PRELIMINARY ANALYSIS OF PILOT RATINGS OF "PARTY LINE" INFORMATION IMPORTANCE

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ABSTRACT

With the introduction of digital datalink communications into the ATC system, there is concern over the potential loss of situational awareness by flight crews due to the reduction in the 'Party Line' Information (PLI). This information is available to the pilot by overhearing communications between ATC and other aircraft. A survey was distributed to determine current PLI use by several pilot operational groups, experience levels and geographic regions. The survey identified numerous important elements. PLI was rated the highest for operations near or on approach to the airport. Several significant variations were found between pilots from different operational groups and experience levels. Traffic and weather information were the most frequently cited as information required to obtain global situation awareness (i.e.. Big Picture).

INTRODUCTION

Current communications between Air Traffic Control (ATC) and aircraft use VHF radio voice communications. There are significant limitations of the voice system as indicated by the high number of Aviation Safety and Reporting System (ASRS) submissions identifying breakdowns and saturating 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 (Lee & Lozito, 1989).

As part of the Federal Aviation Administration's (FAA) National Airspace System modernization plan, digital datalink communications will be introduced as a means of air/ground information exchange between aircraft and ATC facilities. Communications via datalink offer potential benefits in increased system safety and efficiency by reducing transmission and interpretation errors and by allowing more information to be exchanged between aircraft and ground facilities. On the other hand, the transfer of ATC communications from voice to datalink gives rise to numerous human factors issues including a possible loss of flight crew situation awareness. Specifically, the discrete nature of datalink addressing (where an ATC message is directed exclusively to a specific aircraft) may result in a loss of the indirect 'Party Line' Information (PLI) obtained by overhearing communications between ATC and other aircraft. The identification of important PLI elements is necessary to form a basis by which compensatory datalink protocols or strategies can be developed.

BACKGROUND

Previous Work

With the current system of voice ATC communications on shared VHF frequencies, aircraft overhear all conversations on their frequency, thereby having access to a great deal of supplemental information. This PLI is used by pilots to increase their situational awareness with respect to other aircraft, environmental conditions, sector congestion and controller workload.

To determine the significance of PLI, an initial survey was distributed to 1500 American Airline pilots based at Chicago O'Hare. This survey identified the PLI elements judged to be important by air carrier crews, with the most important being *Windshear, Aircraft on Landing/Take-Off Runway, Braking Action* and *Missed Approach Information*. In addition, PLI was indicated as more important during terminal operations and on final approach (Midkiff, 1993).

Research Focus

This research expanded upon the previous survey to determine PLI use by pilots of different operational types, flight experience and geographic region. The number of elements surveyed was expanded to account for the different flight operations and to better determine the importance of specific weather information elements. In addition, to determine the information required for global situation awareness, pilots were asked for a free response to 'What does the 'Big Picture' mean to you?'.

METHOD

Survey Design

The survey was organized in three sections, detailed below.

'Party Line' Information Elements Ratings by Phase of Flight The first section of the survey solicited pilot input on the importance, availability and accuracy of 'Party Line' Information for specific information elements across six

phases of flight, from Ground Operations to Final Approach; in addition, the importance, availability and accuracy of the general and 'prosodic' content of 'Party Line' information were solicited. The subjects were asked to rank the importance, availability and accuracy of each item on 5 point scales, where the numbers 1 and 5 represented the extremes 'Trivial' vs. 'Critical' for the importance rating, 'Non-Existent' vs. 'Common-Place' for the availability rating, and 'Unreliable' vs. 'Reliable' for the accuracy rating.

Datalink Implementation and Information Requirements The second survey included several free response subjective questions, including 'What does the 'Big Picture' mean to you?', and an open request for comments. Pilots were also asked to rate, on a scale from 1 (Datalink Only) to 5 (Voice Communication Only), the preferred mix of voice and datalink communications.

Background Information The operational type, flight ratings, geographic region and other factors in the pilot's flight operations were solicited through multiple-response questions. For operational type, six choices were given: General Aviation (Single-Engine), General Aviation (Multi-Engine), Corporate, Commuter Airline, Major Airline, and Military. The pilots' total flight hours were also solicited.

Subjects

Distribution 4375 surveys were distributed, targeting five different operational groups. 2000 surveys were distributed to General Aviation pilots qualified with at least an Instrument Flight Rating. 1075 surveys were distributed to Commuter Airline pilots, and 800 surveys to Major Airline flight crew, with the assistance of the Airline Pilots Association. 500 surveys were distributed to Military pilots in domestic Navy and Air Force transport and ASW squadrons. In all cases, the surveys were distributed through the continental United States in an attempt to gain broad geographical representation.

Responses Over 715 responses have been received to date, with more still being received. The response rate of 16% was considered normal for a voluntary survey of this type, particularly due to its extensive nature. However, some response bias may be present.

There is a strong interaction between groupings by pilot experience, based upon total flight hours, and pilot operational type. As shown in Table 1, 87% of the pilots with the lowest experience (less than 1000 total flight hours) are General Aviation pilots; no commuter or airline pilots identified themselves as having this little experience. Most of the military pilots had between 1000 and 5000 hours, the commuter pilots had between 5000 and 10000 hours, and the major airline flight crew had over 10000 hours. This effect creates a strong correlation between analyses based on flight experience and on operational type.

	GA	Commuter	Airline	Military
<1000	114	0	0	17
1000-5000	104	28	18	92
5000-10000	15	49	84	12
>10000	5	24	102	0
Ave hours	2178	7763	11874	2896

Table 1. Respondent Pilot Experience vs. Operational Type

Data Analysis

The principle data consisted of importance ratings on a five point scale. The importance of a specific element within each phase of flight was calculated from the mean of all responses for that element. The mean of all elements within the survey sections corresponding to different phases of flight were calculated from all elements within that section. The responses were also subdivided based on respondent characteristics, such as total flight hours or type of flight operation with similar means calculated for these subdivisions. For the preliminary results shown in this paper, standard ANOVA and t-tests were conducted to analyze the differences in the data.

The question 'What does the 'Big Picture' mean to you?' solicited free responses from pilots. For data analysis, common responses were identified and categorized. These responses were tallied in common categories. Because the pilots were free to mention several answers, the occurrences of all responses sum to a value greater than 100%.

The data from other sections of the survey was analyzed with standard ANOVA or Chi-Squared tests as appropriate. Throughout this paper, the term 'significant' implies a demonstrated significance at the conventional 5% level ($p<0.05$), and the term 'highly significant' implies a significance at the 1% level ($p<0.01$) (Hogg & Ledolter, 1992).

Importance Ratings of 'Party Line' Information

Importance Ratings by Phase of Flight Analysis of the entire, undivided data sample shows a significant variation between the averages of the importance ratings of PLI elements across the different phases of flight, as shown in Figure 1. PLI was ranked significantly lower in the 'Cruise' phase of flight than in the phases of flight closer to the airport, such as 'Final Approach'.

The differences in important ratings between pilots with different flight experience levels for each phase of flight can be seen in Figure 1. During cruise, the more experienced pilots give PLI a significantly lower rating than the pilots with the least experience. There is little difference for the overall rating for final approach, which is uniformly considered important. Similar results were found for a comparison of importance ratings between different operational groups. General Aviation pilots, who generally have less flight experience, showed the same higher rating of PLI during cruise than other pilots, while all operational types gave PLI the same rating during final approach.
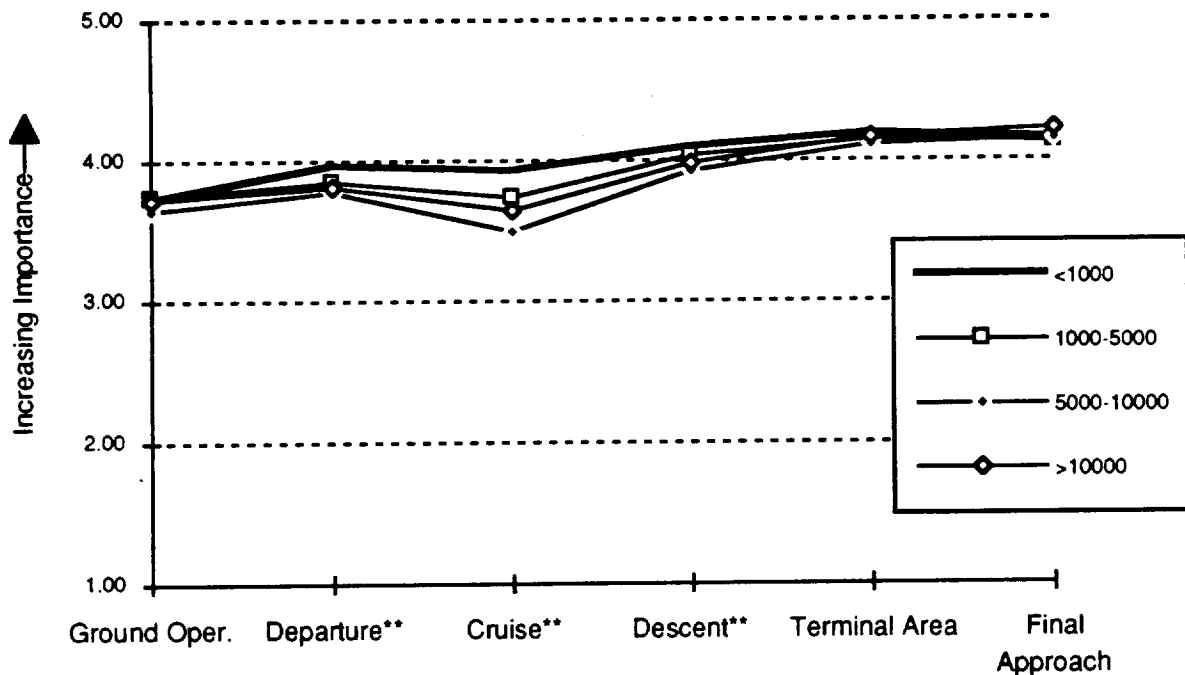

Figure 1. Importance of 'Party Line' Information for Each Phase of Flight Subdivided by Total Flight Hours
*Very Significant Differences (p<0.01) are Marked with '**'*

Identification of the Most Critical Elements The ten elements with the highest overall importance ratings for specific elements over all phases of flight were identified; their comparative values are shown in Figure 2. If the ratings for an element from several different phases of flight were each high enough to identify the element amongst the most important, only the highest rating is plotted and all the highly rated phases of flight are listed.

All elements rated as the most important occur during the terminal area operations and final approach phases of flight, with the one exception of *Thunderstorm Buildups and Deviations*, also rated highly in cruise. In addition, all of these elements except 'Approach Clearance' can be classified as either 'Weather Elements' or 'Traffic Elements'.

The differences in important ratings by pilots with different levels of experience is shown in Figure 3. There is little variance between the pilots with greater than 1000 flight hours; however, the pilots with less flight experience often show large differences that may be explained by their different flight operations. The elements with the two highest ratings, *Aircraft on Your Landing Runway* and *Windshear*, have a lower rating by the pilots with less experience, with highly significant differences.
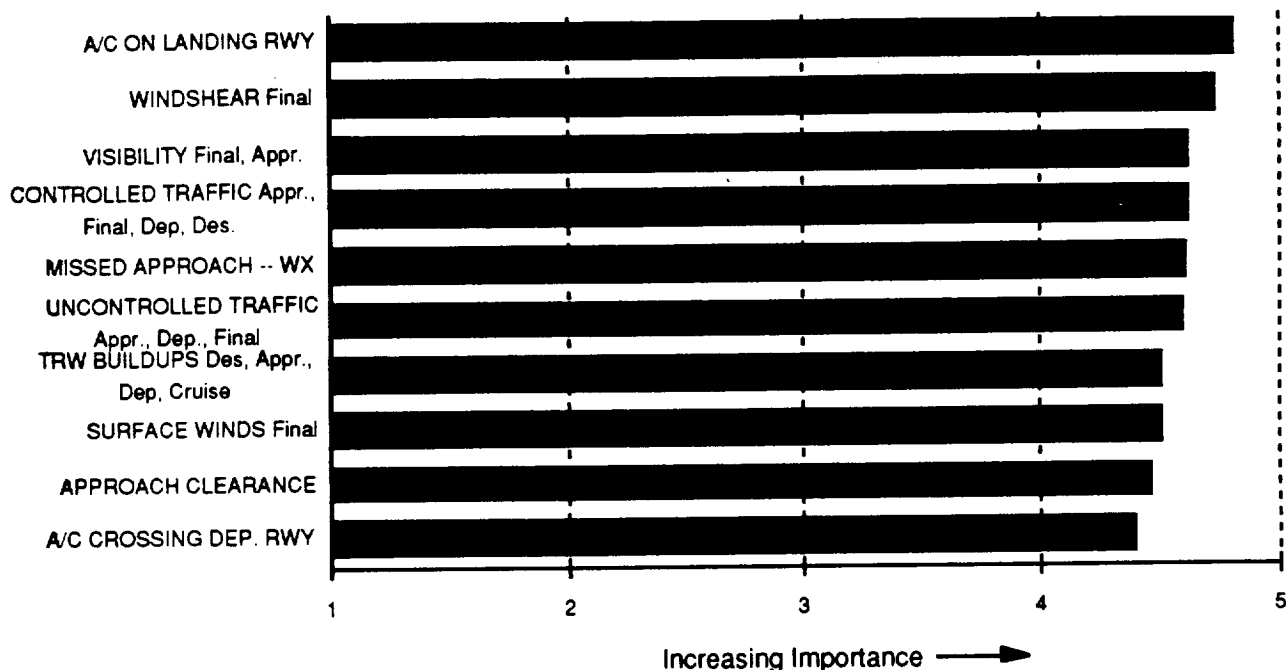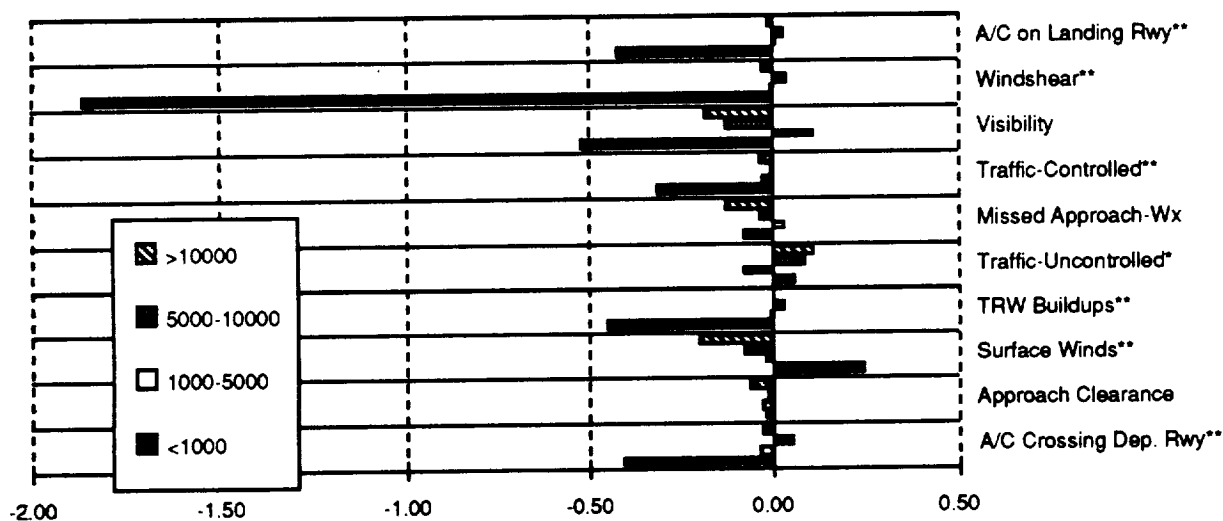
Figure 2. The 10 Most Important Elements

Chart elements (top to bottom):
A/C ON LANDING RWY
WINDSHEAR Final
VISIBILITY Final, Appr.
CONTROLLED TRAFFIC Appr., Final, Dep, Des.
MISSED APPROACH -- WX
UNCONTROLLED TRAFFIC Appr., Dep., Final
TRW BUILDUPS Des, Appr., Dep, Cruise
SURFACE WINDS Final
APPROACH CLEARANCE
A/C CROSSING DEP. RWY

Increasing Importance ——▶

Legend:
>10000
5000-10000
1000-5000
<1000

Chart elements (top to bottom):
A/C on Landing Rwy**
Windshear**
Visibility
Traffic-Controlled**
Missed Approach-Wx
Traffic-Uncontrolled*
TRW Buildups**
Surface Winds**
Approach Clearance
A/C Crossing Dep. Rwy**

Figure 3 The 10 Most Important Elements -- Deviation from Average Based on Flight Experience
*Very Significant Differences (p<0.01) are Marked with '**'*

Element Ratings in Cruise As shown in Figure 4, pilots with low flight experience (less than 1000 flight hours) identified different elements within cruise as being particularly important, in addition to rating PLI more important in cruise overall. The elements rated higher by the low experience pilots are *Visibility and Ceiling, Ride Reports and Turbulence, Winds Aloft, Surface Winds* and *Relative Sequencing of Other Aircraft.* The elements rated lower are *Traffic Avoidance* and *Thunderstorm Buildups and Deviations.* These differences are all statistically very significant (p<0.01).

Element Ratings on Final Approach The combined importance of all PLI elements on Final Approach were rated very closely by all pilots regardless of flight experience. However, as can be seen in Figure 5, some specific elements are rated differently. The elements rated lower by the pilots with less flight experience are *Thunderstorm Buildups and Deviations, Visibility and Ceiling, Windshear* and *Aircraft on Landing Runway.* The elements rated

higher are *Icing Conditions, Winds Aloft, Surface Winds* and *Missed Approach Other Than for Weather.* These differences are all statistically very significant.
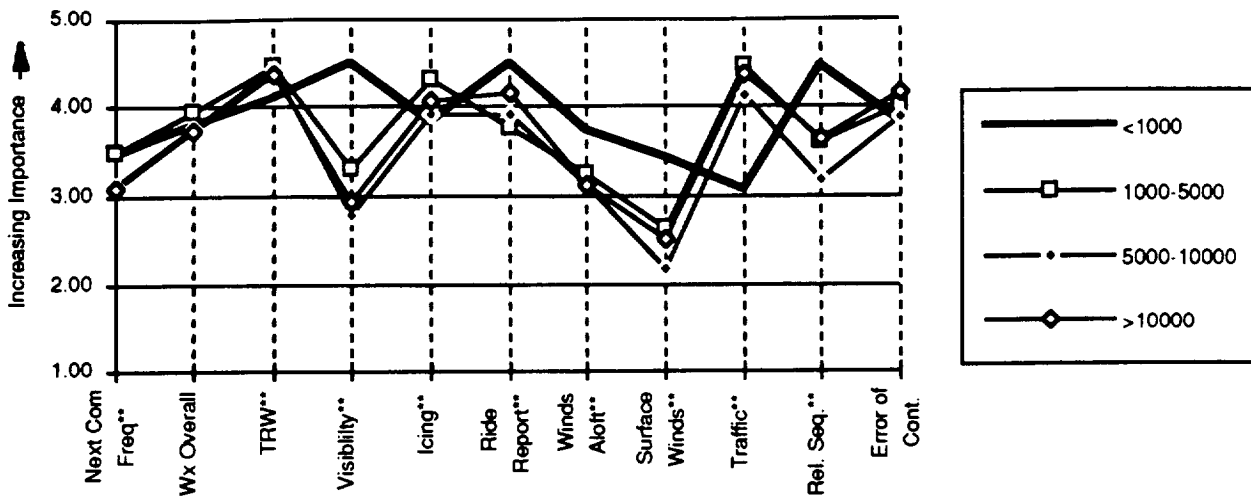

Figure 4. 'Party Line' Information Ratings in Cruise, for All Levels of Flight Experience
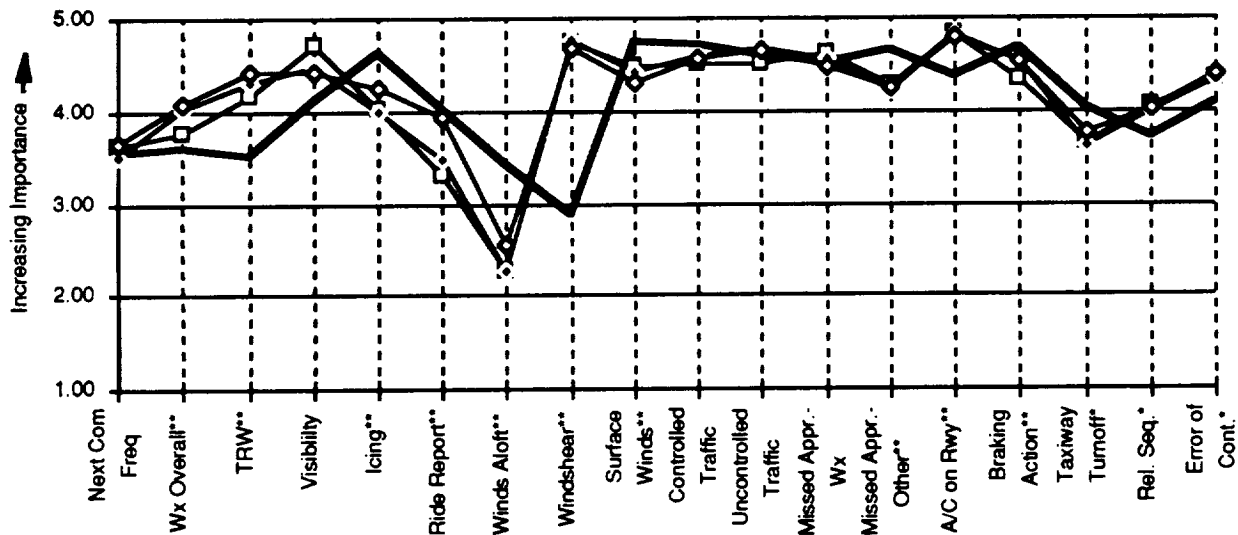*Very Significant Differences (p<0.01) are Marked with '**'*

Figure 5. 'Party Line' Information Ratings on Final Approach, for All Levels of Flight Experience
*Very Significant Differences (p<0.01) are Marked with '**'*

Information Requirements for Global Situation Awareness

The results of pilots' common responses to 'What does the "Big Picture" mean to you?' are shown in Figure 6. The most common response of all pilots, regardless of operational type, included 'Knowing the Position of Other Aircraft'. This need for knowledge of the 'traffic' situation was given by more than half of both the Military and General Aviation pilots. The next most common response was a knowledge of weather, followed by a need to be able to predict likely events and plan ahead, and a need for communication.

Pilot responses differed very significantly for the responses for both 'Weather Situation' and 'Communication'. The General Aviation pilots, in both cases, cited these items more often than other operational groups. Commuter airline pilots gave the least mention to 'Weather Situation' and major airline pilots gave the least mention to 'Communication'.
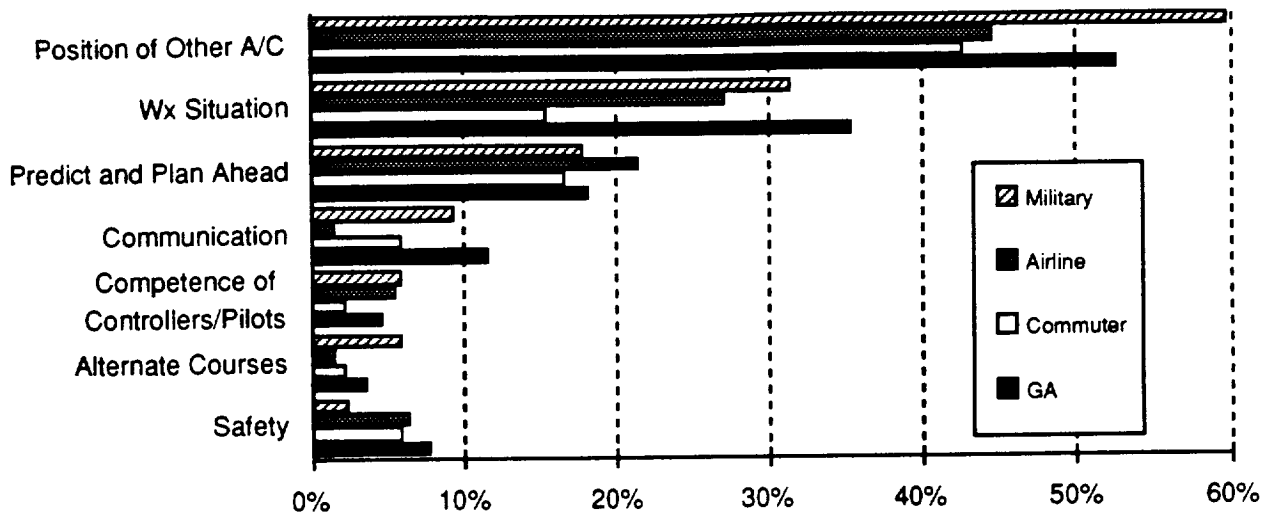
Figure 6. Free Responses to 'What Does the Big Picture Mean to You?'

DISCUSSION

Identification of PLI Elements and Phases of Flight Considered Important

Certain PLI elements have been identified as particularly important; for example, *Aircraft on Landing Runway* and *Windshear*. In addition, PLI has been identified as more important during the phases of flight in the terminal area and approach to landing. These results suggest care should be taken with datalink implementation to maintain the most important information elements which are currently obtained from PLI.

The Effect of Pilot Experience and Operational Type

The importance ratings given to specific elements, and to all elements within specific phases of flight, often ha [' highly significant variations between pilots based upon both flight experience and operational type. Many of these variations may be explained by the differences in flight operations between these groupings of pilots. For example, low-experience General Aviation pilots rarely fly long distances in high-level cruise. Because they are rarely out of contact with busy terminal area and center controllers, they value PLI in cruise more. These variations imply that datalink implementation must consider the information needs of all pilots. Consideration must be given both to compensating for PLI loss to datalink equipped aircraft, and for replacing the 'Party Line' effect on the voice communication frequencies lost by having a reduced proportion of aircraft using voice.

Information Requirements for Global Situation Awareness

Both the importance ratings of specific elements and the pilots' perception of the 'Big Picture' emphasize the need for accurate information describing the traffic and weather situations. Although the specific information elements rated the most important often varied between phases of flight, almost all of the elements rated the highest were related to traffic or weather. As a consequence, traffic and weather information should be given high priority in the development of 'Party Line' compensation strategies.

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