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ANALYSIS OF DATA OBTAINED THROUGH A SPECIALIST
OPINION SURVEY CONDUCTED AT THE
LEESBURG FLIGHT SERVICE STATION

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by

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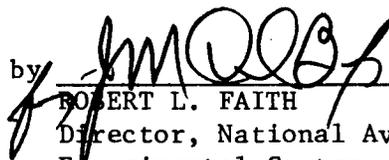
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ABSTRACT

A specialist opinion survey was taken December 1977 at the Leesburg FSS following the institution of automation, collocation at the ARTCC, and consolidation with the Richmond and Charlottesville FSS's. This report presents a statistical analysis and an interpretation of the results of this survey. The survey was intended to assess the effect the changes had on the specialists' responses to the 29 different aspects on which questions were asked.

Two groups of specialists with differing opinions were found. The group of specialists originally from DCA displayed a favorable attitude toward all three categories of change: automation, collocation, and consolidation. The group originally from facilities other than DCA had a neutral attitude toward automation and an unfavorable attitude toward consolidation and collocation. The neutral attitude toward automation can be separated into a favorable attitude toward outward-directed, operational aspects; e.g., "Overall ability to give an adequate briefing" increased, and an unfavorable attitude toward inward-directed, feeling aspects; e.g., "Amount of frustration" increased.

The less favorable attitude of the specialists from facilities other than DCA may be due to a combination of factors such as; problems associated with moving a household, being a newcomer in an established facility, the transfer to a larger facility, the effort required to learn the automated operation, and their shorter length of exposure to MAPS. It is likely that this less favorable attitude reflects a transient negativism which will decrease with time. Another survey conducted, say, 9 months after the original survey would provide a test of this hypothesis.

There was very close agreement in the responses of DCA and ATL specialists to the aspects referring to automation. This agreement lends credence to the assertion that the FSS Specialist Opinion Survey, as used here, is a valuable instrument for illuminating specific areas of the specialist's interaction with an automated system.

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1. BACKGROUND

In 1976, the Washington (DCA) Flight Service Station (FSS) was relocated to Leesburg, Va. Changes were made in the operation of the FSS which can be conveniently separated into three categories:

1. A switch from the manual to the automated mode of operation using the Meteorological Aeronautical Presentation System (MAPS).
2. Collocation of the new FSS in the same physical plant with the Washington Air Route Traffic Control Center (ARTCC) at Leesburg, and
3. Closing and consolidation of the Richmond, Va., (RIC) and the Charlottesville, Va., (CHO) FSS's with the DCA (henceforth, Leesburg) FSS.

These three categories of change are henceforth spoken of as "automation," "collocation," and "consolidation." NAFEC was assigned the task of evaluating these changes by the FAA Systems Research and Development Service (SRDS), ARD-404.

Under NAFEC Program Document (NPD) 13-265, Project 131-402-234, a specialist task activity analysis was performed before and after installation of MAPS. The results of this study, Reference 1, were distributed as a NAFEC data report. Under NPD 13-251, Project 131-402-254, overall operational effectiveness of the three component FSS's prior to consolidation was studied, and a comparable study following consolidation is scheduled for spring 1978. The before-consolidation study, Reference 2, was published as a NAFEC technical letter report. Both of the above studies addressed objective measures of FSS operation. It was felt that subjective data on the ways in which the FSS specialists, themselves, perceived the changes would provide a valuable complement to the objective data. This report documents the collection and analysis of subjective data by means of an FSS specialist opinion survey administered to specialists at the Leesburg FSS.

2. METHOD

A. DATA COLLECTION. Data were collected during the last week in November and the first week in December 1977 at the Leesburg FSS. A total of 33 survey forms were completed. Figures 1 and 2 show the two-page FSS Specialist Opinion Survey form used in this study. The top portion of the first page of the survey asks for background information on the specialist. It was felt that this information might provide bases for grouping the specialists during the data analysis. The 16 items within Part 1 (a. through p.) on the first page are intended to evoke a comparison between the present automated system and the previous manual system. Specifically, the items ask for a judgment as to whether a particular aspect decreased, remained the same, or increased following the change from manual to automated operation. This first page (Figure 1) was also used as part of a survey conducted at the Atlanta, Ga. (ATL) Aviation Weather and Notices To Airmen (NOTAM) System (AWANS) installation, July 1976.

FSS SPECIALIST OPINION SURVEY

Now that you have had some exposure to automation, we would like you to answer the following questions on the basis of your experience to date. Please give us your current opinions, not what you think we want to hear.

NAME (OPTIONAL): _____ DATE: _____

FORMER LOCATION: RIC ___ CHO ___ DCA ___ OTHER _____

NUMBER OF WEEKS AUTOMATION EXPERIENCE: _____

POSITION/S WORKED: _____ SHIFT/S WORKED: _____

1. Using your experience with both the manual and the automated systems, compare the two approaches on the basis of the following aspects. Check the most appropriate block for each aspect. Try to answer every item.

	Aspect on which comparison is to be made	Compared to manual procedures, use of automation involves what changes, if any:				
		A Large Decrease	A Decrease	No Change	An Increase	A Large Increase
a.	Time required to give briefing					
b.	Job satisfaction					
c.	Work involved in data access					
d.	Utilization by private pilots					
e.	Overall ability to give an adequate briefing					
f.	Thoroughness of briefing					
g.	Work involved in taking flight plans					
h.	Speed of finding needed data					
i.	Likelihood of making an error					
j.	Amount of eyestrain					
k.	Ease of answering pilot queries					
l.	Utilization by corporate/military pilots					
m.	Amount of frustration					
n.	Confidence in system					
o.	Feeling of personal competence					
p.	Work involved in giving briefing					

FIGURE 1. FSS SPECIALIST OPINION SURVEY, PART 1, RELATING TO AUTOMATION

2. Using your experience with both a single manual facility and a consolidated automated facility, compare each for the following aspects. Check the most appropriate block for each aspect. Try to answer every item.

Aspect on which comparison is to be made	Compared to former facility, Leesburg involves what changes, if any:				
	A Large Decrease	A Decrease	No Change	An Increase	A Large Increase
a. General level of activity					
b. Job interest					
c. Geographical knowledge required					
d. Level of responsibility					
e. Variety of work-related tasks					
f. Personal/family problems					
g. Pilot satisfaction with quality of service					
h. Acceptability of working conditions					
i. Personal comfort					
j. Pilot satisfaction with specialist availability					
k. Availability of personnel-related facilities, e.g., medical, cafeteria					
l. Flexibility in annual leave arrangements					

3. Do you feel that there are operational advantages associated with being collocated with the ARTCC?
 YES _____ NO _____ MAYBE _____ UNKNOWN _____

FIGURE 2. FSS SPECIALIST OPINION SURVEY, PARTS 2 AND 3, RELATING TO CONSOLIDATION AND COLLOCATION

The 12 items within Part 2 (a. through l.), presented in Figure 2, are intended to evoke a comparison between the present Leesburg FSS and the specialist's former facility. These questions address the issues of consolidation and collocation. The format of Part 2 and the method of answering the items are the same as those for Part 1. Part 3, a single item, asks whether or not the specialist feels that there are operational advantages in being collocated with an ARTCC. The question directly addresses an issue which is, perhaps, the most controversial of the three categories of change in the FSS operation at Leesburg.

B. DATA ANALYSIS. Background information of the specialists was examined to determine whether there were any natural subgroupings which might manifest different points of view relative to the survey. It was deemed likely that the location at which a specialist worked prior to coming to Leesburg might influence his response to the items in the survey. In particular, it was expected that those specialists from the Richmond and the Charlottesville FSS's (which were closed and consolidated with the Leesburg FSS) might harbor some resentment at this uprooting and that this attitude might appear in their responses to the survey. Unfortunately, there were less than five survey forms completed by specialists from these two facilities. No meaningful analysis could be performed on such a small sample. Sixteen of the forms were completed by specialists whose previous location was the Washington FSS. This was a large enough sample for statistical treatment. So, for the analysis, the entire group of 33 respondents was split into two groups: "DCA," consisting of 16 specialists formerly at DCA, and "OTHER," consisting of 17 specialists formerly at flight service stations other than DCA. Most of this latter group had, presumably, transferred to Leesburg FSS at their own option. Thus, three sets of Leesburg data, DCA, OTHER, and both combined as "ENTIRE," were subjected to analysis. In addition to these data from Leesburg, results for Part 1 from the AWANS operation at the Atlanta FSS are included as a basis for comparison. Such a comparison provides a valuable check on the reliability of the survey. For purposes of this report, this latter data set is referred to as "AWANS."

In a survey of this sort in which a comparison with a prior set of conditions; e.g., manual FSS operation, is requested, the individual's memory of the anchoring point or baseline reference fades with time. Thus, it is likely that the responses of the specialists will, with the passage of time, reflect less of a true comparison with the preceding set of conditions and become more an absolute rather than a relative judgment. Also, it was expected that real changes in opinion would occur with increasing experience. In particular, the need to learn new modes of responding tends to generate a resistance to the change, and thus, attitudes can, at the outset, become biased in a negative direction. With the development of proficiency in use of the new system, this negative bias tends to dissipate. As a case in point, four successive AWANS surveys showed that the opinions of the specialist became increasingly more favorable over a period of a year. The mean experience for each of the four data sets was, therefore, considered to be an important independent variable. This and the number of specialists in each set are shown on the following page.

FSS LOCATION	DATA SET	MEAN EXPERIENCE (WEEKS)	NUMBER OF RESPONDENTS
LEESBURG, VA (MAPS)	DCA	90	16
	OTHER	46	17
	ENTIRE	67	33
ATLANTA, GA (PART 1 ONLY)	AWANS	48	20

The data set from Atlanta was the last and most favorable survey taken at that facility. It is also the closest to the Leesburg survey in terms of mean experience. It should, therefore, provide a reasonable basis for comparison with the Leesburg results.

To accomplish the statistical analysis, the following integer numerical values were assigned to the five choices in Parts 1 and 2 of the survey:

- 1 = a large decrease
- 2 = a decrease
- 3 = no change
- 4 = an increase
- 5 = a large increase.

The number of responses within each choice category was weighted by the value of that category and combined using a programmable calculator and standard statistical formulae.

A mean and standard error of the mean were computed for each of the aspects within each of the data sets. Student's t tests were performed to determine the statistical significance of the deviation of the mean response from the center of the scale (3 = no change). For those aspects whose means were significantly above 3.0, the consensus of the specialists was that an increase occurred in that aspect due to the new conditions. If the mean fell significantly below 3.0, a decrease in that aspect was noted. Unless otherwise indicated, a confidence level of alpha equal to or less than .05 was used to determine significance of the t score. Since there was no a priori reason to expect deviations from the mean in only a single direction, two-tailed t tests were used for all the items in Parts 1 and 2.

The questions were phrased so that the expected answers would include a balance of "increase" and "decrease" responses to encourage a careful reading of the items and to discourage stereotyped answering. In Part 1, items a, c, g, i, m,

and p are "negatively phrased." This means that an increase in these aspects would, most likely, be an unfavorable finding; i.e., would be detrimental to the performance of the job. The remaining nine items are positively phrased, and an increase would be a favorable finding. For example, favorable findings would be indicated by an increase in "Thoroughness of briefing" and also by a decrease in "Work involved in data access."

In addition to the t tests for determining which aspects were perceived as changing significantly within each of the data sets, statistical comparisons were made between the data sets. For Part 1 of the survey, the following comparisons were made: DCA vs. OTHER, DCA vs. AWANS, OTHER vs. AWANS, and ENTIRE vs. AWANS. For Part 2, only the DCA vs. OTHER comparison was performed. These comparisons were done for each of the separate aspects within the data sets. The standard formulae for t tests of differences between two means were used. The comparisons of the two groups of specialists at Leesburg (DCA and OTHER) may show whether both groups hold similar points of view on whether they differ substantially. The comparison between the responses for Leesburg and Atlanta may show differences arising from functional differences between the MAPS and AWANS modes of operation and from differences between the specialists at the two facilities.

For Part 3, (last item in Figure 2), the specialists' responses were tallied and subjected to a nonparametric data analysis to determine whether or not there existed a significant consensus. Only the number of definite "yes" or "no" responses were used for the analysis. The "maybe," "unknown," and missing responses (a total of five responses out of 33 surveys) were not considered. The three data sets from Leesburg were analyzed using the binomial sign test. In this test, the number of "yes" and "no" responses are considered analogous to the number of heads and tails occurring during a given number of tosses of a fair coin, p (heads) = .5. The results indicate the probability of a given excess of, say, heads occurring, given an initial 50-50 chance of each toss coming up heads or tails.

In the present case, the assumption is that the respondents are equally likely to answer "yes" or "no" to Part 3. The number of respondents in each data set corresponds to the number of coin tosses. If there is a sufficient excess of one answer over the other (corresponding to a probability of .20 or one chance in five), then the difference is considered to indicate a significant consensus among the specialists in that data set. Since the data from Parts 1 and 2 indicated the existence of opposite biases (positive for DCA and negative for OTHER), one-tail probabilities were used to determine significance. The large sample sign test Z score was computed using a formula corrected for continuity, see page 40 in Reference 3. With a limited sample and a desire to detect differences if they do exist, confidence intervals were reduced from the standard level corresponding to an $\alpha = .05$ to that of $\alpha = .20$. With a sample of 12 respondents, this corresponds to a majority of 2 to 1; e.g., 8 heads to 4 tails. These values generally reflect what would be a reasonable subjective or intuitive judgment of a notable consensus among the responding specialists.

A Yates-corrected chi square value was computed to determine whether there was a significant difference between the response proportions for DCA and OTHER. The results indicate whether or not there is a significant difference in viewpoint between the two groups of specialists regarding operational advantages of collocation. An alpha level of .20 was used as the criterion for significance. Since the data were cast in a 2 x 2 table, there was one degree of freedom.

3. RESULTS

Table 1 presents the response tallies for Part 1 of the survey. The five columns within each of the three headings correspond to the five possible choices or answers on the original form. The three major column headings, from left to right, correspond to the three Leesburg data sets, "DCA" with 16 respondents, "OTHER" with 17 respondents, and "ENTIRE" with 33, which is the sum of the preceding two. In cases in which not all of the specialists responded to a given aspect, the sum of the tallies for that aspect across the five choice categories will fall short of the number of respondents as listed above. Response tallies for Part 2 of the survey are presented in a similar manner in Table 2. These data are included to enable the reader to examine the actual distributions of responses across the choice categories. Such information is often a useful supplement to aid interpretation of the results of the analyses. Original tallies were not available for the AWANS data set.

Table 3 shows the results of t tests performed on the four data sets to determine the presence of any consensus among the specialists in each set. In the interest of brevity, only the significant perceived changes are noted. The actual means, standard errors, and t scores are not presented but will be kept on file at NAFEC. Under the first major column heading, CHANGE, the consensus regarding perceived increases (IN) or decreases (DE) in each aspect is presented for each of the data sets. Under the second major column heading VALUE OF CHANGE, a plus indicates that the writer interpreted these changes as favorable, and a minus indicates that these changes appear to be unfavorable. Under the third major column heading, RELATIVE RANK OF CHANGE MAGNITUDE, the ranks of the size of the perceived change for each aspect within each of the data sets are presented. The largest change was given a rank of 1, the second largest change a rank of 2, and so on to the least change, which had a rank of 16. In general, the more significant the change was, the smaller the numerical value of the rank was.

Here is an example. In Table 3, "Job satisfaction" (row b.) was seen by specialists for DCA as having increased on going from manual to automated operation. This was interpreted as being a favorable change. The DCA specialists saw this as being the fifth most important change. Specialists in the OTHER column saw this aspect as not changing on going from manual to automated operation. They saw "Job satisfaction" as the 15th most important aspect. The rest of Table 3 should be interpreted in the same manner as above.

TABLE 1. RESPONSE TALLIES FOR FSS SPECIALIST SURVEY, PART 1, RELATING TO AUTOMATION: LEESBURG RESULTS GROUPED ACCORDING TO PRIOR FSS LOCATION OF THE SPECIALIST ("DCA", "OTHER", AND BOTH COMBINED AS "ENTIRE")

ASPECT ON WHICH COMPARISON MADE Automated vs. manual facility		RESPONSES FROM SPEC'S FORMERLY AT DCA					RESPONSES FROM SPEC'S FORMERLY AT OTHER FSS'S					RESPONSES FROM THE ENTIRE LEESBURG FSS				
		LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR	LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR	LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR
a.	Time required to give briefing	2	5	6	2	1	2	5	5	4	1	4	10	11	6	2
b.	Job satisfaction	1	0	3	7	5	2	5	1	7	2	3	5	4	14	7
c.	Work involved in data access	3	9	0	3	1	2	5	3	5	2	5	14	3	8	3
d.	Utilization by private pilots	0	2	3	7	3	1	2	9	4	1	1	4	12	11	4
e.	Overall ability to give an adequate briefing	0	0	2	4	10	1	2	2	8	4	1	2	4	12	14
f.	Thoroughness of briefing	0	0	5	2	9	0	3	3	7	4	0	3	8	9	13
g.	Work involved in taking flight plans	0	2	10	3	1	0	2	12	2	1	0	4	22	5	2
h.	Speed of finding needed data	1	0	2	11	2	3	3	1	7	3	4	3	3	18	5
i.	Likelihood of making an error	3	5	3	4	0	3	2	9	2	1	6	7	12	6	1
j.	Amount of eyestrain	0	3	4	8	1	0	0	5	9	3	0	3	9	17	4
k.	Ease of answering pilot queries	1	0	3	9	3	1	3	6	5	2	2	3	9	14	5
l.	Utilization by corporate/ military pilots	1	1	6	5	2	1	2	8	4	2	2	3	14	9	4
m.	Amount of frustration	2	8	2	3	1	2	2	3	7	3	4	10	5	10	4
n.	Confidence in system	1	0	2	6	7	2	5	2	3	5	3	5	4	9	12
o.	Feeling of personal competence	0	0	3	7	6	2	2	6	4	3	2	2	9	11	9
p.	Work involved in giving briefing	4	6	3	1	1	2	7	2	4	2	6	13	5	5	3

TABLE 2. RESPONSE TALLIES FOR FSS SPECIALIST SURVEY, PART 2, RELATING TO CONSOLIDATION AND COLLOCATION: LEESBURG RESULTS GROUPED BY PRIOR FSS LOCATION OF THE SPECIALIST ("DCA", "OTHER", AND BOTH COMBINED AS "ENTIRE")

ASPECT ON WHICH COMPARISON MADE Present compared to prior FSS	RESPONSES FROM SPEC'S FORMERLY AT <u>DCA</u>					RESPONSES FROM SPEC'S FORMERLY AT <u>OTHER FSS'S</u>					RESPONSES FROM THE <u>ENTIRE LEESBURG FSS</u>				
	LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR	LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR	LRGE DECR	DECR	NO CHNG	INCR	LRGE INCR
a. General level of activity	0	1	0	7	7	0	2	1	6	8	0	3	1	13	15
b. Job interest	1	0	3	5	7	3	2	4	6	2	4	2	7	11	9
c. Geographical knowledge required	0	0	0	1	14	1	1	2	3	10	1	1	2	4	24
d. Level of responsibility	0	0	1	3	12	1	6	4	2	4	1	6	5	5	16
e. Variety of work-related tasks	0	1	4	10	1	1	4	5	6	1	1	5	9	16	2
f. Personal/family problems	1	1	9	2	1	0	0	9	3	5	1	1	18	5	6
g. Pilot satisfaction with quality of service	0	3	3	3	7	3	5	2	2	3	3	2	5	5	10
h. Acceptability of working conditions	1	1	2	7	5	3	4	2	7	1	4	5	4	14	6
i. Personal comfort	1	1	3	4	7	4	2	2	6	3	5	3	5	10	10
j. Pilot satisfaction with specialist availability	0	7	4	4	1	7	5	2	1	1	7	12	6	5	2
k. Availability of personnel- related facilities	0	0	5	4	6	0	3	2	6	6	0	3	7	10	12
l. Flexibility in annual leave arrangements	1	0	8	5	2	1	4	7	5	0	2	4	15	10	2

TABLE 3. RESULTS FOR FSS SPECIALIST SURVEY, PART 1, RELATING TO AUTOMATION: SIGNIFICANT DEVIATIONS FROM "NO CHANGE" AND RANKINGS

ASPECT ON WHICH COMPARISON WAS MADE Automated compared to manual facility	CHANGE ¹				VALUE OF CHANGE ²				RELATIVE RANK OF CHANGE MAGNITUDE			
	LEESBURG			ATL	LEESBURG			ATL	LEESBURG			ATLANTA
	DCA	OTHER	ENTIRE	AWANS	DCA	OTHER	ENTIRE	AWANS	DCA	OTHER	ENTIRE	AWANS
a. Time required to give briefing	0	0	0	DE	0	0	0	+	15	11	14	8
b. Job satisfaction	IN	0	IN	IN	+	0	+	+	5	15	8	3
c. Work involved in data access	0	0	0	DE	0	0	0	+	10	16	13	5
d. Utilization by private pilots	IN	0	IN	IN	+	0	+	+	8	14	10	11
e. Overall ability to give an adequate briefing	IN	IN	IN	IN	+	+	+	+	1	2	1	2
f. Thoroughness of briefing	IN	IN	IN	IN	+	+	+	+	2	3	2	1
g. Work involved in taking flight plans	0	0	0	0	0	0	0	0	16	13	15	15
h. Speed of finding needed data	IN	0	IN	0	+	0	+	0	6	9	7	13
i. Likelihood of making an error	0	0	0	DE	0	0	0	+	11	6.5	12	12
j. Amount of eyestrain	0	IN	IN	IN	0	-	-	-	12	1	4	4
k. Ease of answering pilot queries	IN	0	IN	IN	+	0	+	+	7	6.5	6	10
l. Utilization by corporate/military pilots	0	0	0	IN	0	0	0	+	14	5	11	14
m. Amount of frustration ³	DE	IN	0	0	+	-	0	0	13	4	16	16
n. Confidence in system	IN	0	IN	IN	+	0	+	+	4	10	5	9
o. Feeling of personal competence	IN	0	IN	IN	+	0	+	+	3	8	3	7
p. Work involved in giving briefing	DE	0	0	DE	+	0	0	+	9	12	9	6

1. IN = Increase
2. + = Favorable

DE = Decrease
- = Unfavorable

0 = No Change ($p \leq .05$)

3. DCA $p(DE) = .15$, OTHER $p(IN) = .21$

There were 10 favorable changes perceived by the DCA group, 2 favorable and 2 unfavorable changes perceived by the OTHER group, 8 favorable and 1 unfavorable changes perceived by the ENTIRE group, and 12 favorable and 1 unfavorable changes perceived by the AWANS group. Thus, out of 64 possibilities, 32 showed favorable and 4 showed unfavorable changes. The OTHER group showed the least favorable viewpoint; whereas, the AWANS group showed the most favorable viewpoint. "Amount of eyestrain" was seen as having increased by three of the groups. This accounts for three of the four unfavorable changes. "Amount of frustration" was seen as having increased by the OTHER group, accounting for the fourth unfavorable change. All four groups saw "Overall ability to give an adequate briefing" and "Thoroughness of briefing" as having changed for the better. A look at the rankings will show that across all four groups, the former was perceived as having changed the most, while the latter was seen as having the second largest change. The aspect which changed the least (not one of the four groups experienced a significant change) was "Work involved in taking flight plans." "Amount of frustration" would not have shown any changes at the original alpha level of .05 but changes are shown for DCA and OTHER. Note 3 in Table 3 shows the alpha levels for these changes. They were included in the table because "Amount of frustration" was unique in being seen as decreased by the DCA group and increased by the OTHER group. This was the only aspect which was perceived as changing in opposite directions.

The four highest ranking aspects for each of the four groups in Table 3 are as follows:

The DCA group reported:

1. an increase in "Overall ability to give an adequate briefing,"
2. an increase in "Thoroughness of briefing,"
3. an increase in "Feeling of personal competence," and
4. an increase in "Confidence in system."

The OTHER group reported:

1. an increase in "Amount of eyestrain,"
2. an increase in "Overall ability to give an adequate briefing,"
3. an increase in "Thoroughness of briefing," and
4. an increase in "Amount of frustration."

The ENTIRE group reported:

1. an increase in "Overall ability to give an adequate briefing,"
2. an increase in "Thoroughness of briefing,"
3. an increase in "Feeling of personal competence," and
4. an increase in "Amount of eyestrain."

The AWANS group reported:

1. an increase in "Thoroughness of briefing,"
2. an increase in "Overall ability to give an adequate briefing,"
3. an increase in "Job satisfaction," and
4. an increase in "Amount of eyestrain."

Table 4 shows the results of t tests of the significance of the difference between groups for each of the aspects. As detailed in the METHOD section, there are four meaningful comparisons between the groups, one within Leesburg and three between the Leesburg groups and Atlanta AWANS. These comparisons appear as the four column headings under the first major heading, RELATIVE MAGNITUDE. The entries in these four columns indicate whether the first group reported a larger increase, a smaller increase, a smaller decrease, a larger decrease, a decrease versus an increase, or no change versus a decrease compared to the change reported by the second group for the aspect in question. An example should clarify the above statement. At the intersection of row b., "Job satisfaction" and the first column "DCA () COMPARED TO OTHER" appears the entry, "LRGR INCR." This should be read as, "The DCA group reported a significantly larger increase in job satisfaction after automation than did the OTHER group." And for the same column, row m, the expanded statement should read, "The DCA group reported a decrease versus an increase (DECR/INCR) reported by the OTHER group in the amount of frustration." The remaining entries should be interpreted in a similar fashion.

Under the second major heading, RELATIVE GOODNESS, a subjective interpretation is given of the comparison results shown in the first four columns. Here, the entries are simply abbreviations for "better than" and for "worse than." Using the same aspect in the example above, the DCA group saw job satisfaction after automation as having increased more than did the OTHER group; thus, the DCA group viewed the effect of automation on this aspect more favorably than did the OTHER group. Again, for row m, in which DCA saw the amount of frustration decreasing while OTHER saw the amount of frustration increasing with the change to automation, the viewpoint of the DCA group is "better than" or more favorable than that of the OTHER group relative to the automation-induced changes in this aspect. The remaining entries should be interpreted in a similar manner.

The DCA group viewed automation more favorably than did the OTHER group in five of the aspects. The DCA group viewed automation more favorably than did the AWANS group in only one aspect, "Amount of eyestrain." The OTHER group viewed automation less favorably than did the AWANS group in eight aspects. The ENTIRE group viewed automation more favorably than did the AWANS group in one aspect (amount of eyestrain) and less favorably than did the AWANS group in five aspects. Five out of the sixteen aspects showed no significant differences. "Job satisfaction" showed three significant differences. With respect to "Job satisfaction," the OTHER and ENTIRE groups viewed automation less favorably than did the AWANS group, and the DCA group viewed automation more favorably than did the OTHER group.

TABLE 4. RESULTS FOR FSS SPECIALIST SURVEY, PART 1, RELATING TO AUTOMATION: DIFFERENCES BETWEEN GROUPS

ASPECT ON WHICH COMPARISON MADE Automated vs. manual facility	RELATIVE MAGNITUDE				RELATIVE GOODNESS				RELATIVE RANK			
	MAPS ONLY DCA () COMPARED TO OTHER	LEESBURG MAPS VERSUS ATLANTA AWANS			MAPS ONLY DCA () OTHER	LEESBURG MAPS VS ATLANTA AWANS			MAPS ONLY DCA VS OTHER	LEESBURG MAPS/ ATLANTA AWANS		
		DCA () COMPARED TO AWANS	OTHER () COMPARED TO AWANS	ENTIRE () COMPARED TO AWANS		DCA () AWANS	OTHER () AWANS	ENTIRE () AWANS		DCA VS AWANS	OTHER VS AWANS	ENTIRE VS AWANS
a. Time required to give briefing	0	0	SMLR DECR	SMLR DECR	0	0	WRS THN	WRS THN	15	2	6	5
b. Job satisfaction	LRGR INCR*	0	SMLR INCR	SMLR INCR	BTR THN	0	WRS THN	WRS THN	5	5	2	2
c. Work involved in data access	0	0	SAME/ DECR	SMLR DECR	0	0	WRS THN	WRS THN	10	3	1	1
d. Utilization by private pilots	0	0	0	0	0	0	0	0	6	16	9	12
e. Overall ability to give an adequate briefing	LRGR INCR	0	SMLR INCR	0	BTR THN	0	WRS THN	0	2	14	8	10.5
f. Thoroughness of briefing	0	0	SMLR INCR	SMLR INCR	0	0	WRS THN	WRS THN	7	6	4	6
g. Work involved in taking flight plans	0	0	0	0	0	0	0	0	16	8	15	15
h. Speed of finding needed data	0	0	0	0	0	0	0	0	11	14	16	16
i. Likelihood of making an error	0	0	0	0	0	0	0	0	13	7	13	8
j. Amount of eyestrain	0	SMLR INCR	0	SMLR INCR	0	BTR THN	0	BTR THN	8.5	1	12	3
k. Ease of answering pilot queries	0	0	SMLR INCR	0	0	0	WRS THN	0	8.5	12	7	7
l. Utilization by corporate/ military pilots	0	0	0	0	0	0	0	0	14	9	14	10.5
m. Amount of frustration	DECR/ INCR*	0	0	0	BTR THN	0	0	0	3	14	10	13
n. Confidence in system	LRGR INCR*	0	0	0	BTR THN	0	0	0	4	10	11	14
o. Feeling of personal competence	LRGR INCR	0	SMLR INCR	0	BTR THN	0	WRS THN	0	1	11	5	9
p. Work involved in giving briefing	0	0	SMLR DECR	SMLR DECR	0	0	WRS THN	WRS THN	12	4	3	4

NOTE: SMLR = smaller, LRGR = larger, DECR = decrease, INCR = increase, WRS = worse, BTR = better, THN = than, SAME = same or no change, / = versus, 0 = no difference significant at $p \leq .05$ (* $p \leq .07$).

Under the third major column heading, RELATIVE RANK, in Table 4 are shown the ranks of the magnitude of the differences between the group means for each of the aspects. As described above, a rank of one was assigned to that aspect showing the greatest difference. The highest ranking aspects for the comparisons are as follows:

DCA VS. OTHER - The DCA group reported:

1. a larger increase in the "Feeling of personal competence,"
2. a larger increase in "Overall ability to give an adequate briefing," and
3. a decrease in the "Amount of frustration" vs. an increase for OTHER.

DCA VS. AWANS - The DCA group reported:

1. a smaller increase in the "Amount of eyestrain."

OTHER VS. AWANS - The OTHER group reported:

1. no change in "Work involved in data access" vs. a decrease for AWANS,
2. a smaller increase in "Job satisfaction," and
3. a smaller decrease in "Work involved in giving briefing."

ENTIRE VS. AWANS - The ENTIRE group reported:

1. a smaller decrease in "Work involved in data access,"
2. a smaller increase in "Job satisfaction," and
3. a smaller increase in the "Amount of eyestrain."

Table 5 presents the results of Part 2 of the survey which was directed toward eliciting opinions on more general aspects relating to consolidation and collocation. Since this part of the survey was not administered to the AWANS group, only the data from Leesburg (DCA, OTHER, and ENTIRE) appear in this table. Under the first major column heading, CHANGE, significant increases or decreases are shown for the three specialist groups across the 12 aspects (a. through l.) The DCA group saw nine aspects as having increased. The OTHER group saw four aspects as having increased and one aspect as having decreased. The ENTIRE group saw seven aspects as having increased and one aspect as having decreased.

Under the second major column heading, VALUE, are shown the author's subjective judgments as to whether the above increases or decreases represent favorable or unfavorable changes. For three of the aspects, "General level of activity," "Geographical knowledge required," and "Level of responsibility," there was some uncertainty as to the value of the change. The value assigned to the change can differ depending on the subjective viewpoint taken. One might look at the change from the point of view of the specialist, of management, or of the pilot or user of the system. For example, an already busy specialist might see an increase in the "General level of activity" as being unfavorable, and a specialist with time on his hands might see the same change

TABLE 5. RESULTS FOR LEESBURG FSS SPECIALIST SURVEY, PART 2, RELATING TO CONSOLIDATION AND COLLOCATION

ASPECT ON WHICH COMPARISON MADE Present compared to prior facility	CHANGE ¹			VALUE ²			RELATIVE RANK OF CHANGE ³			VIEW OF DCA SPECIALISTS ⁴ VERSUS THAT OF SPECIALISTS FROM OTHER FACILITIES		
	DCA	OTHER	ENTIRE	DCA	OTHER	ENTIRE	DCA	OTHER	ENTIRE	DCA SHOWS A ()	DCA VIEW'T () OTHER	RANK
	a.	IN	IN	IN	±?	±?	±?	3	1	2	0	0
b.	IN	0	IN	+	0	+	5	8.5	5	LARGER INCREASE	BETTER THAN	4.5
c.	IN	IN	IN	-?	-?	-?	1	2	1	LARGER INCREASE	WORSE THAN?	7
d.	IN	0	IN	±?	0	±?	2	8.5	4	LARGER INCREASE	BETTER THAN?	1
e.	IN	0	IN	+	0	+	9	7	9	0	0	9
f.	0	IN	IN	0	-	-	11	5	8	SMALLER INCREASE	BETTER THAN	8
g.	IN	0	0	+	0	0	8	6	11	INCR. VS. DECREASE	BETTER THAN	2
h.	IN	0	0	+	0	0	7	12	10	INCR. VS. DECREASE	BETTER THAN	4.5
i.	IN	0	0	+	0	0	6	10	7	0	0	6
j.	0	DE	DE	0	-	-	12	3	6	SMALLER DECREASE	BETTER THAN	3
k.	IN	IN	IN	+	+	+	4	4	3	0	0	11
l.	0	0	0	0	0	0	10	11	12	0	0	10

1. IN = INCREASE, DE = DECREASE, 0 = NO SIGNIFICANT ($p \leq .05$) CHANGE

2. Value of the change is a subjective judgement. + = FAVORABLE, - = UNFAVORABLE ? = UNCERTAIN

3. A rank of "1" is assigned to the aspect perceived as changing more than any other, "2" the 2nd largest, etc.

4. This is a comparison of two separate groups of specialists at Leesburg FSS, "DCA" having worked at Washington National Airport prior to the change and "OTHER" having come from facilities other than DCA.

as being favorable. Likewise, a facility chief might see an activity increase as being favorable. Therefore, the interpretation of the value of the increase in "General level of activity" was left undecided. The DCA group reported eight favorable changes, one unfavorable change, and one whose value is undecided. The OTHER group reported one favorable change, three unfavorable changes, and one whose value is undecided. And, finally, the ENTIRE group reported four favorable changes, three unfavorable changes, and one whose value is undecided. There was only one aspect, "Flexibility in annual leave arrangement," for which no changes were significant.

Under the third major column heading, RELATIVE RANK OF CHANGE, the relative ranks of the magnitude of the change within the three groups are shown. Here, again, the greatest change was assigned a rank of "1." The three highest ranking aspects for each of the groups are as follows:

The DCA group reported:

1. an increase in "Geographical knowledge required,"
2. an increase in "Level of responsibility," and
3. an increase in "General level of activity."

The OTHER group reported:

1. an increase in "General level of activity,"
2. an increase in "Geographical knowledge required," and
3. a decrease in "Pilot satisfaction with specialist availability."

The ENTIRE group reported:

1. an increase in "Geographical knowledge required,"
2. an increase in "General level of activity," and
3. an increase in "Availability of personnel-related facilities."

Under the fourth major heading, VIEW OF DCA SPECIALISTS VERSUS THAT OF SPECIALISTS FROM OTHER FACILITIES, comparisons are made between the changes reported by these two groups in order to characterize any difference in opinion. As shown in the leftmost column under this heading, there were seven significant differences. The middle column indicates that in six of these, the DCA group viewed the changes more favorably (BETTER THAN) than did the OTHER group. For one aspect, the DCA group viewed the change less favorably. In the leftmost column, the differences are ranked as to their magnitude.

The three aspects on which these differences were the largest are as follows:

The DCA group reported:

1. a larger increase in "Level of responsibility,"
2. an increase in "Pilot satisfaction with quality of service" vs. a decrease for OTHER, and
3. a smaller decrease in "Pilot satisfaction with specialist availability."

Table 6 shows the results of the analysis of the responses to Part 3 of the survey. The actual text of the question is shown. The response tallies are arrayed in tabular form. The first data column of the table contains the number of "yes" responses, and the second column of the table contains the number of "no" responses. The first data row of the table contains the responses from the DCA group, the second row contains the responses from the OTHER group, and the third row contains the responses from the ENTIRE group. The remaining five columns show the results of the analysis. The computed z scores and associated alpha levels appear in columns 3 and 4. Assigning significance to z scores attaining an alpha level less than, or equal to, .20 results in the consensus shown in column 5. The DCA group feels that there are operational advantages associated with being collocated with the ARTCC (almost three to one said "yes"); whereas, the OTHER group feels that there are no such advantages (over two to one said "no"). Combining these two groups into the ENTIRE group results in the lack of a significant consensus. The chi square value and its associated probability or alpha level (columns 6 and 7) show that there is a statistically significant difference in the pattern of responses between the DCA and the OTHER groups.

In order to determine the presence or absence of similar response patterns between pairs of the four groups of specialists, correlation coefficients (r) were computed using the ranked responses. The ranks used in the calculations are found under the third major column heading, RELATIVE RANK OF CHANGE MAGNITUDE, in Table 3 and under the third major column heading, RELATIVE RANK OF CHANGE, in Table 5. The results were as follows:

DCA versus AWANS, $r = .60$, significant beyond the .05 probability level;

OTHER versus AWANS, $r = .09$ not significant;

ENTIRE versus AWANS, $r = .66$, significant beyond the .01 probability level;

DCA versus OTHER (Part 1), $r = .14$, not significant; and

DCA versus OTHER (Part 2), $r = .21$, not significant.

A positive correlation exists between the ranked responses from the DCA and AWANS groups and the ENTIRE and AWANS groups. Since the ENTIRE group is a composite of the DCA and OTHER group and since the OTHER versus AWANS correlation was quite small, the major contribution to the positive correlation derives from the DCA group. A confirmation of this statement exists in the finding of only one significant difference between the DCA and AWANS mean responses (refer to the second column under RELATIVE MAGNITUDE in Table 4). These results tend to validate the use of the FSS Specialist Opinion Survey as an instrument for assessing the subjective reactions of the specialist to changes in the system.

TABLE 6. RESULTS FOR LEESBURG FSS SPECIALIST SURVEY, PART 3, RELATING TO COLLOCATION

3. Do you feel that there are operational advantages associated with being collocated with the ARTCC?

YES _____ NO _____ MAYBE _____ UNKNOWN _____

DATA SET	No. YES RESPONSES	No. NO RESPONSES	SIGN TEST Z SCORE	SIGN TEST ONE-TAIL ALPHA	CONSENSUS	CHI SQUARE VALUE	CHI SQUARE ALPHA
DCA	11	4	1.55	.06	YES	3.49	.06
OTHER	4	9	-1.11	.13	NO		
ENTIRE	15	13	.19	.42	NONE		

4. INTERPRETATION OF RESULTS

The overall attitude of the DCA group was favorable to all of the aspects queried regarding automation, consolidation, and collocation with the possible exception of two relating to consolidation. These were their reports on externally directed, operational aspects of an increase in "General level of activity" and an increase in the amount of "Geographical knowledge required" which were also seen as having increased by the OTHER group. Both of these aspects were in Part 2 of the survey. The overall attitude of the OTHER group was less favorable, tending to be neutral regarding automation and unfavorable regarding consolidation and collocation. The negative opinions of the OTHER group were reflected in the more internally directed, "feeling" statements, "Amount of eyestrain" and "Amount of frustration." When responding to statements regarding externally directed, operational aspects; e.g., "Overall ability to give an adequate briefing" and "Thoroughness of briefing," the OTHER specialists reported favorable changes due to the use of an automated system. For the DCA group, both the internally directed, feeling aspects; e.g., "Feeling of personal competence" and "Confidence in system," and the externally directed, operational aspects; e.g., "Overall ability to give an adequate briefing" and "Thoroughness of briefing," were seen as having changed in a favorable direction following the implementation of automation. All of these aspects were in Part 1.

Why do the specialists in the OTHER group have a less favorable attitude than those in the DCA group? At the outset, it seems difficult to understand their attitude, since most of the specialists in the OTHER group requested a relocation of their own free will. Here are some possible explanations. Firstly, the specialists moving into an established facility are "outsiders," are "new-comers," and must establish a whole set of new relationships with their coworkers and supervisors. Secondly, in the OTHER group, 13 of the specialists came from smaller facilities than DCA. Prior facility information was not available on two of the specialists and one of the specialists came from an FSS the same size as DCA. In general, these smaller facilities had a lighter workload, were more easy-going, had a greater amount of personal interaction and provided in-person, face-to-face briefings. Merely moving to another manual facility with a heavier workload could create a negative attitude in the specialist. For the specialists who had been at DCA, the move to Leesburg did not involve such a large increase in the level of activity. The perceived difference in activity levels is shown in Table 5 wherein both groups of the specialists reported an increase in "General level of activity." As would be expected on the basis of the above discussion, this aspect ranked first in magnitude of change for the OTHER group but third for the DCA group. The decrease in "Pilot satisfaction with specialist availability" reported by the OTHER group probably reflects the specialists dissatisfaction at no longer being able to interact directly with the pilots in face-to-face briefings.

The OTHER group reported an increase in the "Amount of eyestrain," an opinion not shared by the DCA group. Many of the smaller FSS's use a combination of natural daylight and artificial lighting, a situation not substantially different from that at the Washington National FSS. The source for this difference in

opinion might be simply the longer experience of the DCA group with MAPS. The average experience for the DCA group was double that of the OTHER group (90 compared to 46 weeks). The "Amount of eyestrain" reported by OTHER group did not differ from that reported by the AWANS group; whereas, the opinion of the DCA group showed no change in eyestrain due to automation. There were real world differences between the AWANS and MAPS in the level of artificial lighting. It was reported that higher illumination levels were used with MAPS than with AWANS.

The remaining aspect for which the OTHER group reported an unfavorable change is an increase in "Personal/family problems." The process of moving from one geographical location to another, finding housing, arranging financing, and the myriad of other details involve a certain amount of stress. Being a new-comer and establishing new relationships with neighbors, coworkers, and supervisors can be difficult. Going from a small facility with much personal contact with pilots and friendships with coworkers to a larger, perhaps more impersonal, automated facility with less direct contact with pilots could result in a less personally gratifying work situation and cause stress. The requirement to retrain and learn the operation of the automated system would, it seems, impose additional stress on the specialists in the OTHER group. These are some of the conditions which may account for the less favorable attitude of the OTHER specialists. It would seem that information derived from this survey could be valuable in planning indoctrination and training programs for new specialists coming into an automated facility. A program of this sort could do much to minimize the negative effect on the attitudes and morale of incoming specialists.

These results are for a survey taken at the Leesburg FSS in December 1977. Much of the unfavorable attitude is probably due to the psychological resistance to change. Presumably, the attitudes of the OTHER group will become more favorable with the passage of time and with increasing experience in the new FSS and with the automated system. As mentioned before, this increasingly favorable attitude was observed over a period of a year with the FSS specialists using the AWANS at Atlanta. Eventually, the attitudes of the OTHER and the DCA group should converge and become indistinguishable from each other. This speculation could be tested by administering another survey at the Leesburg FSS at a later date, say, the last quarter of 1978.

5. CONCLUSIONS

1. There were two groups of specialists with differing opinions at the Leesburg FSS:

1a. The group of Leesburg specialists originally from DCA displayed a favorable attitude toward all three categories of change; i.e., automation, consolidation, and collocation.

1b. The group of Leesburg specialists originally from facilities other than DCA displayed a neutral attitude toward automation-related changes and a negative attitude toward consolidation- and collocation-related changes.

Their neutral attitude toward automation is a composite which can be separated into a favorable attitude toward outward-directed, operational aspects and an unfavorable attitude toward inward-directed, feeling aspects.

2. The less favorable attitude of the specialists originally from other facilities may be due to a combination of factors such as: problems associated with moving, being a newcomer in an established facility, the transfer to a larger FSS, the extra effort required in learning to use the automated system (MAPS), and their shorter length of exposure to MAPS.

3. The FSS Specialist Opinion Survey is a valuable instrument for probing specific areas of the specialist's interaction with the system. The close agreement of the automation results between the DCA and Atlanta specialists supports this assertion.

6. RECOMMENDATIONS

1. Administer a follow-up FSS Specialist Opinion Survey in the last quarter of 1978 at the Leesburg FSS to determine whether the attitude has become more favorable and to check whether the response patterns of the DCA and the OTHER groups show a greater similarity.

2. The facility might profit by adapting their orientation and training program to incorporate the results of this survey indicating the presence of two differing groups of specialists in the facility and the particular aspects where problems might exist. Use of a subjective survey such as this could provide valuable feedback on the effectiveness of their training program.

3. Modify the FSS Specialist Opinion Survey to reflect not only the direction and magnitude of the perceived change but also its value to the responding specialist. This should be accomplished in such a manner as to retain comparability with the earlier results of the survey, so that the normative data already collected will still be of value.

4. The FSS Specialist Opinion Survey used in this study is for administration following the implementation of the changes to FSS operation. It would appear desirable to design a survey which addresses aspects similar to those in the present survey but which can be administered prior to the implementation of the changes. An AWANS is scheduled for installation at the Indianapolis FSS later this year. Such a survey could be used to obtain a "premodernization" opinion profile which could then be compared to the "post-modernization" opinion profile.

5. Include in the background information section, questions asking, "Did your transfer to your present facility involve moving your place of residence?" _____yes _____no, "How many miles did you move?_____", "Married?_____yes _____no, "Number of children?_____", and "Number of children living at home?_____."

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