraft? Do you have any suggestions for displaying this information in the cockpit?

Can you suggest any methods of compensating for the loss of "Party Line" Information when using a digital datalink and some form of electronic display?

The next questions asked pilots to identify the mix of voice and datalink communications they would prefer both for systems that included some form of compensation for any PLI loss and for systems that did not. These ratings were given on the five point scales, as shown in Figure 2.2

Considering the advantages of datalink (such as frequency congestion relief, unambiguous clearances, etc.) and of party line information (a 'sense of the big picture', ability to hear communications of all other aircraft in the sector), what mix of datalink and voice communications would you like to see?

1	2	3	4	5
DATALINK ONLY		EQUAL DISTRIBUTION VOICE / DATALINK		VHF VOICE COMMUNICATION ONLY

If some mechanism could be developed to datalink critical party line information to the aircraft (e.g. a status display with current wx, sequencing, and/or holding information), what mix of datalink and voice communications would you like?

1	2	3	4	5
DATALINK ONLY		EQUAL DISTRIBUTION VOICE / DATALINK		VHF VOICE COMMUNICATION ONLY

Figure 2.2 -- Preferred Mix of Voice and Datalink Communication Questions

2.2 Distribution and Response Rate

In order to expand upon the survey responses from the Midkiff study, this survey was distributed to pilots from four distinct types of flight operations: General Aviation, Regional/Commuter Airlines, Major Airlines and Military Pilots. In total, 4375 surveys were distributed; 738 were returned, of which 710 were sufficiently complete to be included into the data set. Table 2.5 details the distribution and responses for each type of operation.

	Distribution	Responses
General Aviation	2000	242
Commuter Airlines	1075	114
Major Air Carriers	800	230
Military (Large A/C Based in US)	500	124
Total	4375	710

Table 2.4 -- Distribution and Response Rate

Surveys were distributed to 2000 General Aviation pilots through a commercial mailing list. Because many of the questions dealt specifically with PLI elements available during flight under Instrument Flight Rules, all of these pilots held an Instrument Flight Rating. The surveys were distributed equally between 1000 pilots with Private Airplane ratings and 1000 pilots with Commercial Airplane ratings.

Surveys were distributed to pilots of 17 Commuter/Regional Airlines and 4 Major Air Carriers through the flight safety officers of the Air Line Pilots Association for each airline.

Military pilots were surveyed by batch mailings to domestic Navy and Air Force Squadrons that flew transport or heavy aircraft. These squadrons were selected to avoid any responses that may be skewed by highly specialized operations or by pilots who did not regularly operate in domestic airspace.

The distribution was spread, to the extent possible, over the continental United States to avoid any effects specific to one geographic area.

2.3 Data Analysis

The analysis method of the survey data varied between the different types of survey questions. For all numerical ratings, the data was summarized and tested using standard statistical techniques. The responses to free-response questions were categorized, with the number of similar responses tallied. Variations between responses of pilots from different flight operations were determined by examining the responses of the different groups separately and testing for differences between them as appropriate.

The statistical values calculated and the statistical tests used are summarized in this section, for both the numerical ratings and the free response questions.

2.3.1 Analysis of PLI Importance, Availability and Accuracy Ratings

The ratings of each PLI element were summarized by finding the mean value, standard deviation, coefficient of variation and total number of pilots providing a rating for that element. Any ratings that the pilot purposely omitted were not included in calculating these values. In addition, the number of responses at each particular value was tallied. The percentage of responses at each value was formed by comparing these tallies to the total number of responses returned. Because not all pilots gave ratings to each element, these percentages may not sum to 100%. The same analysis was also used for the combined ratings of all PLI elements within a specific Phase of Flight.

To examine the variations in ratings between pilots with different characteristics, the data sets were also subdivided into sets of responses from particular pilot groups. These groups were: General Aviation pilots, Commuter Airline pilots, Major Airline pilots and Military pilots. Within these subdivisions the mean values, standard deviations and counts of specific responses were calculated.

The PLI elements listed in this survey were chosen for their likely importance to pilots. As a result, many of the elements received very high importance ratings causing the distribution shape of the responses to be skewed to the higher values. Because this distribution is discrete and not normal, the importance of each element can be described by the percentage of high importance ratings it receives, in addition to its mean rating.

The importance ratings were defined on a scaled from '1' (Trivial) to '5' (Critical). In this paper, an element is described as ***Critical*** if a majority of the pilots gave it an importance rating of '5'. However, in addition to the PLI elements which received such

a clear-cut ***Critical*** rating, many other elements received high importance ratings. By its position in this interval scale, a rating of '4' can be interpreted as Important but not Critical. Therefore, an element is described in this paper as ***Important*** if a majority of the pilots give it a rating of either '4' or '5'.

Several statistical tests were conducted to examine the specific variations between responses. The first test, an unpaired t-test, calculated the test statistic Z between two samples of ratings as follows:

$$Z = \frac{\overline{X} - \overline{Y}}{\sqrt{\left(S_x^2 / n_x\right) + \left(S_y^2 / n_y\right)}}$$

where:

$\overline{X}$ = First Sample Mean
$\overline{Y}$ = Second Sample Mean
S_X = First Sample Variance
S_Y = Second Sample Variance
n_X = Number of Responses in Sample X
n_Y = Number of Responses in Sample Y

(Ref. Hogg & Ledolter, 1992)

The unpaired t-test is exact only for data with a normal distribution. Because the ratings given were discrete and skewed towards more important values, a second statistical test not assuming a normal distribution was also conducted. This non-parametric test, a variation on the Wilcoxon rank-sum test, calculated a test-statistic comparing the distribution of two data samples. This test was less specific than the t-test for different means because the distributions can differ by having either significantly different shapes of distributions or significantly different means. Therefore, results from this test had to be carefully examined to determine how the distributions differed and if the means were significantly different.

This test sorts both samples together to generate the overall ranks, in the combined sample, for each of the values. The average rank of the values from each of the samples is then calculated and compared. The final test statistic Z is calculated as follows:

$$Z = \frac{\bar{R}_X - \bar{R}_Y}{(n_X + n_Y)\sqrt{\frac{n_X + n_Y + 1}{12 n_X n_Y}}}$$

where:

R_X = Average Rank of Values in Sample X R_Y = Average Rank in Sample Y

n_x = Number of Values in Sample X n_Y = Number of Values in Sample Y

(Ref. Siegel, 1990)

These two tests generally identified the same significant differences between data sets. Because the distribution of responses on scales with only five discrete values is not normal, only the non-parametric test can be considered to be exact. However, because the number of values in all the data sets was normally quite large (ranging from 100 to over 600 responses), despite most subdivisions, the unpaired t-test provided a near exact approximation.

Although the paired-sample t-test could take advantage of the natural *blocking* inherent in comparisons between ratings made by the same people, the nature of the survey design degraded the accuracy of this test. Because pilots were asked to rate only the elements relevant to their operations, many specific ratings were not given by individual pilots and the pairings were inconsistent.

These statistical tests generated a 'test statistic'. This statistic was then compared against the reference value corresponding to the desired confidence level, as shown in Table 2-6. A magnitude of the test statistic bigger than the reference value identified a statistical difference between the means of the two samples of ratings being compared, at the confidence level of the reference value. If the test statistic was less than the reference values, then no difference could be concluded at that confidence level and the ratings were judged to be the same. A confidence level of ($p<0.01$) was nominally used.

Hypothesis Test Level	Test Value
$p < .10$	1.645
$p < .05$	1.960
$p < .01$	2.576
$p < .001$	3.291

Table 2.5 - Reference Values Identifying Significant Differences Between Sample Means for Desired Test Level (ref. Hogg & Ledolter, 1992)

2.3.2 Subjective Responses

The free-response questions often provoked detailed responses from pilots. These were studied to identify common categories of responses. Then, the number of responses in each category was tallied. Pilots often described several items and therefore the response from a single pilot could be counted in several categories.

These responses were also subdivided by the pilots' characteristics to study variations between different pilot groups. The counts of responses category were also found for each of these subdivisions and then compared. However, for free-response questions like these, exact significance testing of the variations is not possible.

Chapter Three

Importance, Availability and Accuracy Ratings of PLI Elements

The survey asked pilots for numerical ratings of the Importance, Availability and Accuracy of specific PLI elements, in order to develop a quantified evaluation of PLI use and perceived importance. This chapter will examine the Importance, Availability and Accuracy ratings given to PLI information. The high overall rating of PLI importance and the identification of ***Critical*** and ***Important*** PLI elements is discussed. The strong correlation between the Availability and Accuracy ratings is described. Finally, the relationship between the elements' Importance ratings and the Availability and Accuracy ratings is analyzed.

Later chapters will further analyze these ratings. The comparative ratings of PLI between different phases of flight are discussed in Chapter 4. Then, the variations in PLI ratings between pilots from different flight operations are examined in Chapter 5. A complete listing of the overall ratings is given in Appendix C.

3.1 Importance Ratings

The perceived importance pilots place upon PLI is demonstrated by the high ratings pilots gave most PLI elements on a scale from '1' (Trivial) to '5' (Critical). This importance will be examined in two ways. First, the average importance rating given to all PLI elements combined will be examined. Then, the importance ratings of the specific elements will be studied to identify information elements pilots indicate are ***Critical*** or ***Important.***

3.1.1 Overall Importance Rating

The pilots' high overall rating of PLI demonstrates the importance they give the PLI elements listed in the survey. The Critical rating -- the value '5' -- was given 42% of the time and the next highest rating was given in an additional 28% of the responses, generating a high average rating of 3.97 for all elements combined. The individual elements were also rated highly. While the ratings for the elements range from 2.40 to 4.83 on the 1(Trivial) to 5 (Critical) scale, most of the mean ratings were above 4.00 and many of the elements were judged to be ***Critical*** by a majority of the pilots.

3.1.2 PLI Elements Rated Critical in a Majority of Responses

Many of the PLI elements in the survey were rated as ***Critical*** by the pilots in at least one phase of flight, indicating a strong consensus among pilots that these elements are vital for flight operations. Table 3-1 lists these elements with the phases of flight in which these ***Critical*** ratings were given.

The PLI elements rated as ***Critical*** tend to apply to traffic and weather situations which directly affect flight safety. The Traffic PLI elements refer to knowledge required for collision avoidance -- **Aircraft on Landing Runway, Traffic Avoidance, Traffic - Controlled Airports** and **Traffic - Uncontrolled Airports** -- and these elements are considered ***Critical*** in all applicable Phases of Flight. The highest rated weather elements refer to hazards to flight safety -- **Windshear, Missed Approach - Weather, Visibility & Ceiling** during *Terminal Area* operations and *Final Approach*, and **Thunderstorms** in all Phases of Flight.

Element	Phase of Flight	Rating Average	% Pilots Giving 5 (Critical) Rating
Aircraft on Landing Runway	*Final Approach*	4.83	86%
Traffic - Uncontrolled Airports	*Departure*	4.61	71%
	Descent	4.51	68%
	Terminal Area	4.62	72%
	Final Approach	4.61	75%
Traffic - Controlled Airports	*Departure*	4.48	60%
	Descent	4.47	63%
	Terminal Area	4.62	71%
	Final Approach	4.58	72%
Traffic Avoidance	*Cruise*	4.35	57%
Windshear	*Final Approach*	4.76	81%
Missed Approach - Weather	*Final Approach*	4.62	70%
Visibility & Ceiling	*Terminal Area*	4.44	59%
	Final Approach	4.62	68%
Thunderstorms	*Ground Operations*	4.20	52%
	Departure	4.45	58%
	Cruise	4.44	56%
	Descent	4.53	61%
	Terminal Area	4.52	64%
	Final Approach	4.25	57%
Surface Winds	*Final Approach*	4.48	62%
Braking Action	*Final Approach*	4.42	56%
Icing Conditions	*Departure*	4.26	50%
	Descent	4.28	50%
	Terminal Area	4.29	53%
Aircraft Crossing Active Runway	*Ground Operations*	4.42	63%
Approach Clearance	*Terminal Area*	4.47	62%
Terminal Routing	*Terminal Area*	4.35	52%
Missed Approach - Other	*Final Approach*	4.27	50%
Error of Controller	*Ground Operations*	4.38	57%
	Terminal Area	4.33	56%
	Final Approach	4.41	61%

Table 3.1 - Critical PLI Elements

Several other PLI elements were perceived as ***Critical***, although without as strong a consensus. These include other Traffic PLI elements useful for tactical and strategic planning, such as **Terminal Routing** and **Approach Clearance**, as well as other Weather PLI elements useful when planning an approach to landing, such as **Surface Winds** during *Final Approach.* In addition, **Error of Controller** was considered ***Critical*** during the busy phases of flight *Ground Operations, Terminal Area* and *Final Approach.*

3.1.3 Other Elements Rated as Important by a Majority of Pilots

In addition to the PLI elements which were rated as Critical, many elements received Important ratings from the majority of the pilots. The elements with ratings in this ***Important*** range are listed in Table 3.2 with the Phases of Flight in which these ratings were received.

Many of these elements contain Traffic information useful for anticipating flight routings and delays. Examples include **Holding Situation/EFC Validity, Relative Sequencing, Taxiway Turnoff** and **Routing to Runway** (for Departure).

The element **Weather Overall** received ratings within this range for all Phases of Flight. Most of the specific weather elements also received ratings in this range for the Phases of Flight during which they are not considered ***Critical.*** For example, **Visibility & Ceiling** received ***Critical*** ratings for the Phases of Flight in which the landing approach is planned and executed, but during other Phases of Flight -- *Ground Operations* and *Descent* -- its ratings decreased to fall within this ***Important*** range. The variance of weather elements' importance ratings with Phase of Flight is analyzed more completely in Chapter 4.

The element **Error of the Controller** also showed the pattern of receiving ***Important*** ratings during the Phases of Flight during which it was not considered ***Critical*** -- *Departure, Cruise* and *Descent.* **Next Communications Frequency** was rated ***Important*** only in the Phases of Flight preparing for approach and landing -- *Descent, Terminal Area* and *Final Approach.*

Element	Phase of Flight	Rating Average	% Important or Critical Ratings
Holding Situation/EFC Validity	*Descent*	4.28	84%
	Terminal Area	4.19	81%
Relative Sequencing of Other A/C	*Ground Operations*	3.66	55%
	Departure	3.78	63%
	Cruise	3.52	54%
	Descent	3.96	74%
	Terminal Area	4.16	82%
	Final Approach	4.06	77%
"Hold Short" of Rwy - Other A/C	*Ground Operations*	3.96	69%
Taxiway Turnoff	*Final Approach*	3.67	57%
Routing to (Take-Off) Runway	*Ground Operations*	3.60	57%
Weather Overall	*Ground Operations*	3.75	63%
	Departure	3.88	69%
	Cruise	3.87	67%
	Descent	4.01	74%
	Terminal Area	4.08	78%
	Final Approach	3.87	67%
Visibility & Ceiling	*Ground Operations*	3.79	65%
	Departure	3.41	51%
	Descent	4.12	76%
Ride Reports & Turbulence	*Departure*	3.73	61%
	Cruise	3.89	69%
	Descent	3.70	60%
	Terminal Area	3.65	57%
	Final Approach	3.52	56%
Surface Winds	*Ground Operations*	3.61	55%
	Descent	3.79	67%
	Terminal Area	4.27	81%
Icing Conditions	*Ground Operations*	4.09	74%
	Cruise	4.19	80%
	Final Approach	4.09	74%
Error of Controller	*Departure*	4.23	79%
	Cruise	4.01	69%
	Descent	4.19	77%
Next Communications Frequency	*Descent*	3.64	59%
	Terminal Area	3.86	68%
	Final Approach	3.59	57%

Table 3.2 - Important PLI Elements

3.1.4 PLI Elements Receiving Lower Importance Ratings

A small group of elements -- five elements, some in several Phases of Flight -- received ratings from the majority of pilots at or below the mid-point value of '3', indicating pilots generally consider these elements, at some stages of the flight, to be relatively unimportant. These elements, and the Phases of Flight for which they received low ratings, are listed in Table 3.3.

Element	Phase of Flight	Rating Average	# Pilots Giving A Rating At or Below '3'
Winds Aloft	*Ground Operations*	2.67	79%
	Departure	2.89	75%
	Cruise	3.22	61%
	Descent	2.64	78%
	Terminal Area	2.52	77%
	Final Approach	2.40	77%
Next Comm. Freq.	*Ground Operations*	2.80	69%
	Departure	3.42	50%
	Cruise	3.34	52%
Ride Report & Turbulence	*Ground Operations*	3.37	53%
Visibility & Ceiling	*Cruise*	3.15	58%
Surface Winds	*Departure*	3.00	62%
	Cruise	2.54	74%

Table 3.3 - Elements Rated Below the Mid-Point Score by a Majority of Pilots

The element **Winds Aloft** received low ratings for all Phases of Flight, indicating a pilot consensus on the consistently low importance of this element. The other elements received these low ratings only in specific Phases of Flight; their variance between POF is documented in Chapter 4.

3.1.5 Importance Ratings of PLI Elements Not Specific to Phase of Flight

The importance ratings given to the nine Prosodic and General PLI elements are shown in Table 3.4. Two elements, **Call Sign Confusion** and **ATC Problems / Lost Communication**, are considered ***Critical*** by all the pilots. The remainder are considered ***Important***. Pilots, therefore, perceive the information presented by the method of voice communications to be important.

Element	Rating Average	% Pilots Giving Important Rating	% Pilots Giving Critical Rating
Call Sign Confusion	4.53	91%	64%
Controller's Competence	4.32	88%	48%
ATC Problems / Lost Comm.	4.38	87%	53%
Navaid Problems	4.17	79%	44%
Sector Congestion	3.93	74%	22%
Other Pilot's Competence	4.00	72%	35%
Controller's Experience	3.85	69%	26%
Background Transmission	3.61	59%	21%
Other Pilot's Experience	3.57	55%	19%

Table 3.4 -- Importance Ratings of General and Prosodic PLI Elements

3.2 Availability and Accuracy Ratings

The ratings of all PLI elements combined for Availability and Accuracy indicate pilots consider PLI to be generally present and reliable as an information source. The Availability ratings scale was defined from '1' (Non-Existent) to '5' (Common-Place); the Accuracy ratings scale was defined from '1' (Unreliable) to '5' (Reliable). The overall Availability average of 3.64 and the Accuracy average of 3.81 are significantly less than the overall Importance average ($p<.01$).

Unlike the Importance ratings where the extreme rating of '5' was common, pilots generally did not give the maximum value for the Availability and Accuracy ratings. The range between their high and low average ratings is smaller than for the Importance ratings. The mean Availability ratings for specific PLI elements range from 2.63 to 4.35 and the mean Accuracy ratings range from 3.14 to 4.25.

Two notable features of the Availability and Accuracy ratings do merit discussion. First, a strong linear correlation exists between the Availability and Accuracy ratings. Second, almost all of these ratings have a strong correlation with the corresponding Importance ratings, although the Availability and Accuracy ratings for some PLI elements are disproportionally low or high compared to their Importance ratings. This section will detail these correlations and discuss their implications.

3.2.1 Correlation Between Availability and Accuracy Ratings

A strong linear correlation exists between the Availability and Accuracy ratings, with a high correlation co-efficient of .95 and no significant outliers, as shown in Figure 3.1. The Accuracy ratings have a higher average overall, but lower range; Availability varies more widely around a lower overall value. This strong correspondence may be an indication of an increased accuracy of PLI for referencing elements which are commonly available, or may be the result of pilots combining the two ratings together to form a vague 'Quality' measure.

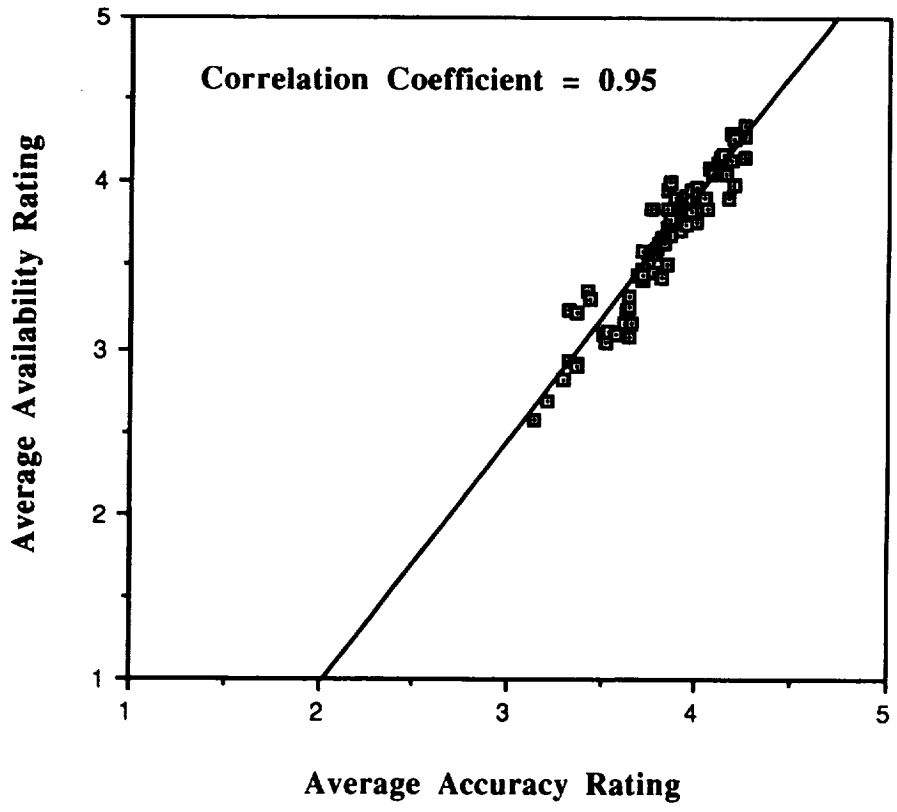

Figure 3.1 Linear Correlation Between the Availability and Accuracy Ratings

3.2.2 Correlation Between Importance Ratings and Availability or Accuracy Ratings

A scatter plot of the elements Importance and Availability ratings is shown in Figure 3.2. Because of the strong relationship between the Availability and Accuracy ratings, a scatter plot of the Importance and Accuracy ratings is similiar and therefore is not shown.

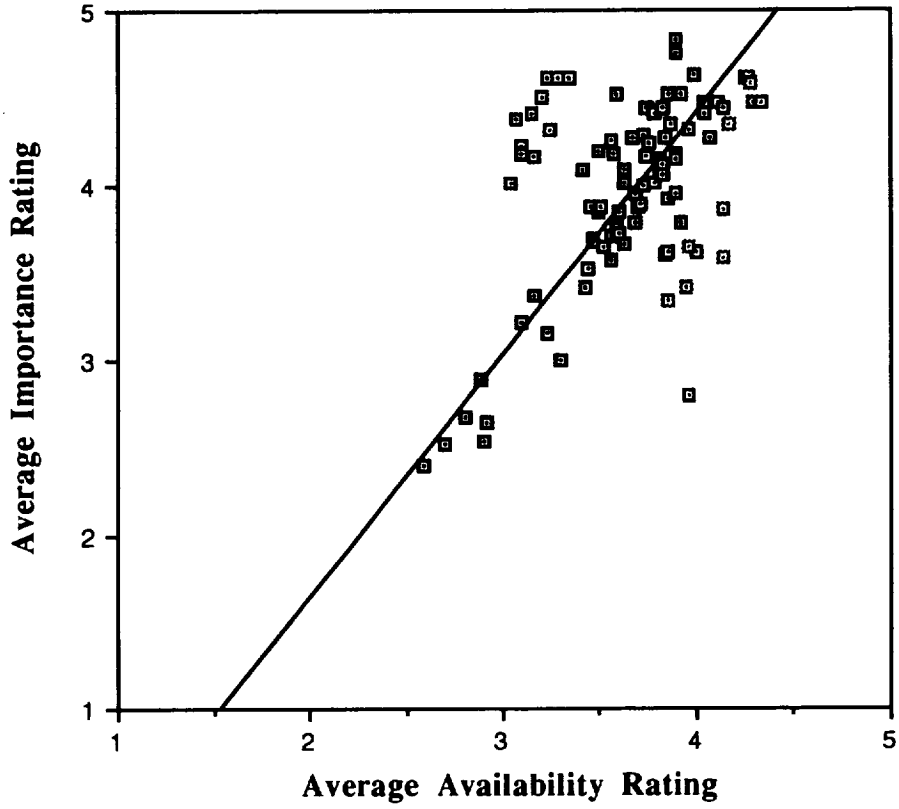

Figure 3.2 -- Importance Ratings Compared to Availability Ratings for All PLI Elements

These ratings for all the elements do not show a strong correlation. However, the PLI elements can be divided into three groups by observation:

- The majority of elements, which have a strong correlation between their Importance and either their Availability or their Accuracy ratings.

• Elements with high Availability and Accuracy ratings and low importance ratings --**Next Communications Frequency, Controlled Traffic, Approach Clearance, Terminal Routing** and **Surface Winds** (*Final Approach* only). These ratings may represent items which are continuously presented by PLI.

• Elements with low Availability and Accuracy ratings but high Importance ratings -- **Error of the Controller** and **Uncontrolled Traffic**. Their relatively low Availability and Accuracy ratings may indicate they are specific information elements for which pilots feel PLI is not an adequate information source.

These groups were verified statistically by comparing the actual Availability and Accuracy ratings to the values expected by a linear line of best fit with the corresponding Importance ratings.

Chapter Four

Variation in Party Line Information Importance Between Phases of Flight

Throughout the different phases of flight, the pilot's requirements for PLI may change considerably. Several factors contribute to these changes: the differences in weather conditions between high-level cruise and low-altitude airport operations, the transitions between control by different Air Traffic Control facilities, and changes in the type of decisions required of the pilot, in the time-critical nature of the decisions, and in pilot workload.

In Midkiff's survey, significant differences were found in the Importance ratings given to the collected Party Line Information (PLI) elements both separately and averaged together within each phase of flight. Similar trends in the PLI importance, availability and accuracy ratings were found by this survey.

This chapter will first discuss the characteristics of each Phase of Flight as they were defined in this study. Then, the effects these Phases of Flight have on the PLI Importance ratings is examined in two ways, by comparing the ratings of all PLI elements in each Phase of Flight combined and by examining the variations in the ratings for each specific element between each Phase of Flight. The trends of the Availability and Accuracy ratings are nearly identical to those shown by the importance information and therefore are not described separately. The Importance Ratings given in each Phase of Flight are listed in Appendix D.

4.1 Flight Operations Throughout All Phases of Flight

A normal flight can be divided the sequential Phases of Flight shown schematically in Figure 4.1. The differences between Phase of Flight relate both to the different conditions the aircraft experiences in each and to the variations in the pilot's duties and workload. This section will detail the definitions of each Phase of Flight used by this survey, and then will examine the characteristic differences between them that are relevant to PLI use and importance.

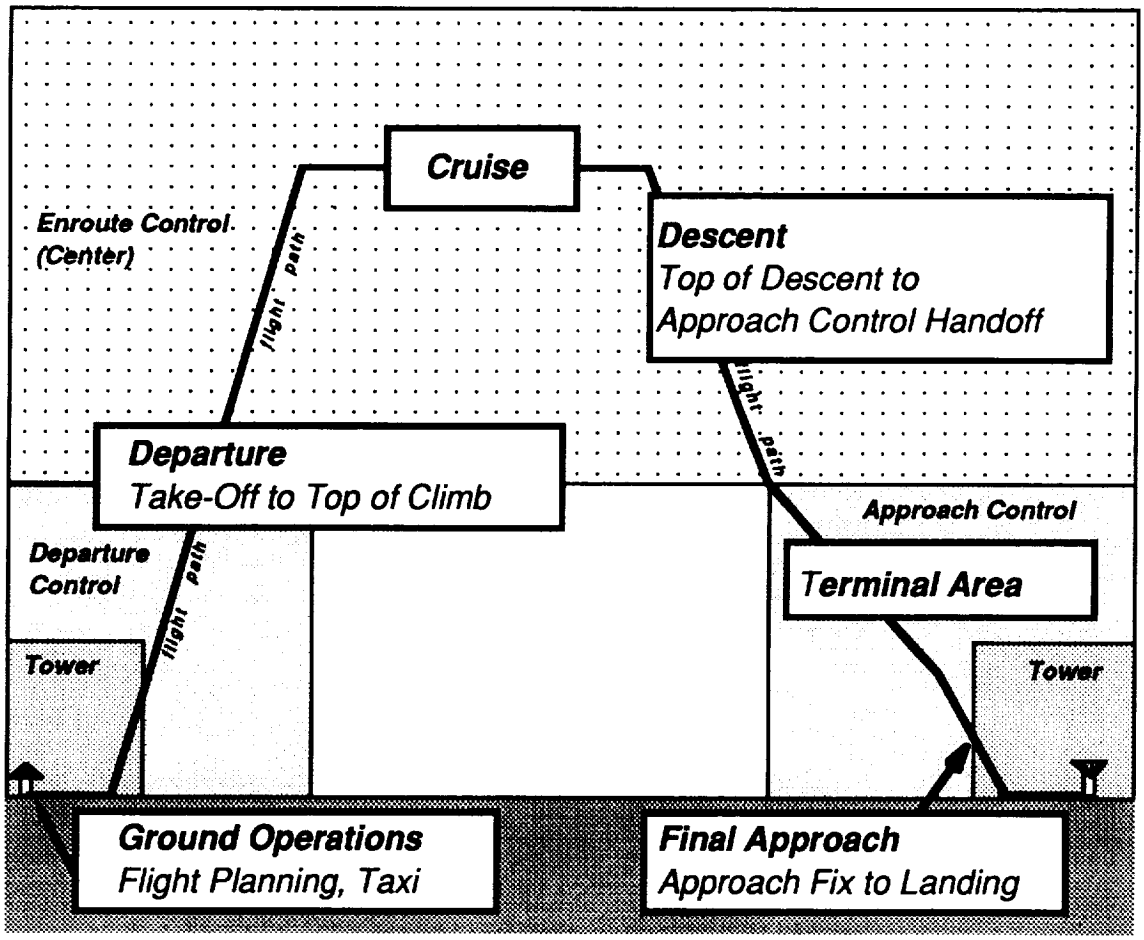

Figure 4.1 Normal Flight Sequence

4.1.1 Descriptions of Each Phase of Flight

A definition of each Phase of Flight was given to the pilots in this survey by the points during flight delineating its beginning and ending. These definitions and a brief description of each Phase of Flight are give here.

Ground Operations

This Phase of Flight was defined to include *Dispatch, Pre-Start & Taxi.* The pilot is presented with PLI during this phase from the time the first radio frequency is monitored until take-off. Depending on the departure airport, the pilot may monitor several frequencies, including the ATIS, ramp control, clearance delivery and ground control frequencies. The pilot's duties include planning the flight route, gathering and updating information needed for the flight, preparing the aircraft systems for flight and taxiing the aircraft.

Departure

This Phase of Flight was defined to span from *Take-Off* to *Top of Climb*. It can be further divided into three distinct segments. During the first, the take-off, the pilots full attention is given to controlling the aircraft. Then, during the initial climb, the pilot follows steering vectors away from the terminal area. Finally, during the cruise climb the pilot and autopilot systems navigate and plan ahead for cruise. The pilot will communicate first with the tower controller, then with the Terminal Area departure controller, and finally will transition to an Enroute Control Center.

Cruise

This Phase of Flight is defined to last from *Top of Climb* to *Top of Descent.* This is usually the longest phase with the least variance in pilot tasks. Generally, the pilot and the aircraft flight systems follow a nearly level and straight course for most of the duration of the flight. The pilot also executes any deviations from the given course due to weather or traffic congestion, and plans ahead for the descent and landing. As the aircraft's position changes, the pilot is passed on to successive Enroute Control Centers.

Descent

The survey defined this Phase of Flight as from *Top of Descent* to *Approach Control Contact.* During this phase the aircraft transitions from its established cruise flight path to a lower altitude where the aircraft is vectored by ATC into position for arrival at the Terminal Area. The pilot must plan ahead for the approach and for any delays and must steer the aircraft as commanded by ATC. The aircraft remains under the supervision of a Enroute Control Center.

Terminal Area

This Phase of Flight was defined as from *Approach Control Contact* to the *Final Approach Fix* and spans most of the time during which the aircraft is supervised by the Terminal Area's approach controller (TRACON). Although this phase is shorter than those preceding, the pilot has many duties requiring immediate attention. In addition to preparing for the final approach, the pilot must also steer the aircraft, as commanded by ATC, for traffic and weather avoidance, holding, and sequencing.

Final Approach

This Phase of Flight was defined as from *Final Approach Fix* to *Runway Threshold.* Especially during adverse weather conditions, the pilot's attention is directed to the safe execution of the final approach and landing. Normally, the planning of the approach is complete before it is started; the pilot's attention is reserved during this phase for its execution. ATC control of the aircraft will transfer during the approach from the approach controller to the airport's tower control.

4.1.2 Changes in Flight Characteristics Between Phase of Flight

In addition to the clearly defined changes in the duties required of a pilot during a flight, several other characteristics of the flight change with POF. These characteristics are both physical conditions affected by the changes in altitude and airspace, and also the less tangible demands placed upon the pilot.

The most obvious physical changes are the changes in weather conditions caused by the ranged of altitudes covered in a normal flight. Some conditions, such as 'Surface Winds' and 'Visibility & Ceiling' are predominantly low-level conditions. Other weather conditions, such as 'Winds Aloft', are found specifically at cruise altitude. An aircraft's exposure to the different weather conditions then varies with the altitude of the aircraft. This exposure is also partially determined by the length of time for which the aircraft is at that altitude. For example, an aircraft departing an airport can climb through altitudes where uncomfortable turbulence is prevalent enough to discourage long-distance cruise.

During the airborne section of the flight, the aircraft passes through three distinct types of airspace: the local 'Tower' control immediately surrounding the airport, the 'Terminal Area' Control (TRACON) extending around the airport area to a distance of about 50nm, and the 'Enroute Center' covering the high-level cruise and areas between airports. Because these transitions generally include moving from 'less crowded' to 'more crowded' airspace during arrival into an airport, several other changes can occur. The voice frequency itself can become 'congested', with nearly continuous transmissions. The traffic situation can change so that the routing of the flight becomes dependent on sequencing of the aircraft to ensure their separation. In congested airspace, especially near busy airports, traffic watch and collision avoidance become vital concerns.

The nature of the tasks required of the pilot also change in several ways throughout flight. During the early stages of the flight, the pilot is responsible for short and long-term strategic planning of the complete flight path based upon the his or her estimates of the future conditions. As the aircraft nears the destination the time span over which the pilot must make these estimates and plan the flight path shortens. Once in the busier terminal area, the pilot's task changes to immediate tactical planning while being vectored by the air traffic controller into position for the approach, and to preparing for the approach. By the time the pilot is established on Final Approach, a majority of planning is done and he/she is primarily concerned with controlling the aircraft.

Many other factors follow this trend of increased severity nearer the airport. For example, the time pressure placed upon the pilot to analyze information and make decisions increases nearer the airport (ref. Hart, Hauser & Lester, 1984). During *Cruise* the pilot is normally free to consider and compare information. In contrast, during *Final Approach* the time available to make decisions such as a missed approach is often reduced to seconds.

Another condition which has been widely studied is pilot workload. Studies show that pilot workload follows a distinct trend of being the lowest during *Cruise* and the highest during *Terminal Area* and *Final Approach.* (Ref. Hart, Hauser & Lester, 1984). With this change in workload may come a change in the capability of the pilots to disseminate PLI. Results from an experimental simulator study suggest that, during high workload conditions, analyzing PLI becomes a lower priority activity compared to more immediate concerns such as completing an approach. (Ref. Midkiff, 1992)

4.2 Overall Variance of PLI Importance with Phase of Flight

An overall comparison of the perceived variations of PLI importance between different Phases of Flight was made by comparing the combined ratings of all PLI elements listed with each, as shown in Figure 4.2. The highest ratings were given to the Phases of Flight nearest the airports, especially *Final Approach*, where a majority of the ratings were ***Critical***, and *Terminal Area*. The lowest importance ratings are given in *Cruise* , where only 30% of the ratings were ***Critical***. The ratings for each successive Phase of Flight are significantly different from the one preceding ($p < 0.01$), except between the ratings for *Final Approach* and *Terminal Area*.

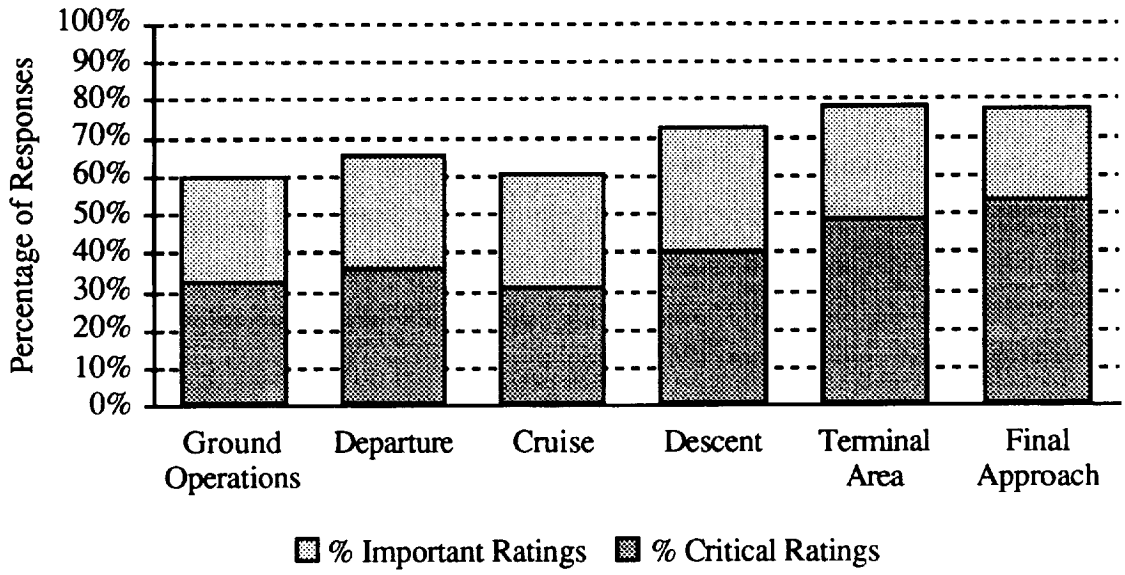

Figure 4.2 -- Combined Importance Ratings of All PLI Elements for Each Phase of Flight

These combined ratings within each Phase of Flight mark a general pattern in PLI importance: significantly lower ratings given in *Cruise*, higher ratings in *Terminal Area* and *Final Approach*. However, these combined ratings may be biased somewhat because the list of PLI elements with each Phase of Flight was set during the survey design. Therefore, some ***Critical*** elements received ratings with specific Phases of Flight, raising the combined ratings for those Phases of Flight.

4.3 Variance of Weather PLI Importance with Phase of Flight

The importance ratings given to the individual weather PLI elements in each Phase of Flight was classified in several patterns. **Weather Overall** followed the same pattern as shown by the combined PLI ratings with lower ratings in *Cruise* and higher ratings on *Final Approach.* The specific weather elements had particular Phases of Flight during which each element is particularly important.

This section will detail these trends and will identify the Phases of Flight during which the individual elements are of particular importance to pilots. The correspondence between the trends for the elements and those predicted by the characteristic tasks of the pilot in the Phases of Flight will also be discussed.

4.3.1 Variance of Weather Overall

The importance ratings of the PLI element **Weather Overall** varies throughout the Phases of Flight with a pattern of lower importance ratings in *Cruise* and higher importance ratings in *Terminal Area*, as can be seen in Figure 4.3. The element is considered ***Important*** for all POF and this perceived importance increases for the Phases of Flight nearer the conclusion of the flight.

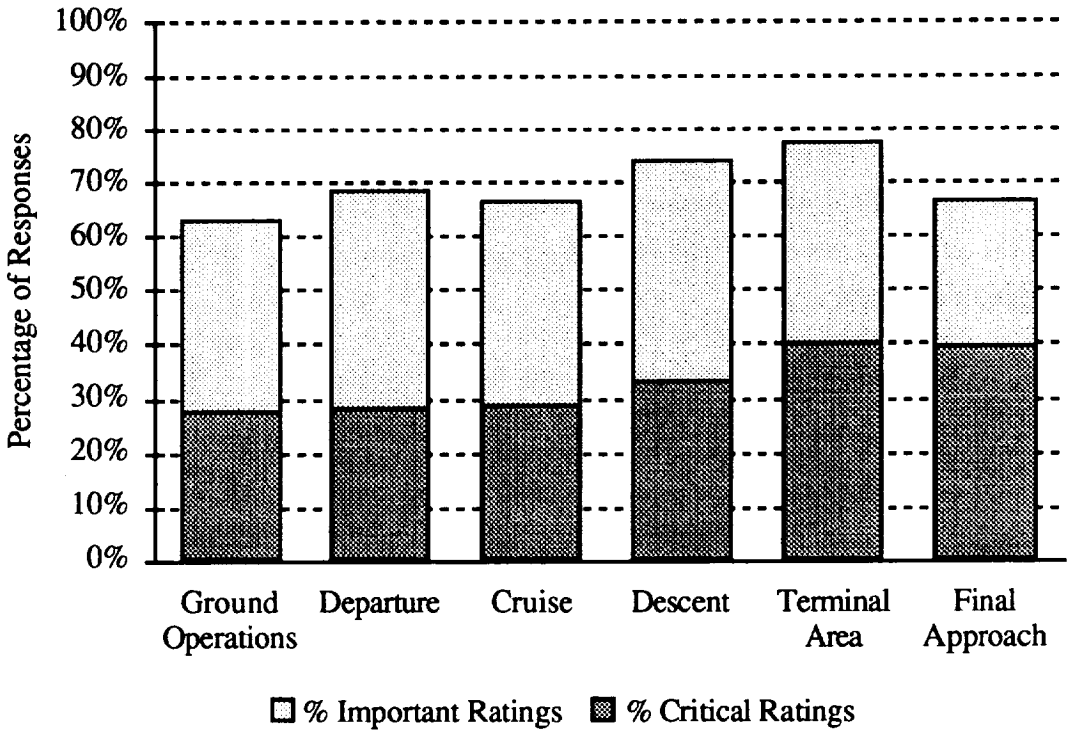

Figure 4.3 -- Importance Ratings of Weather Overall for All Phase of Flight

The importance of **Weather Overall** differs from the general PLI pattern in two ways. First, the percentage of pilots giving this element an ***Important*** rating drops significantly from *Terminal Area to Final Approach*, although the percentage of pilots giving it a ***Critical*** ratings stays the same. This particular discrepancy may indicate a lower need of a pilot to gather weather information on *Final Approach* to plan ahead because the approach is already planned by the time it is started, and because the approach and landing complete the flight.

Second, the importance ratings in *Cruise* are not significantly lower than those for *Ground Operations* and *Departure*. These similar ratings may result from the duties of the pilot during *Cruise*. Even during high-level, long-range cruise, the pilot must monitor any weather conditions that can indicate the most efficient and safe routing and flight level of the aircraft and the pilot must update the estimate of weather conditions at the destination as it becomes available.

4.3.2 Weather PLI Elements Consistently Important for All Phases of Flight

Two elements -- **Thunderstorm Buildups and Deviations** and **Icing Conditions** were consistently perceived to be ***Important*** and ***Critical*** in almost all Phases of Flight, as shown in Figures 4.4 and 4.5. The importance ratings for these elements were always very high, especially during *Descent* and *Terminal Area.* While still very important, the ratings for *Ground Operations* and *Final Approach* were significantly lower than for the other Phases of Flight.

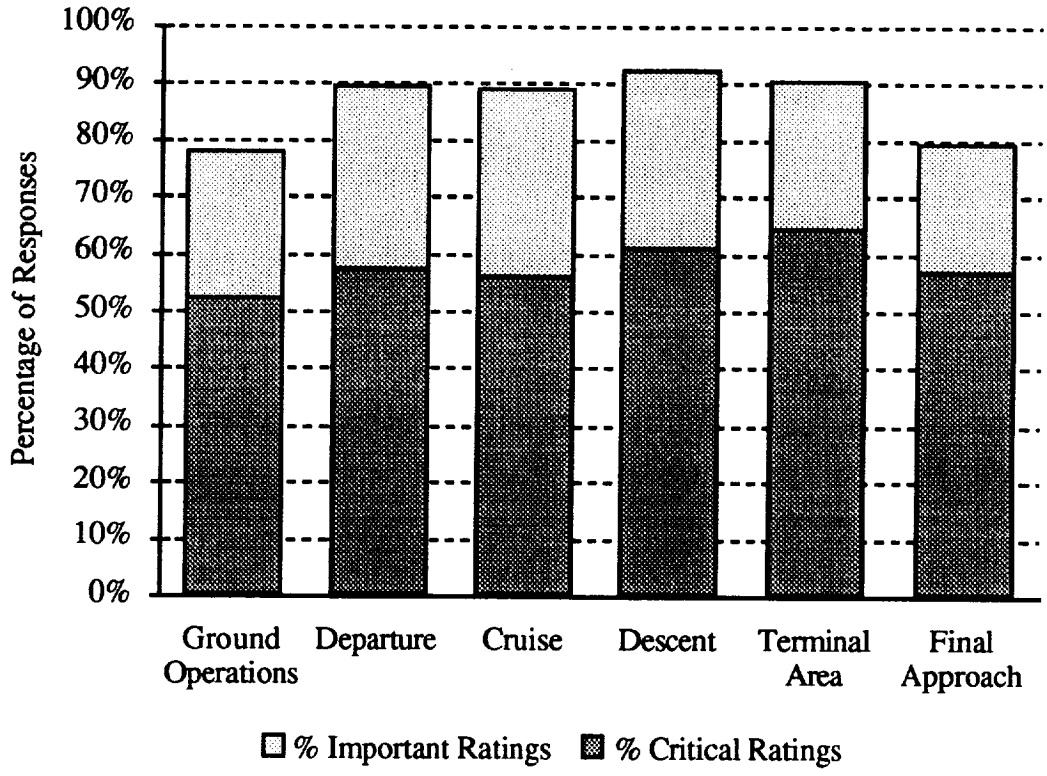

Figure 4.4 -- Importance Ratings of Thunderstorm Buildups and Deviations

The ratings of **Icing Conditions** are shown in Figure 4.5. They followed the same trend as **Thunderstorms and Deviations** but received fewer critical ratings.

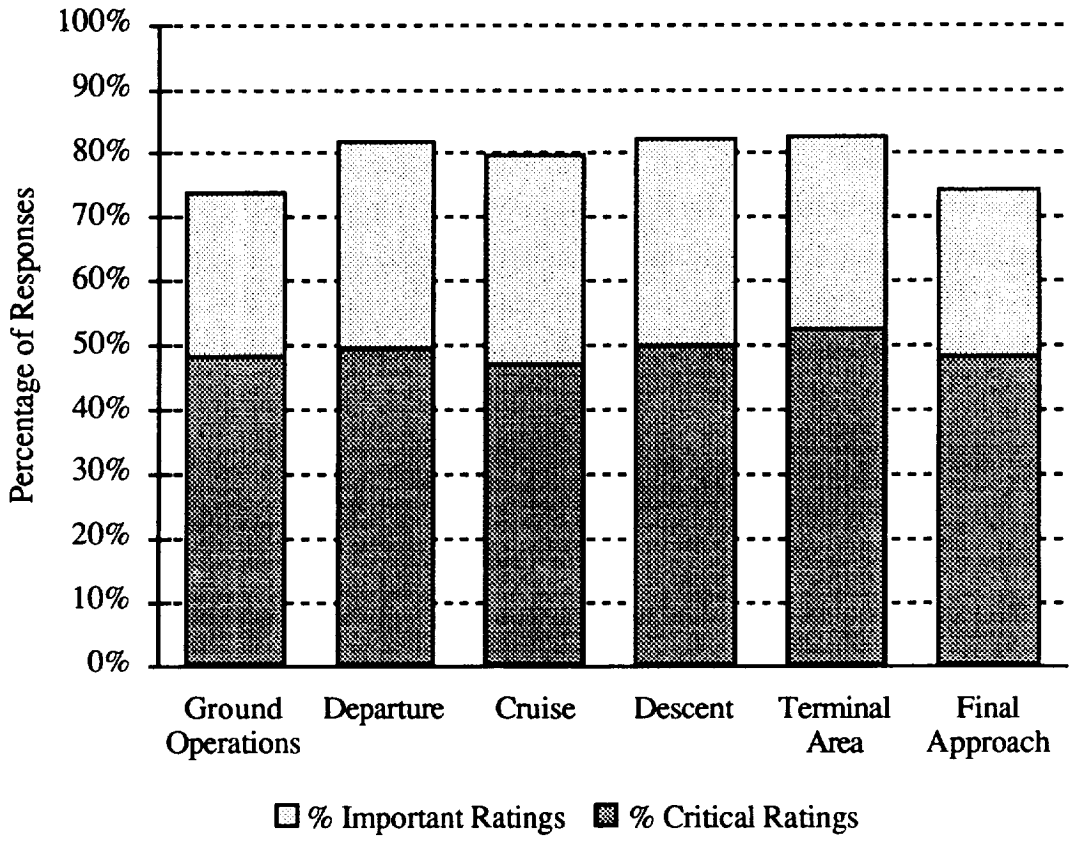

Figure 4.5 -- Importance Ratings of Icing Conditions

4.3.3 Weather PLI Elements Rated Lower in *Cruise*, Higher on *Final Approach*

The importance ratings of two weather elements, **Visibility and Ceiling** and **Surface Winds**, follow a marked pattern of lower ratings in *Cruise* and very high ratings in *Final Approach*, as shown in Figures 4.6 and 4.7 During *Departure* and *Cruise*, the ratings of these elements are low enough to not be considered ***Important*** by a clear majority of the pilots. The importance ratings increase steadily through *Descent, Terminal Area* and *Final Approach* such that they are perceived to be ***Critical*** in both *Terminal Area* and *Final Approach.*

The ***Critical*** ratings of these elements on *Final Approach* can be explained by their importance to the pilot as vital factors in determining the success of executing an approach to land. Although they may be important at other times during the flight, during *Final Approach* these elements can be deciding factors in the execution and completion of the approach and landing. Their ***Important*** ratings during *Descent* and *Terminal Area* likely indicate the desire of the pilot to plan ahead for the approach and landing. During *Cruise*, in comparison, these low-level weather conditions are not very relevant to the immediate flight operations and are only of interest in planning ahead for the landing.

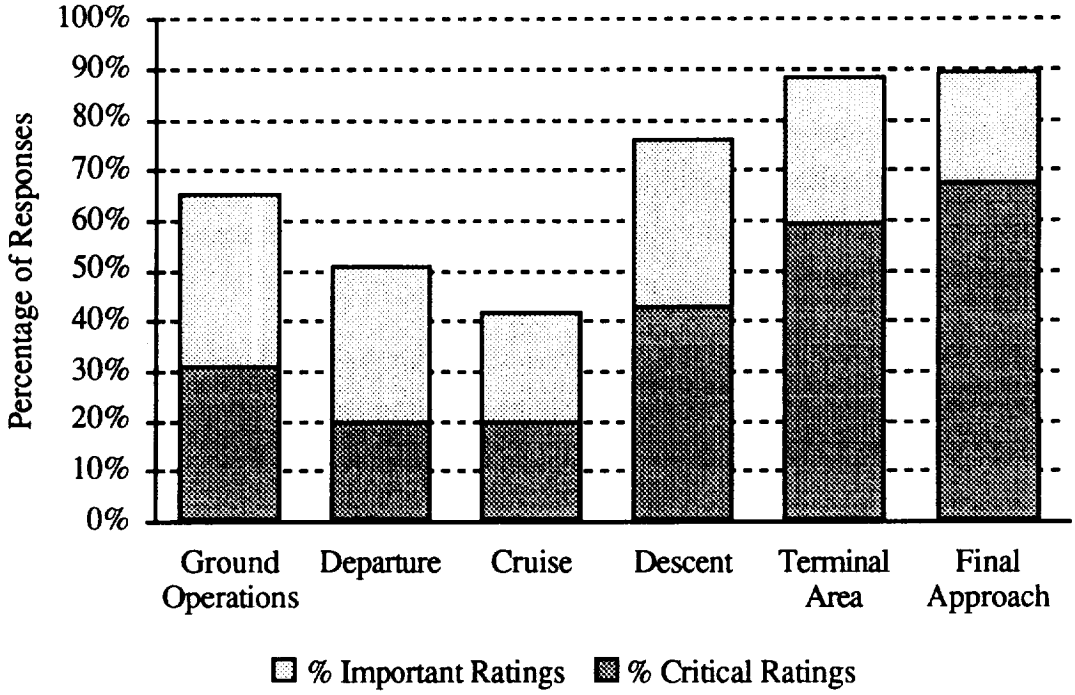

Figure 4.6 -- Importance Ratings of Visibility & Ceiling

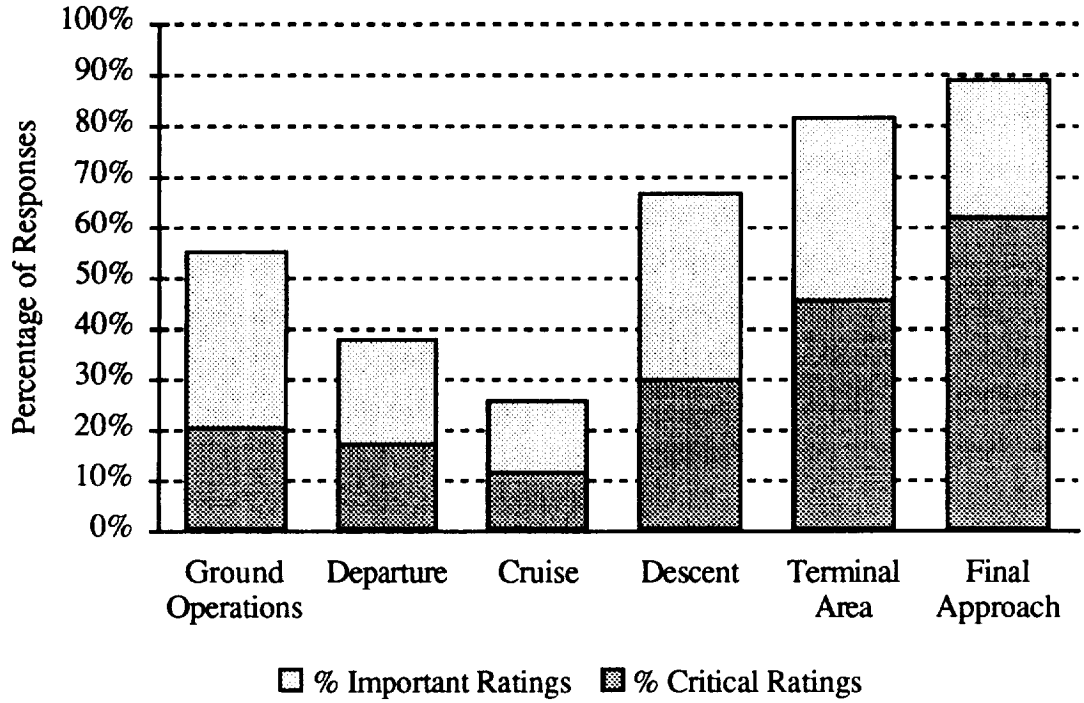

Figure 4.7 -- Importance Ratings of Surface Winds

4.3.4 Elements Rated only for *Final Approach*

Two elements were relevant only to Final Approach -- **Missed Approach - Weather** and **Windshear**. These elements were both rated as very important -- 81% of the responses for **Windshear** and 70% of the responses for **Missed Approach - Weather** were ***Critical*** -- indicating the pilots' perception that these elements are vital for executing a safe approach and landing.

The element **Windshear** is a phenomenon applicable to any low-flying aircraft. Although it was not included in *Departure*, several pilots noted this oversight and added **Windshear** to the PLI element list for this Phase of Flight, with corresponding ***Critical*** ratings.

4.3.5 PLI Weather Elements With the Highest Importance During *Cruise*

As shown in Figures 4.8 and 4.9, two weather elements, **Ride Reports & Turbulence** and **Winds Aloft**, received the highest ratings in *Cruise* and significantly lower ratings in all other phases. These importance ratings reflect several aspects of these elements. First, these elements did not receive very high importance ratings, even in *Cruise* where they scored the highest. Second, they are conditions that effect the aircraft for long periods of time in *Cruise*. During the Phases of Flight closer to the airport, aircraft will be transitioning through the altitudes where these adverse conditions may be occurring and so will not be exposed to them for as long. Finally, neither element usually affects the safety of a flight except in cases of severe turbulence. During *Cruise*, knowledge of this information can enable the pilot to make changes in flight altitude and/or routing that will improve the comfort and efficiency. Therefore, during the busier Phases of Flight such as *Terminal Area* and *Final Approach*, pilots may tend to disregard these PLI elements if they are not severe.

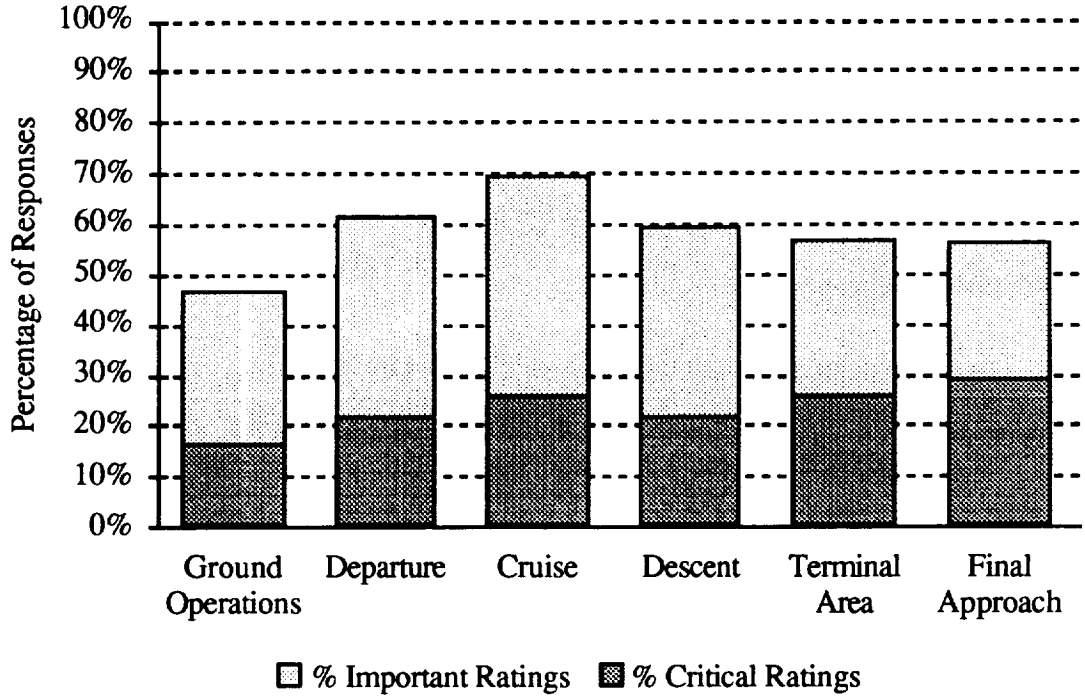

Figure 4.8 -- Importance Ratings of Ride Reports & Turbulence

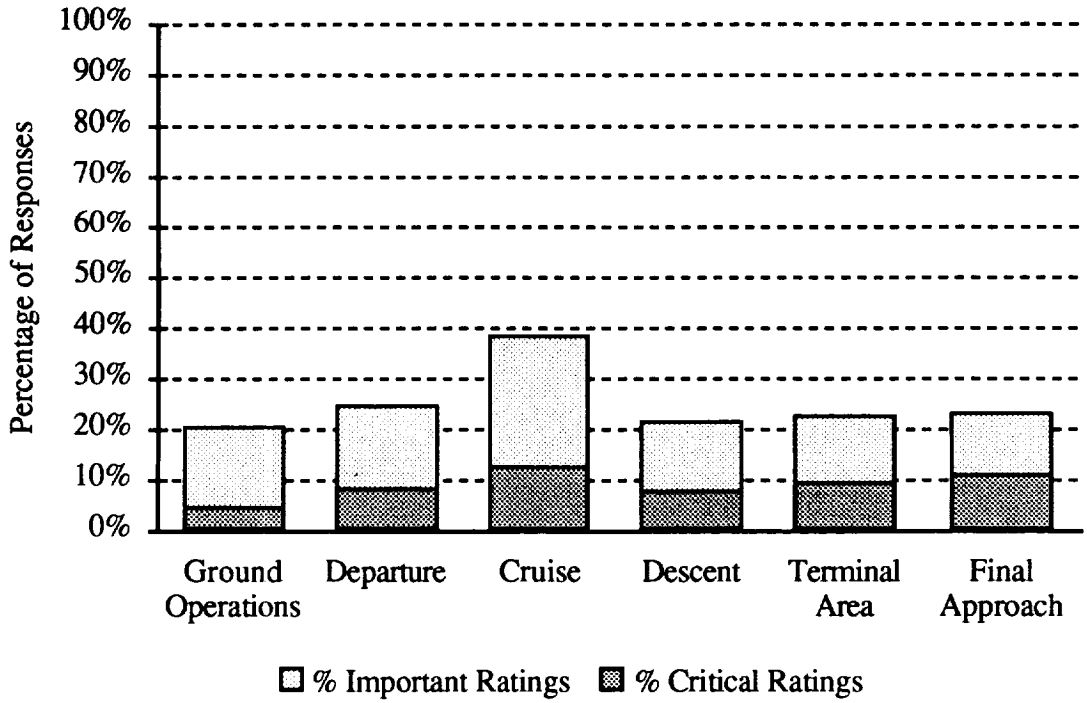

Figure 4.9 -- Importance Ratings of Winds Aloft

4.4 Variance of Traffic PLI Importance with Phase of Flight

All Traffic PLI elements follow the pattern of receiving greater importance ratings during *Terminal Area* and *Final Approach* , lower importance ratings during *Cruise.* These Traffic PLI elements can be categorized into two different groups, Traffic Avoidance and Traffic Planning. Each will be discussed separately.

4.4.1 Traffic Avoidance PLI Elements

The majority of pilots always perceive Traffic Avoidance PLI elements to be ***Critical.*** These elements follow the general trend of lower importance ratings in *Cruise*, higher ratings nearer the airport, as shown in Figures 4.10 and 4.11. All responses for these elements are considered ***Critical*** by a majority of the pilots although the percentage of pilots giving this rating varies significantly with Phase of Flight. **Traffic - Controlled** and **Traffic - Uncontrolled** during *Final Approach* receive the most ***Critical*** ratings and the fewest ***Critical*** ratings are given to **Traffic Avoidance** during *Cruise* . **Traffic - Controlled** and **Traffic - Uncontrolled** receive very similar ratings, with a significant difference between them only during *Departure.*

Although the percentage of ***Critical*** ratings varies with Phase of Flight for these elements, the percentage of Important ratings does not. At least 84% of pilots gave either an important or critical rating to these elements for all Phases of Flight with a slight increase in the ratings for *Terminal Area* and *Final Approach.* Pilots, therefore, always feel traffic avoidance information is ***Important.***

An other Traffic Avoidance PLI element, **Aircraft on Runway,** is also perceived by a very large percentage of the pilots to be ***Critical.*** This element was only rated in *Ground Operations* and *Final Approach*, supporting the trend of increasing importance for the Phases of Flight nearer the airport.

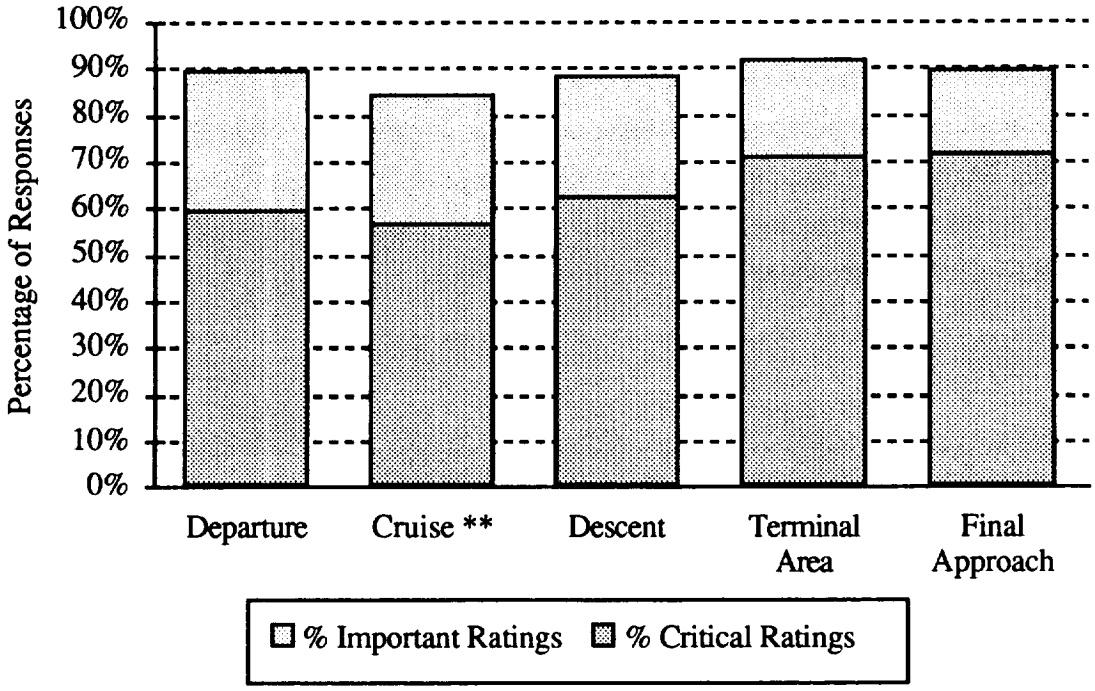

Figure 4.10 -- Importance Ratings for Traffic - Controlled
(Indicates Ratings for the PLI Element Traffic Avoidance in Cruise)**

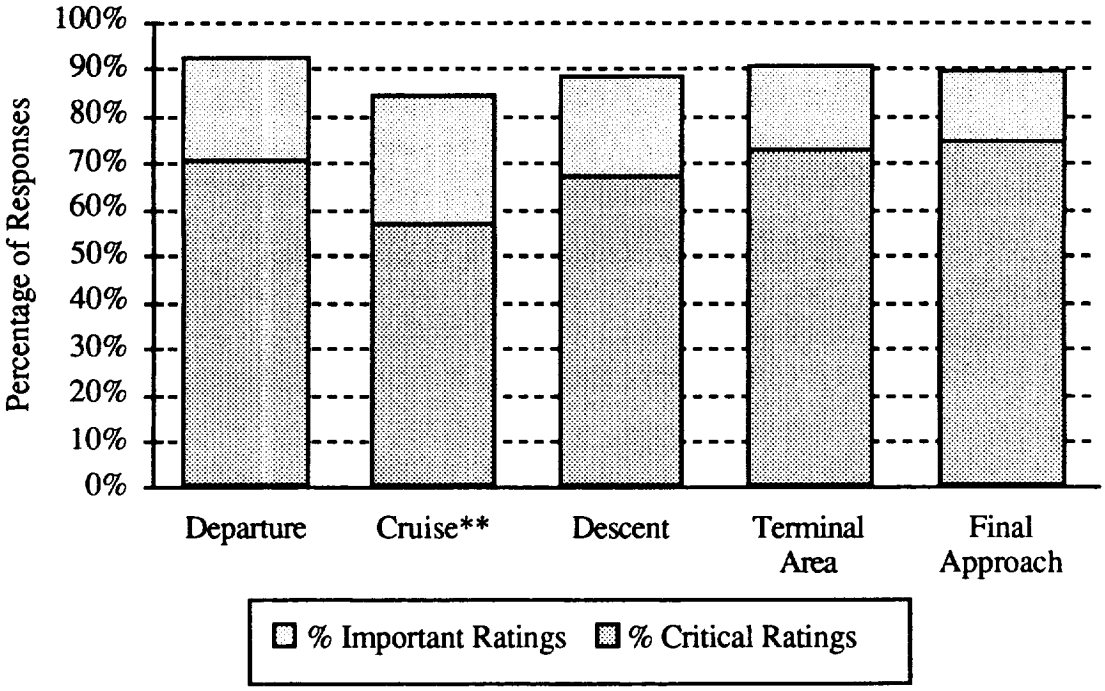

Figure 4.11 -- Importance Ratings for Traffic - Uncontrolled
(Indicates Ratings for the PLI Element Traffic Avoidance in Cruise)**

4.4.2 Traffic Planning PLI Elements

One Traffic Planning PLI element, **Relative Sequencing (of Other Aircraft)**, was given importance ratings in all Phases of Flight, as shown in Figure 4.12. Throughout all phases this element was generally considered ***Important*** but not ***Critical*** by the majority of pilots. The ratings in the *Descent* and *Terminal Area* generally receive the most ***Important*** scores, while *Cruise* receives the least.

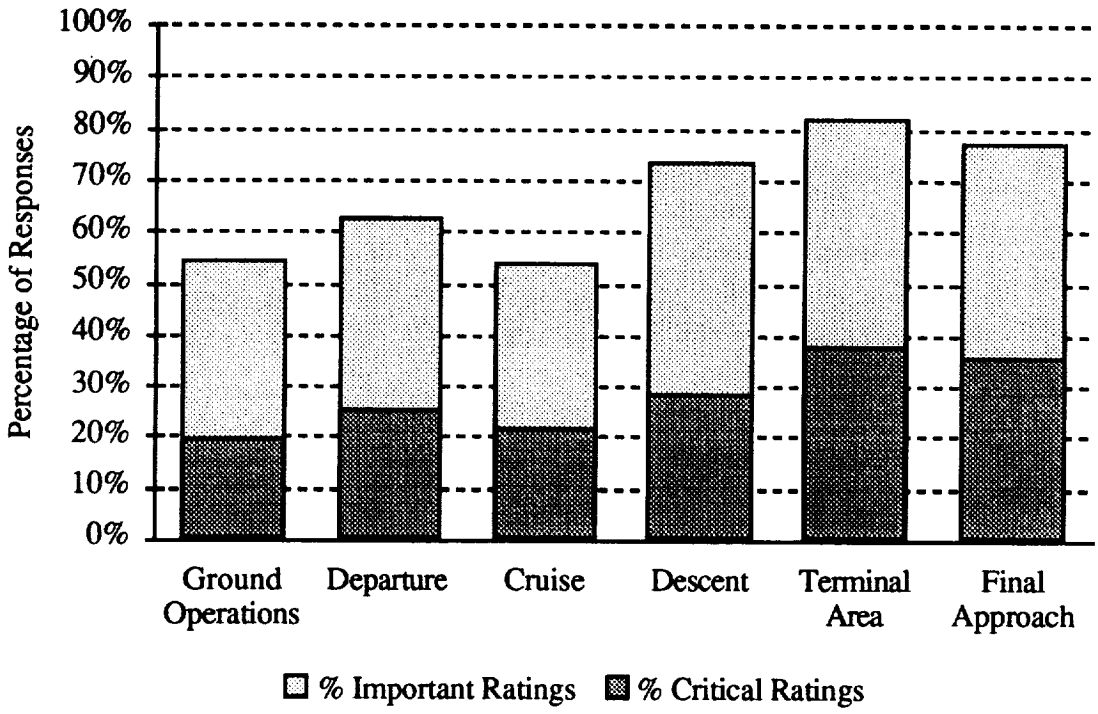

Figure 4.12 -- Importance Ratings of Relative Sequencing

The percentage of ***Important*** and ***Critical*** ratings give to other Traffic Planning PLI elements are shown in Table 4.1. They were each given ratings in only specific POF, such as *Descent*, *Terminal Area*, and *Final Approach*. Their high importance ratings in these Phases of Flight support the pattern of higher PLI importance near the airport.

PLI Element	Phase of Flight	% Pilots Giving Important Rating	% Pilots Giving Critical Rating
Hold Situation/ EFC Validity	*Descent*	84%	45%
	Terminal Area	81%	43%
Terminal Area Routing	*Terminal Area*	87%	52%
Approach Clearance	*Terminal Area*	88%	62%
Missed Approach - Other	*Final Approach*	83%	50%

Table 4.1 -- Importance Ratings of Other Traffic Planning PLI Elements

4.5 Other PLI Elements

The PLI elements such as **Error of Controller** and **Next Communications Frequency** received ratings following the pattern of the combined PLI elements -- less important ratings during *Cruise*, more important ratings during *Terminal Area* and *Final Approach.*, as shown for **Error of Controller** in Figure 4.13. Unlike the differences in ratings found for other PLI elements, however, the differences between the ratings of these PLI elements for the different Phases of Flight do not generally test to be significant to the ($p < 0.01$) level.

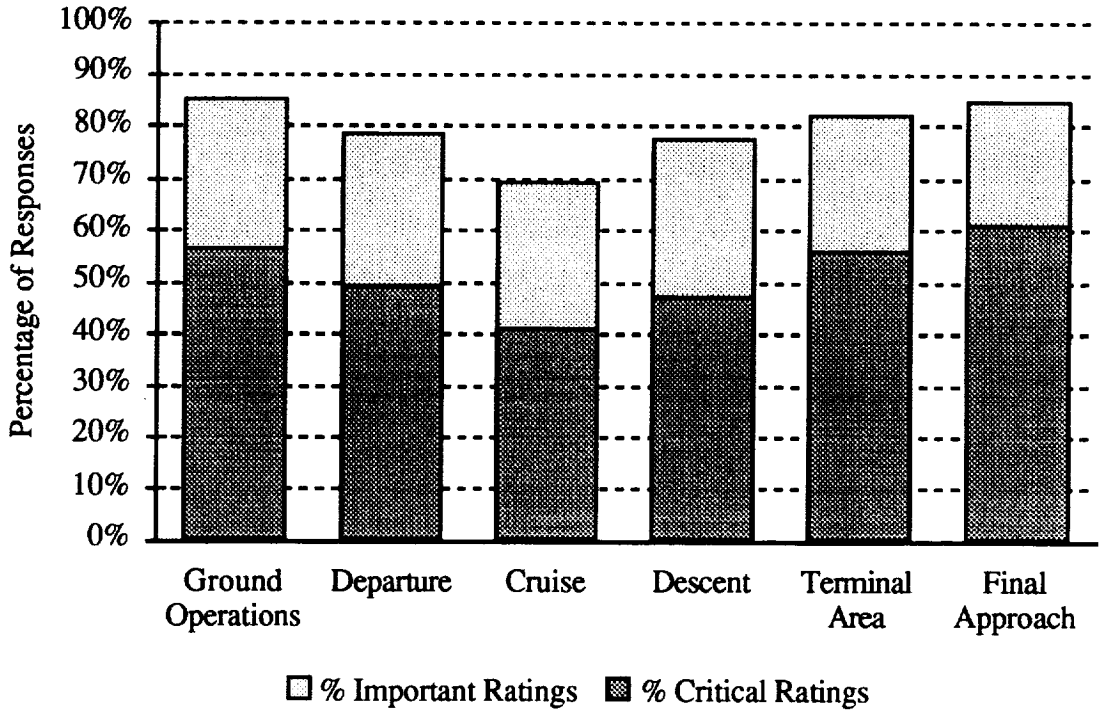

Figure 4.13 -- Importance Ratings for Error of Controller

Chapter Five

Variation in PLI Importance Between Flight Operation Groups

Substantial differences in aircraft, flight profiles and operating procedures exist between pilots of the different type of flight operations. To study the effect these differences have on PLI importance and use, this survey was distributed to pilots from four specific flight operation groups: General Aviation, Commuter & Regional Airlines, Major Airlines and Military transport operations.

Many significant differences ($p < 0.01$) were found between the importance ratings of PLI given by pilots from each flight operation group. These differences can be classified into two types. First, a pattern of lower PLI importance ratings in *Cruise*, higher PLI importance ratings in *Terminal Area* and *Final Approach* is shown by all pilots except the General Aviation pilots in the combined ratings of all PLI elements within each Phase of Flight. Second, each flight operation group identifed specific PLI elements of particular importance to that group.

The responses were also analyzed to determine if other pilot characteristics, such as total flight time, resulted in differences in PLI importance ratings. However, these traits were generally found to correlate with the type of flight operation of the pilot and could not provide any independent insights.

5.1 Pilot Characteristics

This survey was distributed to pilots from four distinct types of flight operations: General Aviation, Commuter & Regional Airlines, Major Airline and Military pilots.

General Aviation includes a broad range of flight operations, from recreational private pilots to professional non-scheduled flight charter businesses. As a group, however, these pilots tend to fly smaller aircraft with less advanced equipment than the other flight operation groups. Their flights often operate at lower cruise altitudes (less than 18,000 feet MSL) and span relatively shorter distances. As a result, General Aviation is very sensitive to adverse weather conditions. In addition, General Aviation aircraft fly more often into smaller airports and have less advanced cockpit instrumentation to aid the pilot than other types of civil aviation operations.

The Commuter & Regional Airline category includes scheduled short-haul operations with aircraft ranging in size from twin-engine turboprop aircraft to smaller jet airliners. These aircraft often fly into both smaller, uncontrolled airports and major terminal areas. Although these aircraft will generally have increased forms of anti-icing equipment and weather radar, many do not have the autoflight systems found in the larger airline aircraft, and may have limited ground support at some airports.

Major Airline pilots fly the well equipped aircraft on scheduled routes. All their aircraft have substantial equipment for weather detection and traffic avoidance. The newest aircraft, such as the Boeing 757, 767, 747-400, MD80, MD11 and the Airbus 320 series, also present the pilot with the electronic or 'Glass' cockpit displays and with autoflight systems capable of navigation and auto-landings. These aircraft may travel both shorter domestic routes and many hour transcontinental or transoceanic flights, with cruise altitudes ranging between 20, 000 feet MSL for shorter flights and 40, 000 feet MSL on longer flights.

The military squadrons to which the survey was distributed were chosen based on their domestic flight operations using larger multi-engine aircraft, such as Airlift, Transport and Coastal Patrol. Some of their aircraft, such as the KC-135, C-130, C-141 and DC-9, are similar to those flown by the Major Airline group.

In addition to surveying for the type of flight operation, the Background Information page of the survey requested detailed information about other characteristics of the pilot which might affect their perceived importance of PLI. These characteristics

included items such as: total flight hours, flight hours in the last year and years as a pilot, flight ratings held, aircraft flown, geographic region, average length of flight, and customary ATC frequency congestion.

However, most of these characteristics were found to correspond strongly to the type of flight operation. For example, as shown in Table 5.1, pilots with the least flight experience (as ascertained by Total Flight Hours) were the General Aviation pilots, while pilots with the most flight experience were the Major Airline pilots. As a result, the differences in the PLI ratings given by low-time and high-time pilots are similiar to the differences in the PLI ratings given by General Aviation and Major Airline pilots. Therefore, where significant variations in PLI ratings exist between pilots with differing characteristics, the differences can generally be correlated to an underlying difference in flight operations.

	Flight Hours			
	0-1500	1500-5000	5000-10000	10000+
General Aviation	[64%]	28%	6%	2%
Commuter Airlines	0%	25%	[48%]	26%
Major Airlines	0%	8%	39%	[53%]
Military	27%	[63%]	11%	0%

[ ] = Largest Amount of Pilots Within Each Range of Flight Hours

Table 5.1 -- Comparison Between Respondents' Flight Hours and Type of Flight Operations

5.2 Variations in PLI Importance Ratings in All Phases of Flight

The relative importance ratings given PLI by pilots from different flight operations changes with the different Phases of Flight. The Commuter and Major Airline pilots generally gave higher importance ratings for PLI elements in *Terminal Area* and *Final Approach* and lower importance ratings in *Cruise*. The General Aviation pilots, on the other hand, gave consistently high importance ratings in all Phases of Flight.

This pattern is shown by the combined importance ratings of all PLI elements listed in each Phase of Flight, as pictured in Figure 5.1. Significant differences exist between the ratings given by each type of pilot in each Phase of Flight except *Final Approach*. The largest difference is in *Cruise*, when all of the pilot types except for General Aviation perceive PLI to be significantly less important than the other Phases of Flight. In contrast, the General Aviation pilots gave the PLI elements more important ratings in *Cruise* than in *Departure* and *Ground Operations*.

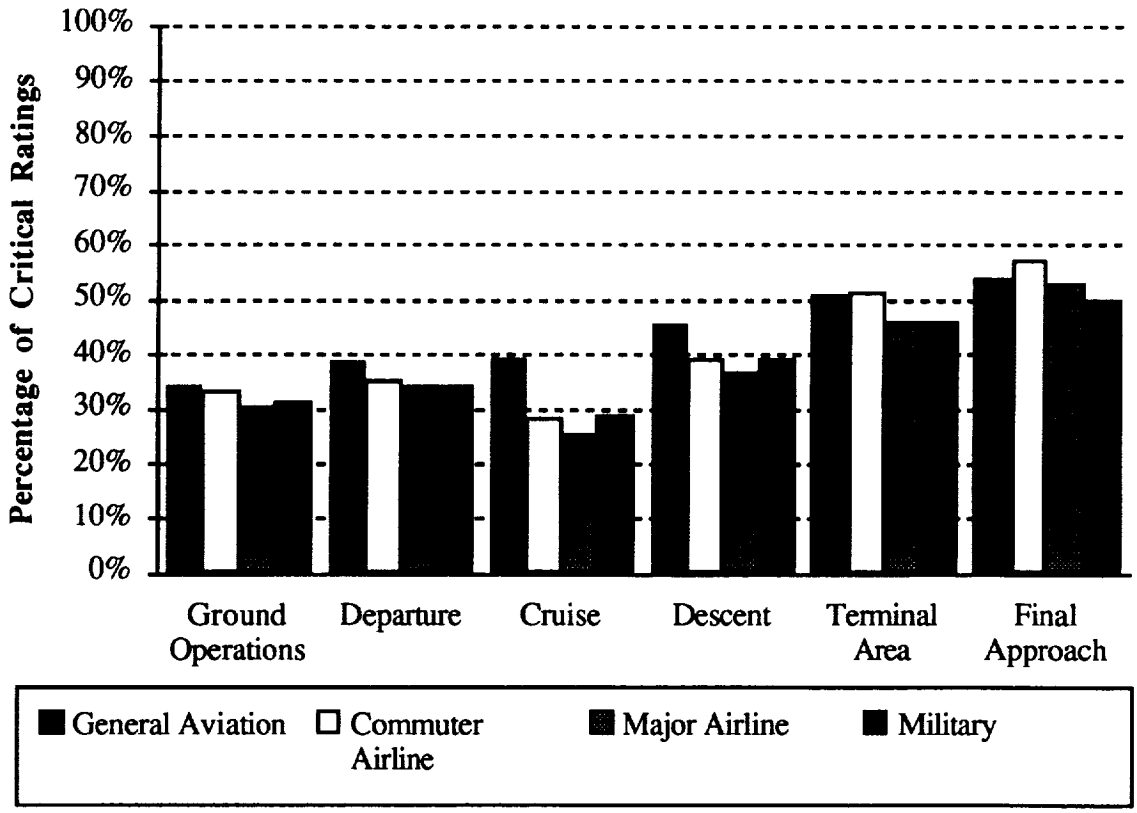

Figure 5.1 -- Combined PLI Importance Ratings for All PLI Elements in Each Phase of Flight (Shown for Each Type of Flight Operation)

The importance ratings of two specific PLI elements also followed this pattern. The ratings for the first PLI element, **Weather Overall**, are shown in Figure 5.2. The General Aviation pilots gave fairly consistent ratings for all Phases of Flight. Comparatively, the Commuter and Major Airline pilots gave significantly lower ratings to this element in *Cruise* and higher importance ratings in *Final Approach* and *Terminal Area.*

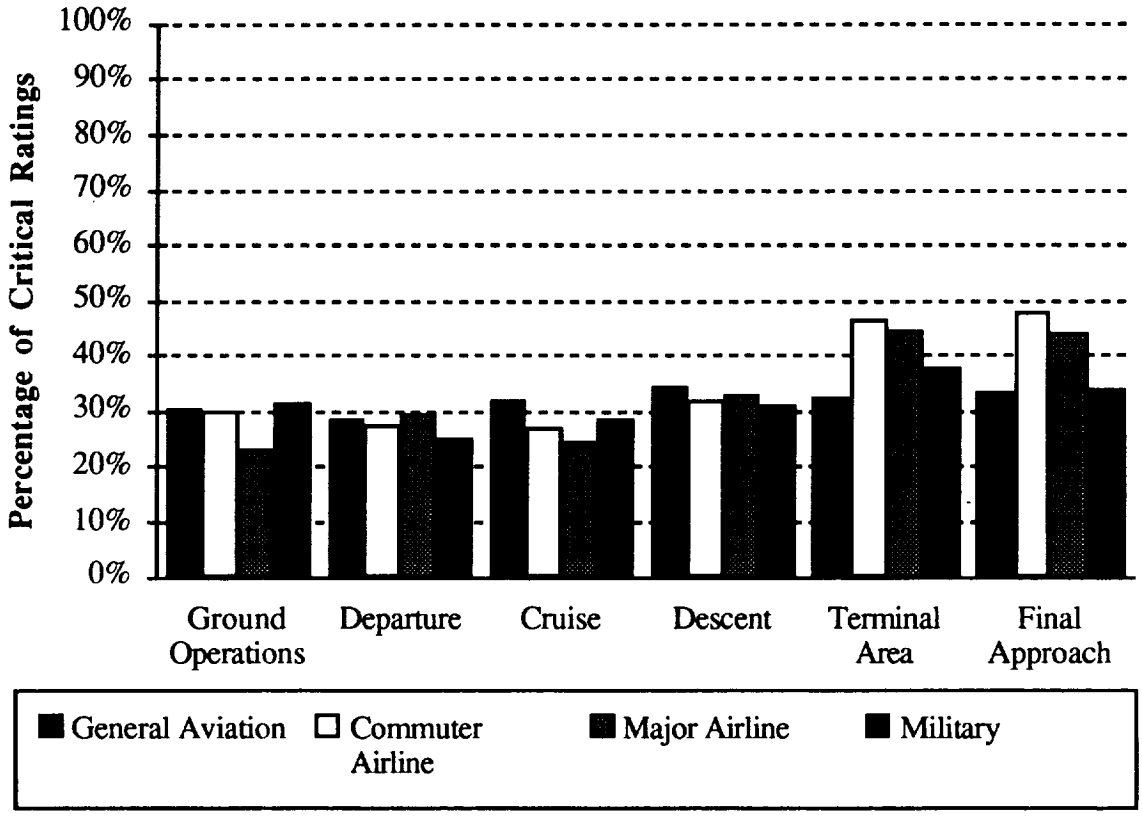

Figure 5.2 -- Weather Overall Importance Ratings in Each Phase of Flight (Shown for Each Type of Flight Operation)

These relative differences in importance ratings were greater for the PLI element **Thunderstorm Buildups & Deviations**, as shown in Figure 5.3. The General Aviation pilots gave this PLI element a significantly higher rating in *Cruise*, while the Commuter and Major Airline pilots gave it a higher rating in *Final Approach.* The Commuter Airline pilots also gave it a higher rating in *Departure.*

The observed variation in PLI importance ratings may be explained by the characteristics of the different types of flight operations. Unlike the other types of flight operations, General Aviation aircraft rarely reach high level cruise for long periods of

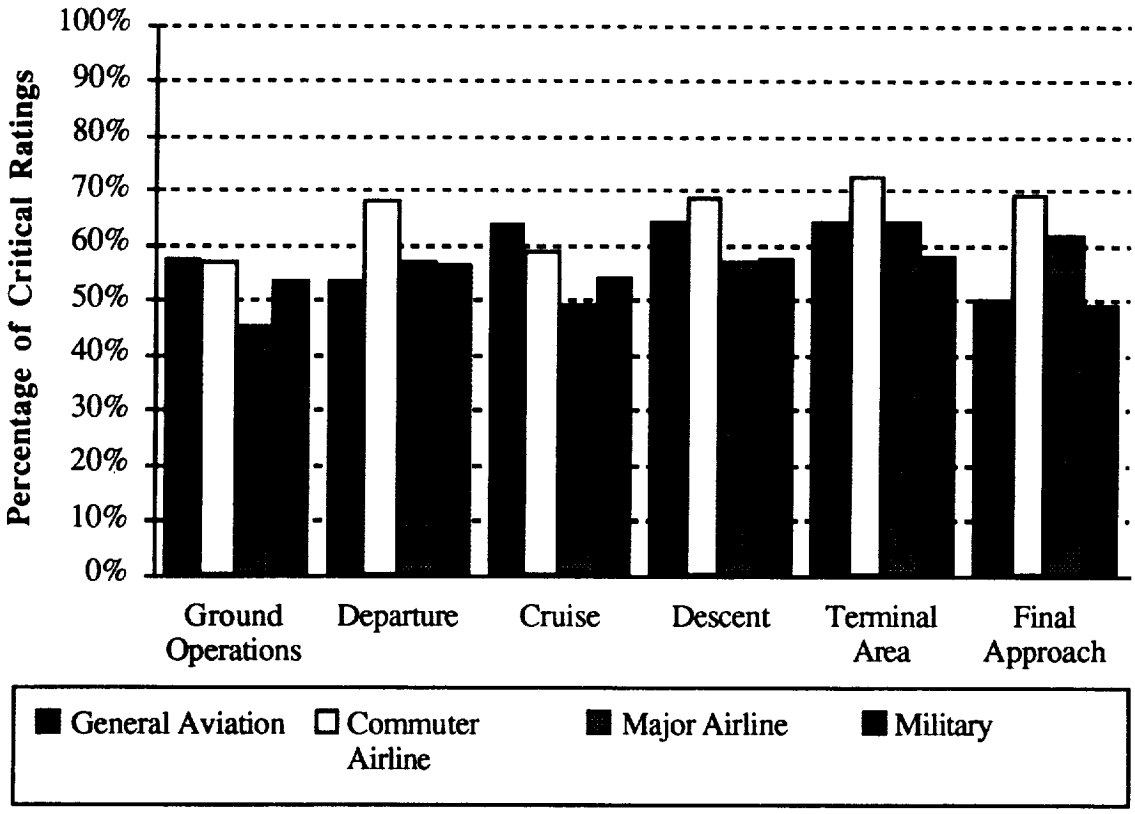

Figure 5.3 -- Thunderstorm Buildups Importance Ratings in Each Phase of Flight (Shown for Each Type of Flight Operation)

time but instead normally cruise at lower altitudes where they are more sensitive to low-level weather conditions and where they are often in transit through busier low-level airspace. Also, they often lack the weather radar equipment standard to the other types of flight operations. Therefore, their information requirements may remain consistently high throughout the flight, without large distinctions between the different Phases of Flight, resulting in their consistently high importance ratings.

In contrast, the flight operations of the Commuter and Major Airline pilots, and of the Military pilots flying larger aircraft, generally involve distinct differences between the different Phases of Flight. Because they follow scheduled high-level cruise flight paths, they are less susceptible to weather conditions and to immediate route changes. However, their operations near the destination can sometimes include a transition to more congested airspace, worse low-level weather and scheduling delays or holds. With these operational differences these pilots identified specific Phases of Flight, *Terminal Area* and *Final Approach*, where they perceive PLI to be especially important.

5.3 PLI Elements Perceived More Important by Major Airline Pilots

The Major Airline pilots consistently identified the PLI element **Ride Reports & Turbulence** as more important than the pilots of other flight operations, as can be seen in Figure 5.4. Except in cases of severe turbulence, this element generally concerns the comfort of the passengers on the aircraft and therefore the Military transport aircraft gave it the lowest importance ratings, General Aviation pilots the next lowest, and the Airline pilots of aircraft the most concerned with a comfortable long-distance cruise gave this element the highest importance ratings

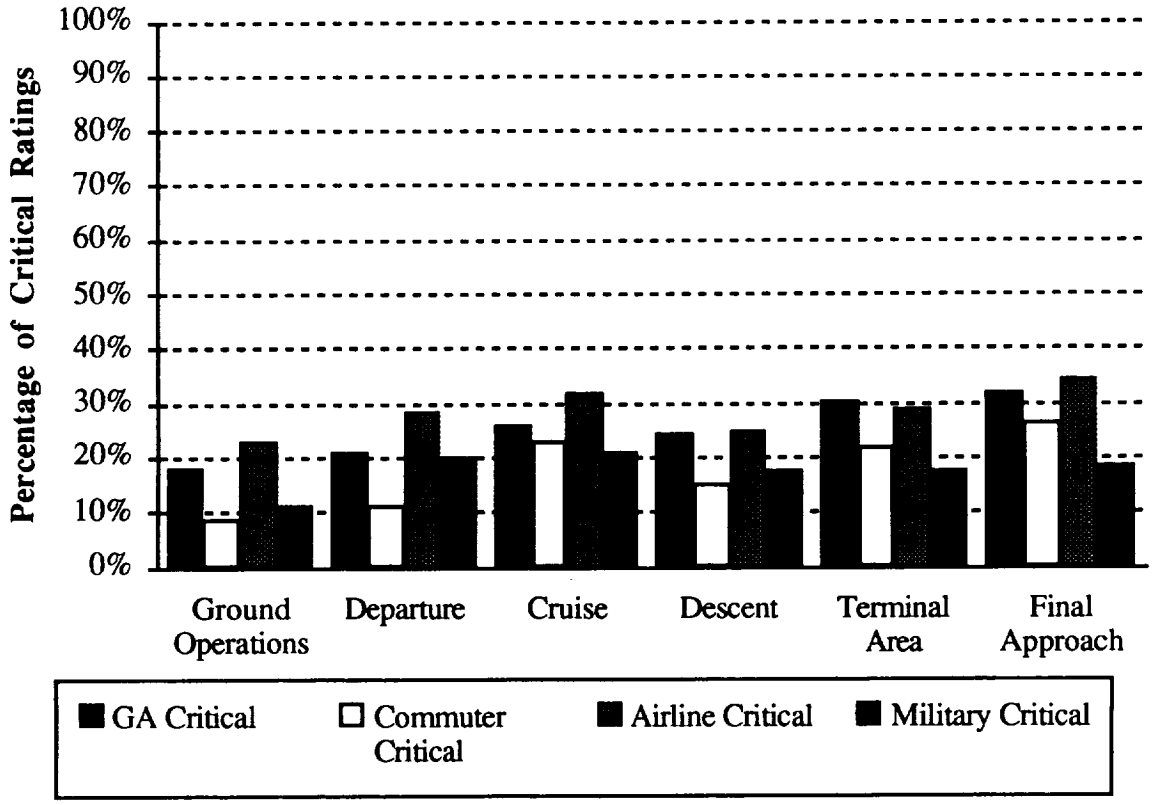

Figure 5.4 -- Ride Report & Turbulence Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

Three other PLI elements, **Routing to Runway** (for Takeoff), **"Hold Short" of Active Runway of Other Aircraft** and **Braking Action**, were also rated as significantly more important by Major Airline pilots. These elements are relevant to their operations from large and busy airports. **Braking Action** is also a greater concern to Major Airline pilots because of their large aircraft which require substantial braking and runway distance to slow from landing speed.

5.4 PLI Elements Perceived More Important by Commuter Airline Pilots

Pilots were asked to rate the importance of the PLI element **Traffic Avoidance -- Uncontrolled Airports** in four Phases of Flight. In the three phases nearest the airport -- *Departure*, *Terminal Area* and *Final Approach* -- this element was given higher importance ratings by the Commuter Airline pilots, as shown in Figure 5.5. In *Descent* this difference in importance ratings is also visible but does not test to be statistically different. These higher importance ratings may result from the type of flights common to these pilots. Although they generally fly fairly modern turbine-powered aircraft over scheduled routes, many of their destinations may be smaller, uncontrolled airports.

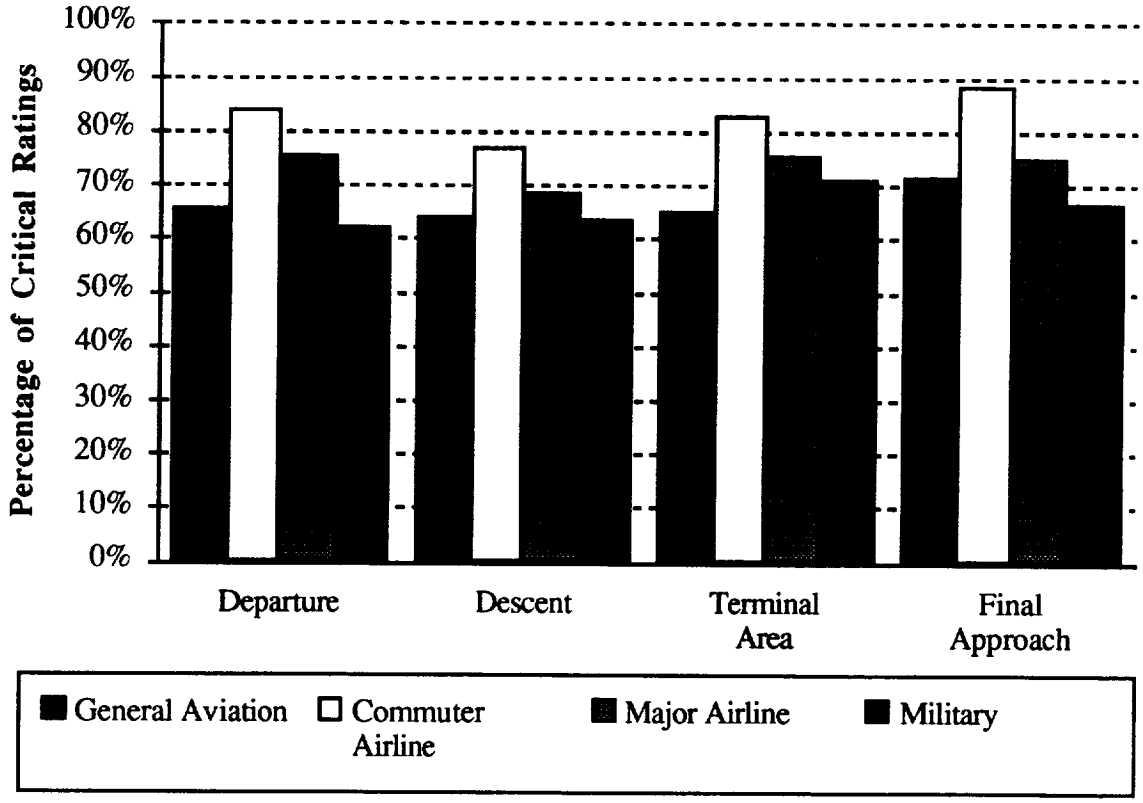

Figure 5.5 -- Uncontrolled Traffic Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

5.5 PLI Elements Perceived More Important by General Aviation Pilots

Several PLI elements were always rated more important by General Aviation pilots. Figure 5.6 shows the percentage of Critical ratings given to **Icing Conditions** by pilots of each flight operation. In all Phases of Flight the ratings given by the General Aviation pilots are very high and are significantly higher than those given by at least one other group. The ratings are the lowest from the Major Airline and Military pilots.

This effect can be explained by the differences in their aircraft. Unlike the larger aircraft of the Military and Major Airline pilots, General Aviation aircraft generally are not certified for flight in known icing conditions and may not be able to climb above icing altitudes. Therefore, inflight icing is a condition which General Aviation aircraft must avoid by knowing where it may occur. These ratings indicate PLI is perceived as an important information source for this element.

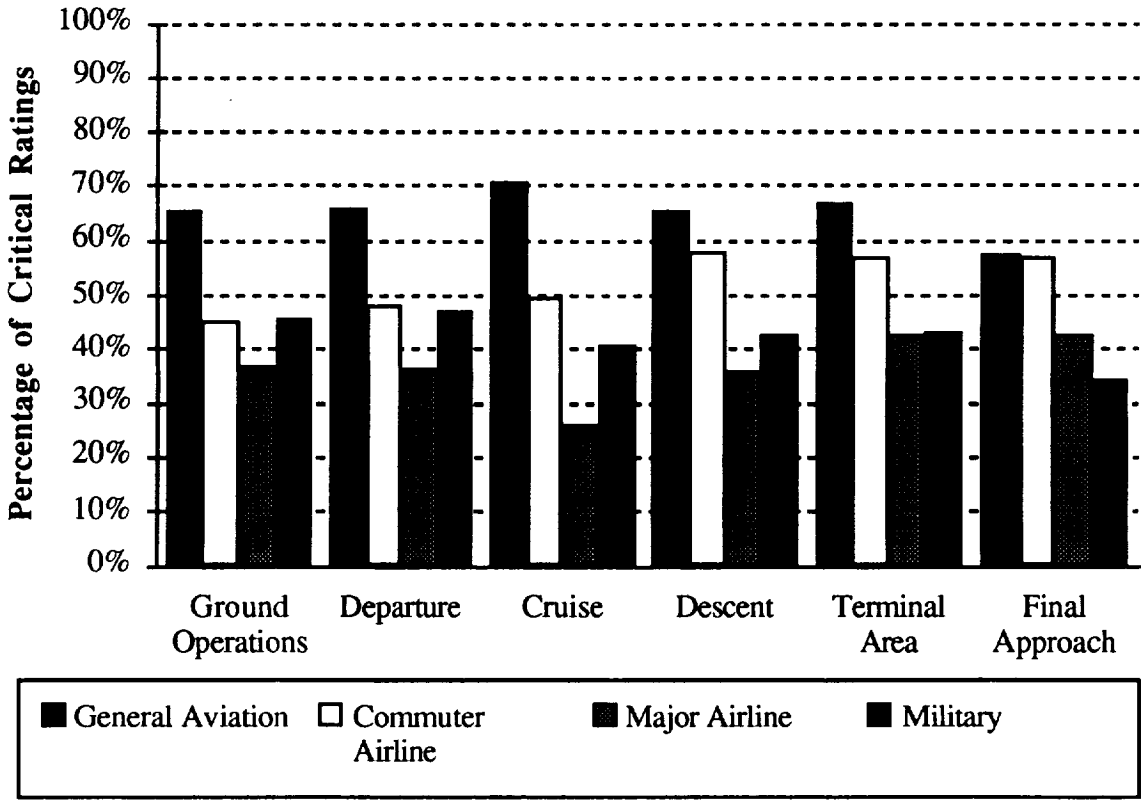

Figure 5.6 -- Icing Conditions Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

Figure 5.7 shows the ratings given **Visibility & Ceiling** by the different types of pilots. In all Phases of Flight except *Ground Operations* the General Aviation pilots gave this PLI element significantly higher importance ratings. The differences are the greatest in *Cruise*, where the Commuter Airline, Major Airline and Military groups gave very low importance ratings. In the Phases of Flight *Terminal Area* and *Final Approach* the ratings given by the Commuter Airline pilots near those of the General Aviation pilots.

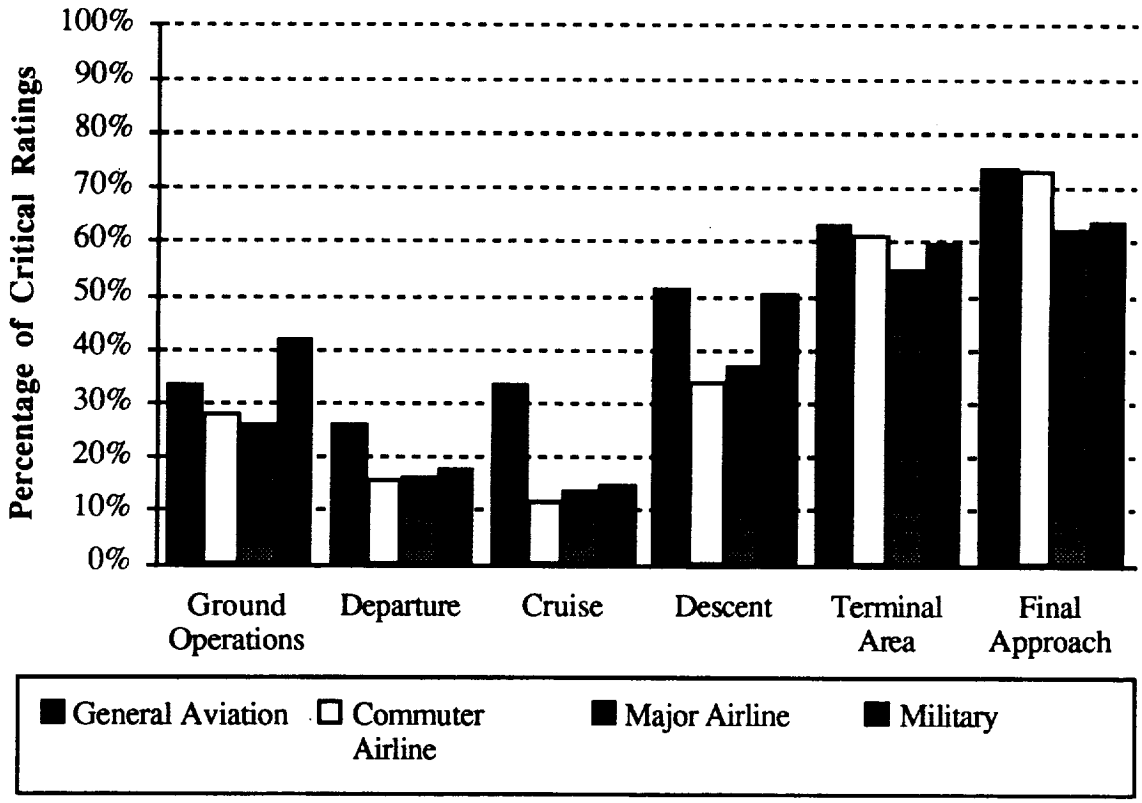

Figure 5.7 -- Visibility & Ceiling Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

These differences may be caused by the differences in the aircraft and equipment. The high importance ratings by General Aviation pilots in *Cruise* may result from their lower cruise altitudes and limited range which can keep them in Instrument Meteorological Conditions for significant portions of their flight. Both the General Aviation and Commuter Airline pilots may not have advanced capabilities for precision approaches and autopilot-approaches available in their aircraft and at the smaller airports they may operate out of. Therefore, this PLI element maybe more important to these pilots during *Terminal Area* and *Final Approach.*

A third Weather PLI element, **Winds Aloft**, also received significantly higher ratings from General Aviation pilots in all POF, as shown in Figure 5.8. These ratings may also result from the characteristics of the General Aviation aircraft. Because these aircraft fly at lower airspeeds, this weather condition had a larger effect on their performance than on the other groups.

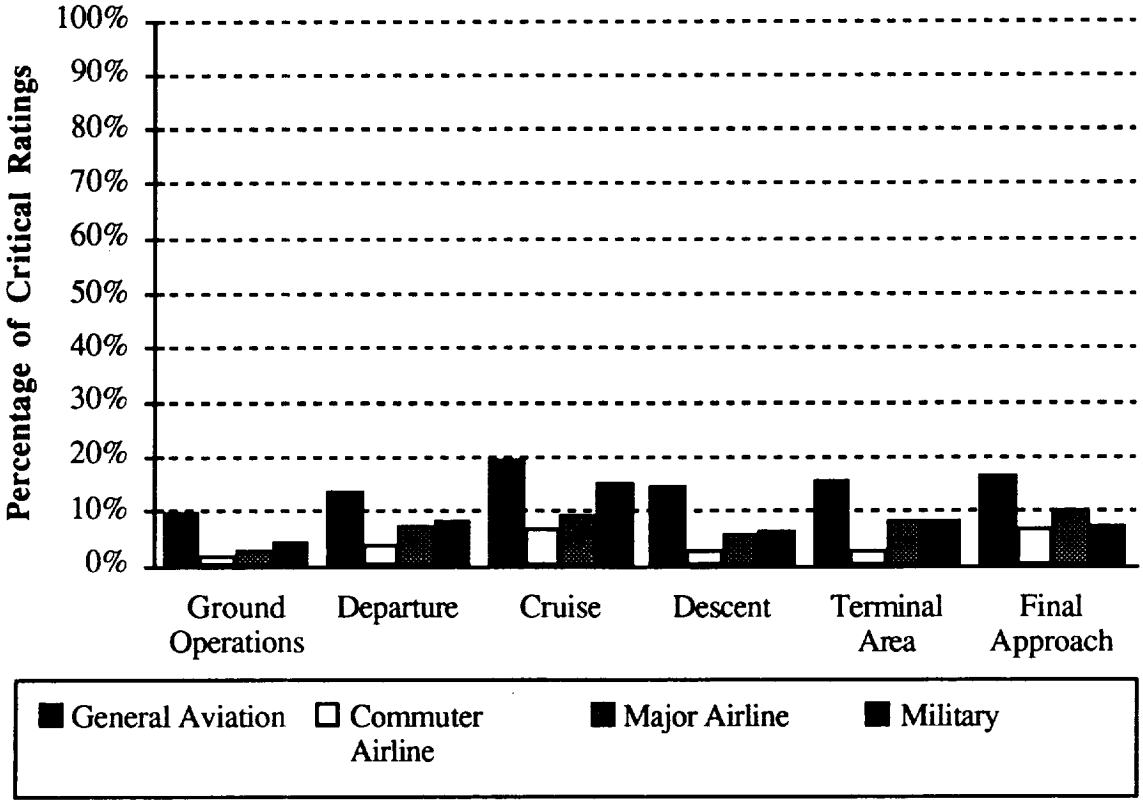

Figure 5.8 -- Winds Aloft Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

One Traffic PLI element, **Relative Sequencing**, received significantly higher importance ratings from General Aviation pilots in *Departure*, *Cruise*, and *Descent*. These ratings are shown in Figure 5.9. These higher ratings may be due to the different airspace the General Aviation pilots often cruise in. Because they generally have lower cruise altitudes and shorter flight, many General Aviation flights stay in the lower level airspace, including the terminal areas of airports near their flight path. These types of airspace are often congested and pilots may often be asked to deviate from their assigned flight path or 'follow' another aircraft to maintain separation.

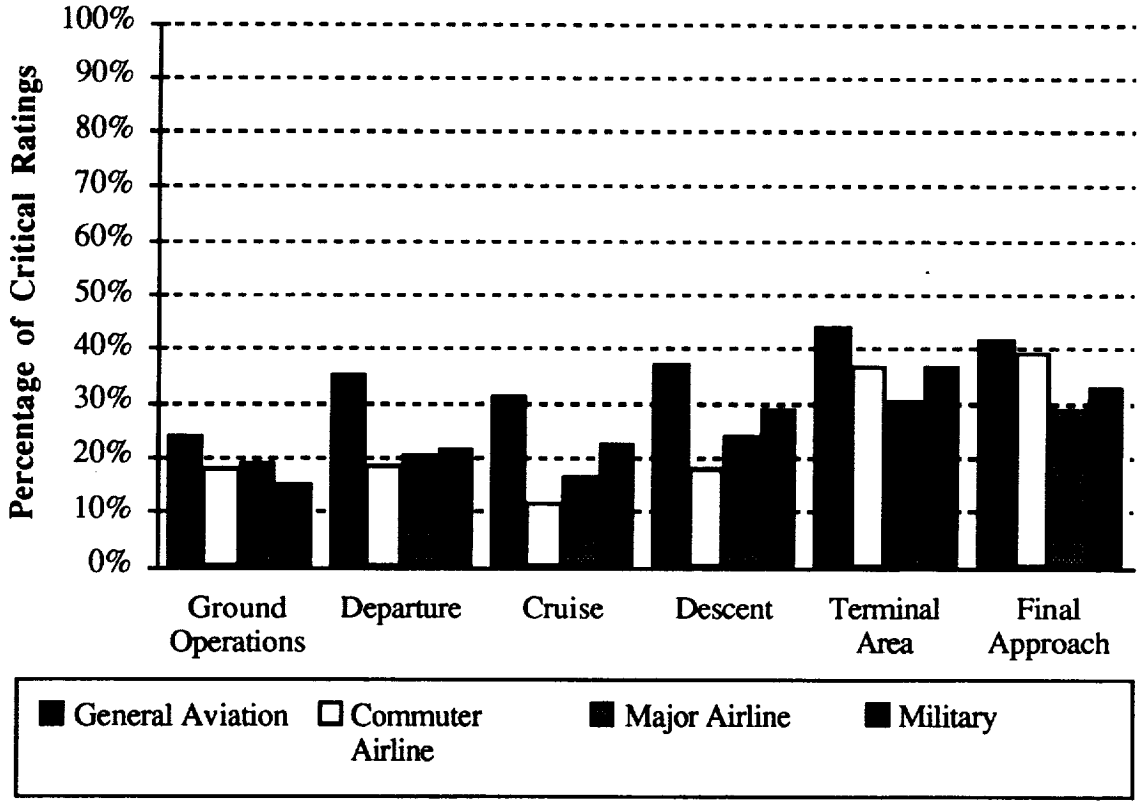

Figure 5.9 -- Relative Sequencing Importance Ratings in Each Phase of Flight (Shown by Each Type of Flight Operation)

The PLI element **Next Communications Frequency** was rated as more important by General Aviation pilots for all Phases of Flight except *Final Approach*, as shown in Figure 5.10. The Military pilots also gave this element very important ratings while the Commuter and Major Airline pilots both gave significantly lower ratings. The General Aviation pilots may perceive this element to be important because of the lower-altitude, more congested airspace they often cruise in, requiring more frequent frequency changes. In addition, General Aviation pilots often fly as single pilots and without the sophisticated autopilots of the airline aircraft. Therefore, because they are required to pay attention to both controlling the aircraft and communications, they may perceive PLI as an immediate and relevant source for this information element.

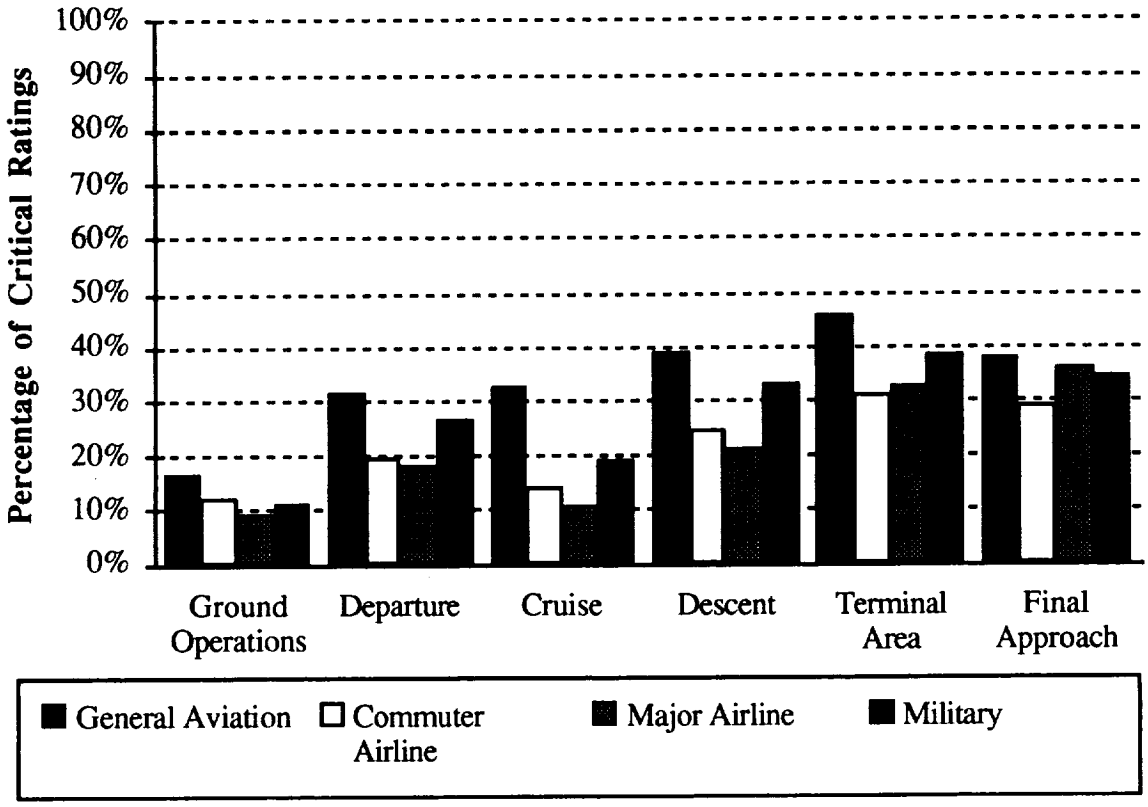

Figure 5.10 -- Next Communication Frequency Importance Ratings in Each Phase of Flight
(Shown by Type of Flight Operation)

5.6 Perceived PLI Importance by Military Pilots

The overall ratings given by the Military pilots tended to be similar to those given by the Major Airline pilots, with some differences in the ratings given to specific PLI elements. Military pilots rated only two related PLI elements, **Traffic - Controlled** (*Descent,* & Terminal *Area* only) and **Traffic Avoidance** (*Cruise*), significantly higher than the other pilot types ($p < 0.05$).

The importance ratings for these elements are shown in Figure 5.11. Because the different groups gave similiar percentages of ***Critical*** ratings, the percentages of ***Important*** ratings are shown instead. The Military pilots gave the highest ratings for all Phases of Flight except for *Final Approach*, where their ratings dropped to become the lowest. These differences may be a result of the Military pilots' different training and local Air Traffic Control at military facilities.

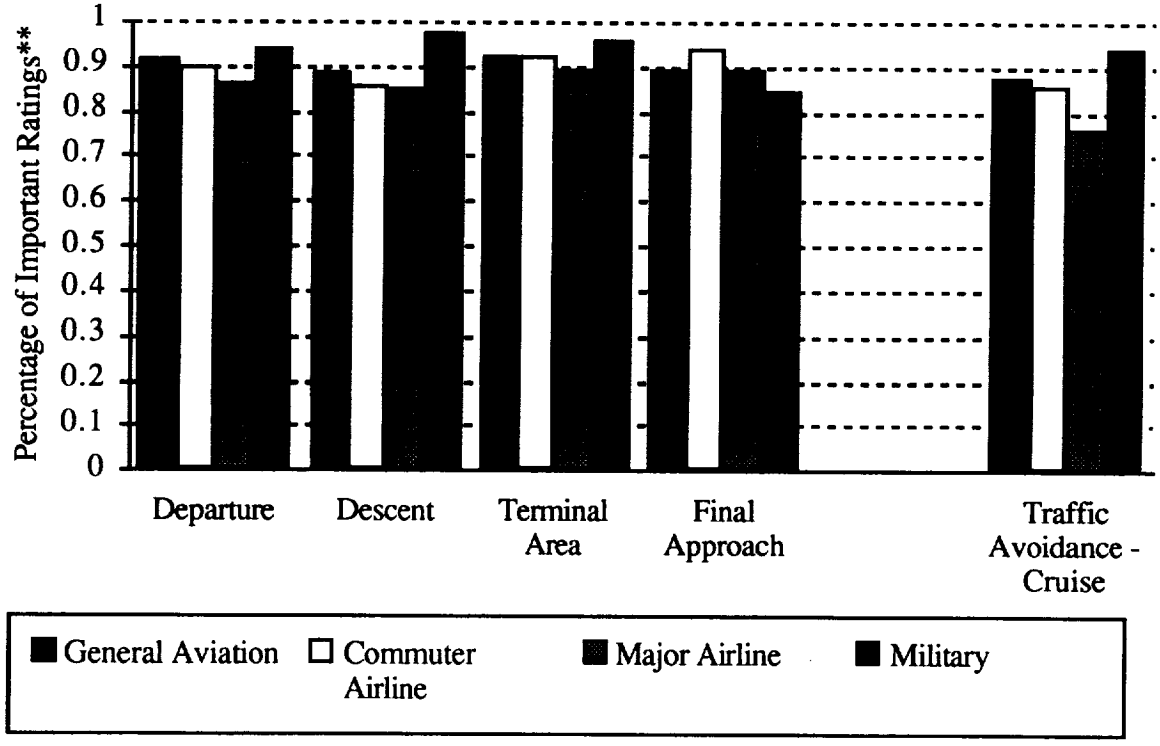

Figure 5.12 - Controlled Traffic & Traffic Avoidance Importance Ratings in Each POF (Shown by Each Type of Flight Operation)

**** Percentage of Importance Ratings Shown to Present Trend Throughout Flight**

Chapter Six

Pilot Information Requirements Subjective Responses

The survey also asked pilots several questions about the information they would like to have presented in the cockpit. The first question asked for free responses to "What does the 'Big Picture' mean to you?", in an attempt to ascertain the information required for Global Situation Awareness. Two related free response questions solicited the total information content pilots would like datalink communications to provide. Finally, the mix of datalink and voice communications pilots would prefer was identified by the pilots on a numerical rating scale. This question was asked twice, for datalink systems both with and without compensation mechanisms for PLI loss.

This chapter details the pilot responses to these questions. The general requirement for Traffic and Weather information was consistently indicated, as was the pilots preference for an mix of voice and datalink communications.

6.1 Information Required for Global Situation Awareness

To solicit the information pilots perceive necessary for Global Situation Awareness, pilots were asked for a free response to this statement: 'There is a concern that, without "Party Line" information, pilots may lose a sense of the "Big Picture." What does the "Big Picture" mean to you?'.

When the responses were examined, they were found to consistently describe the "Big Picture" in terms of items from several categories of information and activities. The frequency of responses in each category were tallied to quantify the percentage of pilots identifying each as necessary, as shown in Figure 6.1. Because each response could include items from several categories, these percentages combine to greater than unity.

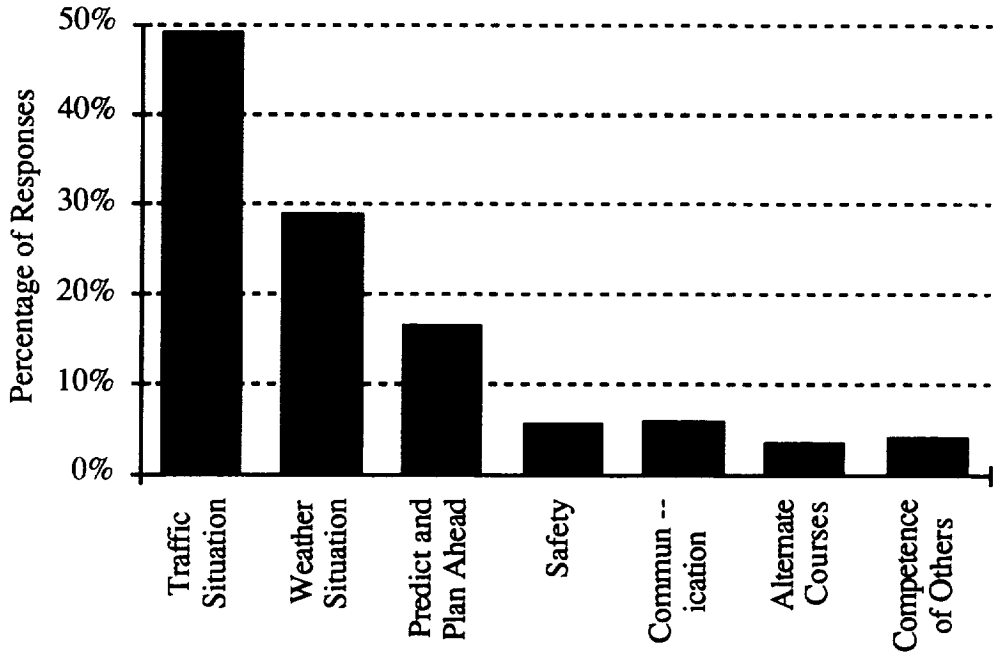

Figure 6.1 -- Information Required for Global Situation Awareness

Nearly half of the responses indicated an understanding of Traffic information is required for Situation Awareness. The specific responses included a desire for knowledge of the positions of other aircraft, either relative to the pilot's aircraft or to ground landmarks. This information was listed as being useful for traffic avoidance and for tactical planning, such as a knowledge of sequencing and terminal routing.

Weather information was also included in many of the pilots' responses. The specific responses expressed a need for the overall weather situation and for specific weather information elements. Also, some responses included a knowledge of the impact these weather conditions on their operations caused by weather, such as the deviations to expect around thunderstorms.

The next categories of responses are more ambiguous and were listed by fewer pilots. The ability to predict and plan ahead was mentioned by 16% of the pilots. Safety was mentioned by 6% of the pilots. Communication with ATC was mentioned by 6%. A sense of the best alternate courses of action was mentioned by 3%. A knowledge of the competence of the controllers and other pilots was listed by 4% of the pilots.

The responses as a function of different types of flight operation are shown in Figure 6.2. Although their statistical significance can not be determined, several differences can be noted. The General Aviation and Military pilots included Traffic and Weather information and Communication more often than the Commuter and Major Airline pilots. The response frequency in all other categories were very similar.

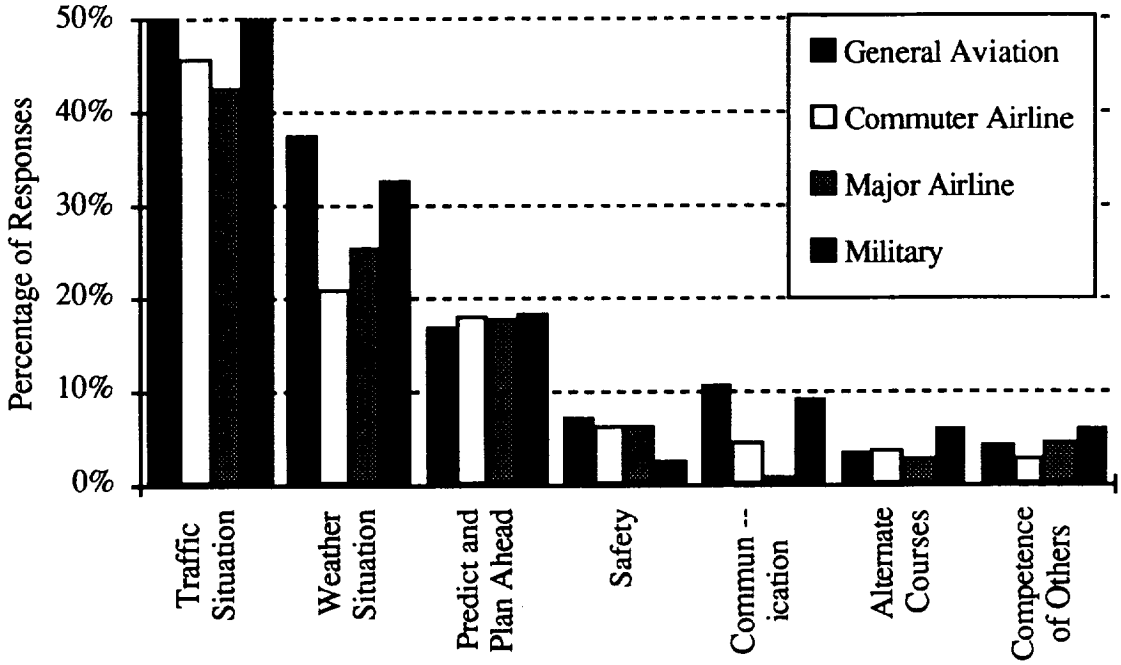

Figure 6.2 -- Information Required for Global Situation Awareness As Given by Pilots of Different Flight Operations

6.2 Information Pilots Would Like Provided by Datalink

To ascertain the information pilots feel is suitable for datalink communications, the surveyed asked for free responses to two questions:

> "Is there any particular information or images which you feel should be datalinked to aircraft? Do you have any suggestions for displaying this information in the cockpit?"

> "Can you suggest any methods of compensating for the loss of "Party Line" Information when using a digital datalink and some form of electronic display?"

The responses were analyzed by tallying the categories of information and displays described by their answers. The final results are shown in Figure 6.3 for the most common categories of information.

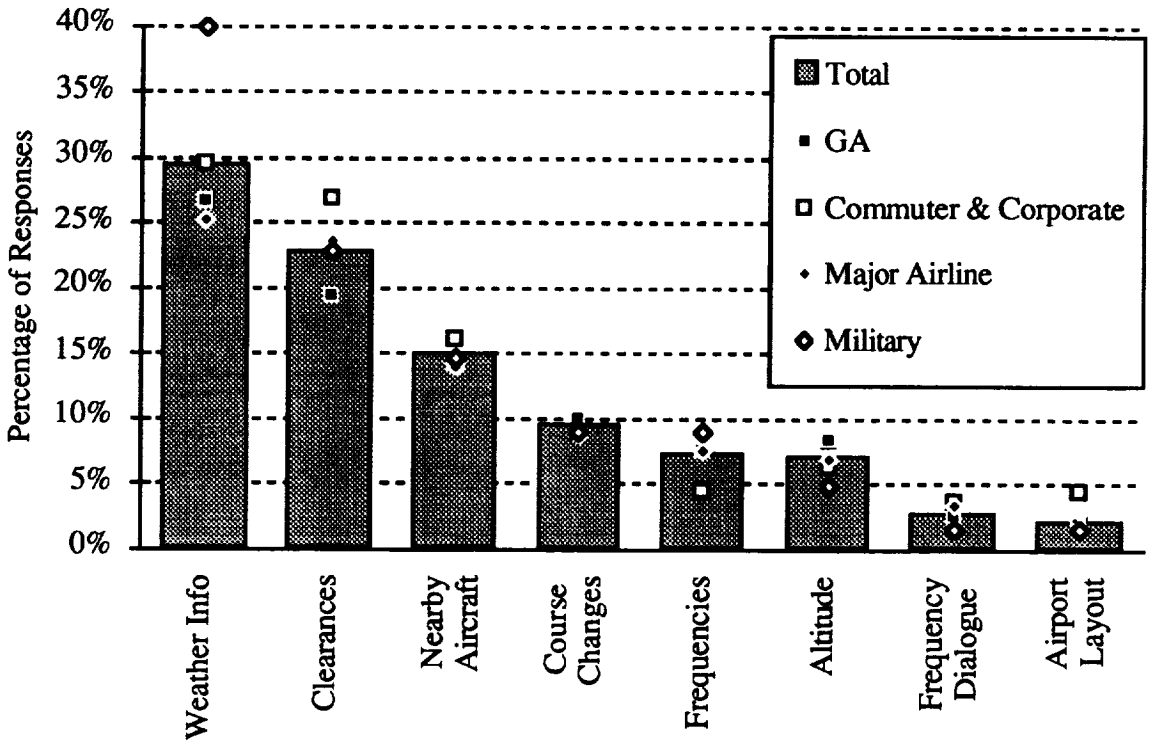

Figure 6.3 -- Information Pilots Would Like Provided by Datalink Communications

Weather information was the most common category of information mentioned. This category includes several more specific responses, such as weather enroute, weather conditions at the destination, and specific weather information elements. The military pilots included this category in their responses the most often, which may result from their operations into airfields without the substantial weather reporting and forecasting capabilities of the major terminal areas.

The ability to receive clearances via datalink communications was also mentioned by many pilots. The responses often cited specific examples, such as the current ability of major airline pilots to receive clearances at the gate through ACARS. This category was mentioned the most often by commuter airline pilots, who may be comparing their own aircraft systems to those of the larger airlines. This category was mentioned the least by General Aviation pilots, who may have not considered datalink clearance delivery a possibility.

Around 15% of the pilots indicated a desire for information about nearby aircraft and collision avoidance. These suggestions included knowledge of relative position of other aircraft to the pilot's aircraft or to ground landmarks, a 'traffic display', and an indication of the aircraft's future path. No group of pilots made mention of this category of information noticeably more than any other.

The next three categories identified specific types of clearances from Air Traffic Control that the pilots feel is suitable for datalink communications: Heading and Course Changes, Communication Frequencies, and Assigned Altitude. There was little disparity between the different types of flight operations in these responses.

Finally, a small percentage of pilots indicated a desire for more advanced datalink displays showing a running dialogue of all transmissions -- voice and datalink -- on that frequency or showing the airport layout with taxi information.

These responses provide valuable insight into the information pilots would like to receive with datalink communications. The questions themselves asked for completely free responses without providing any biases by giving examples of specific capabilities of datalink systems. However, most of the pilots providing responses can be assumed to be unfamiliar with the full technical potential of datalink systems and their possible displays, and therefore the responses may have been influenced by assumptions about limitations of the datalink system.

6.3 Pilot Preferred Mix of Voice and Datalink Communications

Two questions asked pilots for numerical ratings of the mix of voice and datalink communications they would prefer, on a scale from '1' (Datalink Only) to '5' (VHF Voice Communication Only). The first question asked for a rating of datalink systems without compensation for PLI loss, while the second question asked for a rating of a compensated system.

The pilots' average ratings are shown below in Figure 6.4. The ratings centered around the mid-point, indicating a preference for an even distribution of voice and datalink communications. The difference between ratings for the two questions is significant and shows an increased acceptance of datalink communications if care is taken to not reduce the information available to the pilot by reducing PLI without suitable compensation techniques.

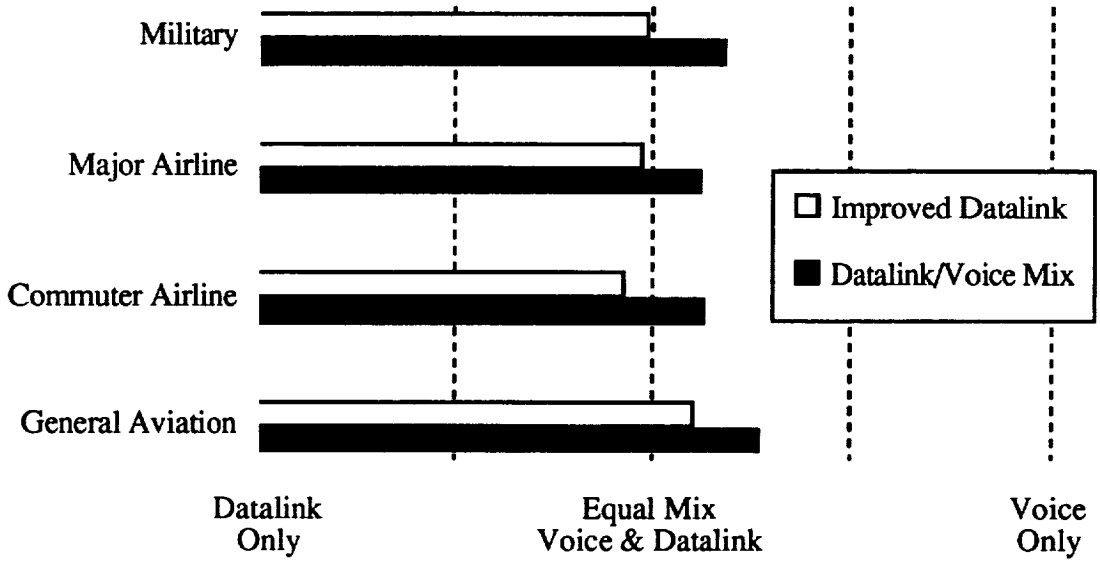

Figure 6.4 -- Pilot Preferred Mix of Voice and Datalink Communications

Chapter Seven

Survey Conclusions

In order to solicit pilot opinions on the Importance, Availability and Accuracy of Party Line Information (PLI), a survey was distributed to pilots. Additional questions also asked for free responses about the information pilots would like presented by datalink communications and the information necessary for global situation awareness. The distribution was expanded from a previous study's to include pilots from four types of flight operations: General Aviation, Commuter Airlines, Major Airlines and Military. The survey responses can be summarized as:

• For the information elements included in the survey, PLI is perceived as important overall by most pilots. This was demonstrated by the high mean importance rating. In addition, the majority of ratings received the highest ***Critical*** value.

• Most of the specific information elements listed in the survey were identified as ***Critical*** or ***Important*** by a majority of the pilots. The most critical elements refer to immediate events required for tactical planning such as **Aircraft on Landing Runway**, **Windshear**, and **Collision Avoidance**. Other critical PLI elements refer to weather conditions useful for strategic planning of the flight path and final approach, such as **Visibility & Ceiling** and **Thunderstorms**.

• The availability and accuracy of PLI was rated as generally reliable and accurate. However, these ratings did not receive the same proportion of extremely high values as the importance ratings. Therefore, no PLI elements were identified as highly "Reliable' or 'Common-Place'.

• The importance ratings given most of the PLI elements correlated closely with their availability and accuracy ratings. However, several elements, including **Uncontrolled Traffic** and **Error of Controller**, received low availability and accuracy ratings but high importance ratings. These elements indicate information pilots feel is important but may not be well presented by Party Line communications.

• The perceived importance of PLI was observed to vary between different Phases of Flight. Overall, PLI received higher importance ratings for the Phases of Flight closer

to the airport, such as *Final Approach*, and lower importance ratings during *Cruise*. The majority of the PLI elements followed this trend, although several PLI elements were identified as particularly important in specific phases.

• A variation in PLI importance throughout the Phases of Flight were indicated by pilots of different types of flight operation. The General Aviation pilots tended to give consistent importance ratings throughout all Phases of Flight, while the Commuter and Major Airline pilots gave much lower ratings in *Cruise* than in *Final Approach*.

• Some specific PLI elements were identified as particularly important to pilots from different types of flight operation. Commuter Airline pilots rated **Uncontrolled Traffic** very highly, and Major Airline pilots rated **Ride Reports & Turbulence** very highly. The General Aviation pilots gave high importance ratings to several weather PLI elements pertaining to conditions their aircraft are not well-equipped to handle, such as **Icing Conditions**.

• In a free response question asking for the information pilots feel is required for Global Situation Awareness, pilots most often cited the a need for Traffic and Weather information. These responses mirrored their high importance ratings for Traffic and Weather PLI elements. This type of information was also cited often in free response questions about the information suitable for presentation by datalink communications.

• The pilots' responses to the survey emphasized their need for specific Traffic and Weather information. Specific PLI elements were identified as very important by pilots. However, Party Line communications was not perceived to be very reliable or accurate, suggesting that it may not be the best modality for providing all types of information to pilots.

• PLI was perceived to be the most important in the *Terminal Area* and *Final Approach* Phases of Flight, less important in *Cruise*. Unless the datalink system is well-compensated for PLI loss, this suggests initial implementation of datalink communications should not be in the high-density and high-workload Terminal Area control sectors.

• Voice communications will remain the best modality for certain time critical information elements, such as **Windshear** and **Missed Approach**.

• Many other issues remain with the implementation of datalink communications systems. For example, new displays such as the traffic display provided by collision avoidance systems (TCAS) may enhance or replace PLI as a source of traffic information. This information is graphical and requires less dissemination by the pilot than a verbal or textual message. Further study of both the content and display of datalink systems should be made, with consideration to the instrumentation already available in the cockpit and the manner of presentation providing the most intuitive and compelling picture of the situation.

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Appendix A:

Sample Copy of Party Line Information and Datalink Survey

DEPARTMENT OF
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"Party Line" Information Survey

Current plans for advanced Air Traffic Control systems anticipate using digital datalink in addition to voice transmissions for some ATC communications. These datalink communications will be addressed only to specific aircraft and may be displayed electronically to the pilot. There has been some concern over the possible loss of "Party Line" in the datalink environment, where "Party Line" is the information overheard in communications between other aircraft and ATC on shared voice frequencies. The use of datalink by any type of aircraft will affect everyone. Even if an aircraft is not equipped with datalink, other aircraft may communicate by datalink rather than voice and therefore not contribute any "Party Line" Information to the shared sector frequency.

In an effort to obtain input from the perspective of the current users of the ATC system, the following survey has been developed to identify "Party Line" Information issues. The valuable input from active pilots, such as yourself, provides a real-world viewpoint on the current ATC system and will help to guide the implementation of datalink in a manner which will best combine the benefits of datalink and the current system. This study is funded by a grant from NASA and will be carried out by the Aeronautical Systems Lab at MIT.

Thank you for your time.

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CONFIDENTIALITY STATEMENT: Participation in this survey is completely voluntary. It is not necessary to give your name at any point. You may decline to answer any of the questions in this survey. All surveys will be de-identified and all information obtained from any individual survey will be kept confidential by the researchers at MIT.

BACKGROUND INFORMATION

Please check the term that best describes the majority of your recent flight activity:

General Aviation (Single-Engine) _____ General Aviation (Multi) _____

Corporate _____ Commuter Airline _____ Major Airline _____

Military _____

Check off your ratings:

Private License _____ Commercial License _____ ATR _____

IFR _____ Multi-Engine _____ CFI _____ CFII _____

Please estimate the following:

Years flying _____ Years as a professional pilot. _____

Total time _____ Total hours IFR. _____

Flight hours in the last 12 months _____

IFR hours in the last 12 months _____

At this time, are you current to fly instruments? Yes No

Please list the aircraft you most frequently fly:

_____ _____ _____

Please indicate how often you fly under the following conditions or with the following equipment:

	Never				Always
Airborne Weather RADAR	1	2	3	4	5
Lightning Detection (e.g. Stormscope)	1	2	3	4	5
Autopilot	1	2	3	4	5
EFIS	1	2	3	4	5
Autoflight/FMS	1	2	3	4	5
TCAS	1	2	3	4	5
ACARS	1	2	3	4	5
Single Pilot IFR	1	2	3	4	5
Other_____	1	2	3	4	5

PARTY LINE INFORMATION

Please circle the values which best describe your perception of the Importance, Availability and Accuracy of each Party Line Information element during each phase of flight. Ignore any items which are not relevant to your type of operation.

PHASE OF FLIGHT	**Importance** *How important is each-item?* Trivial 1 2 3 4 5 Critical	**Availability** *How available is the information when you need it?* Non-Existent 1 2 3 4 5 Common-Place	**Accuracy** *Is Party Line Information a good indication of the actual situation?* Unreliable 1 2 3 4 5 Reliable
Ground Operations: *Pre-Start, Taxi*			
Next Communications Frequency	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Weather Situation			
- Overall	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- TRW Buildups & Deviations	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Visibility & Ceiling	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Icing Conditions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Ride Reports/Turbulence	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Winds Aloft	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Surface Winds	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Routing To Runway	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Relative Sequencing Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
"Hold Short" Instructions Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
A/C Crossing Active Runway While You Are Lined Up For Takeoff	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller Error	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

PHASE OF FLIGHT	Importance (Trivial 1 2 3 4 5 Critical)	Availability (Non-Existent 1 2 3 4 5 Common-Place)	Accuracy (Unreliable 1 2 3 4 5 Reliable)
Departure: *Takeoff To Top Of Climb*			
Next Communications Frequency	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Weather Situation			
- Over-All	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- TRW Buildups & Deviations	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Visibility & Ceiling	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Icing Conditions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Ride Reports/Turbulence	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Winds Aloft	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Surface Winds	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Traffic Avoidance - Controlled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Uncontrolled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Relative Sequencing Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller Error	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Cruise: *Top Of Climb To Top Of Descent*			
Next Communications Frequency	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Weather Situation			
- Over-All	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- TRW Buildups & Deviations	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Visibility & Ceiling	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Icing Conditions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Ride Reports/Turbulence	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Winds Aloft	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Surface Winds	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Traffic Avoidance	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Relative Sequencing Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller Error	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

PHASE OF FLIGHT	Importance (Trivial 1 2 3 4 5 Critical)	Availability (Non-Existent 1 2 3 4 5 Common-Place)	Accuracy (Unreliable 1 2 3 4 5 Reliable)
Descent: *Top Of Descent To Approach Control Contact*			
Next Communications Frequency	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Weather Situation			
- Over-All	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- TRW Buildups & Deviations	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Visibility & Ceiling	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Icing Conditions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Ride Reports/Turbulence	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Winds Aloft	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Surface Winds	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Traffic Avoidance - Controlled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Uncontrolled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Relative Sequencing Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Holding Situations/EFC Validity	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller Error	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Terminal Area: *Approach Control Contact To Final Approach Fix*			
Next Communications Frequency	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Weather Situation			
- Over-All	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- TRW Buildups & Deviations	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Visibility & Ceiling	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Icing Conditions	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Ride Reports/Turbulence	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Winds Aloft	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Surface Winds	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Traffic Avoidance - Controlled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
- Uncontrolled Airports	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Relative Sequencing Of Other A/C	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Holding Situations/EFC Validity	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Terminal Routing/Runway Assignments	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Approach Clearance	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller Error	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

PHASE OF FLIGHT	Importance					Availability					Accuracy				
	Trivial				Critical	Non-Existent				Common-Place	Unreliable				Reliable
Final Approach: *Final Approach Fix To Runway Threshold*															
Next Communications Frequency	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Weather Situation															
- Over-All	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Trw Buildups & Deviations	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Visibility & Ceiling	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Icing Conditions	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Ride Reports/Turbulence	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Winds Aloft	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Surface Winds	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Traffic Avoidance - Controlled Airports	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
- Uncontrolled Airports	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Sequencing	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Missed Approach - Weather Induced	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Missed Approach - Other	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Aircraft On Your Landing Runway	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Braking Action	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Taxiway Turnoff/Planned Runway Exit	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Relative Sequencing Of Other A/C	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Controller Error	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Other_____	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5

MISCELLANEOUS PARTY LINE INFORMATION

	Importance Trivial — Critical	Availability Non-Existent — Common-Place	Accuracy Unreliable — Reliable
Sector Congestion (As Indicated by Frequency Congestion)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller's Experience Level Inferred From Tone of Voice and Speech Patterns	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Pilot's (Of Other Aircraft) Experience Level Inferred From Tone of Voice and Speech Patterns	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Controller's "Level Of Urgency" Inferred From Tone of Voice and Speech Patterns	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Pilot's (Of Other Aircraft) "Level of Urgency Inferred From Tone of Voice and Speech Patterns	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Background ATC Transmissions Used as Reassurance of Being "In Contact" With the Controller. ("Anybody Out There?")	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Call Sign Confusion (Other Aircraft Accepting Your Clearance or Vice Versa)	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
ATC Facility Problems/Lost Communications	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Navaid Problems	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other_____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

ADDITIONAL "PARTY LINE" & INFORMATION MANAGEMENT QUESTIONS

There is a concern that, without "party line" information, pilots may lose a sense of the "Big Picture." What does the "Big Picture" mean to you?

Considering the advantages of datalink (such as frequency congestion relief, unambiguous clearances, etc.) and of party line information (a 'sense of the big picture', ability to hear communications of all other aircraft in the sector), what mix of datalink and voice communications would you like to see?

1	2	3	4	5
DATALINK ONLY		EQUAL DISTRIBUTION VOICE / DATALINK		VHF VOICE COMMUNICATION ONLY

If some mechanism could be developed to datalink critical party line information to the aircraft (e.g. a status display with current wx, sequencing, and/or holding information), what mix of datalink and voice communications would you like?

1	2	3	4	5
DATALINK ONLY		EQUAL DISTRIBUTION VOICE / DATALINK		VHF VOICE COMMUNICATION ONLY

Is there any particular information or images which you feel should be datalinked to aircraft? Do you have any suggestions for displaying this information in the cockpit?

Can you suggest any methods of compensating for the loss of "Party Line" Information when using an digital datalink and some form of electronic display?

Enter any comments about the significance of party line information that were not covered on the previous pages.

Have you ever been in a situation where lack of current weather information forced you to make a bad decision?

Please rate the following in their importance to you for making weather deviation decisions:

	Least Important				Most Important
Airborne Weather RADAR	1	2	3	4	5
ATC RADAR	1	2	3	4	5
Personal Visual Observations	1	2	3	4	5
Lightning Detection (e.g. Stormscope)	1	2	3	4	5
PIREPs	1	2	3	4	5
"Party Line" Information	1	2	3	4	5
Terminal Forecast Weather Info.	1	2	3	4	5
In-Flight Monitoring of ATIS	1	2	3	4	5
Surface Observations from FSS	1	2	3	4	5
In-Flight RADAR Described by FSS	1	2	3	4	5
Predeparture RADAR Summary	1	2	3	4	5
Other_____	1	2	3	4	5

Please give any additional comments below.

Appendix B:

Background Information Summary

	Total	GA	Commuter	Major Airline	Military
Distribution	**4375**	2000	1075	800	500
Responses	**658**	242	124	230	124
Response Rate	**15%**	12%	12%	29%	25%
Ratings & Licences					
Private	**22%**	57%	0%	0%	4%
Commercial	**32%**	42%	16%	8%	61%
ATR	**51%**	0%	84%	92%	26%
Multi-Engine	**84%**	41%	100%	100%	100%
CFI	**103%**	14%	54%	28%	9%
CFII	**26%**	9%	51%	20%	4%
IFR Current	**20%**	74%	100%	100%	100%
Flight Experience					
Years Flying	**18**	17	18	24	10
Years as Pro. Pilot	**15**	12	12	20	9
Total Flight Hours	**6478**	2172	8194	12177	2936
Flight Hours in Last Year	**438**	127	729	649	380
Region					
Northwest	**10%**	9%	3%	14%	10%
Southwest	**17%**	21%	11%	11%	17%
South Central	**7%**	5%	10%	4%	10%
North Central	**17%**	20%	24%	13%	7%
East Central	**8%**	8%	3%	5%	14%
Southeast	**15%**	14%	20%	9%	18%
Northeast	**17%**	17%	11%	22%	9%
Flight Distance					
Local	**4%**	8%	0%	0%	6%
Up to 100 nm	**10%**	20%	5%	2%	4%
100-500 nm	**52%**	61%	87%	28%	25%
500-1500 nm	**26%**	5%	5%	51%	35%
1500nm+	**11%**	0%	2%	16%	25%
Frequency Congestion					
Very congested	**9%**	3%	11%	14%	7%
Busy	**41%**	32%	49%	38%	38%
Moderate	**44%**	52%	25%	29%	50%
Light	**2%**	4%	0%	1%	0%

Appendix C:

Importance, Availability and Accuracy Ratings of Party Line Information,

Listed by PLI Element

Importance Ratings of PLI

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Overall	**3.97**	**1.18**	**6%**	**10%**	**24%**	**38%**	**55%**
Ground Operations	**3.72**	**1.31**	**6%**	**10%**	**23%**	**28%**	**32%**
Next Comm. Frequency	2.80	1.30	21%	21%	27%	18%	12%
Wx - Overall	3.75	1.07	4%	7%	25%	35%	28%
TRW Buildup, Deviations	4.20	1.04	3%	4%	14%	26%	52%
Visiblilty & Ceiling	3.79	1.11	5%	7%	22%	34%	31%
Icing Conditions	4.09	1.11	3%	7%	15%	25%	49%
Ride Reports	3.37	1.13	8%	11%	34%	30%	17%
Winds Aloft	2.67	1.08	17%	25%	37%	15%	5%
Surface Winds	3.61	1.58	5%	10%	30%	35%	20%
Routing to Runway	3.60	1.15	5%	12%	25%	31%	26%
Sequencing	3.66	1.89	3%	10%	32%	35%	20%
Hold Short"-other A/C	3.96	1.09	3%	8%	20%	28%	40%
A/C Crossing Rwy	4.42	0.89	1%	3%	11%	21%	63%
Error of Controller	4.38	0.83	1%	3%	11%	29%	57%
Departure	**3.84**	**1.14**	**5%**	**9%**	**23%**	**32%**	**39%**
Next Comm. Frequency	3.42	1.24	8%	15%	26%	26%	24%
Wx - Overall	3.88	0.96	3%	4%	24%	40%	28%
TRW Buildup, Deviations	4.45	0.75	0%	2%	8%	32%	58%
Visiblilty & Ceiling	3.41	1.18	8%	14%	27%	31%	20%
Icing Conditions	4.26	0.91	1%	3%	13%	32%	50%
Ride Reports	3.73	0.94	2%	8%	29%	40%	22%
Winds Aloft	2.89	1.08	11%	22%	41%	16%	9%
Surface Winds	3.00	1.37	20%	17%	26%	20%	18%
Traffic-Controlled	4.48	0.75	0%	2%	8%	30%	60%
Traffic-Uncontrolled	4.61	0.71	0%	2%	5%	21%	71%
Sequencing	3.78	0.98	3%	6%	29%	38%	25%
Error of Controller	4.23	0.91	1%	4%	17%	29%	49%
Cruise	**3.69**	**1.20**	**7%**	**10%**	**22%**	**30%**	**31%**
Next Comm. Frequency	3.34	1.22	10%	14%	29%	28%	20%
Wx - Overall	3.87	0.95	2%	5%	26%	38%	29%
TRW Buildup, Deviations	4.44	0.73	0%	1%	9%	33%	56%
Visiblilty & Ceiling	3.15	1.32	14%	19%	26%	22%	20%
Icing Conditions	4.19	0.96	2%	4%	14%	33%	47%
Ride Reports	3.89	0.89	1%	4%	25%	43%	26%
Winds Aloft	3.22	1.07	6%	17%	38%	26%	13%
Surface Winds	2.54	1.36	30%	23%	20%	14%	12%
Traffic Avoidance	4.35	0.93	2%	3%	10%	28%	57%
Sequencing	3.52	1.13	6%	12%	28%	32%	22%
Error of Controller	4.01	1.02	2%	5%	23%	28%	41%

Importance Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Descent	**4.01**	**1.06**	**3%**	**6%**	**18%**	**32%**	**41%**
Next Comm. Frequency	3.64	1.21	7%	11%	23%	29%	30%
Wx - Overall	4.01	0.91	2%	3%	21%	41%	33%
TRW Buildup, Deviations	4.53	0.66	0%	1%	6%	32%	61%
Visiblilty & Ceiling	4.12	0.98	2%	4%	17%	33%	43%
Icing Conditions	4.28	0.87	1%	3%	14%	32%	50%
Ride Reports	3.70	0.95	1%	9%	30%	38%	22%
Winds Aloft	2.64	1.15	17%	33%	29%	13%	8%
Surface Winds	3.79	1.11	5%	8%	20%	37%	30%
Traffic-Controlled	4.47	0.83	1%	2%	8%	26%	63%
Traffic-Uncontrolled	4.51	0.84	1%	3%	7%	21%	68%
Sequencing	3.96	0.88	1%	5%	20%	45%	29%
Hold Situation	4.28	0.77	0%	1%	14%	39%	45%
Error of Controller	4.19	0.92	1%	4%	18%	30%	47%
Terminal Area	**4.16**	**1.12**	**4%**	**6%**	**15%**	**34%**	**56%**
Next Comm. Frequency	3.86	1.18	6%	8%	18%	30%	38%
Wx - Overall	4.08	0.98	3%	4%	15%	37%	40%
TRW Buildup, Deviations	4.52	0.76	1%	2%	6%	26%	64%
Visiblilty & Ceiling	4.44	0.80	1%	2%	9%	29%	59%
Icing Conditions	4.29	0.91	1%	3%	12%	30%	53%
Ride Reports	3.65	1.09	4%	11%	28%	31%	26%
Winds Aloft	2.52	1.27	27%	27%	24%	13%	10%
Surface Winds	4.27	1.82	2%	4%	13%	36%	46%
Traffic-Controlled	4.62	0.69	0%	2%	6%	21%	71%
Traffic-Uncontrolled	4.62	0.73	1%	2%	6%	18%	73%
Sequencing	4.16	0.82	1%	2%	14%	44%	38%
Hold Situation	4.19	0.86	1%	3%	15%	38%	43%
Terminal Routing	4.35	0.81	1%	2%	11%	35%	52%
Approach Clearance	4.47	0.82	1%	2%	8%	26%	62%
Error of Controller	4.33	0.89	1%	2%	14%	26%	56%

Importance Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Final Approach	**4.17**	**1.22**	**5%**	**6%**	**14%**	**27%**	**60%**
Next Comm. Frequency	3.59	1.36	12%	11%	20%	22%	35%
Wx - Overall	3.87	1.20	6%	8%	19%	27%	40%
TRW Buildup, Deviations	4.25	1.07	4%	5%	12%	22%	57%
Visiblilty & Ceiling	4.62	2.16	1%	2%	7%	22%	68%
Icing Conditions	4.09	1.10	3%	8%	14%	26%	48%
Ride Reports	3.52	1.30	8%	17%	18%	27%	29%
Winds Aloft	2.40	1.36	36%	23%	18%	12%	11%
Windshear	4.76	0.57	0%	0%	3%	15%	81%
Surface Winds	4.48	0.77	0%	2%	8%	27%	62%
Traffic-Controlled	4.58	0.77	1%	2%	7%	18%	72%
Traffic-Uncontrolled	4.61	0.79	1%	2%	7%	15%	75%
Missed Approach - Wx	4.63	0.64	0%	1%	4%	24%	70%
Missed Approach - Other	4.27	0.88	1%	4%	13%	33%	50%
A/C on Runway	4.83	0.47	0%	0%	2%	12%	86%
Braking Action	4.42	0.77	0%	2%	8%	32%	56%
Taxiway Turnoff	3.67	1.04	4%	7%	31%	33%	24%
Sequencing	4.06	0.91	2%	4%	17%	42%	36%
Error of Controller	4.41	0.88	1%	3%	12%	24%	61%
Prosodic & General Elements							
Sector Congestion	3.93	1.14	1%	5%	20%	52%	22%
Controller Exp.	3.85	0.92	1%	7%	24%	43%	26%
Other Pilot's Exp.	3.57	1.01	4%	9%	32%	36%	19%
Controller's Urgency	4.32	0.77	0%	2%	10%	40%	48%
Other Pilot's Urgency	4.00	0.92	1%	5%	22%	37%	35%
B/G Reassurance	3.61	1.06	5%	9%	28%	38%	21%
Call Sign Confusion	4.53	0.73	0%	2%	7%	27%	64%
Lost Communication	4.38	0.77	0%	2%	11%	34%	53%
Navaid Problems	4.17	0.90	1%	3%	17%	35%	44%

Availability Ratings of PLI

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Overall	**3.64**	**1.09**	**3%**	**11%**	**26%**	**35%**	**24%**
Ground Operations	**3.61**	**1.13**	**4%**	**13%**	**27%**	**31%**	**26%**
Next Comm. Frequency	3.96	1.07	2%	8%	22%	28%	41%
Wx - Overall	3.59	1.03	2%	12%	31%	32%	22%
TRW Buildup, Deviations	3.50	1.06	3%	15%	29%	34%	19%
Visiblilty & Ceiling	3.93	1.01	2%	8%	21%	34%	35%
Icing Conditions	3.41	1.06	4%	16%	33%	29%	17%
Ride Reports	3.16	1.18	9%	21%	29%	26%	14%
Winds Aloft	2.81	1.26	18%	24%	28%	18%	12%
Surface Winds	4.00	1.03	2%	7%	19%	32%	40%
Routing to Runway	3.84	1.00	3%	6%	25%	38%	29%
Sequencing	3.63	1.03	2%	12%	29%	35%	22%
Hold Short"-other A/C	3.90	0.97	2%	6%	26%	35%	31%
A/C Crossing Rwy	4.05	0.96	2%	5%	20%	34%	39%
Error of Controller	3.07	1.13	7%	25%	33%	22%	13%
Departure	**3.50**	**1.09**	**4%**	**14%**	**30%**	**32%**	**20%**
Next Comm. Frequency	3.95	1.01	1%	8%	21%	32%	37%
Wx - Overall	3.45	0.99	3%	12%	37%	33%	15%
TRW Buildup, Deviations	3.75	0.88	1%	7%	29%	43%	20%
Visiblilty & Ceiling	3.43	1.08	4%	15%	33%	30%	19%
Icing Conditions	3.57	0.95	1%	11%	35%	35%	18%
Ride Reports	3.60	0.94	1%	12%	31%	39%	17%
Winds Aloft	2.89	1.11	10%	28%	33%	19%	9%
Surface Winds	3.31	1.33	13%	14%	26%	23%	24%
Traffic-Controlled	4.12	0.84	1%	3%	17%	43%	37%
Traffic-Uncontrolled	3.23	1.18	8%	20%	29%	26%	17%
Sequencing	3.59	0.95	2%	10%	32%	38%	17%
Error of Controller	3.09	1.05	4%	26%	36%	21%	12%
Cruise	**3.47**	**1.07**	**4%**	**14%**	**30%**	**33%**	**18%**
Next Comm. Frequency	3.86	1.00	2%	8%	23%	36%	31%
Wx - Overall	3.51	0.94	1%	12%	37%	34%	16%
TRW Buildup, Deviations	3.83	0.84	0%	6%	26%	46%	22%
Visiblilty & Ceiling	3.24	1.15	8%	19%	31%	27%	15%
Icing Conditions	3.58	0.93	1%	11%	33%	37%	17%
Ride Reports	3.72	0.91	1%	9%	28%	42%	20%
Winds Aloft	3.09	1.03	5%	26%	35%	24%	10%
Surface Winds	2.91	1.33	19%	21%	24%	21%	14%
Traffic Avoidance	3.87	0.89	1%	5%	25%	43%	26%
Sequencing	3.44	1.01	3%	15%	32%	35%	15%
Error of Controller	3.04	1.07	6%	26%	36%	21%	11%

Availability Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Descent	**3.64**	**1.16**	**3%**	**10%**	**28%**	**37%**	**21%**
Next Comm. Frequency	3.97	0.96	1%	6%	21%	37%	34%
Wx - Overall	3.78	1.88	1%	7%	29%	44%	18%
TRW Buildup, Deviations	3.86	0.82	1%	4%	25%	49%	21%
Visiblilty & Ceiling	3.83	0.94	1%	6%	26%	39%	27%
Icing Conditions	3.67	0.87	1%	7%	32%	43%	16%
Ride Reports	3.57	0.90	1%	10%	37%	36%	16%
Winds Aloft	2.92	1.62	11%	27%	33%	20%	8%
Surface Winds	3.69	1.08	4%	10%	23%	36%	25%
Traffic-Controlled	4.05	0.86	1%	3%	20%	43%	33%
Traffic-Uncontrolled	3.21	1.17	9%	20%	28%	29%	15%
Sequencing	3.69	0.90	1%	7%	32%	40%	19%
Hold Situation	3.84	0.87	0%	7%	26%	43%	23%
Error of Controller	3.10	1.03	5%	25%	36%	25%	9%
Terminal Area	**3.82**	**1.01**	**3%**	**8%**	**22%**	**39%**	**28%**
Next Comm. Frequency	4.14	0.86	1%	4%	16%	40%	39%
Wx - Overall	3.82	0.91	2%	5%	25%	44%	24%
TRW Buildup, Deviations	3.93	0.81	0%	4%	23%	48%	24%
Visiblilty & Ceiling	4.15	0.83	0%	3%	17%	41%	39%
Icing Conditions	3.73	0.91	1%	8%	29%	41%	21%
Ride Reports	3.53	0.99	2%	14%	31%	36%	17%
Winds Aloft	2.69	1.22	18%	30%	26%	17%	9%
Surface Winds	4.08	0.92	1%	4%	17%	38%	38%
Traffic-Controlled	4.27	0.74	0%	1%	12%	44%	42%
Traffic-Uncontrolled	3.34	1.17	7%	18%	27%	29%	18%
Sequencing	3.89	0.86	1%	4%	25%	44%	25%
Hold Situation	3.89	0.88	1%	5%	24%	44%	26%
Terminal Routing	4.17	0.77	0%	2%	15%	45%	37%
Approach Clearance	4.34	0.74	0%	1%	11%	40%	48%
Error of Controller	3.25	1.07	5%	21%	33%	28%	13%

Availability Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Final Approach	**3.75**	**1.07**	**3%**	**10%**	**24%**	**35%**	**28%**
Next Comm. Frequency	4.15	0.94	1%	5%	16%	33%	45%
Wx - Overall	3.71	1.05	4%	9%	24%	39%	24%
TRW Buildup, Deviations	3.76	0.96	2%	9%	25%	41%	23%
Visiblilty & Ceiling	4.26	0.81	0%	2%	13%	39%	45%
Icing Conditions	3.63	1.00	2%	12%	28%	38%	20%
Ride Reports	3.44	1.07	4%	16%	31%	32%	18%
Winds Aloft	2.58	1.27	24%	28%	23%	14%	10%
Windshear	3.90	0.90	1%	5%	25%	39%	29%
Surface Winds	4.30	0.81	0%	3%	13%	35%	49%
Traffic-Controlled	4.28	0.78	0%	2%	12%	40%	45%
Traffic-Uncontrolled	3.29	1.19	7%	19%	29%	25%	19%
Missed Approach - Wx	3.99	0.93	1%	6%	20%	39%	34%
Missed Approach - Other	3.84	0.99	1%	9%	24%	37%	29%
A/C on Runway	3.90	0.96	1%	9%	18%	42%	30%
Braking Action	3.78	0.96	1%	8%	28%	38%	26%
Taxiway Turnoff	3.47	1.02	3%	15%	33%	32%	17%
Sequencing	3.83	0.87	1%	4%	28%	43%	23%
Error of Controller	3.15	1.09	6%	23%	34%	25%	12%
Prosodic & General Elements							
Sector Congestion	3.86	0.87	0%	5%	30%	39%	26%
Controller Exp.	3.61	0.94	1%	11%	33%	37%	18%
Other Pilot's Exp.	3.57	0.97	2%	9%	35%	35%	18%
Controller's Urgency	3.97	1.19	1%	5%	24%	40%	30%
Other Pilot's Urgency	3.73	0.94	1%	7%	33%	35%	24%
B/G Reassurance	3.85	0.97	1%	8%	26%	35%	30%
Call Sign Confusion	3.60	1.00	1%	16%	28%	35%	21%
Lost Communication	3.07	1.09	7%	26%	31%	27%	10%
Navaid Problems	3.17	1.03	3%	24%	35%	27%	11%

Accuracy Ratings of PLI

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Overall	**3.81**	**0.96**	**2%**	**6%**	**25%**	**41%**	**25%**
Ground Operations	**3.79**	**1.03**	**3%**	**7%**	**24%**	**37%**	**28%**
Next Comm. Frequency	3.84	1.06	4%	7%	22%	36%	31%
Wx - Overall	3.76	0.91	1%	6%	28%	43%	21%
TRW Buildup, Deviations	3.84	0.98	2%	6%	24%	40%	27%
Visiblilty & Ceiling	3.94	0.94	1%	5%	22%	39%	32%
Icing Conditions	3.71	1.01	3%	10%	25%	39%	23%
Ride Reports	3.66	1.04	3%	10%	27%	36%	23%
Winds Aloft	3.29	1.14	7%	16%	32%	28%	16%
Surface Winds	3.86	1.01	2%	7%	22%	38%	30%
Routing to Runway	3.76	1.08	4%	8%	23%	36%	28%
Sequencing	3.80	1.01	3%	7%	24%	38%	27%
Hold Short"-other A/C	4.03	0.92	2%	3%	20%	39%	35%
A/C Crossing Rwy	4.14	0.93	2%	2%	17%	36%	43%
Error of Controller	3.64	1.05	4%	8%	32%	33%	23%
Departure	**3.74**	**0.96**	**2%**	**7%**	**26%**	**42%**	**22%**
Next Comm. Frequency	3.97	0.97	2%	6%	19%	39%	34%
Wx - Overall	3.77	0.83	1%	4%	31%	45%	19%
TRW Buildup, Deviations	3.94	0.79	0%	3%	23%	49%	24%
Visiblilty & Ceiling	3.81	0.90	2%	5%	26%	44%	23%
Icing Conditions	3.77	0.89	1%	7%	26%	45%	20%
Ride Reports	3.79	0.85	1%	5%	29%	44%	21%
Winds Aloft	3.37	1.03	4%	16%	34%	33%	14%
Surface Winds	3.65	1.08	5%	9%	26%	37%	24%
Traffic-Controlled	4.11	0.80	1%	3%	14%	50%	33%
Traffic-Uncontrolled	3.32	1.15	8%	15%	27%	34%	15%
Sequencing	3.76	0.90	1%	7%	26%	44%	21%
Error of Controller	3.57	0.98	3%	8%	36%	34%	18%
Cruise	**3.71**	**0.95**	**2%**	**7%**	**28%**	**42%**	**21%**
Next Comm. Frequency	3.91	0.99	2%	6%	20%	40%	31%
Wx - Overall	3.74	0.83	1%	5%	31%	46%	17%
TRW Buildup, Deviations	3.94	0.80	0%	4%	21%	50%	24%
Visiblilty & Ceiling	3.63	0.95	3%	7%	32%	40%	18%
Icing Conditions	3.72	0.89	1%	6%	30%	43%	19%
Ride Reports	3.85	0.85	0%	6%	25%	46%	23%
Winds Aloft	3.50	0.99	3%	12%	32%	38%	15%
Surface Winds	3.37	1.15	8%	13%	28%	34%	16%
Traffic Avoidance	3.91	0.89	2%	5%	21%	48%	25%
Sequencing	3.72	0.94	2%	8%	27%	43%	20%
Error of Controller	3.52	0.98	3%	9%	37%	34%	17%

Accuracy Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Descent	**3.79**	**0.91**	**2%**	**6%**	**25%**	**45%**	**22%**
Next Comm. Frequency	3.99	0.93	1%	6%	17%	42%	32%
Wx - Overall	3.86	0.77	0%	3%	26%	51%	19%
TRW Buildup, Deviations	3.95	0.75	0%	2%	23%	51%	23%
Visiblilty & Ceiling	3.97	0.82	1%	3%	21%	49%	26%
Icing Conditions	3.81	0.85	1%	5%	26%	48%	20%
Ride Reports	3.76	0.82	0%	5%	31%	45%	18%
Winds Aloft	3.32	1.02	4%	17%	33%	34%	11%
Surface Winds	3.85	0.90	2%	6%	21%	47%	24%
Traffic-Controlled	4.07	0.78	1%	2%	14%	54%	29%
Traffic-Uncontrolled	3.36	1.14	7%	17%	26%	34%	16%
Sequencing	3.84	0.84	1%	4%	25%	48%	21%
Hold Situation	3.84	0.90	1%	6%	22%	46%	23%
Error of Controller	3.53	0.96	3%	9%	37%	35%	16%
Terminal Area	**3.91**	**0.92**	**2%**	**5%**	**21%**	**44%**	**28%**
Next Comm. Frequency	4.17	0.85	1%	3%	15%	41%	41%
Wx - Overall	3.93	0.82	1%	3%	23%	49%	24%
TRW Buildup, Deviations	4.00	0.76	0%	2%	22%	49%	26%
Visiblilty & Ceiling	4.12	0.78	1%	2%	14%	50%	33%
Icing Conditions	3.84	0.85	1%	4%	27%	46%	22%
Ride Reports	3.74	0.87	1%	6%	32%	42%	20%
Winds Aloft	3.21	1.16	10%	16%	32%	29%	14%
Surface Winds	4.06	0.81	1%	3%	17%	49%	31%
Traffic-Controlled	4.19	0.76	1%	2%	11%	49%	36%
Traffic-Uncontrolled	3.42	1.16	6%	17%	25%	33%	19%
Sequencing	3.96	0.80	0%	3%	21%	50%	25%
Hold Situation	3.92	0.89	1%	5%	22%	44%	27%
Terminal Routing	4.13	0.80	0%	3%	15%	46%	35%
Approach Clearance	4.24	0.82	1%	2%	12%	41%	43%
Error of Controller	3.64	0.98	3%	8%	31%	38%	20%

Accuracy Ratings of PLI (con't)

	Statistics		Percent of Responses at Each Value				
	Averages	Std. Dev.	% of 1's	% of 2's	% of 3's	% of 4's	% of 5's
Final Approach	**3.91**	**0.96**	**2%**	**5%**	**22%**	**40%**	**30%**
Next Comm. Frequency	4.25	0.86	1%	3%	14%	35%	47%
Wx - Overall	3.91	0.85	1%	4%	23%	47%	25%
TRW Buildup, Deviations	3.99	0.82	1%	3%	21%	48%	28%
Visiblilty & Ceiling	4.19	0.80	0%	2%	15%	43%	39%
Icing Conditions	3.82	0.89	1%	5%	28%	42%	24%
Ride Reports	3.69	0.95	2%	7%	30%	39%	21%
Winds Aloft	3.14	1.20	12%	16%	34%	24%	14%
Windshear	3.88	0.94	1%	7%	21%	42%	28%
Surface Winds	4.18	0.82	1%	3%	13%	43%	39%
Traffic-Controlled	4.25	0.78	1%	2%	12%	43%	42%
Traffic-Uncontrolled	3.43	1.19	8%	15%	24%	33%	20%
Missed Approach - Wx	4.19	0.84	1%	2%	14%	41%	41%
Missed Approach - Other	4.05	0.89	1%	3%	20%	39%	36%
A/C on Runway	4.16	0.86	1%	3%	16%	40%	40%
Braking Action	3.85	0.90	1%	6%	25%	44%	24%
Taxiway Turnoff	3.72	0.96	2%	6%	32%	37%	22%
Sequencing	3.92	0.88	2%	3%	24%	44%	27%
Error of Controller	3.61	1.01	4%	8%	34%	35%	20%
Prosodic & General Elements							
Sector Congestion	3.96	0.97	2%	5%	23%	36%	34%
Controller Exp.	3.95	0.88	1%	3%	24%	43%	29%
Other Pilot's Exp.	3.87	0.85	0%	5%	27%	43%	25%
Controller's Urgency	3.75	0.94	1%	6%	32%	36%	24%
Other Pilot's Urgency	3.71	0.93	2%	8%	30%	40%	21%
B/G Reassurance	3.70	0.95	2%	7%	34%	35%	23%
Call Sign Confusion	3.63	0.95	2%	8%	34%	36%	19%
Lost Communication	3.53	0.99	3%	10%	34%	36%	16%
Navaid Problems	3.45	0.99	4%	11%	36%	34%	14%

Appendix D:

Importance Ratings of Party Line Information,

Listed by Phase of Flight

Importance Ratings by Phase of Flight

	Statistics		Percentage of Responses at Each Value				
Combined Ratings	**Averages**	**Std. Dev.**	**% 1's**	**% 2's**	**% 3's**	**% 4's**	**% 5's**
Ground Operations	**3.72**	**1.31**	**6%**	**10%**	**23%**	**28%**	**32%**
Departure	**3.84**	**1.14**	**5%**	**9%**	**23%**	**32%**	**39%**
Cruise	**3.69**	**1.20**	**21%**	**29%**	**67%**	**89%**	**93%**
Descent	**4.01**	**1.06**	**9%**	**19%**	**51%**	**94%**	**118%**
Terminal Area	**4.16**	**1.12**	**4%**	**6%**	**15%**	**34%**	**56%**
Final Approach	**4.17**	**1.22**	**5%**	**6%**	**14%**	**27%**	**60%**

Controlled Traffic	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations							
Departure	4.48	0.75	0%	2%	8%	30%	60%
Cruise							
Descent	4.47	0.83	1%	2%	8%	26%	63%
Terminal Area	4.62	0.69	0%	2%	6%	21%	71%
Final Approach	4.58	0.77	1%	2%	7%	18%	72%

Uncontrolled Traffic	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations							
Departure	4.61	0.71	0%	2%	5%	21%	71%
Cruise							
Descent	4.51	0.84	1%	3%	7%	21%	68%
Terminal Area	4.62	0.73	1%	2%	6%	18%	73%
Final Approach	4.61	0.79	1%	2%	7%	15%	75%

Traffic Avoidance	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Cruise	4.35	0.93	2%	3%	10%	28%	57%

Relative Sequencing	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	3.66	1.89	3%	10%	32%	35%	20%
Departure	3.78	0.98	3%	6%	29%	38%	25%
Cruise	3.52	1.13	6%	12%	28%	32%	22%
Descent	3.96	0.88	1%	5%	20%	45%	29%
Terminal Area	4.16	0.82	1%	2%	14%	44%	38%
Final Approach	4.06	0.91	2%	4%	17%	42%	36%

Weather Overall	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	3.75	1.07	4%	7%	25%	35%	28%
Departure	3.88	0.96	3%	4%	24%	40%	28%
Cruise	3.87	0.95	2%	5%	26%	38%	29%
Descent	4.01	0.91	2%	3%	21%	41%	33%
Terminal Area	4.08	0.98	3%	4%	15%	37%	40%
Final Approach	3.87	1.20	6%	8%	19%	27%	40%

Importance Ratings by Phase of Flight (con't)

	Statistics		Percentage of Responses at Each Value				
TRW Buildups	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	4.20	1.04	3%	4%	14%	26%	52%
Departure	4.45	0.75	0%	2%	8%	32%	58%
Cruise	4.44	0.73	0%	1%	9%	33%	56%
Descent	4.53	0.66	0%	1%	6%	32%	61%
Terminal Area	4.52	0.76	1%	2%	6%	26%	64%
Final Approach	4.25	1.07	4%	5%	12%	22%	57%
Visibility & Ceiling	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	3.79	1.11	5%	7%	22%	34%	31%
Departure	3.41	1.18	8%	14%	27%	31%	20%
Cruise	3.15	1.32	14%	19%	26%	22%	20%
Descent	4.12	0.98	2%	4%	17%	33%	43%
Terminal Area	4.44	0.80	1%	2%	9%	29%	59%
Final Approach	4.62	2.16	1%	2%	7%	22%	68%
Icing Conditions	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	4.09	1.11	3%	7%	15%	25%	49%
Departure	4.26	0.91	1%	3%	13%	32%	50%
Cruise	4.19	0.96	2%	4%	14%	33%	47%
Descent	4.28	0.87	1%	3%	14%	32%	50%
Terminal Area	4.29	0.91	1%	3%	12%	30%	53%
Final Approach	4.09	1.10	3%	8%	14%	26%	48%
Ride Reports	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	3.37	1.13	8%	11%	34%	30%	17%
Departure	3.73	0.94	2%	8%	29%	40%	22%
Cruise	3.89	0.89	1%	4%	25%	43%	26%
Descent	3.70	0.95	1%	9%	30%	38%	22%
Terminal Area	3.65	1.09	4%	11%	28%	31%	26%
Final Approach	3.52	1.30	8%	17%	18%	27%	29%
Winds Aloft	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	2.67	1.08	17%	25%	37%	15%	5%
Departure	2.89	1.08	11%	22%	41%	16%	9%
Cruise	3.22	1.07	6%	17%	38%	26%	13%
Descent	2.64	1.15	17%	33%	29%	13%	8%
Terminal Area	2.52	1.27	27%	27%	24%	13%	10%
Final Approach	2.40	1.36	36%	23%	18%	12%	11%
Surface Winds	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	3.61	1.58	5%	10%	30%	35%	20%
Departure	3.00	1.37	20%	17%	26%	20%	18%
Cruise	2.54	1.36	30%	23%	20%	14%	12%
Descent	3.79	1.11	5%	8%	20%	37%	30%
Terminal Area	4.27	1.82	2%	4%	13%	36%	46%
Final Approach	4.48	0.77	0%	2%	8%	27%	62%

Importance Ratings by Phase of Flight (con't)

	Statistics		Percentage of Responses at Each Value				
Next Comm. Freq.	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	2.80	1.30	21%	21%	27%	18%	12%
Departure	3.42	1.24	8%	15%	26%	26%	24%
Cruise	3.34	1.22	10%	14%	29%	28%	20%
Descent	3.64	1.21	7%	11%	23%	29%	30%
Terminal Area	3.86	1.18	6%	8%	18%	30%	38%
Final Approach	3.59	1.36	12%	11%	20%	22%	35%
Error of Controller	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Ground Operations	4.38	0.83	1%	3%	11%	29%	57%
Departure	4.23	0.91	1%	4%	17%	29%	49%
Cruise	4.01	1.02	2%	5%	23%	28%	41%
Descent	4.19	0.92	1%	4%	18%	30%	47%
Terminal Area	4.33	0.89	1%	2%	14%	26%	56%
Final Approach	4.41	0.88	1%	3%	12%	24%	61%
Misc. Elements Ground Operations	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Routing to Runway	3.60	1.15	5%	12%	25%	31%	26%
"Hold Short" of Runway	3.96	1.09	3%	8%	20%	28%	40%
A/C on Runway	4.42	0.89	1%	3%	11%	21%	63%
Descent/T. Area	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Hold Situation (Descent)	4.28	0.77	0%	1%	14%	39%	45%
Hold Situation (T. Area)	4.19	0.86	1%	3%	15%	38%	43%
Terminal Routing	4.35	0.81	1%	2%	11%	35%	52%
Approach Clearance	4.47	0.82	1%	2%	8%	26%	62%
Final Approach	Averages	Std. Dev.	% 1's	% 2's	% 3's	% 4's	% 5's
Windshear	4.76	0.57	0%	0%	3%	15%	81%
Missed Approach Weather	4.63	0.64	0%	1%	4%	24%	70%
Missed Approach Other	4.27	0.88	1%	4%	13%	33%	50%
A/C on Runway	4.83	0.47	0%	0%	2%	12%	86%
Braking Action	4.42	0.77	0%	2%	8%	32%	56%
Taxiway Turnoff	3.67	1.04	4%	7%	31%	33%	24%

Appendix E:

Importance Ratings of Party Line Information from Pilots of Different Flight Operations

Importance Ratings by Pilots of Different Flight Operations

	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Ground Operations						
General Aviation	**3.79**	4%	10%	24%	27%	35%
Commuter Airline	**3.66**	7%	11%	24%	25%	33%
Major Airline	**3.70**	7%	8%	24%	30%	31%
Military	**3.69**	5%	12%	22%	29%	31%
Next Communications Frequency						
General Aviation	3.09	15%	19%	27%	23%	17%
Commuter Airline	2.64	25%	25%	25%	13%	12%
Major Airline	2.66	25%	20%	29%	16%	9%
Military	2.72	22%	24%	27%	16%	11%
Weather Overall						
General Aviation	3.81	3%	8%	25%	34%	30%
Commuter Airline	3.67	7%	7%	29%	27%	30%
Major Airline	3.69	6%	5%	27%	39%	23%
Military	3.87	1%	12%	17%	38%	31%
Thunderstorms & Deviations						
General Aviation	4.23	3%	6%	14%	20%	58%
Commuter Airline	4.23	4%	5%	13%	21%	57%
Major Airline	4.14	4%	3%	15%	33%	45%
Military	4.28	1%	3%	16%	27%	53%
Visibility & Ceiling						
General Aviation	3.93	3%	5%	21%	36%	34%
Commuter Airline	3.71	5%	11%	21%	36%	28%
Major Airline	3.62	7%	8%	25%	33%	26%
Military	4.02	3%	7%	19%	30%	42%
Icing Conditions						
General Aviation	4.35	4%	5%	9%	16%	66%
Commuter Airline	3.99	3%	11%	16%	25%	45%
Major Airline	3.87	5%	8%	19%	31%	37%
Military	4.16	1%	5%	16%	32%	46%
Ride Reports & Turbulence						
General Aviation	3.43	6%	11%	36%	29%	18%
Commuter Airline	3.15	12%	11%	39%	30%	9%
Major Airline	3.57	8%	6%	29%	34%	23%
Military	3.17	6%	21%	35%	27%	11%
Winds Aloft						
General Aviation	3.00	10%	20%	40%	20%	10%
Commuter Airline	2.43	22%	28%	36%	12%	2%
Major Airline	2.49	22%	27%	34%	14%	3%
Military	2.68	12%	28%	43%	12%	4%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Ground Operations (Con't)	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Surface Winds						
General Aviation	3.74	2%	13%	31%	31%	22%
Commuter Airline	3.53	6%	10%	32%	32%	21%
Major Airline	3.47	7%	10%	30%	36%	17%
Military	3.77	3%	4%	27%	43%	22%
Routing to Runway						
General Aviation	3.47	4%	16%	32%	27%	22%
Commuter Airline	3.71	4%	15%	20%	28%	33%
Major Airline	3.83	4%	7%	21%	38%	30%
Military	3.36	11%	13%	25%	32%	19%
Relative Sequencing						
General Aviation	3.68	3%	11%	27%	36%	24%
Commuter Airline	3.50	3%	12%	34%	32%	18%
Major Airline	3.86	1%	6%	36%	37%	19%
Military	3.36	4%	17%	32%	32%	15%
Aircraft Holding Short of Runway						
General Aviation	3.85	4%	9%	23%	27%	37%
Commuter Airline	4.12	2%	8%	16%	26%	49%
Major Airline	4.10	2%	5%	20%	29%	45%
Military	3.71	5%	12%	18%	35%	29%
Aircraft Crossing Active Runway						
General Aviation	4.35	1%	7%	10%	23%	60%
Commuter Airline	4.44	1%	3%	13%	17%	66%
Major Airline	4.44	1%	2%	11%	22%	63%
Military	4.48	2%	1%	10%	23%	65%
Error of Controller						
General Aviation	4.30	1%	5%	12%	28%	54%
Commuter Airline	4.48	0%	2%	13%	21%	64%
Major Airline	4.40	0%	2%	10%	31%	56%
Military	4.40	1%	2%	9%	34%	55%

Importance Ratings by Pilots of Different Flight Operations (Con't)

	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Departure						
General Aviation	**3.95**	**3%**	**7%**	**21%**	**30%**	**39%**
Commuter Airline	**3.78**	**6%**	**10%**	**21%**	**28%**	**35%**
Major Airline	**3.78**	**6%**	**9%**	**21%**	**30%**	**34%**
Military	**3.83**	**5%**	**8%**	**22%**	**31%**	**34%**
Next Communications Frequency						
General Aviation	3.70	4%	14%	23%	28%	32%
Commuter Airline	3.15	14%	15%	32%	19%	20%
Major Airline	3.19	11%	19%	29%	23%	18%
Military	3.64	5%	13%	22%	34%	27%
Weather Overall						
General Aviation	3.90	2%	4%	26%	40%	29%
Commuter Airline	3.81	3%	4%	29%	36%	27%
Major Airline	3.91	3%	4%	21%	42%	30%
Military	3.83	2%	7%	23%	43%	25%
Thunderstorm Buildups & Deviations						
General Aviation	4.38	1%	3%	9%	34%	54%
Commuter Airline	4.62	0%	1%	4%	27%	68%
Major Airline	4.45	1%	1%	8%	33%	57%
Military	4.42	0%	2%	11%	30%	57%
Visibility & Ceiling						
General Aviation	3.77	3%	7%	28%	36%	26%
Commuter Airline	3.16	11%	20%	27%	26%	16%
Major Airline	3.20	12%	17%	27%	28%	16%
Military	3.40	7%	15%	26%	34%	18%
Icing Conditions						
General Aviation	4.54	1%	1%	7%	25%	66%
Commuter Airline	4.25	2%	5%	8%	38%	48%
Major Airline	4.01	1%	6%	20%	36%	36%
Military	4.21	2%	3%	16%	33%	47%
Ride Reports & Turbulence						
General Aviation	3.66	1%	8%	37%	33%	21%
Commuter Airline	3.61	2%	9%	29%	50%	11%
Major Airline	4.01	0%	5%	16%	50%	28%
Military	3.46	4%	12%	36%	27%	20%
Winds Aloft						
General Aviation	3.16	7%	17%	43%	19%	14%
Commuter Airline	2.58	15%	30%	40%	11%	4%
Major Airline	2.75	14%	25%	41%	13%	7%
Military	2.98	10%	20%	40%	22%	8%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Departure (Con't)	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Surface Winds						
General Aviation	3.08	16%	18%	29%	19%	18%
Commuter Airline	2.85	19%	24%	24%	18%	14%
Major Airline	3.02	21%	14%	23%	24%	18%
Military	2.93	24%	14%	24%	18%	19%
Controlled Traffic						
General Aviation	4.49	1%	2%	6%	32%	60%
Commuter Airline	4.46	1%	3%	6%	30%	60%
Major Airline	4.43	0%	2%	11%	27%	60%
Military	4.54	0%	0%	6%	34%	60%
Uncontrolled Traffic						
General Aviation	4.52	0%	3%	8%	23%	66%
Commuter Airline	4.82	0%	1%	0%	14%	85%
Major Airline	4.65	1%	1%	5%	17%	75%
Military	4.54	0%	1%	6%	31%	62%
Relative Sequencing						
General Aviation	3.96	3%	6%	21%	36%	35%
Commuter Airline	3.70	2%	6%	33%	41%	19%
Major Airline	3.64	4%	6%	34%	36%	20%
Military	3.78	1%	6%	29%	42%	22%
Error of Controller						
General Aviation	4.16	2%	5%	15%	32%	46%
Commuter Airline	4.29	0%	3%	18%	26%	53%
Major Airline	4.22	1%	3%	17%	29%	49%
Military	4.26	0%	1%	22%	27%	50%

Importance Ratings by Pilots of Different Flight Operations (Con't)

	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Cruise						
General Aviation	**3.91**	**4%**	**8%**	**20%**	**28%**	**39%**
Commuter Airline	**3.59**	**8%**	**12%**	**23%**	**29%**	**28%**
Major Airline	**3.52**	**9%**	**11%**	**23%**	**31%**	**26%**
Military	**3.68**	**6%**	**9%**	**24%**	**32%**	**29%**
Next Communications Frequency						
General Aviation	3.78	4%	11%	24%	30%	33%
Commuter Airline	3.07	13%	19%	30%	24%	14%
Major Airline	2.98	14%	18%	33%	24%	11%
Military	3.48	8%	9%	28%	35%	19%
Weather Overall						
General Aviation	4.02	2%	2%	23%	42%	32%
Commuter Airline	3.81	1%	8%	28%	36%	27%
Major Airline	3.71	3%	8%	30%	35%	25%
Military	3.90	3%	3%	26%	40%	29%
Thunderstorm Buildups & Deviations						
General Aviation	4.54	1%	1%	8%	27%	64%
Commuter Airline	4.48	0%	2%	8%	31%	59%
Major Airline	4.34	0%	1%	11%	38%	49%
Military	4.43	0%	0%	11%	35%	54%
Visibility & Ceiling						
General Aviation	3.77	4%	10%	25%	27%	34%
Commuter Airline	2.85	18%	21%	28%	20%	12%
Major Airline	2.74	23%	22%	26%	15%	14%
Military	3.03	11%	27%	24%	23%	15%
Icing Conditions						
General Aviation	4.60	1%	2%	5%	22%	71%
Commuter Airline	4.33	1%	2%	10%	38%	50%
Major Airline	3.77	3%	7%	24%	40%	26%
Military	4.10	2%	5%	16%	37%	41%
Ride Reports & Turbulence						
General Aviation	3.78	2%	5%	34%	33%	26%
Commuter Airline	3.87	2%	4%	23%	48%	23%
Major Airline	4.15	0%	1%	12%	54%	32%
Military	3.69	3%	7%	30%	39%	21%
Winds Aloft						
General Aviation	3.36	5%	17%	35%	24%	19%
Commuter Airline	2.96	10%	20%	41%	22%	7%
Major Airline	3.16	7%	18%	38%	29%	9%
Military	3.33	5%	15%	36%	29%	15%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Cruise (Con't)	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Surface Winds						
General Aviation	2.94	21%	21%	22%	17%	19%
Commuter Airline	2.39	32%	25%	23%	17%	4%
Major Airline	2.24	40%	26%	15%	12%	9%
Military	2.47	31%	24%	23%	12%	11%
Traffic Avoidance						
General Aviation	4.42	3%	2%	8%	27%	61%
Commuter Airline	4.39	2%	1%	10%	30%	57%
Major Airline	4.17	2%	6%	16%	26%	50%
Military	4.51	0%	3%	3%	34%	59%
Relative Sequencing						
General Aviation	3.80	5%	6%	24%	33%	32%
Commuter Airline	3.19	8%	20%	30%	30%	12%
Major Airline	3.38	7%	16%	27%	34%	17%
Military	3.58	4%	9%	34%	30%	22%
Error of Controller						
General Aviation	3.93	4%	10%	18%	27%	42%
Commuter Airline	4.10	0%	5%	27%	20%	47%
Major Airline	4.02	2%	4%	24%	30%	40%
Military	3.95	1%	1%	31%	36%	31%

Importance Ratings by Pilots of Different Flight Operations (Con't)

	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Descent						
General Aviation	**4.11**	**2%**	**6%**	**18%**	**29%**	**46%**
Commuter Airline	**3.95**	**4%**	**8%**	**18%**	**31%**	**40%**
Major Airline	**3.93**	**4%**	**7%**	**18%**	**34%**	**37%**
Military	**4.03**	**2%**	**6%**	**16%**	**36%**	**39%**
Next Communications Frequency						
General Aviation	3.98	3%	6%	21%	31%	39%
Commuter Airline	3.40	9%	16%	28%	22%	25%
Major Airline	3.35	11%	13%	27%	27%	21%
Military	3.82	5%	9%	18%	35%	33%
Weather Overall						
General Aviation	3.99	3%	3%	22%	38%	34%
Commuter Airline	3.98	1%	4%	24%	39%	32%
Major Airline	4.00	2%	2%	22%	41%	33%
Military	4.04	2%	3%	15%	49%	31%
Thunderstorm Buildups & Deviations						
General Aviation	4.54	0%	2%	6%	28%	64%
Commuter Airline	4.65	0%	0%	4%	27%	69%
Major Airline	4.49	0%	0%	6%	36%	57%
Military	4.50	0%	1%	6%	36%	57%
Visibility & Ceiling						
General Aviation	4.33	1%	1%	15%	32%	52%
Commuter Airline	3.89	5%	5%	22%	34%	34%
Major Airline	3.95	4%	4%	20%	34%	37%
Military	4.28	0%	5%	12%	32%	50%
Icing Conditions						
General Aviation	4.53	0%	1%	9%	24%	65%
Commuter Airline	4.42	1%	3%	8%	30%	58%
Major Airline	4.00	2%	5%	20%	37%	36%
Military	4.23	0%	3%	13%	41%	43%
Ride Reports & Turbulence						
General Aviation	3.64	2%	9%	38%	27%	25%
Commuter Airline	3.78	1%	7%	22%	55%	15%
Major Airline	3.90	1%	5%	22%	47%	25%
Military	3.41	3%	17%	35%	28%	18%
Winds Aloft						
General Aviation	2.99	10%	27%	31%	17%	15%
Commuter Airline	2.49	16%	39%	28%	14%	3%
Major Airline	2.42	22%	36%	26%	10%	5%
Military	2.54	18%	34%	28%	13%	6%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Descent (Con't)	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Surface Winds						
General Aviation	3.99	2%	5%	21%	36%	36%
Commuter Airline	3.59	8%	10%	25%	32%	25%
Major Airline	3.60	9%	10%	21%	34%	26%
Military	3.96	3%	6%	14%	46%	31%
Controlled Traffic						
General Aviation	4.49	1%	2%	10%	25%	64%
Commuter Airline	4.40	1%	5%	8%	27%	60%
Major Airline	4.38	3%	2%	10%	24%	61%
Military	4.62	0%	1%	2%	32%	66%
Uncontrolled Traffic						
General Aviation	4.45	1%	4%	8%	23%	64%
Commuter Airline	4.63	1%	3%	6%	13%	78%
Major Airline	4.49	3%	2%	8%	19%	69%
Military	4.55	0%	1%	7%	28%	64%
Relative Sequencing						
General Aviation	4.09	1%	3%	19%	40%	37%
Commuter Airline	3.71	3%	9%	22%	48%	18%
Major Airline	3.89	1%	6%	21%	49%	24%
Military	4.05	0%	2%	21%	49%	29%
Hold Situation / EFC Validity						
General Aviation	4.26	0%	3%	18%	29%	50%
Commuter Airline	4.26	2%	2%	12%	38%	47%
Major Airline	4.31	0%	0%	10%	47%	42%
Military	4.26	0%	1%	12%	47%	40%
Error of Controller						
General Aviation	4.09	2%	8%	14%	29%	47%
Commuter Airline	4.21	0%	3%	23%	25%	49%
Major Airline	4.25	0%	2%	19%	32%	47%
Military	4.19	1%	0%	21%	36%	42%

Importance Ratings by Pilots of Different Flight Operations (Con't)

	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Terminal Area						
General Aviation	4.20	3%	5%	14%	28%	51%
Commuter Airline	4.19	4%	5%	12%	28%	52%
Major Airline	4.12	4%	5%	14%	31%	46%
Military	4.12	3%	5%	13%	32%	46%
Next Communications Frequency						
General Aviation	4.05	4%	6%	17%	27%	46%
Commuter Airline	3.75	4%	12%	21%	31%	31%
Major Airline	3.68	8%	10%	22%	28%	32%
Military	4.00	5%	4%	14%	38%	39%
Weather Overall						
General Aviation	3.92	4%	4%	21%	39%	32%
Commuter Airline	4.12	4%	6%	12%	31%	47%
Major Airline	4.18	2%	4%	13%	37%	44%
Military	4.09	2%	5%	12%	42%	38%
Thunderstorm Buildups & Deviations						
General Aviation	4.48	2%	2%	7%	25%	64%
Commuter Airline	4.65	0%	1%	6%	20%	73%
Major Airline	4.56	0%	1%	4%	29%	64%
Military	4.42	0%	4%	9%	29%	58%
Visibility & Ceiling						
General Aviation	4.51	1%	2%	8%	27%	64%
Commuter Airline	4.51	1%	0%	8%	29%	62%
Major Airline	4.34	2%	1%	11%	30%	55%
Military	4.45	0%	4%	8%	29%	60%
Icing Conditions						
General Aviation	4.49	2%	3%	6%	22%	67%
Commuter Airline	4.40	1%	3%	9%	30%	57%
Major Airline	4.14	1%	3%	18%	35%	43%
Military	4.12	1%	6%	16%	34%	43%
Ride Reports & Turbulence						
General Aviation	3.74	4%	7%	32%	27%	31%
Commuter Airline	3.64	4%	10%	28%	37%	22%
Major Airline	3.81	2%	11%	20%	38%	29%
Military	3.21	7%	20%	35%	20%	18%
Winds Aloft						
General Aviation	2.84	18%	27%	25%	15%	16%
Commuter Airline	2.21	34%	28%	23%	12%	3%
Major Airline	2.35	30%	29%	24%	9%	8%
Military	2.50	30%	24%	20%	18%	8%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Terminal Area (Con't)	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Surface Winds						
General Aviation	4.24	1%	2%	17%	32%	48%
Commuter Airline	4.32	1%	6%	10%	27%	56%
Major Airline	4.28	2%	6%	13%	38%	41%
Military	4.25	2%	1%	10%	46%	42%
Controlled Traffic						
General Aviation	4.57	0%	2%	4%	24%	69%
Commuter Airline	4.67	0%	2%	5%	17%	76%
Major Airline	4.57	0%	2%	8%	21%	69%
Military	4.69	0%	0%	4%	22%	74%
Uncontrolled Traffic						
General Aviation	4.50	1%	4%	7%	24%	66%
Commuter Airline	4.82	0%	0%	2%	14%	84%
Major Airline	4.62	2%	2%	6%	15%	76%
Military	4.59	1%	0%	10%	18%	71%
Relative Sequencing						
General Aviation	4.22	1%	4%	14%	38%	45%
Commuter Airline	4.15	2%	4%	10%	48%	37%
Major Airline	4.07	1%	1%	17%	50%	31%
Military	4.18	0%	1%	17%	46%	37%
Hold Situation / EFC Validity						
General Aviation	4.23	1%	3%	16%	35%	46%
Commuter Airline	4.24	2%	2%	13%	38%	46%
Major Airline	4.15	1%	4%	14%	41%	40%
Military	4.12	1%	4%	15%	43%	37%
Terminal Routing & Runway						
General Aviation	4.39	1%	2%	11%	32%	55%
Commuter Airline	4.30	1%	3%	12%	34%	50%
Major Airline	4.29	1%	1%	12%	38%	48%
Military	4.41	1%	1%	9%	35%	54%
Approach Clearance						
General Aviation	4.52	2%	1%	7%	26%	65%
Commuter Airline	4.46	2%	2%	10%	21%	65%
Major Airline	4.37	2%	2%	10%	28%	58%
Military	4.57	0%	1%	5%	30%	64%
Error of Controller						
General Aviation	4.21	2%	6%	12%	28%	52%
Commuter Airline	4.53	0%	0%	12%	23%	65%
Major Airline	4.35	1%	1%	17%	26%	55%
Military	4.26	2%	1%	17%	29%	51%

Importance Ratings by Pilots of Different Flight Operations (Con't)

	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Final Approach						
General Aviation	**4.16**	**4%**	**6%**	**13%**	**23%**	**54%**
Commuter Airline	**4.22**	**4%**	**5%**	**12%**	**21%**	**58%**
Major Airline	**4.17**	**4%**	**6%**	**11%**	**26%**	**53%**
Military	**4.12**	**5%**	**6%**	**14%**	**26%**	**50%**
Next Communications Frequency						
General Aviation	3.69	11%	8%	22%	22%	38%
Commuter Airline	3.32	16%	16%	20%	19%	29%
Major Airline	3.60	11%	13%	18%	22%	36%
Military	3.64	11%	8%	23%	25%	34%
Weather Overall						
General Aviation	3.63	9%	11%	23%	24%	33%
Commuter Airline	4.01	6%	7%	16%	23%	49%
Major Airline	4.04	3%	8%	15%	30%	44%
Military	3.81	5%	8%	22%	31%	34%
Thunderstorm Buildups & Deviations						
General Aviation	4.14	5%	6%	11%	28%	51%
Commuter Airline	4.48	1%	4%	11%	15%	70%
Major Airline	4.37	4%	2%	9%	23%	62%
Military	4.05	3%	8%	20%	20%	49%
Visibility & Ceiling						
General Aviation	4.64	1%	1%	6%	19%	74%
Commuter Airline	4.59	1%	2%	8%	16%	74%
Major Airline	4.44	2%	2%	9%	25%	62%
Military	4.91	1%	4%	7%	25%	64%
Icing Conditions						
General Aviation	4.23	3%	7%	13%	19%	58%
Commuter Airline	4.23	2%	8%	14%	19%	57%
Major Airline	4.01	3%	10%	13%	32%	43%
Military	3.83	4%	9%	20%	32%	34%
Ride Reports & Turbulence						
General Aviation	3.61	5%	17%	21%	25%	32%
Commuter Airline	3.62	8%	12%	18%	36%	27%
Major Airline	3.67	7%	16%	13%	29%	34%
Military	3.01	17%	23%	21%	20%	19%
Winds Aloft						
General Aviation	2.65	29%	25%	16%	14%	17%
Commuter Airline	2.25	39%	22%	21%	12%	7%
Major Airline	2.34	37%	23%	17%	12%	10%
Military	2.16	42%	23%	18%	10%	7%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Final Approach (Con't)	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Windshear						
General Aviation	4.69	0%	1%	5%	20%	75%
Commuter Airline	4.79	1%	0%	3%	12%	85%
Major Airline	4.78	1%	0%	2%	12%	84%
Military	4.82	0%	1%	1%	13%	85%
Surface Winds						
General Aviation	4.55	0%	2%	8%	24%	66%
Commuter Airline	4.54	1%	1%	10%	20%	69%
Major Airline	4.37	1%	3%	10%	30%	56%
Military	4.54	0%	2%	4%	32%	62%
Controlled Airports						
General Aviation	4.56	2%	2%	7%	18%	72%
Commuter Airline	4.68	1%	1%	3%	19%	76%
Major Airline	4.57	1%	2%	8%	17%	72%
Military	4.49	0%	1%	15%	19%	66%
Uncontrolled Airports						
General Aviation	4.53	2%	3%	8%	16%	72%
Commuter Airline	4.88	0%	0%	1%	10%	89%
Major Airline	4.59	2%	2%	5%	16%	75%
Military	4.48	1%	1%	14%	18%	66%
Missed Approach - Weather						
General Aviation	4.66	0%	1%	4%	19%	75%
Commuter Airline	4.59	0%	1%	6%	27%	66%
Major Airline	4.57	0%	1%	4%	29%	65%
Military	4.72	0%	0%	3%	22%	75%
Missed Approach - Other						
General Aviation	4.26	1%	4%	15%	27%	53%
Commuter Airline	4.26	1%	5%	14%	28%	52%
Major Airline	4.23	0%	4%	13%	37%	46%
Military	4.32	1%	3%	10%	37%	50%
Aircraft on Landing Runway						
General Aviation	4.79	0%	0%	2%	13%	84%
Commuter Airline	4.88	0%	0%	1%	10%	89%
Major Airline	4.82	0%	0%	2%	13%	85%
Military	4.84	1%	0%	1%	10%	88%
Braking Action						
General Aviation	4.19	1%	4%	16%	34%	45%
Commuter Airline	4.58	0%	2%	5%	26%	67%
Major Airline	4.57	0%	2%	2%	33%	63%
Military	4.41	1%	1%	10%	33%	55%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Final Approach (Con't)	Average Rating	Percentage of Responses at Each Value				
		% of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Taxiway Turnoff						
General Aviation	3.60	5%	6%	36%	29%	24%
Commuter Airline	3.79	1%	7%	32%	32%	28%
Major Airline	3.69	3%	8%	29%	36%	23%
Military	3.63	5%	7%	29%	36%	23%
Relative Sequencing						
General Aviation	4.12	2%	5%	16%	36%	42%
Commuter Airline	4.02	4%	5%	17%	35%	40%
Major Airline	3.99	1%	4%	17%	49%	29%
Military	4.06	1%	3%	17%	46%	33%
Error of Controller						
General Aviation	4.34	3%	4%	11%	19%	63%
Commuter Airline	4.43	0%	3%	13%	21%	62%
Major Airline	4.43	0%	3%	13%	24%	61%
Military	4.37	1%	1%	11%	34%	53%

Importance Ratings by Pilots of Different Flight Operations (Con't)

Prosodic PLI Elements	Average Rating	Percentage of Responses at Each Value % of '1's	% of '2's	% of '3's	% of '4's	% of '5's
Sector Congestion						
General Aviation	3.87	1%	6%	19%	56%	19%
Commuter Airline	3.94	2%	6%	14%	53%	25%
Major Airline	3.93	0%	5%	23%	48%	25%
Military	4.04	1%	3%	24%	53%	19%
Controller Experience						
General Aviation	3.83	1%	7%	23%	47%	23%
Commuter Airline	3.93	2%	8%	20%	38%	33%
Major Airline	3.83	1%	6%	26%	42%	25%
Military	3.85	0%	8%	25%	42%	26%
Other Pilot's Experience						
General Aviation	3.67	3%	7%	33%	37%	21%
Commuter Airline	3.85	2%	8%	18%	47%	25%
Major Airline	3.45	5%	9%	35%	35%	15%
Military	3.38	4%	15%	38%	26%	17%
Controller's Level of Urgency						
General Aviation	4.34	2%	1%	9%	40%	49%
Commuter Airline	4.29	0%	3%	15%	33%	49%
Major Airline	4.39	0%	2%	7%	40%	51%
Military	4.19	0%	2%	15%	45%	38%
Other Pilot's Level of Urgency						
General Aviation	4.03	1%	3%	23%	40%	34%
Commuter Airline	4.06	0%	5%	25%	28%	42%
Major Airline	3.99	2%	6%	20%	36%	37%
Military	3.88	0%	7%	25%	42%	26%
Background Reassurance						
General Aviation	3.89	2%	7%	24%	36%	32%
Commuter Airline	3.48	5%	13%	30%	36%	17%
Major Airline	3.43	8%	10%	28%	41%	14%
Military	3.55	3%	9%	34%	35%	18%
Call Sign Confusion						
General Aviation	4.50	1%	4%	7%	23%	66%
Commuter Airline	4.61	1%	0%	5%	26%	68%
Major Airline	4.54	0%	1%	9%	25%	65%
Military	4.47	0%	3%	4%	36%	57%
ATC Problem or Lost Communication						
General Aviation	4.50	0%	2%	8%	29%	61%
Commuter Airline	4.41	0%	1%	13%	30%	56%
Major Airline	4.26	1%	2%	13%	35%	48%
Military	4.35	0%	1%	9%	45%	45%
Navaid Problems						
General Aviation	4.29	0%	3%	15%	33%	50%
Commuter Airline	4.36	0%	2%	11%	36%	51%
Major Airline	3.90	3%	7%	23%	33%	34%
Military	4.28	0%	1%	15%	40%	44%

Appendix F:

Subjective Responses

What Does the "Big Picture" Mean to You?

	Overall	G. Aviation	Commuter	Major Airline	Military
Traffic Situation	**49%**	54%	46%	43%	62%
Weather Situation	**29%**	37%	21%	25%	33%
Predict and Plan Ahead	**16%**	17%	18%	18%	18%
Safety	**6%**	7%	6%	6%	3%
Communication	**6%**	11%	5%	1%	9%
Alternate Courses	**3%**	3%	4%	3%	6%
Competence of Others	**4%**	4%	3%	4%	6%

What is the Preferable Mix of Voice (5) and Datalink Communications (1) ?

	Overall	G. Aviation	Commuter	Major Airline	Military
Datalink/Voice Mix	**3.45**	3.56	3.27	3.26	3.38
Improved Datalink	**3.10**	3.21	2.87	2.97	2.99

What Information Would You Like Provided by Datalink?

	Overall	G. Aviation	Commuter	Major Airline	Military
Weather Info	**20%**	27%	29%	25%	40%
Clearances	**14%**	19%	27%	24%	23%
Nearby Aircraft	**12%**	14%	16%	14%	15%
Course Changes	**7%**	10%	9%	9%	9%
Frequencies	**5%**	8%	4%	7%	9%
Altitude	**5%**	8%	6%	7%	5%
Frequency Dialogue	**2%**	3%	4%	3%	2%
Airport Layout	**2%**	2%	4%	2%	2%