

REPORTING DISCREPANCIES: AN ASSESSMENT OF THE INFORMATIONAL NEEDS OF AIRLINE PILOTS AND MECHANICS

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Communication between airline pilots and mechanics is critical as the two share legal responsibility for the airworthiness of commercial aircraft. Federal Aviation Regulations require information about malfunctions and repairs to be recorded in the aircraft logbook. A survey was administered to pilots and mechanics at two U.S. airlines to assess the degree to which each group found logbook entries to be helpful. The primary goals were to identify problems with log entries and to determine how the level of information provided in the logbook impacts the accomplishment of tasks. Mechanics reported greater dissatisfaction with pilot entries than pilots reported with mechanic entries. Lack of detail emerged as a major problem with logbook entries, which appeared to have a more negative impact on mechanics' ability to accomplish tasks than on pilots' ability to accomplish tasks.

Introduction

The safety and legal airworthiness of commercial aircraft is a responsibility shared by airline pilots and mechanics. While both interact with the aircraft on a daily basis, they do so under different circumstances. This, coupled with differences in their respective training and certification requirements, allows each of these professionals to develop a unique understanding of the structures and systems onboard. In the event that one of those structures or systems fails, pilots and mechanics can each contribute information that aids in identifying and resolving the problem.

Failures or malfunctions of any item on an aircraft are formally called mechanical discrepancies and are required by Federal Aviation Regulations (FARs) to be recorded in the maintenance logbook. Any time a pilot encounters a problem on an aircraft, FAR 121.563 requires that he or she record that problem in the logbook. Whenever a pilot makes such an entry, a mechanic must take some action to address the reported problem. Once the problem has been addressed, FAR 121.701 requires the mechanic to make an entry describing how the problem was resolved. Finally, before taking the aircraft for its next flight, FAR 121.563 mandates that pilots check the logbook to verify that all items reported by previous flight crews have been addressed by a mechanic and that the aircraft is legally airworthy.

While the FARs mandate that logbook entries be made, they offer minimal guidance about what information they must contain. The detail a pilot includes about a discrepancy, for instance, is left to his or her discretion. This can lead to variation in the quantity and quality of information provided. Some pilots may provide a detailed description of a malfunction, while others may provide only a cursory notation. The airlines themselves typically offer pilots only broad guidelines about logbook content in their Flight Operating Manuals (FOM).

For mechanics, the FARs offer only slightly more guidance regarding the content of logbook entries. FAR 43.9, section 1, *Maintenance record entries*, mandates that in their signoff of a repair mechanics include the date the repair was completed, the name of the person performing the work, the signature, certificate number and certificate type of the person approving the work, and "a description (or reference to data acceptable to the Administrator) of work performed." This last item allows a mechanic the option of writing a narrative description of the repair performed or of citing the maintenance manual section(s) in which the repair procedure is detailed. While referencing the maintenance manual is legal, and serves the purpose of creating a record of work done to the aircraft, it does not always provide meaningful information to pilots, who typically do not have familiarity with or access to maintenance repair manuals. Yet pilots must determine whether or not the aircraft is airworthy.

Several studies have reported a degree of dissatisfaction among both pilots and mechanics with the information provided in the logbook. The Australian Bureau of Air Safety Investigations (BASI, 1999) surveyed regional airline mechanics in that country about the use of the aircraft logbook. When mechanics were asked how often the information provided by pilots in the logbook made it easier for them to identify what the problem on the aircraft was, 54% said it did so only "sometimes". This led the authors to conclude that "overall ... descriptions ... given by flight crews were not always adequate, making it difficult for maintenance staff to identify and rectify the defect" (BASI, 1999, p. 40). As there were no pilots included in the study, however, a comparison with their responses cannot be made.

Young, Mattson, and Petrin (1999) surveyed both pilots and mechanics about their use of the logbook. Nearly half (46%) of their respondents (pilots and mechanics) reported problems with logbook entries.

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The most commonly cited problems included entries lacking in detail and failures to make required entries at all. Additionally, Young et al. reported no significant differences between answers given by pilots and mechanics. Respondents to their survey came from all aviation domains (e.g., corporate, airline, military, regional, general aviation). While they compared responses between the two professions across domains, Young et al. made no analysis of differences between the two professions within individual domains.

The goal of the present study was to identify whether there were significant differences in the level of satisfaction with logbook entries between pilots and mechanics within a single domain -- major airlines in the U.S. Limiting the study to a single domain allowed for a comparison of responses from participants operating in similar environments and regulated by the same Federal Aviation Regulations. This study additionally examined the overall helpfulness of logbook entries, the level of information contained in entries, and the impact information provided in log entries had on each group's ability to accomplish necessary tasks.

Method

Participants

Participants were certificated pilots and line mechanics currently employed by two U.S. airlines who agreed to participate in this study.

Materials

Two versions of a questionnaire were developed for this study (one for each group). Both versions consisted of 33 items in booklet form. The structure of the surveys was identical for both groups, with a Demographics section followed by a Survey Questions section. While demographic items were tailored to elicit certification and experiential information specific to each group, survey questions were identical in content, with only minor semantic differences to tailor the questions to the appropriate audience (for example, asking pilots, "How helpful is a pilot's write-up to maintenance in troubleshooting and resolving a discrepancy?" while asking mechanics, "How helpful is a pilot's write-up to you in troubleshooting and resolving a discrepancy?"). Questions in the full survey were presented in a variety of formats, including Likert-type items, rank-order items, and yes/no items. Results reported here represent responses to a series of Likert-type items.

Procedure

Surveys were distributed to 400 line pilots and 400 line mechanics at several hub airports. Surveys were accompanied by an informed consent letter detailing the purpose of the study, outlining participants' rights, and assuring participants of the anonymity of

any information they might provide. Surveys were also accompanied by a postage-paid business-reply envelope which allowed respondents to mail completed surveys directly to the researcher at NASA Ames Research Center in Moffett Field, California.

Results

Of the 800 surveys distributed, 319 were completed and returned, for an overall 40% response rate. Return rate was slightly higher for pilots (43%, n=172) than mechanics (37%, n=147). Results for each employee group were collapsed across airlines as the present study was not designed to examine differences between airlines or corporate cultures. Rather, the use of multiple airlines served to increase sample size and to help mitigate the effects of any organization-specific influences.

Helpfulness of Log Entries

Respondents were asked to rate how helpful they believed their own logbook entries were to the other group and how helpful the other group's log entries were to them. Ratings were made using a 5-point Likert-type scale where 1= "not helpful" and 5= "very helpful", with a midpoint rating of 3= "somewhat helpful".

Pilot entries. The overwhelming majority of pilots believed the logbook write-ups they made were quite helpful to mechanics. Using the 5-point scale, three-fourths (76%) of pilots gave their own entries a rating of four or higher, with roughly half (49%) rating their own entries as "very helpful" (rating of 5) to mechanics. No pilot rated flight crew write-ups as "not helpful" to maintenance (see pilot ratings in Figure 1).

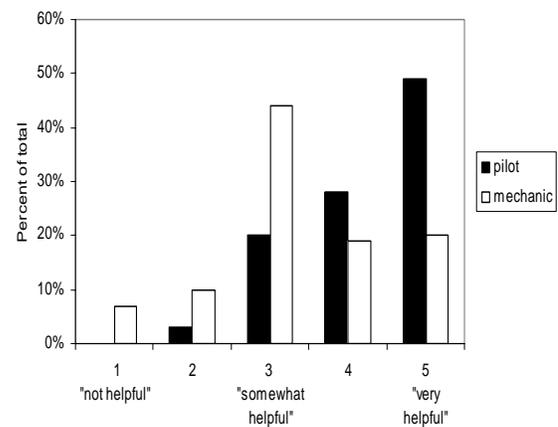


Figure 1: How helpful is a pilot's logbook entry to a mechanic in troubleshooting a discrepancy?

When mechanics were asked how helpful pilot log entries were to them in troubleshooting or repairing discrepancies, the largest percentage (44%) gave

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them a rating of 3 or “somewhat helpful”. Only 20% of mechanics rated pilot write-ups as “very helpful”, while 7% of mechanics felt that pilot entries were “not helpful” at all (rating of 1) to them in their troubleshooting efforts. Overall, mechanics found pilot entries to be significantly less helpful in troubleshooting discrepancies than pilots believed them to be (pilot mean= 4.23, mechanic mean=3.36, $t(317)=7.86$, $p < .001$, see Figure 1).

Mechanic entries. In a similar question, mechanics were asked to rate how helpful they believed their logbook entries were to pilots attempting to determine the airworthiness of an aircraft. Overall, mechanics were notably less confident that the information they provided was helpful to flight crews. Just 33% of mechanics felt their entries were “very helpful” (rating of 5) to pilots, while 30% felt they were fairly helpful (rating of 4). In contrast to pilots, nearly 15% of mechanics felt their signoffs were of little or no helpfulness (rating of 2 or lower) to the other group (see mechanic ratings in Figure 2).

Yet when pilots were asked to rate how helpful maintenance entries were to them in determining the current airworthiness of an aircraft, 77% gave them a rating of 4 or higher on the 5-point scale. Forty-two percent of pilots in fact gave mechanic signoffs the highest rating of 5 (“very helpful”). No pilot rated maintenance entries as “not helpful” at all. Thus the degree to which pilots found maintenance signoffs helpful was significantly higher than mechanics themselves believed them to be: pilot mean=4.13, mechanic mean=3.76, $t(317)=3.13$, $p < .01$ (see Figure 2.)

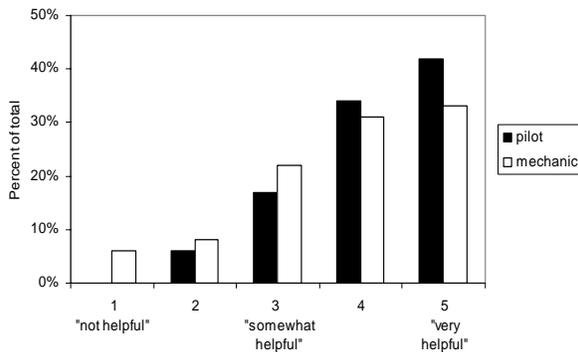


Figure 2: How helpful is the mechanic's signoff to pilots in determining airworthiness of an aircraft?

Level of Information

Pilots and mechanics were asked to rate how frequently they read each other's logbook entries and wanted more information than was provided. Ratings were made on a 5-point Likert-type scale (1= never, 3= sometimes, 5= always).

Pilots. When asked how often they read a logbook entry by a mechanic and wanted more information about a repair than had been given, 76% of pilots gave a rating of 3 or lower, indicating they did so half the time or less. Of these, 21% indicated they rarely (rating of 2) read a mechanic's signoff and wanted more information.

Mechanics. In contrast, when asked how often they read a write-up of a discrepancy by a pilot and wanted more information, 97% of mechanics responded with a rating of 3 or higher indicating they did so at least half the time or more. Of these, 20% stated they “always” read a pilot entry and wanted more information (rating of 5).

Results indicated mechanics read pilot entries and wanted more information significantly more often than pilots read mechanic entries and wanted more information (means 3.03 vs. 3.71, $t(316)=-7.61$, $p < .001$ (see Figure 3).

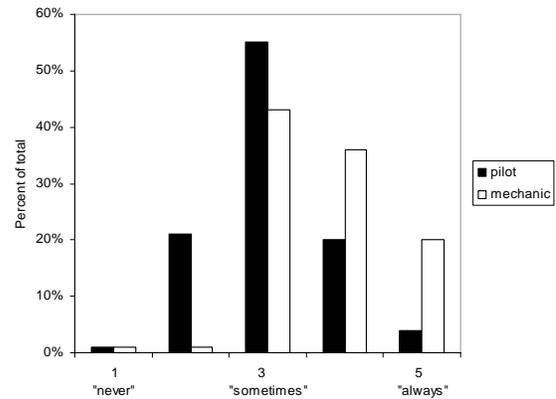


Figure 3. How often do pilots and mechanics read each other's log entries and want more information?

The desire for more information suggests a possible lack of detail in many current entries. To explore this, both groups were queried about the frequency of entries in which minimal detail about a problem or fix was provided. Again a 5-point scale was utilized (1= never, 3= sometimes, 5= always).

Pilot entries. Respondents were first asked to rate the frequency of “inop” write-ups-- pilot logbook entries in which a component or system is described simply as “inop” (short for “inoperative”) with no further detail (for example, “#1 VOR inop”). Using the 5-point scale, 91% of mechanics endorsed a rating of 3 (“sometimes”) or higher, suggesting they received such write-ups from pilots at least half the time or more. Forty percent of mechanics indicated they often or frequently (a rating of 4) received “inop” write-ups.

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In marked contrast, when pilots were asked how often they wrote up items as “inop” with no additional detail, 97% endorsed a rating of 3 or lower, indicating they made such entries half the time or less. Of these, one-third (33%) stated they “never” made such entries, roughly another third (30%) indicated they rarely did so (a rating of 2) while a final third (34%) reported they “sometimes” made such entries.

The difference between how often mechanics reported receiving “inop” write-ups from pilots and how often pilots reported making “inop” write-ups was statistically significant: pilot mean=2.07, mechanic mean= 3.40, $t(316) = -13.9, p < .001$. This difference is dramatically illustrated in Figure 4.

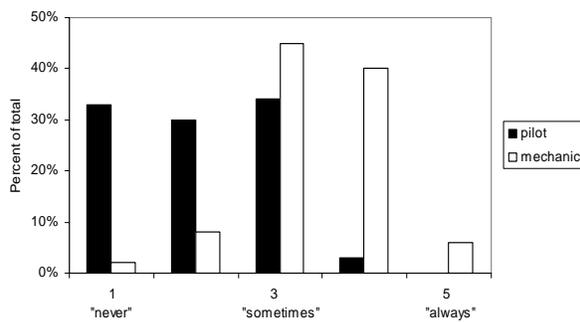


Figure 4. How often do pilots write-up items as “inop” with no additional detail?

Mechanic entries. Crews were also asked about minimal maintenance signoffs—entries in which a mechanic provides no detail about a fix beyond listing the Maintenance Manual section in which the repair procedure may be found (e.g., “repaired in accordance with MM 25-12-32”). The majority (81%) of pilots gave a rating of 3 (“sometimes”) or lower, suggesting mechanics provided more information about a repair than just the Maintenance Manual reference half the time or less. Indeed, 43% said mechanics rarely or never did so (rating of 2 or less).

When mechanics were asked how often they gave more information than just the Maintenance Manual reference, however, three-fourths (76%) reported that they did so half the time or more (a rating of 3 or higher). Thirteen percent in fact stated they “always” (rating of 5) gave more information.

Differences between groups were significant: pilot mean=2.66, mechanic mean= 3.10, $t(315) = -3.97, p < .001$, with mechanics stating they provided detail beyond just the Maintenance Manual reference significantly more often than pilots reported that they did (see Figure 5).

Mechanical discrepancies can re-occur, and pilots may experience difficulty with an item previously written up by other flight crews and repaired by maintenance. In such instances, pilots might attempt to provide new details about the problem not provided in previous pilot entries, or they might simply refer maintenance back to the previous write-up(s).

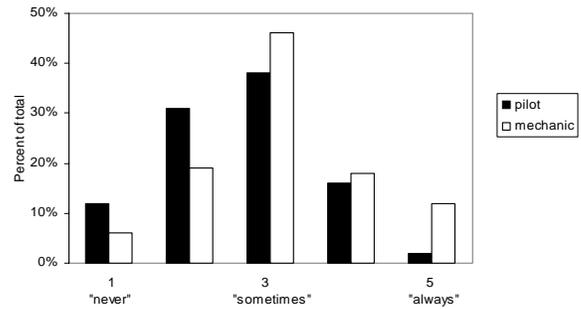


Figure 5: How often do mechanics provide more than just the maintenance manual reference?

Pilots were asked to rate, on a 5 point scale (1= never, 3=sometimes, 5=always) how often they provided new information in their entry of a repeat problem. The vast majority (93%) of pilots stated they did so at least half the time or more (rating of 3 or higher), with the largest share (40%) giving a rating of 4, suggesting they frequently did so.

When mechanics were asked to rate how often they received additional information from pilots, the majority (86%) indicated they did so half the time or less (rating of 3 or lower). The largest percentage (54%) gave a rating of 3 or “sometimes”.

The difference between pilot and mechanic ratings was significant: pilot mean= 3.69, mechanic mean= 2.82, $t(317) = 8.95, p < .001$, with pilots reporting that they gave new information when writing up a recurring discrepancy significantly more often than mechanics reported they did (see Figure 6).

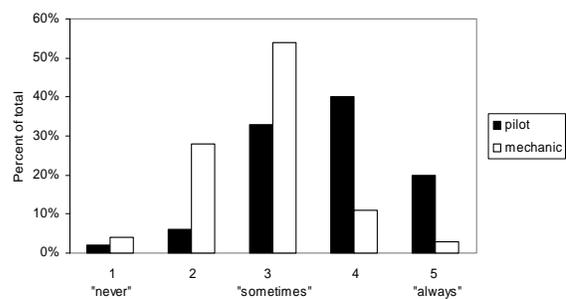


Figure 6. How often do pilots provide new information when writing up a repeat discrepancy?

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Impact of entries

Both groups were asked to rate the degree to which a log entry containing little or no detail impacted their ability to accomplish their respective tasks.

Pilots. Pilots were asked to rate, on a 5-point scale (1= not at all, 3= somewhat, 5= completely), the degree to which a maintenance signoff with minimal or no detail about a fix impacted their ability to determine the airworthiness of an aircraft. Just over a third (35%) of pilots said it “somewhat” impacted them (rating of 3), while another third (33%) said it considerably impacted their ability (rating of 4). However, 21% of pilots indicated such signoffs minimally (rating of 2) impacted their ability to determine airworthiness (see Figure 7).

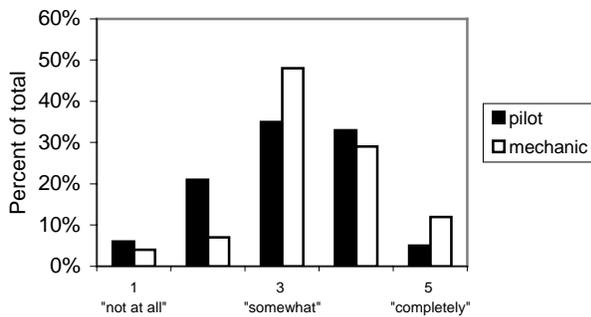


Figure 7. How much does the information provided in logbook impact the ability to accomplish tasks?

Mechanics. When mechanics were asked to rate the degree to which a pilot write-up containing little or no detail impacted their ability to troubleshoot or repair a discrepancy, nearly half (48%) said it did “somewhat” (rating of 3). Another 29% said it considerably impacted them (rating of 4) while 12% of mechanics said a poor pilot write-up “completely” impacted their ability to troubleshoot. Differences between the two groups were significant: pilot mean= 3.09, mechanic mean= 3.37, $t(316) = -2.58$, $p = .01$, with mechanics reporting being more impacted by minimal log entries than pilots (see Figure 7).

More specifically, how might the information provided in the logbook impact the amount of time each professional actually spends accomplishing his/her respective tasks?

Pilots. Pilots were asked to indicate the degree to which the information provided in maintenance signoffs influenced the time they spent conducting their pre-flight inspection of an aircraft. While 41% indicated that this information “somewhat” (rating of 3) influenced the time they spent, one-third of pilots (33%) indicated information contained in a mechanic

entry had little or no influence (rating of 2 or less) on the time they spent pre-flighting an aircraft.

Mechanics. In a similar question, mechanics were asked to rate the degree to which the information provided in entries by pilots influenced the time they spent troubleshooting a problem. The largest percentage of mechanics (44%) indicated this information “somewhat” (rating of 3) influenced the time they spent. Another 31% indicated such information considerably (rating of 4) influenced time they spent troubleshooting. The difference between groups was significant: pilot mean= 2.85, mechanic mean= 3.24, $t(316) = -3.53$, $p < .001$, suggesting that a lack of detail in logbook entries had significantly more impact on the time mechanics spent on key job tasks than on the time spent by pilots (see Figure 8).

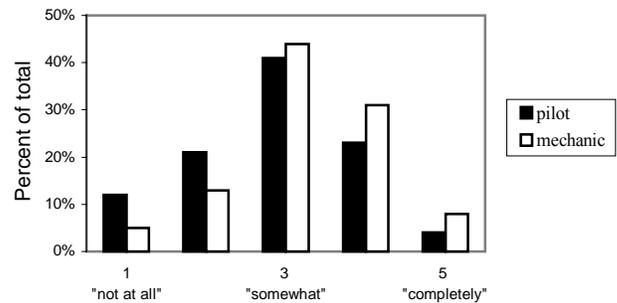


Figure 8. How much does the level of detail provided in logbook impact time spent on key tasks?

Discussion

Pilots and mechanics gave significantly different ratings to three aspects of logbook entries. These were the overall helpfulness of logbook entries, the level of information currently provided in the logbook, and the degree to which they each felt a lack of information in the logbook impacted their ability to do their respective jobs.

The finding that there was a degree of dissatisfaction with logbook entries among both pilots and mechanics was consistent with the findings of Young et al. (1999) and BASI (1999). The present study further found that, within the airline domain, there was a significant difference in the level of dissatisfaction reported by each group. Airline mechanics were significantly less satisfied with logbook entries made by pilots than airline pilots were with log entries by mechanics.

As in the BASI (1999) study, mechanics in the present study rated pilot write-ups as only “somewhat” helpful to them in their efforts to identify and repair a discrepancy. The present study sought to identify *why* pilot entries were rated as less helpful than they might be. The main reason for

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mechanics' dissatisfaction with pilot entries appeared to be a lack of meaningful detail or, in some cases, a lack of any detail at all, about the problem involved (i.e., a component described simply as "inop"). This result replicates and expands the findings of Young et al., and suggests that the most common problems with logbook entries are consistent across aviation domains.

The majority of mechanics in the present study indicated that a lack of information in pilot entries was more the norm than the exception. (It should be noted that the majority of pilots disagreed with this assessment). Nearly all mechanics (97%) reported wanting more information from pilot entries at least half the time.

Interestingly, while the majority of pilots reported that they frequently received logbook entries from mechanics containing minimal detail (i.e., providing only a reference to the Maintenance Manual section where a repair procedure could be found), the pilots consistently rated mechanics' entries as helpful to them in determining the airworthiness of an aircraft. Furthermore, the majority of pilots stated that they typically did not want more information from mechanics' entries than they presently received. This would seem to indicate that the level of detail pilots seek from mechanic entries differs significantly from the level of detail mechanics seek from pilot entries.

This may be due to the fact that, in the strictest legal sense, the most important piece of information a pilot needs to see in a logbook entry is the signature of a mechanic. By signing his/her name in the logbook (along with his FAA certificate number and the date) a mechanic certifies that an aircraft can be returned to service. The pilot's main legal responsibility is to ensure that all open discrepancies have been addressed by maintenance, making the aircraft airworthy. A mechanic's signature in the logbook affirms this. In essence, reading the logbook is a verification process for a pilot. S/he verifies that all pilot write-ups have been signed off by maintenance. If they have, the pilot can continue on to other pre-flight tasks.

Mechanics also read the logbook initially for verification—to verify whether or not there are any new pilot entries. If there are, however, the mechanic must then take further action to resolve the problem. The information provided by the pilot thus serves as the first step in a lengthier process of identifying, troubleshooting, and resolving a discrepancy. Salient detail from a pilot can often facilitate the process of isolating the problem, determining what systems are involved, and choosing the correct solution. A lack of detail can make it harder for a mechanic to identify and repair a discrepancy and can thereby increase the time s/he spends troubleshooting.

Conclusion

These findings suggest that pilots and mechanics use the aircraft logbook in meaningfully different ways. How each crew uses the logbook subsequently influences the amount of detail they seek from log entries. The specific kinds of detail each group seeks from the logbook and the factors that influence the amount of detail included in logbook entries are topics that will be addressed in future papers.

Acknowledgements

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References

Bureau of Air Safety Investigation (1999). Regional airline safety study: Project report. Canberra, Australian Capital Territory: Author.

Federal Aviation Administration (2002). Federal aviation regulations. Washington, D.C.: Author.

Young, J., Mattson, M., & Petrin, D. (1999). Integrating the aviation system toward safety: Implications of interdepartmental human factors training for pilots and maintenance technicians. Proceedings of the 10th Annual Symposium in Aviation Psychology, 1060-1065.