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ABSTRACT

Described is the final phase of a study directed at the development of an on-the-job training (OJT) costing methodology. Utilizing a modification of survey techniques tested and evaluated during the previous phase, estimates were obtained for the cost of OJT for airman training from the 1-level (unskilled to the 3-level (semiskilled) in five category B Air Force specialties. The specialties studied were pavement maintenance, fire protection, food service, fuel service, and material facilities. The cost per graduate of OJT for these specialties was compared to the cost per graduate of resident school technical training. For three of the five specialties, OJT cost per graduate was below the technical training school cost per graduate. Supervisors were surveyed to determine if there was a difference in performance between OJT and technical school graduates in these AFSCs. As was true in the previous phase, no evidence was obtained to support the hypothesis that either OJT or technical school graduates were superior in performance. Conditional cost models were also formulated and tested. The conditional cost models are based on an alternative or opportunity cost concept and represent a refinement of the original cost models. (Author/BJG)

AIR FORCE

HUMAN RESOURCES

LABORATORY

AFHRL-TR-74-73

EVALUATION OF METHODOLOGY FOR ESTIMATING THE COST OF AIR FORCE ON-THE-JOB TRAINING

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AIR FORCE SYSTEMS COMMAND
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Chief, Manpower and Personnel Systems Division

Approved for publication.

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This report describes the final phase of a study directed at the development of an on-the-job training (OJT) costing methodology. Utilizing a modification of survey techniques tested and evaluated during the previous phase, estimates were obtained for the cost of OJT for airman training from the 1-level (unskilled) to the 3-level (semi-skilled) in five category B Air Force specialties. The specialties studied were pavement maintenance (551X0); fire protection (571X0); food service (622X0); fuel service (631X0); and material facilities (647X0). The cost per graduate of OJT for these specialties was compared to the cost per graduate of resident school technical training. For three of the five specialties, OJT cost per graduate was below the technical training school cost per graduate.

Item 20 Continued:

Supervisors were surveyed to determine if there was a difference in performance between OJT and technical school graduates in these AFSCs. As was true in the previous phase, no evidence was obtained to support the hypothesis that either OJT or technical school graduates were superior in performance. Conditional cost models were also formulated and tested. The conditional cost models are based on an alternative or opportunity cost concept and represent a refinement of the original cost models.

PREFACE

This report is the second of two reports describing the results of a contract study entitled "Development, Evaluation, and Application of Methodologies for Determining the Cost of Air Force On-the-Job Training," Contract No. F41609-72-C-0048, conducted by Cooper and Company, Stamford, Connecticut. Mr Bernard Samers, Cooper and Company, was the principal investigator and wrote this report. Mr John N. Taylor, AFHRL/MDS, made a major contribution to the revision of the report. The cooperation of Mr C. L. Niblock, Mrs H. M. Scott, and Mr C. O. Yelverton, Cost and Economics Analysis Division, Headquarters ATC; and Mrs Barbara Horner, RAND, is gratefully acknowledged. Dr Don Meyer's ATC/XPT, sponsorship and enthusiastic interest in this research is sincerely appreciated.

The work was conducted under Project 2077, Personnel and Manpower Management Systems Development, Task 207703, Computer-Based Models of the Air Force Personnel Subsystem. The research is a partial response to RPR 73-02, Optimal Mix of On-the-Job Training and Technical School.

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SECTION I

INTRODUCTION

This report discusses the results of the second phase of a two-phase research effort aimed at developing an On-the-Job Training (OJT) costing methodology and using the methodology to estimate the cost of OJT for a number of selected Air Force specialties. Results of the first phase (hereafter, Phase I), were published in a technical report entitled "The Development of a Methodology for Estimating the Cost of Air Force On-the-Job Training," AFHRL-TR-73-34. During Phase I, three alternative methodologies for estimating the cost of OJT were developed. All three utilized a survey approach and were applied simultaneously to a sample of airmen training from the 1-level (helper) to the 3-level (semi-skilled) in the Administrative Specialty, AFSC 702X0. A preferred methodology was selected, and, using this methodology, an OJT cost estimate per graduate (702X0) was established. Also, an estimate of the cost of resident technical training to the 3-level (Course 3ABR70230 at Keesler AFB) was obtained. It was observed that the OJT cost per graduate for the Administrative Specialty was significantly below the resident Technical Training School (TTS) cost per graduate. It was also concluded that, in terms of performance as perceived by supervisors, both types of training resulted in approximately the same quality of graduate.

The general approach taken in the Phase I study, as well as in this present study, was to utilize the OJT supervisor survey responses in cost models or equations to compute cost element or factor estimates. The cost elements considered included

(1) Cost of trainee time spent in training

(2) Cost of supervisor time devoted to training

(3) Remedial training cost

(4) Records management cost

(5) Cost of delayed entry into training

(6) Equipment and material costs,

and the sum of these cost elements comprise the OJT cost per graduate.

For purposes of comparing OJT and TTS costs, adjustments to the TTS costs were made to reflect (1) the cost of training the 3-level TTS graduate (trainee cost only) to a level of proficiency equivalent to the OJT trained 3-level (TTS Equivalency Cost), and (2) the cost associated with the TTS graduate's delayed entry time into the work force due to such activities as personnel processing (TTS Delay Cost).

In the study reported here (Phase II of the overall research effort), the OJT costing methodology was applied to five additional AFSC's; the survey instrument and cost models were further refined; and the question of OJT instructor and trainee productivity was explicitly investigated.

SECTION II

DESCRIPTION OF STUDY

1. AIR FORCE SPECIALTIES SELECTED

The five Air Force specialties studies in this research effort were all Category B skills. (Category B specialty trainees may upgrade from the 1 to the 3-level either by attending TTS or completing OJT). The specialties studied were:

AFSC 551X0	Pavements Maintenance Specialist
AFSC 571X0	Fire Protection Specialist
AFSC 622X0	Cook
AFSC 631X0	Fuel Specialist
AFSC 647X0	Material Facilities Specialist

These specialties were selected to provide a wide range of skills, training environments, work intensities and locations. A brief description of the types of work activity performed in each of the specialties is provided in Appendix I. More detailed job descriptions appear in AFM 39-1.

2. SURVEY METHODOLOGY

The overall study objective was to develop a methodology for collecting data necessary to develop cost estimates. In Phase I, three distinct methods for soliciting data by mail questionnaire were explored, and the most promising of these was utilized in Phase II.

To be specific the Phase II methodology drew heavily on (1) work sampling methodology based on self-recording (i.e., respondents were asked to record the actual hours spent by trainees and instructors on a daily basis for one week); and (2) the use of pre-existing recorded data in Air Force files on the duration of training. In addition, respondents were asked to provide their "average experience" and best judgment on some aspects of training. This kind of question was limited, however, to areas where no other existing measures were obtainable; and the questions were aimed at aggregate

data rather than at small elements of activity on which judgments might be suspect.

The specifics of the methodology with respect to sampling and follow up are discussed below under Development and Administration; and the survey instrument is in Appendix II.

3. IDENTIFICATION OF COST ELEMENTS

The cost elements investigated in Phase II were the same (with one exception—equipment and materials)[1] as those utilized in the Phase I study and by Dunham (1972). They included:

a. Trainee time spent in training

b. Instructor time devoted to training

c. Remedial training

d. Records management

e. Delayed entry to training

f. TTS delayed entry

g. TTS equivalency

The two major elements of cost considered are the time of instructors and the time of trainees. To improve the accuracy of the estimated costs, these two elements have been broken down into several finer elements including the instructor time devoted to training and record keeping, the time the instructor and the trainee spent in remedial training (after a trainee has failed the Apprentice Knowledge Test or the Career Development Course (CDC), end of course exam), the time the trainee spends in training, and the time the trainee spends waiting to enter training. Record keeping, remedial training, and waiting are insignificant compared with either the cost of trainee or instructor time devoted to training.

4. CONDITIONAL COST MODELS

In Phase I it was implicitly assumed that instructor time devoted to training is a "real" cost. In other words, if the instructor was not conducting OJT, he would devote his time to some other

[1]The cost of equipment and macerials in Phase I represented .6% of the total OJT cost.

activity productive to the Air Force—specifically, an activity otherwise being performed by someone else. Similarly, it was assumed that trainee time spent in training is a real cost. That is, if he were not being trained, he could be serving in some other capacity—perhaps at a lower skill level; and conversely that part of the time he spends at work, when he is not receiving training, is productive.

In Phase II an attempt was made to examine the effects of some of these assumptions explicitly. Each supervisor was asked (Appendix II, question 8) to indicate whether or not the number of his NCOs could be reduced, without a reduction in performance, if OJT were discontinued in his section. If he responded positively, he confirmed the assumption of Phase I. If he responded negatively, it was assumed that the NCO must be there anyway, that training is indeed an auxiliary activity, and that the elimination of training would not result in a decrement of costs.

Each supervisor was also asked (Appendix II, question 12) if he could carry out the productive work of his section without any loss of effectiveness with no OJT trainees. If he responded positively, it was assumed that the trainees do not really contribute to productivity (although they may be doing make-work) and therefore trainee costs are not only the marginal cost of the trainees' time while receiving instructions, but rather the costs of all their time. If he responded negatively, it was assumed that the OJT trainees do contribute to productivity and that their productive time is not a real element of training costs.

These concepts are incorporated in "Conditional Models" which treated the costs of instructor time and trainee time as a function of the individual supervisor's responses to questions, 8 and 12.

5. DEVELOPMENT AND ADMINISTRATION

The original concept of this overall study involved the exploration of three different methodologies in Phase I on a single AFSC and the application, in Phase II, of the best methodology to five other AFSC's. Although, in principle, the concept was followed, it was certainly modified in the conduct of the research. As was indicated in the Phase I report, the limited number of Administration specialists available for each sample made it important to combine all three methodologies in a single survey instrument, which was administered to each Administrative Supervisor. It also was a conclusion of the Phase I study that a "mixed methodology" asking different questions by different techniques,

and, in fact, developing certain data from other existing sources was the best strategy for Phase II. Thus, the Phase II methodology is really a combination of a number of items tried out in Phase I rather than a simple selection and reapplication of one aspect of Phase I.

Finally, other modifications to improve the phrasing of questions were also utilized in Phase II. Perhaps the best way to put it is to say that Phase II simply represents another iteration in improving the methodological development of a survey technique for generating OJT costs.

As in Phase I, the questionnaire was pilot-tested at the Air Force bases in the San Antonio area, including Lackland, Kelly, and Randolph; and some modifications were made to the phrasing of questions as a result of these tryouts. (Additional modifications derived from Phase II results are also proposed later in this report).

The sampling scheme was designed to achieve as wide a sample of bases as possible, and simultaneously to assure that no single base was overburdened with surveys. The original plan called for 100 surveys from each AFSC, from 25 bases. After a listing of the number of airmen in OJT to the 3-level for each AFSC was prepared at the Air Force Human Resources Laboratory (AFHRL) at Lackland, it became apparent that this plan would not be successful since there were not enough airmen in training in three of the AFSC's.

The final decision rule for selecting the bases and airmen to be surveyed was the following:

> Sample all available airmen in on-the-job training from the 1-to the 3-level at each CONUS Air Force base; however, no base shall receive more than 6 surveys in an AFSC.

In aggregate, 527 surveys were sent to 76 bases. It was, however, only possible to send 47 surveys in AFSC 55130, 53 in AFSC 57130, and 58 in AFSC 64730. Supervisors in AFSC 62230 received 195 surveys, and supervisors in AFSC 63130 received 174.

Approximately one month after the surveys were sent, telephone follow-ups were made to all the bases which had not completely responded to the survey, and this was continued on a bi-weekly basis until every base had fully responded.

SECTION III

RESULTS

1. RESPONSE

228 usable surveys were returned in total—30 in AFSC 55130, 25 in AFSC 57130, 90 in AFSC 62230, 72 in AFSC 63130, and 11 in AFSC 64730.

It should be emphasized that this does not represent a 43% response as might be concluded from the numbers at first glance. In general, it is more appropriate to describe the response as closer to a total Air Force population of those training situations available at the time the survey was made, rather than a fractional sample with a high non-response bias. (The one exception, perhaps, is for AFSC 64730 where the response was indeed very small).

The tape files maintained on the population of trainees in OJT at each base quickly become out-of-date due to upgrading, transfers, discharges, etc. Thus, many of the bases returned unused surveys, indicating they had no trainees in the designated AFSC or had completed as many as there were trainees and were returning the balance.

In AFSC 70230—the Administrative Specialty—studied in Phase I, most of the sections surveyed were small (averaging 7 people). Each supervisor typically had one or two trainees. (The average number of trainees in a section was 1.3). In Phase II, for the new AFSC's, the average number of personnel in a section was 43 with 2.6 trainees to the 3-level. Since the population counts were based on trainees, but the surveys were directed to supervisors, there were over 60 duplicate surveys submitted by supervisors of more than one trainee. On the principle that we are attempting to identify the cost of trainees in different training situations, rather than trainees, per se, duplicate surveys were not tabulated.

All responses were reviewed and manually edited before they were keypunched for data processing. Despite considerable improvement of the instrument the edit procedure led to additional recommendations for question improvement. These suggestions for specific question modifications are presented after the actual survey instrument in Appendix II. Numerical results of the survey are presented in the next subsection.

2. SURVEY RESULTS

The results across the AFSC's are presented in Table 1. Tables 11 through 15 in Appendix III contain the summary results, by AFSC, of the responses to the survey; questions are identified by number and a brief description. The complete questions can be found in the survey instrument, Appendix II. Appendix III also contains comments on many of the responses to specific questions.

Tables 2 through 7 list the results of the Cost Estimating Relationships or Models. Explicit definition of the models can be found in Appendix IV. There is at least one model for each of the seven cost elements previously identified and these correspond to the models utilized in Phase I.

In addition, there are five new cost models which attempt to address the problem of capacity to train and the problem of whether the trainees are productive, when not engaged in the training activity. These last five models are called Conditional Models because the costs depend or are conditional upon answers given by the supervisor about productivity and capacity in his particular section. When costs are defined as the consequences of the choice between real alternatives (Fisher, 1971, p.44), then the conditional models are improved estimators of cost because they depend on the real consequences that might result from changing the number of OJT trainees in any particular section.

The following paragraphs present a brief discussion of each of the models (see Appendix IV also).

Model 1 uses: (1) the estimate of duration of training derived from the AFHRL/Lackland files on historical data for trainees by AFSC, and (2) training time per trainee based on answers to question 18. On the average, Model 1 shows the cost of trainee time at about $650.

Model 2 uses the same estimate of training duration as Model 1, and the time spent on training by the instructors for each AFSC is based on responses to question 20. Model 2 shows instructor time at about $866 on the average.

Model 3 estimates the cost of typical delay in waiting to start 3-level training and is based on the responses to question 2. Model 4 estimates the cost of remedial training and is based on the responses to question 11. Model 5 estimates the cost of records

TABLE I: SUMMARY OF RESPONSES TO QUESTIONS ALL AFSC'S[1]

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	2.59	2.01	217
1.2	Number Upgrading To 5 Level	4.40	2.95	210
2.	Days Delay In Start To 3 Level	12.39	9.45	225
3.	Days Delay In Start To 5 Level	11.45	8.57	214
4.	Weeks, Proficiency To Award	5.89	5.83	217
5.	Week Of Training	10.86	7.86	201
6.	Percent Of Training Completed	57.09	27.75	205
7.	Percent Of 3 Skill On Arrival	16.45	18.88	213
8.	Reduction in NCOs Possible Pct	0.13	0.02	223
9.	Record Keeping Hours	2.19	1.73	223
10.1	Pct Of 3 Skill, Tech Scl Grad	40.94	23.41	224
10.2	Additional Weeks To 3 Level	4.25	2.91	219
10.3	Difference In Training Pct	0.60	0.03	220
10.4	OJT Superior Pct	0.51	0.04	130
11.1	Pct Failing ECT	18.60	22.47	199
11.2	Weeks, Remedial Training	4.13	2.41	206
11.3	Trainee Remedial Hours	8.51	5.31	206
11.4	Instructor Remedial Hours	6.53	4.55	203
12.	Effective Without Trainees Pct	0.36	0.03	225

13.

Wk	Trainee Hrs Productive Mean	Std Dev	N	Trainee Hrs Instruction Mean	Std Dev	N
1	15.52	10.38	206	24.48	10.38	206
4	19.57	8.41	206	20.43	8.41	206
8	24.62	7.27	205	15.38	7.27	205
12	29.03	7.77	200	10.97	7.77	200
16	33.54	8.34	198	6.46	8.34	198
20	36.33	7.50	190	3.67	7.50	190

14.	Number Of Personnel In Section	42.78	27.76	222
15.	More Trainees Possible	3.81	3.03	222
16.	More Trainees Without 5s	2.12	2.61	224
17.	Number of 3 Level Trainees	2.40	1.80	205
18.	Trainee Hrs Training Per Trnee	12.91	7.33	201
19.	Trainee Hrs Productive	20.08	10.38	176
20.3	Instructor Hrs E3	9.38	7.69	45
20.4	Instructor Hrs E4	11.75	9.69	118
20.5	Instructor Hrs E5	10.86	10.20	144
20.6	Instructor Hrs E6	7.54	6.35	72
20.7	Instructor Hrs E7	4.94	4.77	18
20.8	Instructor Hrs E8	2.67	1.15	3
20.9	Instructor Hrs E9	2.50	0.71	2
20.10	Instructor Hrs GS5-GS9, Off	10.20	9.30	25
	Average Instructor Hrs/Trnee	12.18	10.20	190
	Average Grade Of Instructor	4.87	0.95	193

[1]Note that question parts a, b, c, etc., are coded .1, .2, .3, etc.

TABLE 2: COST ESTIMATING RELATIONSHIPS FOR AFSC 55130

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	664.17	554.86	22
2	Instructor Time	773.33	794.94	20
3	Delayed Entry Time	158.68	97.95	25
4	Remedial Training Time	46.51	45.49	17
5	Records Management Time	44.32	30.44	20
6	Tech School Equiv Time	64.19	50.05	19
7	Tech School Delay Time	187.86	130.45	25
11	Conditional Trainee Time	1010.10	715.30	22
12	Conditional Instructor Time	40.73	203.67	25
14	Conditional Remedial Training Time	13.81	21.69	21
15	Conditional Records Mgt Time	2.17	10.86	25
16	Conditional Tech School Equiv Time	64.94	67.77	21

TABLE 3: COST ESTIMATING RELATIONSHIPS FOR AFSC 57130

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	869.55	411.97	27
2	Instructor Time	1256.54	1352.37	27
3	Delayed Entry Time	306.28	189.22	30
4	Remedial Training Time	42.45	33.25	22
5	Records Management Time	75.25	78.39	27
6	Tech School Equiv Time	133.92	196.54	25
7	Tech School Delay Time	279.50	216.72	29
11	Conditional Trainee Time	1614.51	884.21	29
12	Conditional Instructor Time	384.10	1290.00	30
14	Conditional Remedial Training Time	10.07	21.33	25
15	Conditional Records Mgt Time	8.55	25.36	30
16	Conditional Tech School Equiv Time	144.19	211.22	27

TABLE 4: COST ESTIMATING RELATIONSHIPS FOR AFSC 62230

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	706.29	415.01	81
2	Instructor Time	995.92	784.54	73
3	Delayed Entry Time	309.09	213.27	88
4	Remedial Training Time	40.13	39.77	65
5	Records Management Time	107.22	91.70	71
6	Tech School Equiv Time	94.87	102.30	66
7	Tech School Delay Time	307.33	228.42	83
11	Conditional Trainee Time	1460.62	1018.61	86
12	Conditional Instructor Time	84.59	385.83	86
14	Conditional Remedial Training Time	11.42	27.32	79
15	Conditional Records Mgt Time	8.35	41.79	85
16	Conditional Tech School Equiv Time	101.77	130.62	77

TABLE 5: COST ESTIMATING RELATIONSHIPS FOR AFSC 63130

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	450.80	282.69	60
2	Instructor Time	533.98	411.49	59
3	Delayed Entry Time	278.03	235.76	72
4	Remedial Training Time	51.49	34.04	51
5	Records Management Time	59.00	57.65	59
6	Tech School Equiv Time	127.93	125.31	59
7	Tech School Delay Time	248.01	171.11	67
11	Conditional Trainee Time	662.90	456.18	62
12	Conditional Instructor Time	67.54	200.21	70
14	Conditional Remedial Training Time	16.58	32.14	62
15	Conditional Records Mgt Time	8.29	26.91	70
16	Conditional Tech School Equiv Time	91.08	108.78	62

TABLE 6: COST ESTIMATING RELATIONSHIPS FOR AFSC 64730

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	747.50	457.90	11
2	Instructor Time	997.19	499.63	11
3	Delayed Entry Time	317.13	283.21	11
4	Remedial Training Time	30.15	14.46	8
5	Records Management Time	166.05	138.19	9
6	Tech School Equiv Time	102.73	56.99	11
7	Tech School Delay Time	348.06	251.85	10
11	Conditional Trainee Time	1405.86	864.26	11
12	Conditional Instructor Time	0.0	0.0	10
14	Conditional Remedial Training Time	3.97	6.15	7
15	Conditional Records Mgt Time	0.0	0.0	10
16	Conditional Tech School Equiv Time	63.32	27.49	10

TABLE 7: COST ESTIMATING RELATIONSHIPS FOR ALL AFSC'S

	MODEL	MEAN $	STD DEV $	N
1	Trainee Time	649.60	421.40	201
2	Instructor Time	866.15	824.26	190
3	Delayed Entry Time	282.58	215.52	226
4	Remedial Training Time	44.17	37.06	163
5	Records Management Time	83.37	83.21	186
6	Tech School Equiv Time	108.37	122.45	180
7	Tech School Delay Time	272.93	204.22	214
11	Conditional Trainee Time	1196.29	904.43	210
12	Conditional Instructor Time	111.06	553.30	221
14	Conditional Remedial Training Time	12.89	27.27	194
15	Conditional Records Mgt Time	7.28	31.66	220
16	Conditional Tech School Equiv Time	98.34	131.20	197

management and is based on question 9. Models 3, 4 and 5 are identical to models used in Phase I. They cover three relatively small portions of the total cost of training and are based on questions which ask for average experience rather than journal recording. The magnitude of these estimates—approximately $400—is consistent with the results in Phase I.

Models 6 and 7 relate to the TTS graduate. Model 6 estimates the cost of bringing the TTS graduate up to the level of an OJT-trained airman. It is based on the average cost per week of training (both instructor and trainee) as developed in Models 1 and 2, and is an estimate of the average time it takes to bring the TTS graduate to an equivalent OJT 3-level. Model 7 is merely the average delay awaiting the start of 5-level training for the TTS graduate. Both Models 6 and 7 can be thought of as additions to TTS costs to make them comparable to OJT costs.

Perhaps, the more interesting and useful set of models are 11, 12, 14, 15 and 16. These are the Conditional Models previously identified. Using the Conditional Models, trainee costs are about $1200 and instructor costs $100. The sum of the average conditional model is $300 less than the sum of the first five models.

In other words, using the conditional models implies a higher cost of the trainee's time, because the trainees may not contribute to productivity, and therefore all the time they are in training (for those who don't contribute) is a cost of training, just as it is for those in resident technical school. On the other hand in many of the training situations, the instructor's time is essentially free, since he must be there for other reasons, and in fact has "free" time to do the training. On balance, when a more careful analysis of real costs is made conditional on the training situations as they actually exist, the conditional cost models have a lower average cost by about $300.00.

Table 8 summarizes the results of the models for each AFSC for both the basic and conditional models. The numerical results show the differences between the conditional and basic models as well as the distinct differences between AFSC. It should be pointed out, however, that the differences among the costs of OJT in each AFSC are primarily a function of the duration of training which is derived from historical data from Air Force personnel files. (See Appendix III).

In summary, the numerical results show no startling differences from the 1st Phase. There are differences among AFSC's, as one might

TABLE 8: SUMMARY COSTS[1]

AFSC	SUM OF MODELS 1 TO 5			SUM OF MODELS 11,12,3,14,15		
	Mean	Std Dev	N	Mean	Std Dev	N
55130	$2411	$1324	21	$2346	$1448	24
57130	$1791	$1159	16	$1299	$ 799	18
62230	$2165	$1181	64	$1941	$1155	77
63130	$1382	$ 625	50	$1044	$ 592	56
64730	$2264	$ 438	7	$1749	$1039	7
ALL AFSC	$1916	$1094	158	$1647	$1120	182

[1]These summary costs are derived by averaging the sums of the models for each survey; not by adding up the average results for each model. This gives a direct estimate of the variance of the sum without making any limiting assumptions about independence or covariance.

expect, due primarily to differences in duration of training, but the other results are very similar, for example:

- It takes about 19 weeks to complete 3-level proficiency training on the average.
- An OJT trainee spends about 13 hours per week in training, and, in many cases, the rest of his work week may not be productive work.
- An instructor spends about 12 hours per week per trainee, but this is usually not his primary task and a reduction in training workload will not typically reduce costs.
- The other elements of cost are relatively small.
- A TTS graduate has only about 40% of the capability of an OJT trained airman when he starts, and it takes him about four weeks to make up the difference.

3. TECHNICAL TRAINING SCHOOL COSTS

In Phase I, TTS costs were derived from estimates developed by RAND Corporation based on a generalized costing methodology which included total recurring costs, both fixed and variable, (Allison, 1970). In reporting the findings, however, the fixed costs of TTS were eliminated to make them more like "marginal costs" and improve the comparability with OJT costs.

TTS Cost Per Graduate estimates for the AFSC's studied in Phase II are displayed in Table 9, Resident Technical Training School Cost Estimates. Cost and Economic Analysis Division, Management Analysis Directorate, ATC Comptroller is the source of the costs shown for four of the AFSC's listed in Table 9. Cost Per Graduate estimates for AFSC 62230 were not available from ATC and were developed by RAND using their costing methodology. This RAND cost estimate reflects only variable cost and not fixed cost. In addition, it is appropriate to add the results of Model 6, TTS Equivalency Time, and Model 7, TTS Delayed Entry Time into Training to the

TABLE 9: RESIDENT TECHNICAL TRAINING SCHOOL COST ESTIMATES

(DOLLARS)

AFSC	Cost Per Graduate	Delay And Equivalency Costs	Total Cost Per Graduate
55130	1443	423	1866
57130	1879	252	2131
62230	2920	409	3329
63130	2152	339	2491
64730	1081	403	1484

Cost Per Graduate. These results are also shown in Table 9.

4. PERFORMANCE OF OJT AND TECH SCHOOL GRADUATES

The problem of assessing the relative performance of OJT graduates versus TTS graduates is indeed complex. Based on the Phase I research as well as other research, it was concluded in the Phase I report that no evidence had been advanced to support the hypothesis that either OJT or TTS graduates were superior to each other in performance (see, in particular, Dunham 1973). Some additional evidence on the perceived performance of the two types of training was collected during Phase II. Responses to questions 10.c and 10.d indicated that 60% of the supervisors (all AFSC's) perceived no significant difference in the performance of either type of trainee once he had achieved the 5-level. Of those who did perceive a difference in performance, 51% indicated that OJT graduates were superior to TTS graduates. This additional data corroborates the previous conclusion, viz., that neither type of training results in superior performance at the 5-level.

IV. DISCUSSION OF RESULTS

1. Methodology

During Phase I, three different survey methodologies were explored for generating cost data, and on the basis of the results the Phase II methodology was developed. This methodology can be differentiated from the others tried in Phase I by the following:

- Use of existing data files for information on duration of training.
- Use of simple questions on average experience where the parameters affect cost elements which are relatively small.
- Use of journal recording by the respondent supervisor over a sample period in order to estimate parameters which affect the major cost elements.
- Use of a survey instrument which is independent of AFSC.

In addition to the above four characteristics, which were essentially recommended in the Phase I Final Report, another important difference in the methodology was examined. This was the use of conditional models which attempted to identify what the actual cost consequences of changing the number of trainees or instructors in a particular section might be, from actual results obtained from that section.

The Phase II survey showed that this was not only possible, but that the conditional models gave substantially different answers for the cost of trainee time and instructor time, when compared to the basic models which were developed in Phase I. By coincidence the differences were in opposite and offsetting directions so that the summary results were not as dramatically different as they might have been, but the differences for the cost of instructor time and the cost of trainee time were nevertheless substantial.

The study once again confirmed the ability to get estimates of trainee and instructor time by journal recording; that is, most respondents completed the questions, with what appear to be reasonable answers.

They also appear to have some reliability and consistency in terms of comparison to previous studies, and other data in this

study. In addition, the response, where trainees were actually available, was apparently very close to total so that non-response bias did not seem to be a problem.

Finally, it was possible to obtain answers about the significance of the time (cost) data being collected in each individual section and therefore to build aggregate conditional models, which may reflect a more appropriate conceptualization of costs than the simpler models used in Phase I.

Of course, each time a survey instrument is utilized, additional improvements to the question phrasing and survey format can be generated. Careful manual editing of each survey was carried out with the objective of not only assuring the quality of numerical results, but also to ferret out inadequacies and to make improvements in the instrument. A list of these specific recommendations is attached to the sample instrument provided in Appendix II.

2. RELATIONSHIPS OF OJT COSTS TO TTS COSTS

Table 10 displays the estimated OJT costs for both the standard and the conditional models, as well as TTS costs by AFSC. Recall that the sample size for AFSC's 57130 and 64730 were quite small and, therefore, of limited value. For completeness, OJT/TTS cost estimates from previous studies (AFSC's 29130 and 70230) are also included.

TABLE 10: COMPARISON OF OJT COSTS AND RESIDENT TECHNICAL TRAINING SCHOOL COSTS (DOLLARS) PER TRAINEE

AFSC	Standard OJT Costs	Conditional OJT Costs	TTS Costs
55130	2411	2346	1866
57130	1791	1299	2131
62230	2165	1941	3329
63130	1382	1044	2491
64730	2264	1749	1484
29130[a]	1311	—	2780
70230[b]	1545	—	2281

[a] Dunham, 1972

[b] AFHRL-TR-74-34 (Phase I Report)

V CONCLUSION

1. SIGNIFICANCE OF RESULTS

The most significant finding of the Phase I and Phase II results is that it is possible to develop reasonable estimates of OJT cost using mail survey techniques. Further, Phase II demonstrated that it is possible to refine and improve the techniques so that the survey is brief, less costly, easier to implement and AFSC independent.

As in Phase I and in Dunham's earlier work, the results indicate differences between OJT and TTS. Once again it is important to caution that the cost differences pointed out will only be the consequences of Air Force policy if the Air Force acts in ways which will generate such costs. If, for example, the Air Force sends more DDA's to OJT but does not reduce the size of its technical training school faculty, then there will be no cost savings. Even the conditional models in this study, and the cost elements they represent, assume that the variable elements of cost will change with the number of trainees as a matter of AF management policy. It is also once again appropriate to state another caution with respect to the concept of quality. Neither Dunham's study nor Phase I or II of this study detected real differences in quality between OJT and TTS based on supervisor's opinions or other criteria; however, if there were important differences, these should affect Air Force decisions.

2. RECOMMENDATIONS

The results obtained in Phase II with the five additional AFSC's considered, suggest that it is possible to implement a system for collecting cost data by survey for other AFSC's. Whether or not this is worthwhile depends, in part, on whether the Air Force is prepared to use this information, as well as other data, to allocate trainees between OJT and TTS. Note again that this would result in lower costs only if: (1) the allocation procedure or model was appropriately designed, and (2) the Air Force acted to reduce costs consistent with the model's assumptions.

Thus, the major recommendation of this study is that the Air Force begin the collection of cost data on OJT for additioanl AFSC's and additional skill levels using survey techniques similar to those developed in Phase II of this study.

REFERENCES

1. Allison, S.L., A Computer Model For Estimating Resources And Costs Of An Air Force Resident Technical Training Course, WN-7044-PR, Santa Monica, California: RAND Corporation, 1970.

2. Dunham, Captain A. D., Estimated Cost Of On-The-Job Training To The 3-Skill Level In The Communication Center Operations Specialty, AFHRL-TR-72-56, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas, (1972). AD-753 093.

3. Dunham, Captain A. D., Optimal Utilization Of On-The-Job Training And Technical Training School, Proceedings of Military Testing Association, Annual Meeting, San Antonio, Texas, 1973

4. Dunham, Captain A.D., Nordhauser, Major F., and Samers, B., The Development of A Methodology For Estimating The Cost Of Air Force On-The-Job Training, AFHRL-TR-74-34, Air Force Human Resources Laboratory, Lackland Air Force Base, Texas, (1974). AD-785 141.

5. Fisher, G. H., Cost Considerations in Systems Analysis, New York: American Elseyer, 1971.

APPENDIX I

DESCRIPTIONS OF AFSC'S

55130: Pavements Maintenance Specialist

The Pavements Maintenance Specialist will construct, maintain and repair pavements and other surface areas, which may include airfield mats and membranes, aircraft revetments, railroads, subgrades, and drainage structures. He may also perform erosion control measures, operate fixed and mobile plants, quarries and borrow pits.

57130: Fire Protection Specialist

The Fire Protection Specialist extinguishes aerospace vehicle and real property fires, rescues personnel, prevents fire and water damage, operates firefighting vehicles and equipment, performs fire protection and prevention duties, operates fire alarm communication systems, and administers first aid.

62230: Cook

The Cook selects, prepares, cooks, arranges, decorates and serves foods in kitchens, dining halls, aircraft, and in the field, correctly utilizing and maintaining equipment and insuring that sanitation and safety precautions are carried out.

63130: Fuel Specialist

The Fuel Specialist receives, stores, issues, transports, samples, inspects, and documents petroleum products and fuels, missile propellants and other special chemicals necessary for the operation of aircraft and missiles. He understands the technical characteristics of the products, the hazards involved and the precautions necessary for their appropriate handling.

64730: Materiel Facilities Specialist

The Materiel Facilities Specialist receives, prepares for, storage, stores, segregates, inventories, issues, delivers, prepares shipments, identifies, inspects and classifies property.

Sources:

Specialty Training Standards, Headquarters U. S. Air Force, Washington, D. C.

551X0	Pavements Maintenance Specialist	2 Dec. 1970
57130	Fire Protection Specialist	7 May 1970
622X0	Cook	31 Dec. 1970
631X0	Fuel Specialist	10 July 1970
647X0	Materiel Facilities Specialist	19 April 1970

APPENDIX II
SURVEY INSTRUMENT

DEPARTMENT OF THE AIR FORCE
AFHRL PERSONNEL RESEARCH DIVISION (AFSC)
LACKLAND AIR FORCE BASE, TEXAS 78236

REPLY TO ATTN OF: PESE (Capt Dunham, 4106)

SUBJECT: OJT Cost Survey

MAY 31 1973

TO: OJT Supervisors

1. The purpose of the attached survey(s) is to collect data concerning On-the-Job Training to the 3-skill level. This survey data, along with information from other sources, will be used in decisions concerning OJT and Technical Training School.

2. Answering the survey questions with some thought and effort will aid Air Force decision makers in the management of your AFSC.

3. Permission to conduct this survey was granted by Hq USAF/DPXOS, reference Air Force Personnel Test (AFPT) Number 80-5X6X-109.

FOR THE COMMANDER

OSCAR A. BERTHOLD, Colonel, USAF
Chief, Personnel Research Division

1 Atch
Survey

INSTRUCTIONS TO OJT SUPERVISORS

The accompanying survey is part of a research effort directed toward evaluating the costs and benefits of "On the Job Training." Your cooperation in completing the survey is requested. While it will probably take less than an hour of your time, the information you provide will be very valuable to the research and will help to improve Air Force policies concerning OJT and Technical Training School.

If you do not quite understand a question, give the best answer you can and feel free to write in an explanatory comment next to the question or on the back of the form. If you are completely uncertain about what a question means, enter a "?". If a question, for some reason, does not apply to your unit, enter "N.A."

The survey is divided into two parts: A and B. Part A asks you to try to make the best estimates you can about your average experience.

Part B asks you to keep a record of activities, each day for a week. It is important that you do this daily, so that what was actually done is fresh in everyone's mind. If you also feel that the week you reported on is not representative of your normal operations, so indicate by writing in an appropriate comment; and if you can, indicate what the average value ought to be in your judgment.

If you have any questions, contact Capt Dunham, Autovon 473-4106.

Q Number [ ][ ][ ][ ][ ]

Upgrade Training in AFSC [ ][ ][ ][ ][ ][ ][ ]

SPECIAL INSTRUCTIONS

1. The trainee's supervisor should complete this survey. Approximately one half (1/2) hour will be required to complete Part A, and five minutes per day for a week will be necessary for Part B.

2. When answering the questions, be sure to have a Job Proficiency Guide (STS), and the Consolidated Training Record AF-623 for each person undergoing training, handy to refer to.

3. The person who fills out this survey is encouraged to ask for the help of others, such as the OJT Monitor or an instructor when uncertain about the answer to a question.

4. Part A which should be completed immediately, is to be returned together with Part B within 8 days. Do not start Part B before completing Part A.

5. If there is difficulty in deciding what information is being asked for in any question, contact Capt Dunham, Autovon 473-4106.

BACKGROUND INFORMATION

NAME [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ] [ ] [ ]

Last First Initial Middle Initial

GRADE If Air Force NCO enter "4" for E4, "5" for E5, etc.
If Air Force Officer enter "0."
If Civilian enter last digit of GS GRADE, e.g., "1" for GS.11. [ ]

SOCIAL SECURITY NUMBER [ ][ ][ ] [ ][ ] [ ][ ][ ][ ]

PAS CODE [ ][ ][ ]

PART A

1. How many trainees do you have upgrading to the 3 and 5 level in your section?

☐ 3 level trainees ☐ 5 level trainees

2. When a man (or woman) first reports directly from Basic Military Training, it may take some time before he actually begins training and work, even though his "date of entry" to training may be the same as his reporting date. This delay may be due to personnel processing, the need to wait for security clearance, or some other cause. Approximately how many days does it take before the newly arrived "helper" actually begins OJT?

☐☐ work days

3. There is also delay in entering training associated with the arrival of a 3 level from Technical School. In addition to personnel processing, familiarization with procedures specific to your situation may be necessary before he/she actually begins 5 level training. On the average, this delay is:

☐☐ work days

4. On the average, how many weeks elapse between achievement of 3 level proficiency and actual award of the 3 skill level AFSC?

☐☐ weeks

5. What week of training is your most average 1 level (helper) in?

☐☐ week

6. What % of the 3 level proficiency training do you estimate he has completed?

☐☐ %

7. When he arrived what % of the duties of a 3 level could he complete?

☐☐ %

8. If you stopped doing OJT training would you be able to reduce the number of NCO's in your work area without significantly reducing effectiveness? (Insert a "1" for Yes, or a "0" for No).

☐

9. During the training period for 3 level OJT, the instructor (trainer) must spend some time keeping training records up to date. On the average over the whole training period, how many hours (or fractions of hours) per week does the instructor (trainer) spend in record keeping for one trainee?

☐☐ Hrs.

Part A (cont'd)

10. The newly arrived Tech School-trained 3 level is not as productive at first as the OJT-trained 3 level is, although he may soon close the gap.

a. In your estimate, what percentage of the workload of an OJT-trained 3 level can the Tech School graduate handle immediately after his arrival? ☐☐ Percent

b. How many weeks does it take before the Tech School-trained 3 level works with as little supervision as an OJT-trained 3 level? ☐☐ Weeks

c. After both types of 3 levels are awarded their 5 level, on the average do you consider either to have superior performance? (Insert a "1" for Yes, or a "0" for No.) ☐

d. If your answer was "yes," which type of 3 level do you consider to have better performance? (Insert a "1" for OJT, or a "0" for Tech School.) ☐

11. If extra (remedial) training is conducted in your office for trainees who fail the End of Course Exam (Apprentice Knowledge Test), answer the following questions:

a. In your experience, what percent of the 3 level trainees fail the End of Course Test the first time they take it? ☐☐ Percent

b. On the average, how many weeks of additional training are given to airmen who fail the End of Course Exam before they take the test again? ☐☐ Weeks

c. How many hours per week, during the normal work week, does the trainee spend engaged in this remedial training? ☐☐ Hrs.

d. How many hours per week, during the normal work week, does the instructor spend engaged in this remedial training? ☐☐ Hrs.

12. If you stopped doing OJT training and had no replacements for the trainees could your section continue to perform its mission without significantly reducing effectiveness? (Insert a "1" for Yes, or a "0" for No.) ☐

GO ON TO NEXT PAGE

Q Number [| | | | |]

Part A (cont'd)

13. Based on your past experience, and, if you feel you need help, the experience of other qualified personnel in your section, list the average number of productive and non-productive hours of work for the trainee upgrading to the 3 level for each week between start of training and award of skill level. For instance, in the fourth week of training your trainee spent approximately 30 hours receiving instruction and reading and 10 hours doing productive work. Your second entry would look like this:

4	10	30

Note that the hours for each week must sum to 40, and you must have an entry in every week. If, on the average, trainees complete training between the 12th and 16th week, then the entry for the sixteenth week should show a "40" under productive and a "0" under instruction.

Weeks of Training (to the 3-level)	Trainee Productive Hrs Per Week	Instruction & Reading Hrs Per Week
1		
4		
8		
12		
16		
20		

14. What is the total number of personnel in your section (officer, enlisted, and civilian)? [|] no. of pers.

15. In addition to the trainees you now have responsibility for, how many more 1 level trainees could your section train right now without significantly reducing the effectiveness of section operations? (ignoring the limit on authorized number of personnel) [ ] 1 level trainees

16. If you had to lose a qualified 5 level for each new 1 level trainee (helper), how many more 1 level trainees could your unit train right now without significantly reducing the effectiveness of section operations? [ ] 1 level trainees

GO ON TO NEXT PAGE

PART B

FOR ONE WEEK PLEASE KEEP A RECORD AT THE END OF EACH DAY OF THE AMOUNT OF TIME SPENT IN EACH CATEGORY.

17. How many DDA airmen do you currently have enrolled in OJT to the 3 level?

☐ Airmen

18. Record daily the total hours your 1 level trainees spend on reading and receiving instruction each day. (Be sure and ask your trainees for their assistance in completing this question).

19. Record daily the total hours your 1 level trainees spend in activities contributing to office productivity.

20. Record daily the total hours of instruction provided by each grade of instructor.

Q Number ☐☐☐☐☐

	Mon	Tues	Wed	Thur	Fri
E3	☐☐	☐☐	☐☐	☐☐	☐☐
E4	☐☐	☐☐	☐☐	☐☐	☐☐
E5	☐☐	☐☐	☐☐	☐☐	☐☐
E6	☐☐	☐☐	☐☐	☐☐	☐☐
E7	☐☐	☐☐	☐☐	☐☐	☐☐
E8	☐☐	☐☐	☐☐	☐☐	☐☐
E9	☐☐	☐☐	☐☐	☐☐	☐☐
GS-5	☐☐	☐☐	☐☐	☐☐	☐☐
GS-6	☐☐	☐☐	☐☐	☐☐	☐☐
GS-7	☐☐	☐☐	☐☐	☐☐	☐☐
GS-8	☐☐	☐☐	☐☐	☐☐	☐☐
GS-9	☐☐	☐☐	☐☐	☐☐	☐☐
Officer	☐☐	☐☐	☐☐	☐☐	☐☐

AFTER YOU HAVE COMPLETED THE ENTRIES FOR FIVE DAYS RETURN THE SURVEY TO YOUR BASE CBPO

RECOMMENDED REVISIONS TO INSTRUMENT

The following recommended minor revisions to the instrument result from detailed review and editing of the responses. They should be regarded as suggestions for improving future instruments, should the Air Force decide to implement the work on a broad scale.

Question 5 should read "trainee working toward the 3-level" rather than "1 level helper."

Question 9: The Answer block should have three spaces with a decimal, i.e., 

Question 13: Interesting for research purposes but can probably be eliminated.

Questions 15 & 16: (See Question 5).

Question 17: Should be stated identically to question 1 or eliminated.

Question 18 & 19: (See Question 5).

Question 20: Add "for trainees working to the 3-level." Eliminate E-9 through Officer and insert "Other"--use average wage.

On Page 1, Grade: Change instruction to read — If civilian enter a "1."

APPENDIX III
SUMMARY RESULTS

TABLE 11 : SUMMARY OF RESPONSES TO QUESTIONS AFSC 55130

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	1.70	0.91	27
1.2	Number Upgrading To 5 Level	2.86	2.22	29
2.	Days Delay In Start To 3 Level	13.43	8.30	30
3.	Days Delay In Start To 5 Level	11.72	9.09	29
4.	Weeks, Proficiency To Award	7.04	8.13	26
5.	Week Of Training	12.56	11.67	25
6.	Percent Of Training Completed	53.46	32.73	24
7.	Percent Of 3 Skill On Arrival	23.50	25.99	28
8.	Reduction In NCO's Possible Pct	0.20	0.07	30
9.	Record Keeping Hours	1.47	1.64	30
10.1	Pct Of 3 Skill, Tech Scl Grad	43.20	24.59	30
10.2	Additional Weeks To 3 Level	4.71	4.56	28
10.3	Difference In Training Pct	0.47	0.09	30
10.4	OJT Superior Pct	0.36	0.13	14
11.1	Pct Failing ECT	12.19	14.64	26
11.2	Weeks, Remedial Training	3.96	2.31	26
11.3	Trainee Remedial Hours	9.96	5.49	26
11.4	Instructor Remedial Hours	6.60	4.78	25
12.	Effective Without Trainees Pct	0.53	0.09	30

13.

	Trainee Hrs Productive			Trainee Hrs Instruction		
Wk	Mean	Std Dev	N	Mean	Std Dev	N
1	18.69	8.24	29	21.31	8.24	29
4	20.97	7.76	29	19.03	7.76	29
8	25.03	5.47	29	14.97	5.47	29
12	30.03	5.63	29	9.97	5.63	29
16	35.79	6.63	29	4.21	6.63	29
20	37.07	5.82	28	2.93	5.82	28

14.	Number Of Personnel In Section	30.67	20.04	30
15.	More Trainees Possible	3.97	3.08	30
16.	More Trainees Without 5's	3.10	2.80	30
17.	Number Of 3 Level Trainees	1.71	0.90	28
18.	Trainee Hrs Training Per Trnee	14.33	5.97	27
19.	Trainee Hours Productive	20.80	9.58	25
20.3	Instructor Hrs E3	14.00	9.59	5
20.4	Instructor Hrs E4	17.00	18.14	16
20.5	Instructor Hrs E5	9.13	4.02	15
20.6	Instructor Hrs E6	7.90	9.47	10
20.7	Instructor Hrs E7	5.67	1.15	3
20.8	Instructor Hrs E8	0.0	0.0	0
20.9	Instructor Hrs E9	0.0	0.0	0
20.10	Instructor Hours GS5-GS-9, Off	11.25	6.18	4
	Average Instructor Hrs/Trnee	14.41	14.86	27
	Average Grade Of Instructor	4.92	1.17	28

TABLE 12: SUMMARY OF RESPONSES TO QUESTIONS AFSC 57130

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	4.33	2.90	24
1.2	Number Upgrading To 5 Level	6.32	3.05	25
2.	Days Delay In Start To 3 Level	6.96	4.30	25
3.	Days Delay In Start To 5 Level	7.88	5.47	25
4.	Weeks, Proficiency To Award	5.83	4.83	23
5.	Week Of Training	8.21	5.96	24
6.	Percent Of Training Completed	54.71	21.78	24
7.	Percent Of 3 Skill On Arrival	7.91	11.30	22
8.	Reduction In NCO's Possible Pct	0.04	0.04	25
9.	Record Keeping Hours	2.12	1.53	25
10.1	Pct Of 3 Skill, Tech Scl Grad	45.20	22.84	25
10.2	Additional Weeks To 3 Level	3.33	1.24	24
10.3	Difference In Training Pct	0.60	0.10	25
10.4	OJT Superior Pct	0.53	0.13	15
11.1	Pct Failing ECT	13.55	22.30	20
11.2	Weeks, Remedial Training	3.48	0.99	23
11.3	Trainee Remedial Hours	11.87	7.03	23
11.4	Instructor Remedial Hours	7.17	5.97	23
12.	Effective Without Trainees Pct	0.24	0.09	25

13.	Trainee Hrs Productive			Trainee Hrs Instruction		
	Wk	Mean	Std Dev N	Mean	Std Dev	N
	1	12.26	10.51 19	27.74	10.51	19
	4	16.68	10.26 19	23.32	10.26	19
	8	22.22	7.50 18	17.78	7.50	18
	12	26.29	8.85 14	13.71	8.85	14
	16	32.64	11.20 14	7.36	11.20	14
	20	34.09	11.79 11	5.91	11.79	11

14.	Number Of Personnel In Section	65.13	28.40	24
15.	More Trainees Possible	3.80	3.58	25
16.	More Trainees Without 5's	2.13	3.27	24
17.	Number Of 3 Level Trainees	4.17	2.71	23
18.	Trainee Hrs Training Per Trnee	14.18	11.34	22
19.	Trainee Hours Productive	15.23	10.26	17
20.3	Instructor Hrs E3	7.00	6.68	4
20.4	Instructor Hrs E4	11.57	8.17	14
20.5	Instructor Hrs E5	11.18	12.85	17
20.6	Instructor Hrs E6	11.44	7.80	9
20.7	Instructor Hrs E7	5.00	0.0	1
20.8	Instructor Hrs E8	4.00	0.0	1
20.9	Instructor Hrs E9	2.00	0.0	1
20.10	Instructor Hours GS-5-GS-9, Off	15.38	13.73	8
	Average Instructor Hrs/Trnee	9.96	9.02	20
	Average Grade Of Instructor	5.32	1.01	21

TABLE 13: SUMMARY OF RESPONSES TO QUESTIONS AFSC 62230

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	2.64	2.03	86
1.2	Number Upgrading To 5 Level	4.99	2.87	84
2.	Days Delay In Start To 3 Level	13.56	9.35	88
3.	Days Delay In Start To 5 Level	12.89	9.58	83
4.	Weeks, Proficiency To Award	5.41	5.07	87
5.	Week Of Training	11.95	7.92	77
6.	Percent Of Training Completed	56.63	28.33	81
7.	Percent Of 3 Skill On Arrival	19.44	19.36	85
8.	Reduction In NCO's possible Pct	0.08	0.03	86
9.	Record Keeping Hours	2.28	1.76	87
10.1	Pct Of 3 Skill, Tech Scl Grad	47.57	20.52	84
10.2	Additional Weeks To 3 Level	4.54	2.44	82
10.3	Difference In Training Pct	0.71	0.05	82
10.4	OJT Superior Pct	0.51	0.07	57
11.1	Pct Failing ECT	21.09	22.29	82
11.2	Weeks, Remedial Training	4.52	2.49	84
11.3	Trainee Remedial Hours	6.96	4.48	83
11.4	Instructor Remedial Hours	5.48	3.88	83
12.	Effective Without Trainees Pct	0.43	0.05	87

13.

	Trainee Hrs Productive			Trainee Hrs Instruction		
Wk	Mean	Std Dev	N	Mean	Std Dev	N
1	18.07	11.03	82	21.93	11.03	82
4	21.00	8.50	81	19.00	8.50	81
8	25.16	7.96	81	14.84	7.96	81
12	29.23	8.00	79	10.77	8.00	79
16	32.65	8.34	79	7.35	8.34	79
20	35.35	8.17	79	4.65	8.17	79

14.	Number Of Personnel In Section	40.34	24.18	87
15.	More Trainees Possible	3.82	2.84	87
16.	More Trainees Without 5's	1.92	2.22	89
17.	Number Of 3 Level Trainees	2.39	1.74	83
18.	Trainee Hrs Training Per Trnee	11.34	5.98	81
19.	Trainee Hours Productive	20.05	10.85	66
20.3	Instructor Hrs E3	11.38	8.94	21
20.4	Instructor Hrs E4	11.05	8.19	41
20.5	Instructor Hrs E5	11.02	11.01	59
20.6	Instructor Hrs E6	5.50	4.32	28
20.7	Instructor Hrs E7	3.45	1.51	11
20.8	Instructor Hrs E8	2.00	0.0	1
20.9	Instructor Hrs E9	3.00	0.0	1
20.10	Instructor Hours GS5-GS-9, Off	6.67	5.57	9
	Average Instructor Hrs/Trnee	12.06	10.10	73
	Average Grade Of Instructor	4.73	0.71	73

TABLE 14: SUMMARY OF RESPONSES TO QUESTIONS AFSC 63130

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	2.44	1.66	70
1.2	Number Upgrading to 5 Level	3.95	2.87	62
2.	Days Delay In Start To 3 Level	12.19	10.34	72
3.	Days Delay In Start To 5 Level	10.40	7.18	67
4.	Weeks, Proficiency To Award	6.13	6.16	70
5.	Week Of Training	10.82	6.45	66
6.	Percent Of Training Completed	61.99	26.08	68
7.	Percent Of 3 Skill On Arrival	12.25	14.47	69
8.	Reduction In NCO's Possible Pct	0.19	0.05	72
9.	Record Keeping Hours	2.33	1.76	72
10.1	Pct Of 3 Skill, Tech Scl Grad	31.34	23.79	74
10.2	Additional Weeks To 3 Level	4.14	3.13	74
10.3	Difference In Training Pct	0.54	0.06	72
10.4	OJT Superior Pct	0.56	0.08	39
11.1	Pct Failing ECT	19.41	25.36	63
11.2	Weeks, Remedial Training	3.98	2.78	65
11.3	Trainee Remedial Hours	9.06	5.08	66
11.4	Instructor Remedial Hours	7.81	4.66	64
12.	Effective Without Trainees Pct	0.26	0.05	72

13.

	Trainee Hrs Productive			Trainee Hrs Instruction		
Wk	Mean	Std Dev	N	Mean	Std Dev	N
1	12.58	9.69	66	27.42	9.69	66
4	18.28	8.22	67	21.72	8.22	67
8	24.07	7.34	67	15.93	7.34	67
12	28.37	8.07	67	11.63	8.07	67
16	33.29	8.70	66	6.71	8.70	66
20	37.17	6.72	63	2.83	6.72	63

14.	Number Of Personnel In Section	47.34	30.21	70
15.	More Trainees Possible	3.99	3.20	69
16.	More Trainees Without 5's	2.06	2.85	70
17.	Number Of 3 Level Trainees	2.23	1.47	60
18.	Trainee Hrs Training Per Trnee	13.79	7.45	60
19.	Trainee Hours Productive	21.21	10.03	57
20.3	Instructor Hrs E3	5.54	2.47	13
20.4	Instructor Hrs E4	11.18	6.97	39
20.5	Instructor Hrs E5	11.64	10.35	45
20.6	Instructor Hrs E6	8.48	6.28	21
20.7	Instructor Hrs E7	13.50	13.44	2
20.8	Instructor Hrs E8	0.0	0.0	0
20.9	Instructor Hrs E9	0.0	0.0	0
20.10	Instructor Hours GS-5-GS9, Off	7.33	2.31	3
	Average Instructor Hrs/Trnee	11.90	8.59	59
	Average Grade Of Instructor	4.87	1.10	60

TABLE 15: SUMMARY OF RESPONSES TO QUESTIONS AFSC 64730

	QUESTION	MEAN	STD DEV	N
1.1	Number Upgrading To 3 Level	1.40	0.70	10
1.2	Number Upgrading To 5 Level	2.00	1.49	10
2.	Days Delay In Start To 3 Level	13.91	12.42	11
3.	Days Delay In Start To 5 Level	14.60	10.56	10
4.	Weeks, Proficiency To Award	5.64	5.33	11
5.	Week Of Training	4.11	2.47	9
6.	Percent Of Training Completed	38.13	31.03	8
7.	Percent Of 3 Skill On Arrival	19.44	22.00	9
8.	Reduction In NCO's Possible Pct	0.0	0.0	10
9.	Record Keeping Hours	2.67	1.66	9
10.1	Pct Of 3 Skill, Tech Scl Grad	39.09	21.66	11
10.2	Additional Weeks To 3 Level	3.64	1.21	11
10.3	Difference In Training Pct	0.45	0.15	11
10.4	OJT Superior Pct	0.40	0.22	5
11.1	Pct Failing ECT	20.13	20.39	8
11.2	Weeks, Remedial Training	3.50	0.53	8
11.3	Trainee Remedial Hours	5.63	1.77	8
11.4	Instructor Remedial Hours	5.13	2.17	8
12.	Effective Without Trainees Pct	0.36	0.15	11

13.	Trainee Hrs Productive			Trainee Hrs Instruction		
	Wk	Mean	Std Dev N	Mean	Std Dev	N
	1	11.00	6.99 10	29.00	6.99	10
	4	18.00	4.22 10	22.00	4.22	10
	8	27.00	4.22 10	13.00	4.22	10
	12	32.45	7.16 11	7.55	7.16	11
	16	37.00	4.22 10	3.00	4.22	10
	20	39.44	1.67 9	0.56	1.67	9

14.	Number Of Personnel In Section	17.27	11.33	11
15.	More Trainees Possible	2.18	1.60	11
16.	More Trainees Without 5's	1.36	1.03	11
17.	Number Of 3 Level Trainees	1.36	0.67	11
18.	Trainee Hrs Training Per Trnee	13.73	8.03	11
19.	Trainee Hrs Productive	20.36	10.92	11
20.3	Instructor Hrs E3	6.50	2.12	2
20.4	Instructor Hrs E4	8.00	2.78	8
20.5	Instructor Hrs E5	7.88	4.29	8
20.6	Instructor Hrs E6	7.25	1.50	4
20.7	Instructor Hrs E7	2.00	0.0	1
20.8	Instructor Hrs E8	2.00	0.0	1
20.9	Instructor Hrs E9	0.0	0.0	0
20.10	Instructor Hours GS5-GS9, Off.	5.00	0.0	1
	Average Instructor Hrs/Trnee	13.11	7.19	11
	Average Grade Of Instructor	4.74	0.55	11

NOTES TO TABLES 11 THROUGH 15

The "STD DEV" is "S," a maximum likelihood estimate of the "Universe Standard Deviation" derived from the sample. A confidence limit on the sample mean would be derived from the "Standard Error of the Mean": $S/\sqrt{n}$. N is the number of valid responses. (Blanks are not counted).

Questions 8, 10.3, 10.4 and 12, are dichotomous variables with the results expressed as a proportion, (e.g., 0.34 = 34 percent). Thus the mean is a fraction and the standard deviation is $\sqrt{p\,q/n}$ which is the "Standard Error of the Mean" for the Binomial Distribution.

DISCUSSION OF RESPONSES TO QUESTIONS

Question 1 yields the number of trainees in a section upgrading to the 3 level. As was previously suggested for the five AFSC's the average number of trainees was much greater than in AFSC 70230 studied in the first Phase. Note, however, that the range of averages for the five AFSC's was from 1.40 in AFSC 64730 to 4.33 in AFSC 57130.

Questions 3 to 7 show no surprises and very little differences from Phase I. It is assumed that at any point in time there is a uniform distribution of time in training (Questions 5 and 6) and on the average it takes about 22 weeks to complete training. Results in AFSC's 64730 and 55130 would indicate shorter duration for these AFSC's, however, actual training duration data derived from AFHRL files (shown at the end of Appendix IV), do not confirm this; and it is likely that the samples in those two AFSC's are small enough so that bias (of unknown source) may be a problem.

Question 4 is critical in estimating duration, since the data in Air Force files provide dates encompassing the inception of training to the award of AFSC. In OJT this award may come several weeks after OJT proficiency has been achieved and OJT to the 3 level completed.

Questions 8 and 12 are both new and interesting. The results of Question 8 suggest that only 13% of the supervisors felt it was possible to reduce the number of NCO's if OJT were stopped. Question 12 implies that only 36% of the sections could perform their mission effectively without trainees. These questions provided the basis for the conditional models, and their impact on the cost results has already been discussed.

Question 13 displays the change in amount of time spent on training over the training period and essentially confirms the theory suggested in Phase I—namely, that the time spent in training does drop off substantially.

Question 14 indicates the size of the sections sampled and shows the range of averages for each AFSC—from 17 in AFSC 64730 to 65 in AFSC 57130.

Questions 15 and 16 suggest additional capacity to train without an increase in costs, which is another way of stating the result of Question 8. The NCO's work is not primarily training. He needs to be there for other reasons and the capacity to train is built in.

The hours spent in training per week, Question 17, is on the average, about thirteen, which is also just about half-way down the trend indicated by Question 13.

APPENDIX IV
COST MODELS

GENERAL TERMS

Constants

WE2 through WE15 - wages/hour

WE2 - WE9 = wages for E2 - E9

WE10 - WE14 = wages for GS-5 - GS-9

WE15 = wages for 2nd Lt.

F_k = Average time from entry to training to award of AFSC (in weeks) for kth AFSC.

Notation

8 is the constant "8"

8. means the answer to question "8."

8.i. means the answer to question "8.i." where i goes from 1 to n

"|" is the conditional: that is

C = WE2 (4.) | 5.1. = 1

means Cost = WE2 (answer to question 4) given the answer to question 5.1 is 1.

MULTIPLE USE TERMS

The following terms are repeated several times in the models and for convenience are identified symbolically:

- Sum of Instructor Hrs/Wk

$$SI = \sum_{i=3}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} (20.i.j)$$

- Weighted sum of Instructor Cost/Wk (Instructor Hrs x Wages)

$$WSI = \sum_{i=3}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} WEi\ (20.i.j)$$

- Duration of Training

Average time from entry to training to award of AFSC (in weeks) for the kth AFSC less time from proficiency to award

$$D = (F_k - 4.)$$

BASIC MODELS

MODEL 1 - TRAINEE TIME COST

$$TTC = (\text{Trnee wages/hr.}) \sum_{i=1}^{5\ \text{days}} (\text{trnee hrs/day})/\text{no. of trnees}) \ (\text{duration})$$

$$M1 = (WE2) \sum_{i=1}^{5} (18.i./17.) \ (D)$$

MODEL 2 - INSTRUCTOR TIME COST

ITC = (Weighted Sum of Instructor Cost Wk)/(no. of trnees)(duration)

M2 = (WSI/17.)(D)

MODEL 3 - DELAYED ENTRY TIME COST

DETC = (Trainee wages/day) (delay in entry to 3 level training)

M3 = (WE2)(8)(2.)

MODEL 4 - REMEDIAL TRAINING TIME COST

RTTC = (Average wage/instructor hr)(instructor hrs remedial trng) + (trainee wages/hr)(trainee hrs/wk remedial training) times (Wks, remedial training)(Pct failing ECT)

M4 = (WSI/SI)(11.d.) + (WE2)(11.c.)(11.b.)(11.a./100)

MODEL 5 - RECORDS MANAGEMENT TIME COST

RMTC = (Average Wage/Instructor hr.)(rcrd kpng hrs/wk)(duration)/no. of trnees

M5 = (WSI/SI)(9.)(D)/17.

MODEL 6 - TTS EQUIVALENCY TIME COST

TETC = {(Wks to equivalency)(1-Percent capability)/2}

(Average cost for trainee and instructor time/wk)

M6 = {(10.b.)(1-10.a./100)/2} (M1 + M2)/D

MODEL 7 - TTS DELAY TIME COST

TDTC = (Trainee wages/day) (days delay)

M7 = WE3(8)(3.)

CONDITIONAL COST MODELS

MODEL 11 - CONDITIONAL TRAINEE TIME COST

CTTC = Model 1 if trainee contributes to productivity

CTTC = (Trainee wages/hr)(40)(duration) if trainee does not contribute to productivity

M11 = M1 | (12.) = 0

M11 = (WE2)(40)(D) | (12.) = 1

MODEL 12 - CONDITIONAL INSTRUCTOR TIME COST

CITC = Model 2 if NCO's can be reduced if training stops

CITC = 0 if NCO's cannot be reduced

M12 = M2 | (8.) = 1

M12 = 0 | (8.) = 0

MODEL 14 - CONDITIONAL REMEDIAL TRAINING TIME COST

CRTTC = Model 4 if trainee contributes to productivity and NCO's can be reduced

CRTTC = (Average wage of instructor)(Instructor hrs remedial trng)(wks, remedial trng)(Pct failing ECT) if trainee does not contribute to productivity and NCO's can be reduced[3]

CRTTC = (trainee wages/hr)(trainee hrs remedial training)(wks, remedial training)(Pct failing ECT) if trainee contributes to productivity and NCO's cannot be reduced

CRTTC = 0 if the trainees do not contribute to productivity and NCO's cannot be reduced

M14 = M4 | (12.) = 0, (8.) = 1

M14 = (WSI/SI)(11.d.)(11.b.)(11.a./100) | (12.) = 1, (8.) = 1

M14 = (WE2) (11.c.)(11.b.)(11.a./100) | (12.) = 0, (8.) = 0

M14 = 0 | (12.) = 1, (8.) = 0

MODEL 15 - CONDITIONAL RECORDS MANAGEMENT TIME COST

CRMTC = Model 5 if NCO's can be reduced

CRMTC = 0 if NCO's cannot be reduced

M15 = M5 | (8.) = 1

M15 = 0 | (8.) = 0

MODEL 16 - CONDITIONAL TECH SCHOOL EQUIVALENCY TIME COST

CTETC = (Wks to equivalency) (1 - Percent capability/2) (conditional costs for trainee and instructor time)

M16 = {(10.b.) (1-10.a./100)/2}

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[3]Note: trainee cost in this case is included in Model 11, (Condition: (12.) = 1)

INTERMEDIATE OUTPUT MODELS

MODELS 31-32 - ACTIVITY PER WEEK/TRAINEE

X	Y
18	31
19	32

$$APWT = \sum_{i=1}^{5} \text{Activity/Day/Trainee}$$

$$M(Y) = \sum_{i=1}^{5} Xi./17.$$

MODELS 33-39 - ACTIVITY PER WEEK

X	Y
20.3	33
20.4	34
20.5	35
20.6	36
20.7	37
20.8	38
20.9	39

$$APW = \sum_{i=1}^{5} \text{Activity/Day}$$

$$M(Y) = \sum_{i=1}^{5} Xi.$$

MODEL 40 - ACTIVITY PER WEEK/GRADE

$$ABW = \sum_{i=10}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} \text{(Activity/day)/No. of grades}$$

$$M40 = \sum_{i=10}^{15} \sum_{j=1}^{5} 20.i.j/N$$

MODEL 41 - INSTRUCTOR HRS/TRAINEE

$$IHT = \sum_{i=3}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} \text{(Instructor hrs/no. of trainees)}$$

$$M41 = SI/17.$$

MODEL 42 - AVERAGE GRADE OF INSTRUCTOR

$$AGI = \sum_{i=3}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} (\text{Instrctr hrs for ith grade})(\text{instrctr grd})/(\text{total inst hrs})$$

$$M42 = \sum_{i=3}^{15\ \text{grades}} \sum_{j=1}^{5\ \text{days}} \frac{20.i.j.(G)^4}{SI}$$

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[4]For E-3 to E-9, G = 3 to 9—For GS-5 to GS-9 G = 5 to 9—For Officer G = 10.

SUMMARY MODELS

MODEL 20 - SUM OF OJT COST

$$M20 = M_1 + M_2 + M_3 + M_4 + M_5$$

MODEL 21 - CONDITIONAL

$$M21 = M_{11} + M_{12} + M_3 + M_{14} + M_{15}$$

VALUES OF CONSTANTS

F_k DURATION OF TRAINING IN WEEKS

k	MEAN	S. D.	N
55130	26.14	12.88	229
57130	21.50	9.01	456
62230	26.79	11.77	527
63130	16.68	7.14	894
64730	24.68	10.78	869

WE HOURLY WAGES

2	2.85	10	4.03
3	2.98	11	4.53
4	3.46	12	5.03
5	4.13	13	5.57
6	4.88	14	6.14
7	5.52	15	5.05
8	6.20		
9	7.16		