APPENDIX D
RESULTS FROM RAND SKILLS AND EXPERIENCE QUESTIONNAIRE

NTSB data systems did not contain all the information necessary for RAND to perform its assessment of staffing, workload, and training issues, nor was sufficient time available for individual discussions with all technical staff members at NTSB. To broaden the coverage of its assessment, RAND developed a confidential structured questionnaire that it distributed in August 1998 to managers and technical staff at NTSB headquarters and at all regional and field offices across the United States. The questionnaire solicited information about the staff in the areas of

- position and background
- professional development
- accident investigation skills
- transportation mode-specific skills.

This information supplemented interviews with NTSB employees and analysis of products from NTSB data systems. The cover letter accompanying the questionnaire and the questionnaire itself can be found in Appendix E.

SAMPLE

The questionnaire was sent to *every* employee at the NTSB involved in accident investigation activities. The 269 recipients of the questionnaire represented the full population of relevant employees (see Table D.1). Researchers used the NTSB phone directory, which groups employees by organizational affiliation, to help identify appropriate questionnaire recipients. Although the NTSB's organizational structure left little room for ambiguity, RAND researchers also consulted with NTSB management and staff to ensure that all staff members in appropriate organizations were surveyed.

ADMINISTRATION

Questionnaires were mailed directly to each individual with a cover letter explaining the purpose of the survey (see Appendix E).

Respondents were not asked for their names, and mailing materials were included so that NTSB employees could return the surveys directly to RAND with no involvement of NTSB management. Survey recipients were assured that NTSB management would see only aggregated results from the survey, a principle to which researchers adhered throughout the study.

RAND researchers used several means to encourage responses. Concurrent with administration of the survey, RAND was conducting extensive interviews with various NTSB staff. At each of these meetings, the staff was reminded of the importance of returning their surveys. RAND researchers met frequently with NTSB management and gave them updates about the response rate, and encouraged them to remind employees to return questionnaires. NTSB management did in fact remind employees at regular NTSB meetings to return the surveys. Milestone briefings by RAND in August and December of 1998 provided quantitative results about response rates, underscoring the importance of encouraging employee responses.

Responses were entered into an Excel spreadsheet to facilitate analysis. Researchers analyzing the survey results performed the quality control function.

RESPONSE RATES

A total of 149 employees responded to the survey during the fall of 1998, representing a 55 percent response rate from a targeted population of 269 employees receiving the survey (see Table D.1). The greatest number of responses came from the OAS (at headquarters and regional offices) and the ORE. These offices, the largest in the NTSB, were the focal point for RAND's assessment because they perform aircraft accident investigations.

Because of the small samples, no comparisons were made for individual surface transportation offices, although some comparisons were made for the surface transportation staff as a group. In addition, results from the "Skills and Experience Inventory" portion of the survey were not used. The original intent was to survey, in a structured way, the skills of the NTSB staff by specialty area, but with a response rate of just over 50 percent and a median staffing depth of two in the OAS

Table D.1

Response Rates for RAND Skills and Experience Survey

Category	Sent	Received	Percent Response
Aviation safety (HQ)	56	29	52
Aviation safety (Reg)	56	29	52
Surface transportation			
Highway	17	13	76
Railroad	14	12	86
Pipeline	15	10	67
Marine	11	4	36
Research & engineering	61	31	51
Safety recommendations	10	6	60
Government affairs	2	1	50
Managing director	1	1	100
Other regional offices	26	13	50
Total	269	149	55

specialties and one in the ORE specialties, RAND had no assurance of fully capturing a complete picture of the skills at the NTSB. There was no way to ascertain whether observed skill gaps were real or just reflected a failure of the relevant experts to respond.

APPLICABILITY OF THE RESPONSES

Because 55 percent of those receiving the survey chose to respond, the respondents corresponded to a self-selected subgroup of the technical staff at the NTSB. For the most part, RAND had no independent means to verify whether the respondents were a representative subgroup. If this were possible using alternative data sources, the survey may not have been required in the first place. RAND did acquire information late in the study that permitted comparisons of survey responses and actual experience at the NTSB.

Mean experience levels computed using internal NTSB data sources fell well within the 95 percent confidence interval for the mean experience level derived from survey responses. Similarly, training levels reported by OAS employees in the questionnaire generally fell within the range of training hours recorded by the administrative officer in the OAS.

DESCRIPTION OF THE SURVEY

RAND research used questionnaire responses regarding position, background, and professional development of the NTSB staff in the following areas:

- Position and Background
  - --NTSB office symbol
  - --Management or staff
  - --Nature of prior employment
  - --Educational background
  - --Total transportation experience
  - --NTSB experience
  - --Age
- Professional Development
  - --Time for training
  - --Duty cycle
  - --Average workweek
  - --Sources of professional development

Position and background questions provided a means to characterize the workforce. This information was also correlated with answers to professional development questions to characterize how different populations worked and trained. Respondents identified the office within which they worked at the NTSB. This was used to compare the characteristics of different populations of data. They also provided information about prior employment, years of experience, educational attainment, and their age.

Professional development questions addressed the aggregate amount of time employees worked, how they spent their time, and where they obtained training. Respondents were asked a simple question regarding whether they had adequate time for training. The duty cycle question provided a structured set of choices for respondents to provide a breakdown of how they spent their time "during the past year." This provided a rich level of detail unavailable in normal NTSB data systems.

Similarly, the questionnaire asked respondents the number of hours they worked, on average, during a representative week during the past year. They were expressly asked to include time worked in excess of 40

hours, as appropriate. The question was asked in this manner to encourage respondents to average their varying workloads at the NTSB over a year's period to arrive at an answer. There is also some evidence that using a "last year" reference period rather than a "last week" period may reduce the tendency for exaggeration (see the next section). Finally, the questionnaire provided respondents with a structured set of choices to identify their sources of professional development.

ACCURACY OF SELF-REPORTED WORKWEEKS

The accuracy of self-reported workweeks is a subject of considerable research, as investigators try to measure trends in working hours and more generally how Americans spend their work time (Robinson and Bostrom, August 1994, pp. 11–23; Robinson and Godbey, 1997; Schor, September 26-28, 1997; Jacobs, December 1998, pp. 42–53). In a paper and subsequent book, Robinson strongly endorses the time-diary approach as the best means for collecting accurate information about work activities. This data-intensive approach involves distributing thousands of time diaries to respondents who enter information in 15-minute increments for one day.

By requiring various groups of respondents to account for their time on different days of the week, researchers can then construct synthetic workweek estimates by adding equal proportions of each day of the week, while relying on the large sample to compensate for any atypical days reported by certain respondents (Robinson and Godbey, 1997).

Robinson compared self-estimates of workweeks with time-diary results, using the latter as an objective standard, and found respondents tended to overestimate their workweeks as estimated workweeks grew longer, particularly for those claiming workweeks of over 45 hours.[1] Robinson concedes that the diary data employed in the analysis "were not designed nor intended to uncover the discrepancies . . . described" and call for methodological experiments

[1]In the 40- to 44-hour estimated workweek category, estimates exceeded the time diary results by about 2 hours. This grew to 3 hours in the 45- to 49-hour estimated workweek category, and 9 hours in the 50- to 54-hour category (Robinson and Bostrom, August 1994, pp. 16–17).

to draw distinctions between measurement techniques (Robinson and Bostrom, August 1994, pp. 19–20). Finally, he suggests, "While they may exaggerate their work hours, there is no question that people who estimate that they work long hours actually do put in more hours on the job" (Robinson and Godbey, 1997, p. 193).

A recent paper offers a new interpretation of Robinson and Ann Bostrom's results. Jacobs developed a new measure of the workweek, derived from departure and return times. He then compares the resulting workweeks with self-reports, tests for factors that might introduce bias in self-reports, and considers how the differences in reference periods for estimates could influence the results (Jacobs, December 1998, pp. 42-53). His results indicate that some of the observed discrepancies in time-diary and self-reported workweeks are the consequence of a statistical artifact.[2]

The new measures of workweek largely corroborate self-reported measures. Jacobs tested social psychological factors, nature of job factors, and demographic factors to determine whether they helped explain discrepancies between calculated and reported workweeks. He found few predictor variables, indicating that errors in self-reported measures appear to be largely random in nature. Jacobs also found that changing reference periods of workweek estimates from "last week" to "last year" may reduce the tendency for respondents to exaggerate the number of hours worked.

These academic discourses on the efficacy of various means for measuring workweeks and the results derived from them have clearly not evolved to a consensus. The RAND survey selected a reference period for the workweek question that was not specifically tied to the day the survey was administered or specific to the prior week. This approach may help to reduce dispersion in workweek estimates and may also be better suited to measuring workweeks in an organization such as the NTSB, in which unpredictable random accident occurrences can affect workloads.

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[2]Jacobs demonstrates that discrepancies that appear as exaggerations "may instead be merely a reflection of the statistical artifact of regression to the mean between two measures that are correlated with some error" (Jacobs, December 1998, p. 46).

RAND wanted respondents to average out the workweeks they had experienced. The self-reported workweek estimates complemented other indicators of workload, such as overtime payments, that were available in the NTSB's data systems.

STATISTICAL COMPARISONS OF SUBSETS OF RESPONDENTS

The RAND analysis statistically tested for differences in workweeks, training activity, experience levels, and other factors, across various subsets of respondents. For example, RAND analysis compared whether employees from the OAS tended to have longer workweeks than other employees at the NTSB by using the Student's t-test. The t-test assumed a two-tailed distribution and that the two samples had unequal variance. This comparison was used to determine the probability that the two samples arose from two underlying populations having different mean measures.

STAFFING AND WORKWEEK RESULTS

Total Professional Experience of OAS Members and Other Respondents

Respondents from the OAS tended to have more total years of experience as transportation professionals than did other respondents (see Table D.2). This includes applicable experience prior to joining the NTSB. Differences between the experience level of OAS respondents and other respondents were significant at the 98 percent level using a t-test.

Ages of NTSB Technical Staff Members

One hundred forty-seven respondents answered the age question (see Table D.3). Reported ages ranged from 20 to 70 with a mean of 47 years. Among the respondents, only 38 reported an age below 40 years.

Respondents from the OAS tended to be older than other respondents. Differences were significant at the 99.9 percent level.

Workweeks of NTSB Technical Staff Members

One hundred thirty-five respondents answered the workweek question (see Table D.4). OAS staff estimated a longer workweek than other respondents. Differences in the workweeks reported by OAS respondents

Table D.2

Total Professional Experience, in Years, Reported by OAS and Other Respondents

	OAS	Others
Responses	58	90
Mean experience (years)	23.0	19.0
Median experience (years)	25.0	22.0
Standard deviation (years)	10.6	11.5
95% confidence interval (years)	2.7	2.4

Table D.3

Ages Reported by OAS and Other Respondents

	OAS	Others	All Respondents
Responses	58	89	147
Mean age (years)	50.0	44.0	47.0
Median age (years)	51.0	46.0	48.0
Standard deviation (years)	9.2	10.6	10.4
95% confidence interval (years)	2.4	2.2	1.7

Table D.4

Reported Workweeks for the OAS and Other Respondents

	OAS	Others	All Respondents
Responses	55	80	135
Mean workweek (hours)	49.8	46.0	47.5
Median workweek (hours)	50.0	45.0	46.5
Standard deviation (hours)	6.3	7.9	7.5
95% confidence interval (hours)	1.7	1.7	1.3

and other respondents were statistically significant at a greater than 99 percent confidence level.

Differences in Workweeks by Experience Level

Employees having 15 or more years of experience at the NTSB reported longer workweeks than less-experienced respondents (see Table D.5), who all reported average workweeks of similar length. A total of 135 valid responses reported workweeks and years of experience at the NTSB.

Pairwise comparisons by experience group showed a statistically significant difference in workweeks reported by those respondents having 15 or more years of experience at the NTSB and those who had less experience. Table D.6 shows the probability that responses from the two experience groups are statistically distinct when compared using a t-test. The shaded cells in the table show those pairwise comparisons that are statistically significant. Other pairwise comparisons involving respondents with less experience were not statistically significant.

Table D.5

Reported Average Workweek and Experience at the NTSB

NTSB Experience (years)	Responses	Workweek (hours) Mean	Median	SD	95% CI
0–4	38	46.8	45.5	4.8	1.5
5–9	29	46.3	45.0	8.1	2.9
10–14	35	46.6	46.5	8.8	2.9
15+	33	50.4	50.0	7.5	2.6

Table D.6

Pairwise Comparisons of Workweeks Reported by Experience Groups

NTSB Experience (years)	NTSB Experience (years) 15+	10–14	5–9
0–4	98%	9%	26%
5–9	96%	14%	–
10–14	94%	–	–

Percentage of Time Spent Answering Public Inquiries

The survey asked respondents to estimate the percentage of work time spent answering public inquiries concerning such areas as accident

theories and safety ideas. Interviews with some members of the technical staff suggested that this activity was interfering with their ability to perform their other duties. The mean time spent answering public inquiries was 6.2 percent for all respondents, corresponding to more than three workweeks per year (see Table D.7).

Table D.7

Reported Percentage of Time Spent Answering Public Inquiries

Responses	149
Mean time answering public inquiries (%)	6.2
Median time answering public inquiries (%)	5.0
Standard deviation (%)	6.6
95% confidence interval (%)	1.1

TRAINING AT NTSB

Percentage of Time Spent Training

The survey asked respondents to estimate the percentage of work time spent in training (see Table D.8). The average across the NTSB was 3.4 percent, corresponding to slightly less than nine days per year of training. OAS respondents estimated they spent less of their time in training than did other respondents. Based on a t-test of the responses, differences were significant at a greater than 99 percent level.

Table D.8

Reported Percentage of Time Spent on Training

	OAS	Others	All Respondents
Responses	58	91	149
Mean time training (%)	2.4	4.0	3.4
Median time training (%)	2.0	4.0	3.0
Standard deviation (%)	1.9	3.5	3.0
Confidence interval 95% (%)	0.5	0.7	0.5

Years of Experience at the NTSB in Relation to Training

Survey responses suggested a monotonically declining trend in the percentage of time spent in training as experience at the NTSB increased

(see Table D.9). Pairwise comparisons by experience group showed a statistically significant difference in time spent in training reported by those respondents having five or fewer years of experience at the NTSB and more experienced respondents. The shaded cells in Table D.10 show those pairwise comparisons that are statistically significant at levels greater than 90 percent. Other pairwise comparisons involving respondents with more experience were not statistically significant.

Table D.9

Reported Training Time and Experience at the NTSB

NTSB Experience (years)	Number of Responses	Mean Time Training (%)
<5	44	4.7
5-9	32	3.3
10-14	38	2.7
15+	35	2.6

Table D.10

Pairwise Comparisons of Training Time Reported by Experience Groups

NTSB Experience (years)	NTSB Experience (years)		
	15+	10-14	5-9
<5	98%	99%	93%
5-9	53%	61%	-
10-14	<1%	-	-

Effect of Workload on Training

Comparisons of actual data collected on training time and overtime expenditures for the technical staff from the OAS showed a negative correlation. Similarly, comparisons of tuition and travel expenses for training and overtime expenditures for NTSB staff members as a whole also showed a negative correlation, suggesting as workloads increased, training tended to decrease. The survey afforded another opportunity to address this issue by examining the relationship between respondents' reported training time and workweek hours.

Survey respondents reporting workweeks of 55 hours or more reported that they spent less time in training than those working fewer hours

(see Table D.11). Pairwise comparisons indicated that training differences among different workweek groups were significant only for the 55-plus hours a week group and groups working 45 to 54 hours per week (see Table D.12). These results suggest that some staff working long hours are training despite having extended workweeks, although that becomes difficult for the longest of workweeks.

Table D.11

Reported Workweek Hours and Training Time

Average Workweek (hours)	Mean Time Training (%)	Number of Valid Responses
<40	2.8	6
40-44	3.3	30
45-49	3.6	37
50-54	3.7	37
55+	2.3	25

Table D.12

Pairwise Comparisons of Training Reported by Workweek Groups

	Average Workweek (hours)			
Average Workweek (hours)	55+	50–54	45–49	40–44
<40	24%	39%	33%	19%
40–44	81%	42%	33%	–
45–49	96%	18%	–	–
50–54	93%	–	–	–