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A METHODOLOGY AND ANALYSIS FOR COST-EFFECTIVE TRAINING IN THE AN/TSQ-73 MISSILE MINDER

Charles C. Jorgensen

ARI FIELD UNIT, FORT BLISS

U. S. Army
Research Institute for the Behavioral and Social Sciences

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(10) Charles C. Jorgensen

Submitted by:
Michael H. Strub, Chief
ARI Field Unit, Fort Bliss, Texas

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Approved by:

E. Ralph Dusek, Director
Individual Training & Performance
Research Laboratory

J. E. Uhlaner, Technical Director
U.S. Army Research Institute for
the Behavioral and Social Sciences

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A METHODOLOGY AND ANALYSIS FOR COST-EFFECTIVE TRAINING IN THE AN/TSQ-73 MISSILE MINDEF

INTRODUCTION

A training developer faces two fundamental problem areas in performing a cost and operational effectiveness analysis (COEA). The first is to determine what will be taught, what training hardware is needed, and where that hardware will be used. The second is to insure that the method used optimizes the effectiveness of a given student population. Effectiveness is defined as the change in performance from a pre-instruction level to a post-instruction criterion.

Training decisions must be made in real dollar terms, reflective of differences in the training variables. The entire process from training decisions through costing is a multivariate task involving many interacting factors and a variety of potential methodologies. The usual task of the researcher in developing a particular methodology consists of selecting which approach to use and then validating whether or not the final product does in fact represent a real improvement over already existing procedures. In the real world this is a time-consuming and expensive process. As an alternative, the opposite approach, the non-empirical expert-judgement method, also falls short of ideal. The compromise approach presented in this paper systematizes the decision processes for elements that are too expensive to validate, and combines them with elements that can be validated. This approach is based on the idea that improvement is almost always possible by systematizing the application of the selected technique, whether that technique has been field proven as optimal or not.

At some point in the research effort it is essential to create real training programs for weapon systems and to do a complete costing and performance evaluation of each student population. This is needed not only to validate the techniques for generating costable alternatives, but also to determine what the interactions are between the types of training programs and later performances. Without such empirical evaluation, all methods would ultimately be reduced to educated guessing, dependent totally on the ability of the analyst to predict transfer of training. Even so such a full-scale test is an expensive and large-scale effort which should be undertaken only with extensive advance planning to assure that the results can be advantageously used in later cost estimations.

Three goals were paramount in the selection of the approach presented in this paper. The first goal is flexibility. An adequate technique must be 1) capable of incorporating changes resulting from new research information, 2) capable of handling managerial variables affecting local and army-wide decisions, 3) able to adjust to different costing techniques, and 4)adaptive to a wide variety of conditions. As a second goal, the technique must be easily described, quickly learned, and inexpensive. Finally, the technique must interface smoothly with existing Training and Doctrine Command (TRADOC) structure and be able to easily incorporate new psychological research relating to transfer of training, decision making,

and utility theory. Cost-effectiveness analysis depends in part on psychological research in task and skill analysis which categorizes the critical functions that a training device must reflect. This research alone will not predetermine what kind of training system will be chosen because it constitutes only one dimension of a multidimensional decision space. With a multidimensional framework in mind, the training developer must select that particular conglomeration of hardware and courseware materials which most effectively reflects the actual training needs of the given weapon system. This task is neither obvious nor subject to easy solutions, and any method that is proposed must make conscious trade-offs among the possible training variables.

The methodology presented in this paper visualizes the problem of cost effectiveness in the following ways: First, it assumes an average level training developer who may or may not be aware of the latest psychological training options available to him and who may or may not be aware of all current managerial policies that affect his choices. Second, it assumes that TRADOC and the training manager have policies which they expect to see reflected in cost and operational effectiveness analysis (COEA) decisions. Third, the COEA analyst may or may not have access to a complete Train Up Study (TUS) from which to refine his decisions. Fourth, he is probably under time pressure to supply alternate programs as training input for one component of a complete COEA analysis. Fifth, he has a limited number of support personnel.

These constraints imply that a decision procedure should contain not only psychological variables but managerial and technological variables as well. Nevertheless, an important point is that a COEA analyst does not have to explicitly consider all those factors himself but only assure they are meaningfully reflected in the final decision process. Thus, the developer does not have to consider each factor if the mechanism of the decision method assures that they weigh in the final outcome. If a methodology can be constructed so as to structurally contain the implications of previous decisions, they need not again be considered each time a new analysis is performed. The work involved for each case is then only the determination of which variables and policies are newly applicable. In this way, an increased burden falls onto the managers because they must clearly formulate for the training developer what policies are to be implemented and what their expected impact is to be. But this "burden" should be an advantage to the manager in that it will assure that his policies are enacted.

The crux of the problem then is how to develop methodology so that it links decison variables explicitly to costable aspects of training systems. In order to explore this issue in the most realistic possible context, the present methodological development was linked to an ongoing COEA which was being conducted on five air defense systems, one of which was the AN/TSQ-73 missile minder.

Distinct bounds were placed on the scope of the information to be used. First, only operations occurring in the AN/TSQ-73 van were considered. This was necessary because the results of operator actions taken in any one part of a complex system interact with all other areas. In the case of the missile minder, this would have meant experimental analysis ranging from remote maintenance facilities to ground/air communication nets. Such a massive context would have quickly blurred the research focus. Second, two MOS categories provided student populations for the 25(L) MOS which was costed in this paper. They were the 16J (system operator) and 14G (command and control officer). The 25(L) MOS is somewhat unusual in that it blends the training skills of a system operator, computer operator, and maintenance man into a single MOS. Thus, although the analysis was confined to costing this MOS and determining its training requirements, the effort nonetheless encompassed a sufficiently wide variety of skills and knowledge to insure a representative sample.

In order to evaluate the immediate usefulness of the methodology, it was decided that the effort would address the same formal requirements that were stated in the full study directive for the training COEA. The COEA study directive included three basic training requirements. They were:

1. Rank order alternate training programs by cost effectiveness and recommend a course of action for each alternative.

2. Determine what new training methods are applicable to each alternative system.

3. Discover what tests are required to determine the effects of different levels and techniques of training in the selected system.

Within the limitations mentioned above, these objectives were met in this study as follows: First, rank-ordering, objective number 1, was answered by creating a method to generate an alternate training program. All of the five systems had at most one program, and funds were not available to create new training programs to serve as input into the COEA. This was in part because no train-up study was available when the proponent was tasked with producing the study directive. Also, some of the systems which were to be costed existed only on paper and actual equipment was not available. Once a method for generating such an alternative program was produced, it still remained to cost the program in order to provide a comparison with appropriate portions of the existing system. Ideally, this input should have considered every factor in the existing program. Within the available COEA schedule, this was not possible. As a result, the ARI input constitutes only an approximation to the cost of training the 25(L) MOS.

Objective number 2 was addressed as a byproduct of objective number 1. In the course of performing the training analysis, over 75 potential training delivery methods were considered. Application of the methodology reduced this set to 18 which were applicable for training the 25(L) MOS. Their names are given in Table 1. They are described in Appendix A under the listed paragraph number. For managerial reasons, the full set of 18 was not costed but a reduced set was costed and is included in Appendix C.

Table 1

TRAINING METHODS ACCEPTABLE FOR IMPLEMENTATION IN SELECTED TASKS OF THE 25(L) MOS IN THE Q-73 MISSILE MINDER

	Name of Concept	Paragraph Number in Appendix A
1	Case study folder	1
2	Flash cards	2
3	Performance aids	4
4	Reference texts	5
5	Reference charts	6
6	Self-scoring exercises	7
7	Dial access-scheduled audio	9
8	Audio, active language lab	10
9	Radio system with responders	14
10	Filmstrip projection	16
11	Microform mapping	17
12	Microform with adjunct equipment	18
13	Dynamic mock-ups	19
14	Laboratory carrel	37
15	Branching teaching machine	51
16	CAI - PLATO IV	64
17	CMI	66
18	Manual simulation game	72

Training requirement number 3 was highly general and as a result, it was difficult to provide specific answers. Once a COEA methodology is accepted, the implications for validation tests will fall out directly. Until validation tests are run, all methods must rely on the current state of the art in transfer-of-training predictions and will have a relatively high potential for error. In this paper, the question of effectiveness depends on the correctness of the training concept selection matrix. To the extent that the matrix predicts high transfer of training choices, the method will be valid for cost effectiveness conclusions.

METHOD

The method used in this study is encompassed in six logical stages:

1. Limits on available transfer-of-training technology were determined and sources of information for the analytic steps were identified.

2. The task environment for Q-73 operators was specified in terms of variables which could be systematically paired to costable elements of the training programs.

3. For each task in the Q-73 van, three alternate methods for training that task were determined. This required the creation of a decision matrix linking the 75 potential training methods to 55 psychological variables used to describe critical training characteristics of each task.

4. The large set of training device selections thus generated was condensed into a smaller set of training systems which took into account basic managerial and cost considerations not treated in the previous step.

5. Each costable item in this reduced program was then described in dollar values along 37 variables representing seven general classes of cost information.

6. A Navy costing program was modified for an Army IBM system 360 DOS (disk operating system) and run. The output provided a large variety of calculated costing information that was used by decision makers in the training COEA.[1]

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[1]The author would like to thank Dr. Richard Braby of the Naval Training and Evaluation Group (TAEG) for supplying a copy of the Training Effectiveness, Cost Effectiveness Prediction Program (TECEP) and in giving permission to reproduce certain material from TAEG Report #16. I would also like to thank Specialist 5 Nadean Jones for her help in processing task data and Mr. Bob Chalmers of the US Army Air Defense School (USAADS) for supplying cost figures used in this analysis.

These stages will now be considered in greater detail. Stage one required extensive coordination with both USAADS and US Army TRADOC Systems Analysis Activity (TRASANA) and was accomplished during the period when the study plan was being developed. ARI conducted preliminary literature searches on a wide variety of sources. After taking into account availability, documentation, practicality, and specialized Army needs, the Navy TECEPT costing approach was chosen as the best potential starting point. This report is available on microfiche from the Defense Documentation Center as AD-A012 859 (A Technique for Choosing Cost-Effective Instructional Delivery Systems, R. Braby, J. M. Henry, and W. F. Parrish).

Stage two required generation of a selection procedure that linked available task analysis information to cost-able elements of the training program. The approach used a 55 by 75 cell matrix. Along the y axis were numbers corresponding to paragraph descriptions of psychological properties such as reinforcement schedule, type of feedback, sensory modality, and decision making. Along the x axis were 75 numbers corresponding to potential training concepts which could be used to meet psychological requirements for a given task. These included such items as microform mapping, case study folders, CAI terminals, and branching texts. The complete list of properties and training concepts is presented in Appendix A.

The values for each cell in the matrix were developed as follows. For each training concept, three independent raters determined whether each of the 55 psychological variables could be duplicated by the delivery concept. The degree to which each variable could be applied was broken down into three categories: applicable (A), partially applicable (P), not applicable. The three ratings for each concept were then logically collapsed across raters. For example, if the three ratings for a given variable were A,A,P or A,A, blank, the cell value in the overall matrix was coded as A. Similar rules were developed for each of the logical combinations of rater choices. After all 75 concepts had been evaluated in this fashion, the ratings were plotted in tabular form in the matrix (Figure 1). This matrix was then covered with a plastic sheet so that it could be marked on and be reused by simply wiping the matrix clean with a cloth. This was necessary so that stage three could be implemented.

In the third stage, each of 219 tasks (defined by task description sheets supplied by USAADS) was coded in terms of task applicability to each of the 55 psychological variables. Thus, each task in the Q-73 system was redefined in terms of the same set of variables as those used to define the training concepts. This then permitted the use of the matrix as a selection device. For each task, the list of applicable psychological variables was marked in grease pencil along the y axis of the plastic-covered matrix. This in effect defined a unique subset of the full matrix which applied to each task. For each of the 75 training concepts, a column sum was made by counting the number of A's

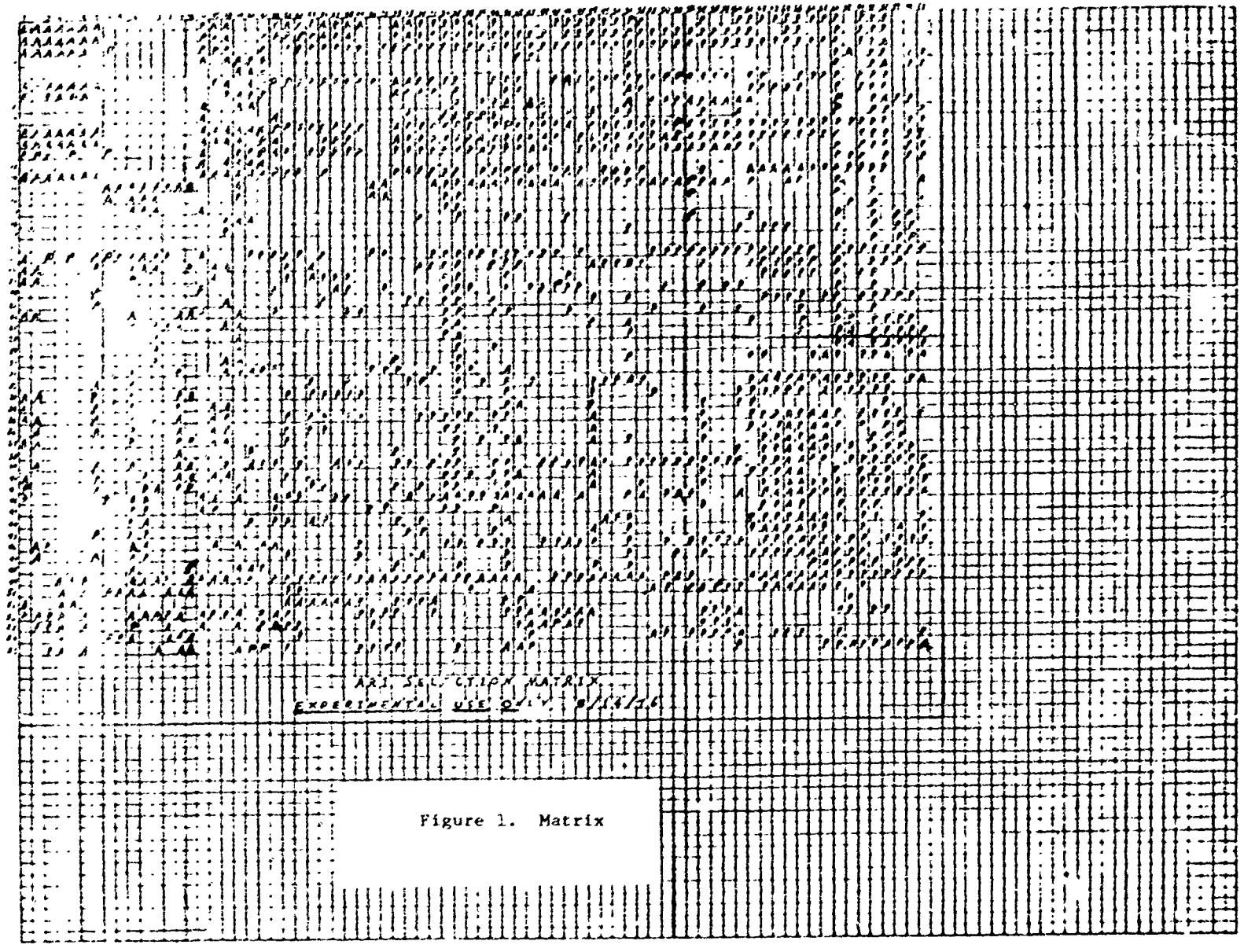

Figure 1. Matrix

which were applicable. These are marked at the bottom of each column in the picture (Figure 2). Those three columns with the highest number of applicable psychological variables were then chosen as the training concepts most applicable for implementing that task. In case of ties, the candidate with the largest number of partially applicable variables (P's) was chosen. The top three concepts were then tabulated for each of the 219 tasks.

In the fourth stage, these lists were collapsed to facilitate reduction into a cost-able program. Five basic criteria were used in this aggregation:

1. Practicality for the Fort Bliss Air Defense School

2. Logical areas of task type as defined by the school

3. Number of tasks which could be taught on a single device

4. The availability of information on the training concepts for costing and transfer of training estimations

5. The approximate percentage of time occupied by each task.

Table 2 presents this reduced program. The training concepts are described in detail in Appendix A. From this set, a final subset was chosen for costing. Because of the unavailability of some cost data, the final set was reduced considerably. Thus a large degree of available precision in the technique was not used in the final stages. Three components were costed for the alternate program:

1. Actual equipment used four percent of the 17-week training course.

2. Reference texts, classroom aids, and branching texts used 45.2 percent of the time.

3. Mock-ups with movable parts and selected maintenance functions used 50.8 percent of the time.

In stage five, each member in this reduced set was costed by USAADS in terms of the 37 variables shown in Appendix B. Some of this information was immediately available, some had to be inferred, and some was classified and approximations substituted in their place.

In the final stage, the TECEPT costing program was modified by ARI to permit use of the Army 360 Management Information Systems Office (MISO) at Fort Bliss. Output listings are provided in Appendix C. These listings provide the ARI content input for the COEA study directives. They represent the estimated cost of one alternative training program for the 25(L) MOS as it applies to tasks taking place in the Q-73 van. The listing should be interpreted in the following manner.

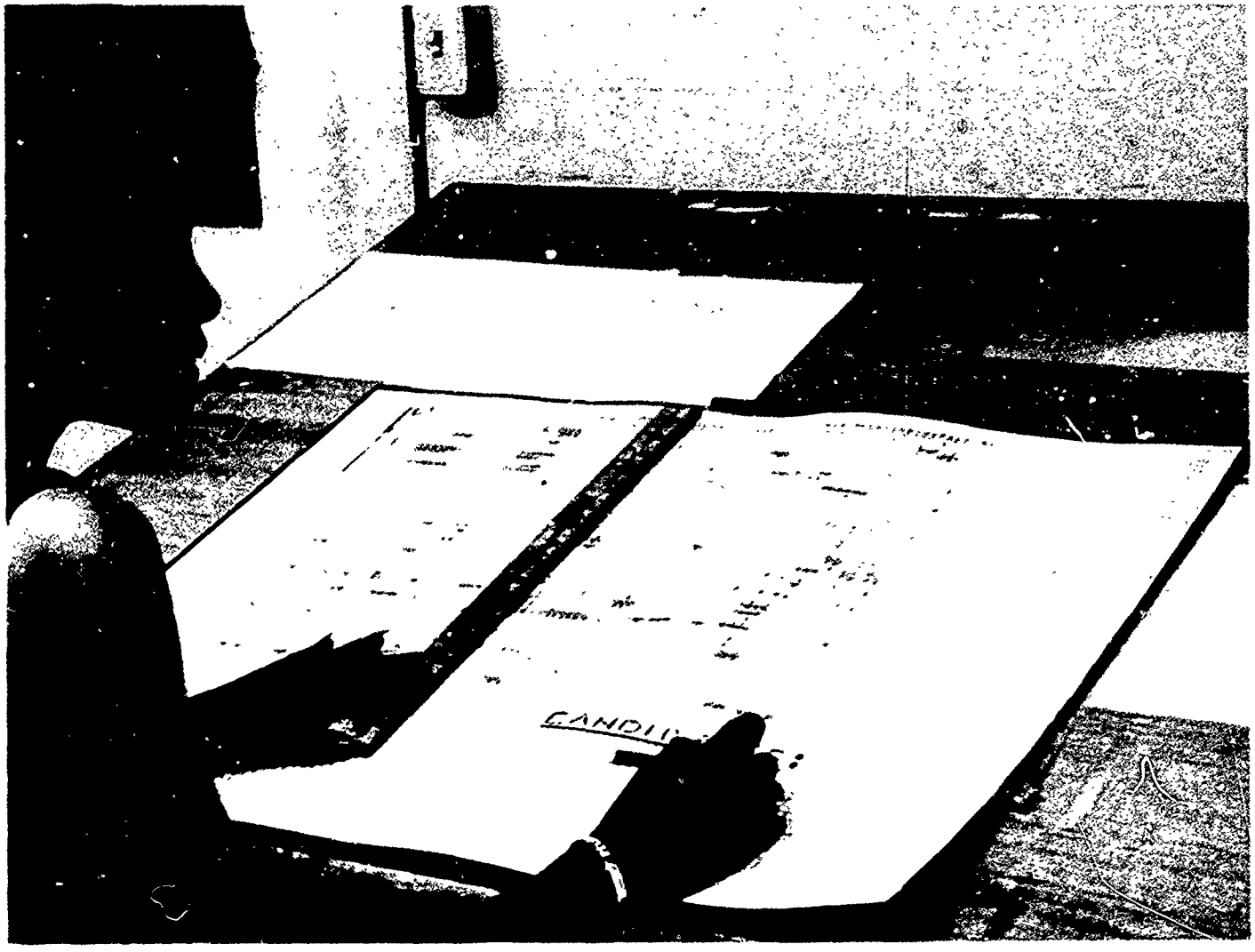

Figure . . Matrix Column Sums

Table 2

REDUCED PROGRAM SELECTION SHEET
(AN/TSQ-73 training concept selection for use in costing the 25(L) MOS)

Area Label and Task Number Key	USAADS Task Numbers	Training Concept Numbers	Rounded Percentage of Total Course Time Devoted to Tasks
A System march order & emplacement	1.0-6.0	19, 18, 69, 72	4
B System initialization & site adaptation			
1	7.1-7.2, 11, 14-17.3	19, 4	.4
2	7.3-10, 13	18, 18	1.4
3	12.0-12.5	6, 4, 19	2.1
C Display console operations			
1	18-26.10	19, 4, 18	.7
2	27.1-29.3	19, 4, 6	.3
D Maintenance operations			
1	30.2-30.3, 34.0-34.5	51, 19, 4	.4
2	30.1, 31.0-33.3		
	34.6-63.0	18, 17, 19, 4	47.4
E Operation under unusual conditions	64-66.2	17, 18, 19	.2
F Generation of simulated raid programs	67-70.0	17, 18	N/A
G Maintenance management	71.0-73.0	5, 4, 17	.9
H Site management supervisory assistance tasks	74.0-77.0	17, 4, 1	42.2

First, each of the three components of the training program for the 35(L) MOS are listed sequentially in the same format. A header is presented showing what concept has been costed, followed by a percentage value which shows the approximate amount of the 17-week-time period to be spent using the concept. This is followed by a list of costing variables shown both in life cycle form and in overall values. Together, they comprise the input data to the program. This listing is followed by similar layout for the calculated information for that component. The input/output cycle is repeated for each component. Because costing experts may desire to weigh each component's dollar use on a basis other than time, the costed data for each component is treated as though it constituted the entire 17-week program. This also facilitates variable comparisons between different components because each is then costed on the same basis.

Following the component information is a single page showing all three components simultaneously and their dollar costs on eight key decision variables. After this sheet are a series of twenty additional variables which could be considered. These variables are all tabulated under a single column labeled method 1. The method corresponds to an additional feature of the program which was not used. It is possible that a costing expert may be interested in variable interactions under different sets of assumptions. Because only one set of assumptions was used in this exercise, only one costing method is represented in the table. As many as eight sets are possible.

It should be stressed that this input is not intended as a final product but rather as an illustration of the concrete application of the methodology to a recurring requirement in COSA's. It is anticipated that USAADS personnel involved in future COSA's can use this technique as one way of providing costed alternatives for TRADOC COSA requirements. In its present state, the costing portion of the methodology is ready for immediate application, subject to acceptance of the variable definitions in Appendix B. Refinement of the task analytic portion of the methodology is ongoing and will also be computer implemented.

AN EXAMPLE: "GENERATE A SITE ADAPTED TAPE"

To illustrate the implementation of this procedure, an example of how one task sheet was coded is given below. Figure 3 shows a typical task sheet supplied by USAADS. The average task sheet includes four sources of information. It considers skills, attitudes, and knowledges as well as secondary data--such as references to more detailed descriptions of the tasks, the approximate amount of time spent in performing the task, and the relation the task has to similar jobs in the Q-73 system. Table 3 shows how this particular task sheet was evaluated. It is presented in terms of the task appropriate members of the 55 psychological variables shown in Appendix A. These selected variables were then marked on the selection matrix by rows (see Figure 2). Next, each column was summed by adding the cell values for each applicable psychological variable. The three largest sums were then chosen. They corresponded to the three delivery system column numbers best suited for this particular task. They were:

Concept Name	Concept Number	Number of Applicable Variables Summed
Microform with information mapping and adjunct equipment	18	9
Mock-ups, panels and dynamic demonstrators	19	11
Small-scale models and static mock-ups	20	8

This operation was repeated for all task sheets in the 25(L) MOS. Because this resulted in 219 sets of possible costing selections, it was necessary to collapse these alternatives into smaller sets for detailed consideration by costing experts. This reduction followed the procedures set forth earlier and resulted in the program shown in Table 2. The reduction produced ten concepts as candidates for different components of the training program. They are described in Appendix A by number. From these ten, the final program was reduced to the three actually listed because of cost information availability and managerial requirements beyond the control of ARI.

JOB TASK DATA (TRADOC Reg 350-100-1)	COURSE: AN/TSQ-73 System Operator/Repairman
	FILE NO.: 8.3
	DATE: 31 May 1974

TASK

System initialization (software)

SUBTASK

Generate a site adapted tape.

JOB CONDITIONS

Standard job task condition level 1.

Incumbent uses DTM 9-1430-651-14, chapter 4, DTM 9-1425-650-12.

JOB STANDARD

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DTM 9-1430-651-19, para 4-16 and 4-18, and table 4-14.

An experienced man can perform this task in 5 minutes or less.

SUPPORTING SKILLS AND KNOWLEDGES

SO1. Be able to use the keyboard printer unit to enter computer codes and program formats.
SO2. Be able to physically mount and dismount program tapes on magnetic tape unit (MTU).
SO3. Be able to logically mount and dismount tapes on magnetic tape unit (MTU).
SO4. Be able to read keyboard printer unit output to determine succeeding actions required.
SO5. Be able to take actions specified by the computer printout and enter required data via the keyboard printer unit.
SO6. Be able to recognize fault detection codes on the ADP status and control panel.
SO7. Be able to discriminate between normal and abnormal program entry printout indications.
SO8. Be able to identify the master tape from a site adapted tape.

KO1. Know when master program changes are necessary for site adaptation.
KO2. Know when to initiate off-line initialization procedure for entering site-adapted data.

ATTITUDES

1. Be aware that when mounting a tape, care must be taken not to pinch fingers between tape cartridge and the magnetic tape unit.
2. Be aware that normal indications change very rapidly on the ADP.

Figure 3. Typical task data sheet

Table 3

SELECTED PSYCHOLOGICAL VARIABLES AND USAGE RATIONALE

AN/TSQ-73 System Operator/Repairman

TASK: System Sofeware Initialization
#8.3 on USAADS Task List for the 25(L) MOS

The assumptions during each selection are presented in the following format: First, the number of the psychological characteristic and description given in Appendix A; second, a title identifier; third, the choice rationale.

1. Visual Alphanumeric - selected because task involves:

   a. Usage of alphanumeric elements on computer keyboard
   b. Computer codes and formats
   c. Fault detection codes and indicators

4. Visual Objects - selected because a real 3-D object may be used as the training device. For example, the keyboard printer may be needed.

6. Visual Still - selected because task involves usage of:

   a. DMT
   b. Computer printout

10. Black and White Visual Field - selected because task involves usage of:

   a. Elements on keyboard
   b. Computer printout
   c. DMT

13. Exact Scale (one-to-one mock-ups) - selected because such objects may be used as actual training devices.

14. Proportional Scale - selected because such devices may be used for:

   a. Briefings
   b. Demonstrations
   c. Actual training devices
   d. Reviewing and testing

18. Tactile Cues - (signals received through the sense of touch) - selected of its usefulness in learning to operate the computer keyboard.

19. Internal Stimulus - selected because of internal sensations felt when error is made (example: when wrong key is punched on keyboard printer, it is sensed).

22. Multiple Choice - selected because this task involves decision making.

27. Manipulative Acts - selected because this task involves:

   a. Mounting and dismounting tapes
   b. Operating keyboard
   c. Turning switches on and off

30. Procedural Manipulative Acts - selected because sequential steps are involved in the operation of this task.

32, 35, & 39. Feedback - selected because fault and normal indicators provide trainee with immediate and continuous content feedback.

45. Automatic Sequencing and Pacing - selected because:

   a. trainee must remain alert
   b. trainee must remain at the threshold level of his ability to learn

48. Dynamic Modeling (simulation model) - selected because simulated models may be used for:

   a. Practical exercises
   b. Training and testing devices
   c. Illustrating and reviewing

49. Fixed Study Position (location) - selected as relevant because equipment for such a task is usually in a fixed location.

APPENDIX A

PSYCHOLOGICAL VARIABLES AND TRAINING CONCEPTS

Included in this section are the psychological variables numbered 1-55 followed by the training concepts labeled 1-75. Thus if the sample program sheet calls for concept 19, it is referencing a dynamic mock-up including panels and demonstrators. If the example task references variable 16, it is referring to an audio property having the capability of full frequency reproduction.

PSYCHOLOGICAL VARIABLES

STIMULUS CAPABILITIES

Visual Form

1. Visual Alphanumeric - words, numbers and other symbols presented graphically.

2. Visual Pictorial, Plane - a two-dimensional image, a representation is the form of a photograph or drawing.

3. Visual Line Construction, Plane - a two-dimensional figure made of lines, such as a mathematical curve or graph.

4. Visual Object, olid - a three-dimensional image or reality that is viewed from exterior perspectives.

5. Visual Environment - a three-dimensional image or reality that is viewed from inside.

Visual Movement

6. Visual Still - a static visual field, as with a still photograph, drawing or printed page.

7. Visual Limited Movement - a basically static visual field with elements that can be made to move, as with an animated transparency or simple panel with switches that move.

8. Visual Full Movement - a visual field in which all elements can move, as with a motion picture, flight simulator, or operational aircraft.

9. Visual Cyclic Movement - a visual field which moves through a fixed sequence and then repeats the sequence in a repetitive manner, as with a film loop.

Visual Spectrum

10. Black and White - a visual field composed of either black or white elements, as with the printed page or line drawings.

11. Gray Scale - a visual field composed of black, white and continuous gradations of gray, as with a black and white photograph or television picture.

Visual Spectrum (continued)

12. Color - a visual field composed of various segments of the visual spectrum, as with color television or motion pictures.

Scale

13. Exact Scale - actual visual field or a one-to-one replication of that field as with a full-sized mock-up, simulator, or operational system.

14. Proportional Scale - a representation of reality in other than full scale, such as a scaled model map or photograph.

Audio

15. Voice Sound Range - a limited quality of sound which enables spoken words to be used as the medium of communications, but not suited to more demanding tasks, such as music or sound recognition exercises.

16. Full Sound Range - a quality of sound reproduction that contains all the significant elements of the sound and is suited to the demanding task of sound recognition exercises.

17. Ambient Sounds -a complex sound environment with sounds emanating from various sources and from various directions, including background noise and task significant sounds.

Other

18. Tactile Cues - signals received through the sense of touch, including sensations related to texture, size or shape.

19. Internal Stimulus Motion Cues - the sensations felt by a person when he moves his arm, leg, fingers, etc.

20. External Stimulus Motion Cues - the sensations felt by a person when he is moved by some outside force in such a way that his body experiences roll, pitch, yaw, heave, sway and/or surge.

TRAINEE RESPONSE MODES

21. Covert Response - a response which the trainee creates in his mind but does not express in an observable manner.

22. Multiple Choice - a response mode in which a trainee selects a response from a limited set of responses.

TRAINEE RESPONSE MODES (continued)

23. Pre-programmed Verbal Performance - a response mode in which a trainee creates a short answer to a question having a limited set of correct answers.

24. Free-Style Written Performance - a response mode in which a trainee writes a response in his own words.

25. Decision Indicator - a verbal or perceptual motor response in which the trainee indicates that he has made a divergent type decision.

26. Voice Performance - a response mode in which a trainee speaks, including conversation.

27. Fine Movement Manipulative Acts - a response mode in which a trainee makes discreet and small movements of dials, switches, keys or makes sensitive adjustments to instruments. Act may involve use of small instruments.

28. Broad Movement Manipulative Acts - a response mode in which a trainee makes large movements of levers or wheels on large pieces of equipment or by the use of hand held tools.

29. Tracking - a response mode in which a trainee continuously controls a constantly changing system, such as steering an automobile or holding a compass bearing in steering a ship.

30. Procedural Manipulative Acts - a response mode in which a trainee performs the sequence of steps in a procedure, such as in the carrying out of the items on the checklist for pre-flighting an aircraft or turning on a radar system.

INFORMATION FEEDBACK LOGIC

Form of Feedback

31. Intrinsic Feedback - information the trainee receives from his own internal movements or from proprioceptive stimulation.

32. Action Feedback - externally displayed cues inherent in the task, including such forms as instrument indications and the display of answers to questions as in linear programmed instruction.

33. Augmented Feedback - immediate presentation of information to the trainee on how the results of his performance conform to some criterion or an objective reference.

Form of Feedback (continued)

34. Reconstruction Feedback - critical analysis or evaluation of trainee performance, usually at the completion of an exercise or a significant block of instruction.

Content of Feedback

35. Correct Response Data - an indication of correct response is provided the trainee either immediately after he responds or automatically in the event he does not respond within a specified time.

36. Score Date - the trainee receives quantitative information about his performance (such as amount, percent and rate date).

37. Diagnostic Data - the trainee is informed of inadequate performance, its cause, and prescribed remedial actions.

38. System Performance Data - the trainee observes changes in the state of a system as a consequence of his actions in the system.

Time Schedule for Feedback

39. Immediate - feedback provided in continuity with a trainee's action, either continuously as accrued or at the conclusion of each student response.

40. Fixed - feedback provided to the trainee at prescribed times, such as at the end of an exercise or at timed intervals.

41. Variable - feedback provided to a trainee according to a variable schedule which may change as a function of stage of training or level of performance. This includes the provision for intermittent presentations to permit probabilistic schedules of reinforcement.

EVENT SEQUENCE LOGIC

42. Linear - a fixed sequence of instructional events, as in linear programmed instruction and motion pictures.

43. Cyclic - a special case of linear sequence in which a limited segment of a linear program is repeated continuously throughout a period of time, as with a film loop.

44. Branching - a sequencing of instructional events with the trainee routed to appropriate advanced or remedial material based upon his answers to diagnostic questions imbedded at intervals in the material.

EVENT SEQUENCE LOGIC (continued)

45. Automated (Machine) Adaptive - an automatic sequencing and pacing of events designed to keep a trainee at the threshold level of his ability to learn at all times.

46. Instructor Selected Sequence - the ordering of events by the instructor, such as in a lecture-recitation period in the traditional classroom or in tutoring.

47. Trainee-Initiated Inquiry - the selection, sequencing and pacing of learning events by the trainee.

48. Dynamic Modeling - system programming in the form of a simulation model which enables the trainee to exercise the model and observe the corresponding effects.

INSTRUCTIONAL SETTING

49. Individual Trainee at Fixed Location - a fixed study position for individualized instruction, such as in a school with carrels or CAI. terminals.

50. Individual Trainees with Simultaneous Instruction at Many Locations - any site that can be used with a telecommunication mode of instruction, as with scheduled radio or broadcast television.

51. Individual Trainee with Independent Instruction at Any Location - any site that can be used by a student for independent study as with books or programmed instruction texts.

52. Small Group - a meeting site accommodating up to 15 people, enabling small group dynamics to function; both leaderless and leader-directed groups; a small classroom.

53. Large Group at Single Location - a meeting site for more than 15 people, such as a large classroom or auditorium.

54. Large Groups at Dispersed Locations - two or more group meeting sites that can be linked with communication equipment for a common training program, as with two-way closed circuit TV between classrooms at two different schools.

55. Team Setting - a single site that is equipped to enable a group of individuals to perform as a team, as in a weapon system simulator or operational system.

TRAINING CONCEPTS

Print Materials

1. Case Study Folder - A folder of detailed background information on a problem requiring a decision or plan of action; to be read by the trainee prior to his (1) making a decision on how to resolve the issue and (2) participating in a critique on various solutions.

2. Flash Cards - A set of cards designed to be used by an instructor in front of a group of trainees to drill the group in the recall of memory type information.

3. Printed Materials - Handouts - Handouts are a class of printed materials issued to a student for his use and retention to augment regular instructional materials. They are usually instructor prepared, machine copied materials of one or two pages highlighting specific topics or updating existing materials.

4. Printed Materials - Performance Aids - Performance aids are a class of printed materials that aid in job performance by providing data that should not be committed to memory. They include checklist routines, conversion tables, equipment test tolerance matrices and the like.

5. Printed Materials - Reference Books - Reference books are a class of printed materials used to identify certain facts or for background information such as dictionaries, encyclopedias or technical publications.

6. Printed Materials - Reference Charts - Reference charts are a class of printed material pictorially displaying data used to identify certain facts or for background information. Included are data charts, schematic diagrams, topographical maps and the like.

7. Printed Materials - Self-Scoring Exercises - Self-scoring materials include exercises and quizzes used in conjunction with standard curriculum, or programmed instruction. The class includes electrographic or mark sense materials scored by keys or computer, punch mark and other mechanical score indicating equipments, chemically scored materials, etc., that have the capability of providing near immediate student feedback without the use of prolonged scoring procedures.

8. Dial Access Information Retrieval System - Random Audio - Dial access information retrieval is an electronic system for distributing audio (and/or visual) materials and programs which are stored in a location

remote from where they are dialed and received. Random audio means that audio materials are retrievable at any time by electronically triggering a tape duplicating machine that makes a student copy from a master tape within the library.

9. Dial Access Information Retrieval System - Scheduled Audio - Scheduled audio means that audio materials may be dialed at any time, but once a program has begun, subsequent users must join the program in progress.

10. Language Laboratory - Audio, Active - Compare Mode - An audio presentational device that distributes audio information via a control console to student stations equipped with headsets, microphone for console/instructor-student inter-communication, and a tape recorder. Student may interact with taped instructional material, rewind and play back or store responses. Student responses may be monitored or recorded at console.

11. Language Laboratory - Audio Passive Mode - An audio presentational device that distributes audio information from a control console to student stations equipped with headsets. Audio source may be a phonograph record, a taped recording, or a motion picture sound track.

12. Physiological Trainer (Hostile Environment) Auditory - A training device designed to place controlled stress on the human hearing system through use of a physiologically and/or psychologically adverse sound environment, to enable a trainee to learn to function in this adverse environment.

13. Radio System - AM/FM - A passive audio system consisting of a broadcast studio, transmitting station, and student radio receivers. The system uses designated AM/FM frequency bands for information transmission.

14. Radio System with Responders - A multi-channel two-way radio communication system that operates within UHF or VHF-FM frequency bands limiting broadcast ranges. Network may be open or use encoding/decoding techniques or responders for individual channel privacy.

15. Telephone Conference System - A telephone system with switching matrix capability that allows multiple station two-way audio communication at two or more remote locations.

Visual Only Systems

16. Filmstrip Projection System - A single frame projector or attachment thereto that will accept a filmstrip format and project the film images upon a viewing screen. See: Sound Filmstrip Projection System.

17. Microform with Information Mapping - Microimagery, such as microfilm, used as a medium of instruction with the additional requirement that

each block of information be clearly identified as introduction, overview, test, review questions, index and other discrete titles, and that each type of information be positioned in a standard location within the medium format.

18. Microform with Information Mapping and Adjunct Equipment - The theoretical configuration of a training system to support individualized instruction composed of microimagery in an information map format, a microform reader, and a piece of auxiliary equipment, such as a mock-up, which is the subject of the instruction.

19. Mock-ups, Panels, and Demonstrators - Dynamic - A visual training aid that allows an instructor to demonstrate manipulative principle, movement in time or space, steps of a procedure, linear effect within systems or changes in condition of equipment or systems through one or more operating phases.

20. Models and Static Mock-ups - Small Scale - A three-dimensional training aid built to scale and representing operational equipment. It may be a solid or cutaway model capable of disassembly by which spatial and/or sequential relationships are represented. Also included are layout models, recognition model sets, and terrain or topographical models.

21. Mock-ups, Panels and Demonstrators - Static - A training aid used to demonstrate relative shape, size, composition or function of an object or system by a visual-cognitive process performed by the trainee. Such non-moving, real or "scaled" aids include cutaway models, diagrams, blow-apart hardware displays, etc.

22. Slide Projector System - 2" x 2" - A class of single frame picture projectors that will accept a standard 2" x 2" slide and project the contained image upon a viewing screen.

23. Printed Material - Workbook - Workbooks are a class of printed material used to augment or replace instructional texts by providing a mix of text information and practice exercises within a single book or manual.

24. Printed Material - Textbook - Textbooks are a class of printed material dealing with a subject of study, intended for use at a specified level of instruction and used as a principal source of organized information.

25. Programmed Text - Branching - A printed text containing frames of information and multiple choice questions concerning the information, organized in such a way that the trainee's choice of response directs him to remedial frames or advanced material, as appropriate. The material is carefully sequenced, tested and revised

to ensure that a specific student population will achieve stated behavioral objectives with a predetermined level of success.

26. Programmed Text - Branching with Adjunct Material/Equipment - A form of program in which additional materials such as drawings, catalogues, or equipment are used with the regular branching programmed text.

27. Programmed Text - Linear - A printed text containing a fixed sequence of small frames of information usually in the form of questions requiring the trainee to construct a simple written response, which is immediately evaluated. The material is carefully sequenced, tested, and revised to ensure that a specific student population will achieve stated behavioral objectives with a predetermined level of success.

28. Programmed Text - Linear with Adjunct Material/Equipment - A form of program in which additional material such as drawings, catalogues, or equipment are used with the regular linear programmed text.

29. Study Card Sets - A deck or decks of cards designed to present training information to an individual student.

Audio Only Systems

30. Audio Disc Playback System - An audio system that uses a record player and sound recorded on a disc (record) that may be played back by a listener.

31. Audio Tape System - An audio system that uses a tape recorder/reproducer to record sound on magnetic tape that may be played back upon request by a listener.

32. Simulation - Paper - The representation of selected dynamic characteristics of a system through the use of charts, tables, static photographs, drawings, and lists of performance characteristics under specified conditions. This information is presented in such a way that the trainee can study the initial performance of the system, change inputs to or elements within the system and note changes in the performance of the system.

33. Teaching Machine - Linear, Still Visual - An individualized instruction system composed of a fixed linear sequence of small step programmed instruction frames (still) and a manually controlled device to display the information.

34. Teaching Machine - Branching, Still Visual - An individualized instruction system composed of large step multiple choice programmed

instruction frames (still) and a manually controlled device to select, sequence and display program frames in an order dependent upon the trainee's last response.

Audio-Visual Systems

35. Audio Tape with Printed Material - An audio system that uses a tape recorder/reproducer to record sound on magnetic tape that may be played back upon request. Printed materials such as texts, worksheets, PI, schematics, test materials, etc., used with audio tapes offer a variety of training applications.

36. Carrel - AV Equipped - A small enclosure or alcove incorporating a desk used for individual studies, supplied with audio and visual materials and supporting equipment.

37. Carrel - Laboratory - A small enclosure or alcove incorporating a desk, to be used by one or two trainees and equipped with a set of special tools and material for carrying out a hands-on learning event. It may include audio-visual systems.

38. Dial Access Information Retrieval System - Scheduled Audio/Video - Dial access information retrieval is an electronic system for distributing audio and visual materials and programs which are stored in a location remote from where they are dialed and received. Scheduled audio/video means that presentations are retrievable at any time except that once a program has begun, subsequent users must join the program in progress.

39. Filmstrip Projection System with Audio - A sound filmstrip projector represents a family of audio-visual devices using single frame visual filmstrips with sound on magnetic tape or records. Visuals and sound may be manually or automatically synchronized. Commercial equipment options include front or rear screen projection, remote and stop action capability, and cartridge loading models.

40. Filmstrip Projection System with Audio and Adjunct Equipment - A system for presenting information via a filmstrip projector and synchronized audio tape and special equipment that is the subject of study. The use of adjunct equipment with the AV media provides the capability for a variety of "hands-on" training tasks to be performed.

41. Instructional Kit with Instructor - A teaching kit designed for specific subject area instructional support. Kit allows the instructor to use a varied or multi-level teaching approach to instruction by including appropriate visual aids, audio tapes, models, charts, demonstrators, reference and test materials.

42. Instructional Kits for Trainees - A modular package of materials for students that contains all materials required for a segment of instruction. Kit may contain programmed instruction, audio-visual materials, tools, materials, typical samples, reference materials and testing materials as appropriate.

43. Motion Picture Projection System - Commercial, 16MM and Super 8MM Films - A motion picture projection system implying the use of professionally prepared 16mm or S-8mm sound motion picture films for training. Appropriate 16mm or S-8mm projector and projection screen are included.

44. Motion Picture Projection System - Low Budget 16MM and Super 8MM Films - A motion picture projection system implying the use of locally produced sound motion picture films for training. Such films are acceptable for training, but often lack the professional quality of commercial films. Appropriate 16mm or S-8mm projector and projection screen are included.

45. Microform with Information Mapping, and Audio - The theoretical configuration of a training system to support individualized instruction composed of microimagery in an information map format, a microform reader, an audio tape in a cassette and an audio cassette playback unit.

46. Overhead Projection System with Instructor - A system consisting of a horizontal stage projector designed to use a vertical throw for focusing an enlarged transparency image upon a projection screen. An operator is normally required to change the transparency and furnish verbal commentary.

47. Sound Slide Projection System - A system for presenting information by means of an audio tape and a series of synchronized projected visual slides.

48. Student Response System - AV Supported - A student feedback response system using programmed audio and/or visual presentations. It consists of four major components: control console with response readouts, student responders, audio visual devices, and a programmer. Options include paper tape readouts and computer interface terminals.

49. Teaching Machine - Branching, Still Visual with Audio - An individualized instruction system composed of large step multiple choice programmed instruction frames (still) with synchronized sound and a manually controlled device to select, sequence and display program frames in an order dependent upon the trainee's last response.

50. Teaching Machine - Branching, Still and Motion Visual with Audio - An individualized instruction system composed of large step multiple

choice programmed instruction frames (still and motion) with synchronized sound and a manually controlled device to select, sequence and display program frames in an order dependent upon the trainee's last response.

51. Teaching Machine - Branching, with Adjunct Equipment - An individualized instruction system composed of large step multiple choice programmed instruction frames (still or motion with or without audio) with a manually controlled device to select sequence and display program frames in an order dependent upon the trainee's last response. Associated with this equipment is a second piece of equipment, such as a mock-up, which is the subject of instruction and is operated according to instructions from the basic teaching machine.

52. Teaching Machine - Linear, Still Visual with Audio - An individualized instruction system composed of a fixed linear sequence of small step programmed instruction frames (still and motion) with synchronized audio, and a manually controlled device to display the audio and visual information.

53. Teleconference System - A telecommunication system that allows audio and visual two-way communication between two or more remote locations.

54. Television - Cable (CATV) - A hybrid CCTV system offering selective, multiple channel, encoded programming to cable network patrons. A typical system consists of a signal receiving antenna system for the master station and relay of amplified signal channels via area substations to system subscribers. Programming may also be generated and transmitted between substations offering multiple options for conference or training. Programs are encoded for privacy and control of viewing audience.

55. Television - Cartridge (CTV) - A cartridge television system (CTV) consists of packaged video tape programs, video recorder, playback and display units, and control equipment offering high selectivity and availability for individualized programming. Program cartridges may be prerecorded, locally produced, or recorded off-the-air.

56. Television - Closed Circuit (CCTV) Without Feedback - CCTV without feedback is an electronic transmission system for images and sound using a coaxial cable distribution system. System design includes one or more studios or control rooms, a signal distribution center, and signal distribution cables terminating in reception areas equipped with receiver/monitors. Off air, live or video taped programs may be used.

57. Television - CCTV with Feedback - CCTV with feedback is the transmission of a live presentation with audio feedback via microphone

or telephone in each receiving classroom. Live instructor is required in student-instructor-CCTV loop to activate the feedback mode.

58. Television - Non-Magnetic Video Disc System - An experimental form of television, similar in function to cartridge television, in which the program is encoded on a thin plastic disc, distributed to users where it is rotated at high revolutions per minute on a player which reads the data and sends program signals into the antenna terminals of a standard color television receiver. Random access capability.

59. Television - Open Broadcast - Open broadcast television is the electronic transmission of images with accompanying sound from a single channel VHF and UHF station and shorter range multiple channel 2500 MHZ systems.

60. Television - Portable Video Tape System - A low cost video tape recording and playback system which is self-contained and portable. Typical systems consist of one or two mobile vidicon cameras, a small scan video tape recorder and a monitor receiver. Immediate area programming and open broadcast reception and recording is standard.

61. Television - Video Disc with Adjunct Equipment - A theoretical configuration of a video disc system in which random access capabilities are used by a trainee in retrieving step-by-step procedures and diagnostic routines as an aid in performing these operations on a piece of equipment.

CAI/CMI

62. Computer Assisted Instruction (CAI) - A form of individualized instruction that employs digital computer technology to manage and display information to a student, accept student responses, provide knowledge of results, and select subsequent learning event.

63. Computer Assisted Instruction - PLATO IV Basic Configuration - An individualized computer based teaching system being developed by the University of Illinois at Urbana-Champaign, and includes up to 4096 terminals, a communication network, a central computer and the author language TUTOR.

64. Computer Assisted Instruction - PLATO IV, Basic Configuration and Audio - System includes basic configuration of PLATO IV plus a random access audio playback system.

65. Computer Assisted Instruction - PLATO IV, Basic Configuration with Adjunct Equipment - Includes the basic terminal with externally connected auxiliary equipment.

66. Computer Assisted Instruction

a. PLATO IV Configuration with adjunct equipment and audio-terminal device with externally connected auxiliary equipment including random access audio playback system.

b. TICCIT - A CAI system designed by Mitre Corporation which allows the student to manage his own instruction. In this type of system, the computer processes information about student achievement from on- or off-line terminals and directs the student to a sequence of off-line training modules suited to the student's style of learning and level of achievement.

67. Computer Simulation

a. On-Line - A trainee station equipped with a computer terminal in which the trainee operates in direct interface with the computer as part of the program loop. By his inputs, the trainee determines his allowable performance parameters and discerns the effect of his inputs upon the system being simulated.

b. Off-Line - A trainee station equipped with a computer terminal enabling a trainee to select a computer simulation program, enter his own variables (batch processing) and run the simulation to determine the performance of the simulated system under a variety of conditions.

68. Game - Computer Supported Simulation - Any contest, governed by rules, between teams or individuals, where the contest is a dynamic model of some real system, and a computer is used in performing some of the calculations necessary for the operation of the model as in computer supported war gaming.

69. Game - Manual Simulation - Any contest between teams or individual players, governed by rules, where the contest is a dynamic model of some real system, and is played without the aid of a computer.

70. Logic Trainers - A class of trainers that synthetically allow electronic, mechanical, fluid or gaseous conceptual system logic training without the use of actual hardware.

71. Game - Computer Simulation, Solitaire, with Visual Display - Any contest, governed by rules, between a single player and a computer with visual attachments where the contest is a dynamic model of some real world system or event.

72. Operational Equipment

a. With Manuals - A unit of operational equipment being used for instructional or training purposes with is supporting technical

documentation such as operator's guides, maintenance manuals and parts lists. May be an electronic black box, rifle, or truck.

b. Real Environment - An operational system used for training such as an aircraft, ship or track vehicle. Part task, full task, sub-team, team or multi-team training may be conducted in conjunction with or independent of normal operations.

c. Synthetically Stimulated - An operational system that is used for training by interfacing input equipments in the form of tapes, black boxes, or computers. Such input equipments present programmed data to the operational system allowing it to be used for training or evaluative purposes. May be used for part task, full task, sub-team, multi-team training or combinations thereof.

73. Physiological Trainer (Hostile Environment) Visual - A training device designed to place controlled stress on the human visual system, through the use of physiologically and/or psychologically adverse or low threshold visual signals, to enable a trainee to learn to function in this adverse environment.

74. Physiological Trainer (Hostile Environment) Surface and Internal Senses - A broad category of training devices designed to provide the cutaneous, kinesthetic and olfactory sensors with physiologically and/or psychologically adverse signals, to enable a trainee to function in adverse pressure, temperature, pain or disorientating motion environments.

75. Procedure Trainer

a. Basic - Training hardware designed for basic training, familiarization or transition type procedure training for normal, alternate and emergency operation of operational hardware. Trainer systems respond with a lesser degree of fidelity of performance than is required for simulators. May be used for various combinations of part task, full task, sub-team, team or multi-team training.

b. Adjunct Displays and Logic - Training hardware designed for basic training, familiarization or transition type procedure training for normal, alternate and emergency operation of operational hardware. Trainer systems respond appropriately to trainee inputs but to a lesser degree of fidelity of performance than is required for simulators. May be used for various combinations of part task, full task, sub-team, team or multi-team training. Adjunct displays and logics may include scoring attachments, adaptive control, automatic demonstrations, enhanced displays, automated briefing and debriefing capability, automatic coaching, remedial exercise prescriptions or follow-on assignments.

APPENDIX B

The variable descriptions and equation logic used in the Navy costing program taken from TAEG Report Number 16 by permission of the author.

Because the costed data in appendix three utilizes a large number of variables, it was believed important to provide the reader with sufficient information to specify exactly what calculations were included in each result. Since the calculations are nested logically, this can only be done through a complete variable and equation description of the costing rationale. The relevant information is thus reproduced intact from TAEG Report 16 for use by Army costing personnel who may require indepth insight, should the program be used for future COEA's.

The input variables are classified into seven classes as follows: (1) facilities, (2) equipment, (3) instructional material development, (4) personnel, (5) students, (6) supplies, and (7) miscellaneous. A definition of each variable follows:

1. Facilities

FACOST	Total costs of facilities acquisition and refurbishing which are necessary for implementation.
LOFFA	Expected years of life of FACOST assets.
CPSQFT(I)	The annual cost of operation and maintenance of facilities per square foot (includes operation, maintenance, janitorial service, utilities, etc.). Include the annual opportunity costs of facilities where applicable.
SQFTIN	Total square feet required for each instructor.
SQFTST	Total square feet required per student position.
SQFTAM	Total square feet required for administrative overhead.

2. Equipment

EQCISP	The cost of equipment necessary for implementation (that which is not dependent on the number of student positions). Do not include equipment which is uniquely associated with student positions (i.e., costs included in variable EQIMPC).
LOFEQI	The expected years of life of equipment included in EQCISP.
CAQSP(I)	Total cost of equipment to be acquired in each year of planning period following implementation. Include cost of equipment which represents expansion or addition to the program plus replacement costs for that equipment included in EQCISP.
LOFEQ(I)	The expected years of life of equipment which has been included in CAQSP(I).

OMFEQ(I) Total annual operation and maintenance cost of fixed equipment; i.e., the operation and maintenance cost of equipment not uniquely related to student positions. O&M costs of equipment included in variable EQCISP and CAQSP(I).

EQIMPC The cost of equipment (per student position) which must be acquired for implementation. Do not include equipment which is not uniquely related to student positions (i.e., do not include equipment costs included in variable EQCISP).

LOFEQ The expected years of life of student position equipment; i.e., equipment included in EQIMPC.

COPMT(I) Annual operation, maintenance, and replacement costs of equipment associated with each student position in each year of the planning period; i.e., the O&M costs of equipment included in variable EQIMPC and the replacement costs of any student position related equipment.

TSPOSD The percentage of planned operating time the student position equipment is nonfunctional because of unplanned contingencies; i.e., equipment failure, weather, etc. (percentage of down time equals one minus the percentage availability).

3. Instructional Material Development

UIMD The percentage of time spent in the training medium (for the nonrecycled student) for which unique hours of instructional material must be developed.

UIMDYR(I) The number of unique hours of new instructional material to be developed in each year of the planning period. (The model assumes that any materiel developed and reflected in this variable is unique to the course and will be fully depreciated at the end of the planning period.) This variable does not include any updating of original course material.

UPDATE	Update factor for instructional material. Percentage of the original development of instructional material expended each year to maintain the courseware.
EVIM	The percentage of the original development cost of the instructional material which remains at the end of the planning period.
CIMD	Average cost of developing the master copy for one hour of instruction (i.e., the per unit instructional material development costs).

4. Personnel

INTSPO	Instructor-to-student position ratio.
SALINR	Average annual salary and benefits for one instructor.

5. Supplies

SUPPLY	Average cost of expendable supplies per student while in the training medium.

6. Students

GRAD(I)	The number of students who must be trained for each year of the planning period; i.e., the number who must complete the program and graduate
STUDSL	Average annual salary and benefits for one student.
STCST1	Average student travel costs to and from school. Do not include any travel done as part of the course.
STCST2	Average student travel costs which are incurred as part of the course. Do not include any costs to and from school.

7. Miscellaneous

N	The number of years in the planning period. (In setting the planning period, guidance can be found in SECNAVINST 7000.14A, pages 7 & 8.)

ARATE	The attrition rate. The percentage of students who enroll in the program but never complete the training.
DRATE	The discount rate (10 percent according to DoD Instruction 7041.3).
NSCHOP	The time in weeks the student position is available per year.
TLENGH	The average time in weeks spent in the training medium for the nonrecycled student.
TLEGTH	The average hours per week the student spends in the medium.
RCRATE	Recycle rate equals the percentage of students enrolling in the training who will repeat some part of the program.
ARCYTM	Average recycle time in weeks equals the average amount of time a student spends in repeating any and all parts of the course.
ESP	The percentage of student positions above the computed number which are to be acquired to provide for fluctuations in student inputs through the system.

The following variables are computed by the model from the above input data:

1. Facilities

TSQFT	Total square feet of facilities required: TSQFT=(SQFTST)(PSP)+(INTSPO)(PSP)(SQFTIN)+SQFTAM.
FCOST(I)	Total cost of facilities for each year of the planning period: FCOST(I)=(TSQFT)(CPSQFT(I)).

2. Equipment

NSPR(I)	Number of student positions required for the system:

NSPR(I)=((SMNRRC(I)+STUDNM(I))/(WSCHOP)/(1-YSOPSD).

MNSP — Mean number of student positions for planning period:

$$MNSP = \sum_{I=1}^{N} NSPR(I)/N.$$

PSP — Planned number of student positions:

PSP=MNSP+(ESP)(MNSP).

EAQCI — Equipment acquisition costs necessary for implementation:

EAQCI=(EQINPC)(PSP)+(EQCISP).

TAEQC(I) — Total annual operation, maintenance and equipment acquisition costs for each year of the planning period:

TAEQC(I)=(CAQSP(I)+(COPMT(I))(PSP)+OMFEQ(I).

E_3 — Annual depreciation of student position equipment:

E_3 = (EQINPC)(PSP)/LOFEQ.

R — Internal computed variable indicating the years of life remaining in equipment at end of planning period.

RVEQ — Remaining value of student position equipment at end of planning period:

RVEQ=(R)(E_3).

RVEQ2 — Remaining value of equipment purchased in each year of planning period (- for all (LOFEQ(I) -N)≥ 0):

$$RVEQ2 = \sum_{I=1}^{N} (LOFEQ(I)-N) * (CAQSP(I)/LOFEQ(I)).$$

NSPR(I)=((SMWRRC(I)*STUDNM(I))/(WSCHOP)/(1-TSOPSD).

MNSP — Mean number of student positions for planning period:

$$MNSP = \sum_{I=1}^{N} NSPR(I)/N.$$

PSP — Planned number of student positions:

PSP=MNSP*(ESP)(MNSP).

EAQCI — Equipment acquisition costs necessary for implementation:

EAQCI=(EQINPC)(PSP)*(ACQISP).

TAEQC(I) — Total annual operation, maintenance and equipment acquisition costs for each year of the planning period:

TAEQC(I)=(CAQSP(I)*(COPMT(I))(PSP)+OMFEQ(I).

E_3 — Annual depreciation of student position equipment:

E_3 = (EQINPC)(PSP)/LOFEQ.

R — Internal computed variable indicating the years of life remaining in equipment at end of planning period.

RVEQ — Remaining value of student position equipment at end of planning period:

RVEQ=(R)(E_3).

RVEQ2 — Remaining value of equipment purchased in each year of planning period (- for all (LOFEQ(I) -N)≥ 0):

$$RVEQ2 = \sum_{I=1}^{N} (LOFEQ(I)-N) * (CAQSP(I)/LOFEQ(I)).$$

AASIN — Average annual student inputs required to provide the number of graduates specified in each year:

$$AASIN = \sum_{I=1}^{N} STUD(I)/N.$$

STUDMW(I) — Total time required in training for all students in each year of planning period to train the required number of students (to specified objectives) utilizing the media set under consideration (exclude recycle time):

$$STUDMW(I) = (TLENGH)(STUD(I))(1-.5(ARATE)).$$

SMWRRC(I) — Total time required for recycling for all students in each year of planning period:

$$SMWRRC(I) = (RCRATE)(STUD(I))(ARCYTM).$$

AOB(I) — Average number of students on board for each year:

$$AOB(I) = (SMWRRC(I)+STUDMW(I))/WSCHOP.$$

AAOB — Mean number of students on board for entire planning period:

$$AAOB = \sum_{I=1}^{N} AOB(I)/N.$$

TRAVEL — Total annual travel costs for all students:

$$TRAVEL = (AASIN)(STCST1)+(STCST2)(AASIN)(1-0.5\ ARATE).$$

SSALRY(I) — Total costs of student salary and benefits for all students for each year of planning period:

$$SSALRY(I) = ((SMWRRC(I)+STUDMW(I))/52)(STUDSL).$$

6. Supplies

SUPPY(I) — Total cost of student supplies for each year in planning period:

$$SUPPY(I) = (STUD(I))(SUPPLY).$$

7. Miscellaneous

UDACST(I) — Total nondiscounted costs for each year in planning period:

$$UDACST(I)=FCOST(I)+TAEQC(I)+AIMMC(I)+CINSTR(I)+SUPPY(I)+SSALRY(I)+TRAVEL.$$

H_4 — Total nondiscounted cost of alternative:

$$H_4=\sum_{I=1}^{N} UDACST(I)+FACOST+EAQCI+ACIMD - RVAS/(1+DRATE)^N.$$

RVAS — Remaining value of equipment and instructional material at end of planning period:

$$RVAS=RVEQ+RVIM+RVFA$$

PVALUE — Present value (cost) of alternative:

$$PVALUE=\sum_{I=1}^{N} ((UCACST(I)(2+DRATE))/(2(1+DRATE)^I)+[FACOST+EAQCI+ACIMD]-[RVAS/(1.0+DRATE)^N].$$

C_3 — Average discounted costs per student position:

$$C_3=PVALUE/PSP$$

CINT — Initial system acquisition costs for facilities, equipment, and instructional material development:

$$CINT=FACOST+EQACI+ACIMD.$$

ANCSP — Average annual nondiscounted costs per student position.

$$ANCSP=H_4/(N)(PSP)$$

ADCSP — Average annual discounted costs per student position:

$$ADCSP=PVALUE/(N)(PSP)$$

ACSP — Initial system acquisition costs for facilities, equipment, and instructional material development per student position:

ACSP=CINT/PSP.

UAC — Uniform annual costs:

$$UAC = PVALUE / \sum_{I=1}^{N} \left[(2+DRATE)/(2(1+DRATE)^{I}) \right].$$

APPENDIX C

The costed components of an alternate program for training the 25(L) MOS in the AN/TSQ-73 missile minder. Components are costed on the basis of a 17-week, 35-hour per week class period. A total cost for the program could be calculated as the sum of the component costs multiplied by their percentage of use given at the top of each component listing. Full details of all calculations are given in appendix two. Input data from USAADS is listed for each component on average and life cycle basis for a 20-year costing period.

C-2

INPUT DATA

ARI INPUT TO O-73 COEA BASED ON TASK-DRIVEN SELECTION METHODOLOGY ATMOS.
ACTUAL EQUIPMENT-USED & PERCENT OF 17 WEEK TRAINING COURSE

YEAR	1	2	3	4	5	6	7	8	9
GRADUATES REQD./YEAR	56.0	85.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
COST/SQ FT.	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
OPERATION AND MAINT. COST/YR.	141.00	141.00	141.00	141.00	141.00	141.00	141.00	141.00	141.00
DEP COST OF FIXED EQUIPMENT	28.20	28.20	28.20	28.20	28.20	28.20	28.20	28.20	28.20
ANNUAL ACQUISITION COST/STUD. POS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED LIFE OF CAPSPEC ASSETS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIQUE HOURS OF IMD/YR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

YEAR	10	11	12	13	14	15	16	17	18
GRADUATES REQD./YEAR	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
COST/SQ FT.	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
OPERATION AND MAINT. COST/YR.	141.00	141.00	141.00	141.00	141.00	141.00	141.00	141.00	141.00
DEP COST OF FIXED EQUIPMENT	28.20	28.20	28.20	28.20	28.20	28.20	28.20	28.20	28.20
ANNUAL ACQUISITION COST/STUD. POS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED LIFE OF CAPSPEC ASSETS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
UNIQUE HOURS OF IMD/YR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

YEAR	19	20
GRADUATES REQD./YEAR	15.0	15.0
COST/SQ FT.	1.52	1.52
OPERATION AND MAINT. COST/YR.	141.00	141.00
DEP COST OF FIXED EQUIPMENT	28.20	28.20
ANNUAL ACQUISITION COST/STUD. POS	0.0	0.0
EXPECTED LIFE OF CAPSPEC ASSETS	0.0	0.0
UNIQUE HOURS OF IMD/YR	0.0	0.0

NO. OF YEARS IN PLANNING PERIOD	20
FACILITIES ACQUISITION OR REHABILITATION COST	93556.00
EXPECTED LIFE OF FACILITIES (YEARS)	25.00
SQ FT/INSTR. POS.	64.0
SQ FT/STUDENT POS.	93.0
TOTAL SQ FT REQUIRED FOR HUMAN OVERHEAD	1488.00
EQUIP. IMPLEM. COST INDEPEND. STUD POS	837655.00
LIFE OF IMPLEMENTATION EQUIPMENT	25.00
EQUIPMENT IMPLEMENTATION COST/STUD POS	0.0
LIFE OF STUD POS EQUIP	25.0
TIME STUDENT POS ARE OCCUPIED	0.55
PER CENT OF TRAINING MEDIUM TIME REQUIRING UNIQUE HOURS OF IMD	1.00
UPDATE FACTOR	0.20
VALUE OF IN AT END OF PLANNING PER.	0.0
HOURLY COST OF IMD	64.61
INSTR./STUDENT POS. RATIO	0.200
SALARY OF ONE INSTR.	16800.00
SUPPLIES COST/STUDENT	1515.00
STUDENT SALARY	8154.00
AVE. STUDENT TRAVEL COST TO/FROM SCH	105.00
AVE. STUDENT TRAVEL AS % OF COST OF COURSE	0.0
ATTRITION RATE	0.15
DISCOUNT RATE	0.10
WEEKS & POST OPERATIVE/YR	50.0
NO. OF TRAINING WEEKS AVAILABLE/YR	50.00
LENGTH OF TRAINING IN WKS.	17.00
SKILLS DECAY PER CENT IN T. TRAIN MEDIUM	35.0
RECYCLE RATE	0.0
AVE. RECYCLE TIME IN WKS	0.0
EXCESS NO. IN STUDENT POSITIONS	0.40

GFI INPUT TO G-73 COFA BASED ON TASK-DRIVEN SELECTION METHODOLOGY ATMOS.
ACTUAL EQUIPMENT-USED 4 PERCENT OF 17 WEEK TRAINING COURSE

OUTPUT SUMMARY YEARS 1- 9

YEAR	1	2	3	4	5	6	7	8	9
STUDENT INPUT	65.9	100.0	17.6	17.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	2.4	3.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
NO. OF STUDENT POSITIONS REQUIRED	7.6	11.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NO. OF INSTRUCTORS REQUIRED	1.1	1.6	0.3	0.3	0.3	0.3	0.3	0.3	0.3
NONDISCOUNTED ANNUAL FAC. COST	2888.	2888.	2888.	2888.	2888.	2888.	2888.	2888.	2888.
NONDISCOUNTED ANNUAL EQUIPMENT COST	577.6	577.6	577.6	577.6	577.6	577.6	577.6	577.6	577.6
NONDISCOUNTED ANNUAL IM COST	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
NONDISCOUNTED ANNUAL INSTR. COST	18201.1	27626.4	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3
NONDISCOUNTED ANNUAL SUPPLY COST	126164.6	191495.9	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	19112.1	29009.4	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	169597.3	254255.5	49908.3	49908.3	49908.3	49908.3	49908.3	49908.3	49908.3

OUTPUT SUMMARY YEARS10-18

YEAR	10	11	12	13	14	15	16	17	18
STUDENT INPUT	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
NO. OF STUDENT POSITIONS REQUIRED	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
NO. OF INSTRUCTORS REQUIRED	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
NONDISCOUNTED ANNUAL FAC. COST	2888.	2888.	2888.	2888.	2888.	2888.	2888.	2888.	2888.
NONDISCOUNTED ANNUAL EQUIPMENT COST	577.6	577.6	577.6	577.6	577.6	577.6	577.6	577.6	577.6
NONDISCOUNTED ANNUAL IM COST	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5	18.5
NONDISCOUNTED ANNUAL INSTR. COST	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3	4875.3
NONDISCOUNTED ANNUAL SUPPLY COST	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3	5119.3
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	45508.3	49908.3	49908.3	49908.3	49908.3	49908.3	49908.3	49908.3	49908.3

OUTPUT SUMMARY YEARS19-20

YEAR	19	20
STUDENT INPUT	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	0.7	0.7
NO. OF STUDENT POSITIONS REQUIRED	2.0	2.0
NO. OF INSTRUCTORS REQUIRED	0.3	0.3
NONDISCOUNTED ANNUAL FAC. COST	2888.	2888.
NONDISCOUNTED ANNUAL EQUIPMENT COST	577.6	577.6
NONDISCOUNTED ANNUAL IM COST	18.5	18.5
NONDISCOUNTED ANNUAL INSTR. COST	4875.3	4875.3
NONDISCOUNTED ANNUAL SUPPLY COST	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	5119.3	5119.3
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	45508.3	49908.3

AVE. ANNUAL STUDENT INPUT	24.18
AVE. ANNUAL NO. OF STUDENTS ON BOARD	0.89
PRESENT COST OF ALTERNATIVE	1640238.00
NONDISCOUNTED COST OF ALTERNATIVE	2224719.00
AVE. DISCOUNTED COST/GRADUATE	3990.85
NONDISCOUNTED COST/GRADUATE	5412.94
AVE. DISCOUNTED COST/STUDENT POSITION	420989.44
INITIAL EQUIPMENT ACQUISTION COST	833655.00
INITIAL FACILITIES ACQUISTION COST	93556.00
INITIAL IM DEV COST	92.39
INITIAL SYSTEM ACQUISTION COST FOR FACILITIES,EQUIP,AND IMD	927303.38
REMAINING VALUE OF EQUIPMENT	166730.94
REMAINING VALUE OF IM	0.0
AVE. NO. OF INSTRUCTORS REQUIRED	0.40
AVE. NO. OF STUDENT POSITIONS REQD.	3.90
FACILITY REQUIREMENTS IN SQ FT	1900.21
AVE. ANNUAL NONDIS. COST/STUD POS	28550.23
AVE. ANNUAL DISCOUNTED COST/STUD POS	21049.47
ACQUISTION COST/STUD POS	238005.06
UNIFORM ANNUAL COST	183486.31

INPUT DATA

	1	2	3	4	5	6	7	8	9
	35.0	80.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
	.5000	15000	15000	15000	15000	15000	15000	15000	15000
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	10	11	12	13	14	15	16	17	18
	.500	.500	.500	.500	.500	15.0	15.0	15.0	15.0
	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
	15000	15000	15000	15000	15000	15000	15000	15000	15000
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	19	20
	15.0	15.0
	1.52	1.52
	15000	15000
	0.0	0.0
	0.0	0.0
	0.0	0.0
	0.0	0.0

	0
	0.0
	0.0
	0.0
	.4000
	0.0
	75000
	0.0
	75000
	0.0
	.001
	0.0
	1.0
	16.0
	0.0
	6600.0
	2500.0
	2134.0
	.125
	0.0
	1.0
	1.0
	0.0
	56.0
	27.0
	.50
	3.0
	1.0
	0.0

SECOND CONTINUE COMPONENT OF ALTERNATE PLACEMENT-USED 45.2 PERCENT OF TIME THIS
REFERENCE TEXTS--LESSONS 105-240 PRINTING TEXTS

OUTPUT SUMMARY YEARS 1- 9

YEAR	1	2	3	4	5	6	7	8	9
STUDENT INPUT	65.9	100.6	7.6	7.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	27.5	91.0	7.4	7.4	7.4	7.4	7.4	7.4	7.4
NO. OF STUDENT POSITIONS REQUIRED	36.6	90.5	10.3	10.3	10.3	10.3	10.3	10.3	10.3
NO. OF INSTRUCTORS REQUIRED	.4	2.1	0.4	0.4	0.4	0.4	0.4	0.4	0.4
NONDISCOUNTED ANNUAL MISC. COST	3316.	3316.	3316.	3316.	3316.	3316.	3316.	3316.	3316.
NONDISCOUNTED ANNUAL EQUIPMENT COST	297.2	297.2	297.2	297.2	297.2	297.2	297.2	297.2	297.2
NONDISCOUNTED ANNUAL IM COST	345.8	345.8	345.8	345.8	345.8	345.8	345.8	345.8	345.8
NONDISCOUNTED ANNUAL INSTR. COST	7213.1	35120.4	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7
NONDISCOUNTED ANNUAL SUPPLY COST	164705.8	244934.9	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6
NONDISCOUNTED ANNUAL STUDENT SALARIES	215566.4	327800.2	57648.1	57848.1	57848.1	57848.1	57848.1	57848.1	57848.1
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	410404.1	619570.3	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3

OUTPUT SUMMARY YEARS10-18

YEAR	10	11	12	13	14	15	16	17	18
STUDENT INPUT	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
NO. OF STUDENT POSITIONS REQUIRED	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.3
NO. OF INSTRUCTORS REQUIRED	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
NONDISCOUNTED ANNUAL MISC. COST	3316.	3316.	3316.	3316.	3316.	3316.	3316.	3316.	3316.
NONDISCOUNTED ANNUAL EQUIPMENT COST	297.2	297.2	297.2	297.2	297.2	297.2	297.2	297.2	297.2
NONDISCOUNTED ANNUAL IM COST	345.8	345.8	345.8	345.8	345.8	345.8	345.8	345.8	345.8
NONDISCOUNTED ANNUAL INSTR. COST	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7	6197.7
NONDISCOUNTED ANNUAL SUPPLY COST	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6	44117.6
NONDISCOUNTED ANNUAL STUDENT SALARIES	57848.1	57848.1	57848.1	57848.1	57848.1	57848.1	57848.1	57848.1	57848.1
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3	114757.3

OUTPUT SUMMARY YEARS19-20

YEAR	19	20
STUDENT INPUT	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	7.4	7.4
NO. OF STUDENT POSITIONS REQUIRED	10.3	10.3
NO. OF INSTRUCTORS REQUIRED	0.4	0.4
NONDISCOUNTED ANNUAL MISC. COST	3316.	3316.
NONDISCOUNTED ANNUAL EQUIPMENT COST	297.2	297.2
NONDISCOUNTED ANNUAL IM COST	345.8	345.8
NONDISCOUNTED ANNUAL INSTR. COST	6197.7	6197.7
NONDISCOUNTED ANNUAL SUPPLY COST	44117.6	44117.6
NONDISCOUNTED ANNUAL STUDENT SALARIES	57848.1	57848.1
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	114757.3	114757.3

AVE. ANNUAL STUDENT INPUT	24.18
AVE. ANNUAL NO. OF STUDENTS ON BOARD	10.11
PRESENT COST OF ALTERNATIVE	1747796.00
NONDISCOUNTED COST OF ALTERNATIVE	3097278.00
AVE. DISCOUNTED COST/GRADUATE	4252.54
NONDISCOUNTED COST/GRADUATE	7535.95
AVE. DISCOUNTED COST/STUDENT POSITION	88219.25
INITIAL EQUIPMENT ACQUISTION COST	0.0
INITIAL FACILITIES ACQUISTION COST	0.0
INITIAL IM DEV COST	1728.81
INITIAL SYSTEM ACQUISTION COST FOR FACILITIES,EQUIP,AND IMD	1728.81
REMAINING VALUE OF EQUIPMENT	0.0
REMAINING VALUE OF IM	0.0
AVE. NO. OF INSTRUCTORS REQUIRED	0.51
AVE. NO. OF STUDENT POSITIONS REQD.	19.81
FACILITY REQUIREMENTS IN SQ FT	2181.42
AVE. ANNUAL NONDIS. COST/STUD POS	7816.69
AVE. ANNUAL DISCOUNTED COST/STUD POS	4410.96
ACQUISTION COST/STUD POS	87.26
UNIFORM ANNUAL COST	195518.38

INPUT DATA

TYPE OF EQUIPMENT OR ALTERNATE PROGRAM-USED 50.2 PERCENT OF TIME STUDY.
RECEIVING WITH MOVABLE PLATE AND SELECTED RETENTIVE FUNCTIONS

TYPE	1	2	3	4	5	6	7	8	9
DEPRECIATED AMOUNT/YEAR	50.0	49.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
INTEREST RT.	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
DEPRECIATION AND MAINT. COST/YR.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
PER COST OF FIXED EQUIPMENT	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
ANNUAL ACQUISITION COST/CONV. PCS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED LIFE OF CONVERTED ASSETS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANNUAL RETURN OF INV/YR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TYPE	10	11	12	13	14	15	16	17	18
DEPRECIATED AMOUNT/YEAR	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0
INTEREST RT.	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52	1.52
DEPRECIATION AND MAINT. COST/YR.	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
PER COST OF FIXED EQUIPMENT	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
ANNUAL ACQUISITION COST/CONV. PCS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXPECTED LIFE OF CONVERTED ASSETS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANNUAL RETURN OF INV/YR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TYPE	19	20
DEPRECIATED AMOUNT/YEAR	15.0	15.0
INTEREST RT.	1.52	1.52
DEPRECIATION AND MAINT. COST/YR.	100.00	100.00
PER COST OF FIXED EQUIPMENT	20.00	20.00
ANNUAL ACQUISITION COST/CONV. PCS	0.0	0.0
EXPECTED LIFE OF CONVERTED ASSETS	0.0	0.0
ANNUAL RETURN OF INV/YR	0.0	0.0

NO. OF YEARS IN PLANNING PERIOD	20
FACILITIES ACQUISITION OR REPLACEMENT COST	93556.00
EXPECTED LIFE OF FACILITIES EMPLOYED	25.00
SC ESTIMATED PCS.	64.0
SC INVESTMENT PCS.	53.0
TOTAL SC FT REQUIRED FOR ADMIN OVERHEAD	1488.00
EQUIP. SUPPLR. INIT. IMPLEMD. STUD ECP	60000.00
LIFE OF IMPLEMENTATION EQUIPMENT	25.00
EQUIPMENT IMPLEMENTATION CONTRACTING ECS	0.0
LIFE OF STUD PCS EQUIP	25.0
TIME CONSTANT PCS ARE WORK	0.01
PER CENT OF WORKING MONTH TIME	
REQUIRING UNSKILLED HOURS OF IMD	1.00
UPDATE FACTOR	0.10
VALUE OF SD AT END OF PLANNING PER.	0.0
MONTHLY COST OF IMD	64.01
INSTR./STUDENT PCS. NEED	0.500
SALARY OF INSTR.	14000.00
SUPPLIES COST/STUDENT	1515.00
STUDENT SALARY	8156.00
AVG. STUDENT TRAVEL COST TO/FROM SCH	100.00
AVG. STUDENT TRAVEL AS % OUT OF COURSE	0.0
ATTRITION RATE	0.15
DISCOUNT RATE	0.10
AVAIL SCHOOL OPERATES/YR	50.0
NO. OF TRAINING WEEK AVAILABLE/YR	50.00
LENGTH OF TRAINING IN WKS.	25.30
SUPERVISORY HRS. SPENT IN C. TRNG MODULE	17.6
RECYCLE RATE	0.0
AVG. RECYCLE TIME IN WKS.	0.0
EXCESS NO. OF STUDENT POSITIONS	0.40

TFIRD COSTABLE COMPONENT OF ALTERNATE PROGRAM-USED 50.2 PERCENT OF TIME ATMOS.
MOCK-UPS WITH MOVABLE PARTS AND SELECTED MAINTENANCE FUNCTIONS

OUTPUT SUMMARY YEARS 1- 9

YEAR	1	2	3	4	5	6	7	8	9
STUDENT INPUT	65.9	100.0	17.6	17.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	30.9	47.0	8.3	8.3	8.3	8.3	8.3	8.3	8.3
NO. OF STUDENT POSITIONS REQUIRED	43.6	66.4	11.7	11.7	11.7	11.7	11.7	11.7	11.7
NO. OF INSTRUCTORS REQUIRED	6.3	9.5	1.7	1.7	1.7	1.7	1.7	1.7	1.7
NONDISCOUNTED ANNUAL FAC. COST	5877.	5877.	5877.	5877.	5877.	5877.	5877.	5877.	5877.
NONDISCOUNTED ANNUAL EQUIPMENT COST	2268.3	2268.3	2268.3	2268.3	2268.3	2268.3	2268.3	2268.3	2268.3
NONDISCOUNTED ANNUAL IM COST	114.9	114.9	114.9	114.9	114.9	114.9	114.9	114.9	114.9
NONDISCOUNTED ANNUAL INSTR. COST	105028.5	150618.3	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6
NONDISCOUNTED ANNUAL SUPPLY COST	126164.6	191499.9	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	242627.8	368274.4	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	484716.5	730008.3	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8

OUTPUT SUMMARY YEARS10-18

YEAR	10	11	12	13	14	15	16	17	18
STUDENT INPUT	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
NO. OF STUDENT POSITIONS REQUIRED	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
NO. OF INSTRUCTORS REQUIRED	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
NONDISCOUNTED ANNUAL FAC. COST	5877.	5877.	5877.	5877.	5877.	5877.	5877.	5877.	5877.
NONDISCOUNTED ANNUAL EQUIPMENT COST	2268.3	2268.3	2268.3	2268.3	2268.3	2268.3	2268	2268.3	2268.3
NONDISCOUNTED ANNUAL IM COST	114.9	114.9	114.9	114.9	114.9	114.9	114.9	114.9	114.9
NONDISCOUNTED ANNUAL INSTR. COST	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6	28132.6
NONDISCOUNTED ANNUAL SUPPLY COST	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6	64989.6
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8	137811.8

OUTPUT SUMMARY YEARS19-20

YEAR	19	20
STUDENT INPUT	17.6	17.6
AVE. NO. OF STUDENTS ON BOARD	8.3	8.3
NO. OF STUDENT POSITIONS REQUIRED	11.7	11.7
NO. OF INSTRUCTORS REQUIRED	1.7	1.7
NONDISCOUNTED ANNUAL FAC. COST	5877.	5877.
NONDISCOUNTED ANNUAL EQUIPMENT COST	2268.3	2268.3
NONDISCOUNTED ANNUAL IM COST	114.9	114.9
NONDISCOUNTED ANNUAL INSTR. COST	28132.6	28132.6
NONDISCOUNTED ANNUAL SUPPLY COST	33794.1	33794.1
NONDISCOUNTED ANNUAL STUDENT SALARIES	64989.6	64989.6
NONDISCOUNTED ANNUAL TRAVEL COST	2635.2	2635.2
NONDISCOUNTED ANNUAL OPERATION COST	137811.8	137811.8

AVE. ANNUAL STUDENT INPUT	24.18
AVE. ANNUAL NO. OF STUDENTS ON BOARD	11.36
PRESENT COST OF ALTERNATIVE	2229949.00
NONDISCOUNTED COST OF ALTERNATIVE	3848322.00
AVE. DISCOUNTED COST/GRADUATE	5425.66
NONDISCOUNTED COST/GRADUATE	9363.31
AVE. DISCOUNTED COST/STUDENT POSITION	95185.44
INITIAL EQUIPMENT ACQUISTION COST	60000.00
INITIAL FACILITIES ACQUISTION COST	53556.00
INITIAL IM DEV COST	1148.77
INITIAL SYSTEM ACQUISTION COST FOR FACILITIES, EQUIP, AND IMD	154704.75
REMAINING VALUE OF EQUIPMENT	12000.00
REMAINING VALUE OF IM	0.0
AVE. NO. OF INSTRUCTORS REQUIRED	2.29
AVE. NO. OF STUDENT POSITIONS REQD.	22.48
FACILITY REQUIREMENTS IN SQ FT	3866.66
AVE. ANNUAL NONDIS. COST/STUD POS	8558.44
AVE. ANNUAL DISCOUNTED COST/STUD POS	4955.27
ACQUISTION COST/STUD POS	6881.06
UNIFORM ANNUAL COST	249454.75

	PRESENT COST	AVERAGE DISCOUNTED COST PER GRADUATE	UNIFORM ANNUAL COST	ACQUISITION COST FOR FACILITIES, EQUIP. AND INSTRUCTIONAL MATERIAL DEVELOPMENT
COMPONENT ONE				
ACTUAL EQUIPMENT	1640238.0	3990.8	183486.3	927303.4
COMPONENT TWO				
REFERENCE TEXTS	1347756.0	4252.5	195518.4	1728.8
CLASSROOM AIDS				
BRANCHING TEXTS				
COMPONENT THREE				
MOCK-UPS	2229549.0	5425.7	249454.8	154704.8
MAINT. AIDS				

	AVE. NO. OF INSTRUCTORS (IN MAN-YEARS PER YEAR)	AVE. NONDISCOUNTED ANNUAL INSTRUCTOR COST	AVE. NO. OF STUDENT POSITIONS REQUIRED	AVERAGE HOURS PER GRADUATE IN MODULE
COMPONENT ONE				
ACTUAL EQUIPMENT	0.4	6679.1	3.9	1.4
COMPONENT TWO				
REFERENCE TEXTS	0.5	8490.9	19.8	15.8
CLASSROOM AIDS				
BRANCHING TEXTS				
COMPONENT THREE				
MOCK-UPS	2.3	38541.7	22.5	17.8
MAINT. AIDS				

AVERAGE ANNUAL STUDENT INPUT

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE ANNUAL NUMBER OF STUDENTS ON BOARD

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	11.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

PRESENT COST OF ALTERNATIVE

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	1640238.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING TEXTS	1747796.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	2229949.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DISCOUNTED COST OF ALTERNATIVE

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	2224719.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRINTING TEXTS	3097776.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	3848322.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE DISCOUNTED COST/GRADUATE

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	3990.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	4252.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	5425.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ACADEMIC DISCOUNTED COST/GRADUATE

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	5412.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	7536.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	9363.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE DISCOUNTED COST/STUDENT POSITION

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	420989.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRORATING TEXTS	86219.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	99185.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

INITIAL EQUIPMENT ACQUISITION COST

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	833655.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRORATING TEXTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	60000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

INITIAL FACILITIES ACQUISITION COST

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	93550.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	93556.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

INITIAL INSTRUCTIONAL MATERIALS DEVELOPMENT COST

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	97.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	1728.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	1148.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

INITIAL SYSTEM ACQUISITION COST FOR FACILITIES, EQUIPMENT, AND IMP

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	927303.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	1728.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	154704.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REMAINING VALUE OF EQUIPMENT

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	166730.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	12000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

REMAINING VALUE OF INSTRUCTIONAL MATERIALS

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	0.0	C.C	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	0.0	C.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE NUMBER OF INSTRUCTORS REQUIRED

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	0.4	C.0	0.0	0.0	0.0	C.C	0.0	0.0
BRANCHING TEXTS	0.5	C.C	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	2.3	C.C	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE NUMBER OF STUDENT POSITIONS REQUIRED

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	3.9	C.C	0.0	0.0	0.0	C.0	0.0	0.0
BRANCHING TEXTS	19.8	C.C	0.0	0.0	0.C	0.C	0.0	0.0
MOCK-UPS	22.5	C.C	0.0	0.0	0.0	0.0	0.0	0.0

FACILITY REQUIREMENTS IN SQUARE FEET

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	1900.2	C.0	0.0	C.C	C.0	0.C	0.0	0.0
BRANCHING TEXTS	2181.4	C.C	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	3866.7	C.C	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE ANNUAL NONDISCOUNTED COST PER STUDENT POSITION

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	28550.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	7816.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCK-LPS	8556.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

AVERAGE ANNUAL DISCOUNTED COST/STUDENT POSITION

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	21049.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	4411.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ACCK-LPS	4459.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ACQUISITION COST/STUDENT POSITION

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	238005.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	87.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	6881.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

UNIFORM ANNUAL COST

	METHOD 1	METHOD 2	METHOD 3	METHOD 4	METHOD 5	METHOD 6	METHOD 7	METHOD 8
ACTUAL EQUIPMENT	183486.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BRANCHING TEXTS	195518.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MOCK-UPS	249454.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0