THE IMPACT OF UTILIZATION PATTERNS ON THE COST EFFECTIVENESS OF TRAINING DEVICES

DR. RICHARD BRABY
Land/Sea Trainers, Applications Division
Naval Training Device Center

The cost effectiveness of various Navy training device utilization programs appears to be much lower than it could be. This is the result, in part, of an uneven distribution of design effort between hardware design and application design. Almost the entire design effort is now being focused on the development and the support of hardware. Only a very limited amount of effort is being applied to the application problem, that of planning how to use the training device to achieve instructional objectives.

The active inventory of Naval Training Device Center produced devices is approaching a total acquisition cost of 1/2 billion dollars. However, the real value of this investment to the Navy is a function of how much and how well these devices are being used. At this point in time, it appears that by increasing the sophistication of application planning, and subsequently the patterns of use, dramatic increases in cost effectiveness can be achieved in many of the Navy's training device programs.

The purpose of this paper is to describe certain "measures" of trainer utilization styles and "measures" of the cost effectiveness of these various styles or patterns of use. Also, certain materials and services will be identified that can be provided by Naval Training Device Center and its contractors, to aid the fleet in increasing its sophistication in the use of major training devices.

Trainer effectiveness (see figure 1) is the product of a trainer (with certain system effectiveness characteristics) being used in an instructional program (with certain application effectiveness characteristics) to aid students in achieving required instructional objectives.

Certain effectiveness measures are currently being used, or are being proposed. However, most of the past measurement effort has been in the area of hardware performance. As noted on the left side of figure 1, there are the measures, the mean time between failure, and the mean time to repair. These measures depict the reliability and maintainability of a training device. The AMP factor, which is the ratio of annual operation and maintenance cost to the acquisition cost, depicts whether a device has relatively high or low annual operating costs.

The achieved utilization rate, in its various forms, is an overall measure of trainer effectiveness which integrates factors from both the left and right sides of figure 1. This is the one widely used measure of trainer effectiveness. Knowing that a specific training device is being used an average of 70% of each 8 hour work day is a significant indicator of the overall usefulness of the trainer, but it leaves a great deal unsaid and unmeasured.

It is important to note that at this time there are no standard measures of application effectiveness.

Returning briefly to the measure, the "achieved utilization rate", what type of information is being displayed with this measure? When we report that a device has 40% utilization, what types of utilization might be included? Let us assume that we wish to learn how a specific team type weapon system trainer is being used. To do

TRAINER EFFECTIVENESS

MEASURES: Achieved Utilization Rate

* ?

TRAINER	APPLICATION PROGRAM
Design Characteristics	Exercise Design Characteristics
Maintenance Characteristics	Instructor Performance Characteristics
Measures:	Measures:
* Mean Time Between Failures	* ?
* Mean Time To Repair	* ?
* AMP	* ?

Figure 1. Trainer Effectiveness

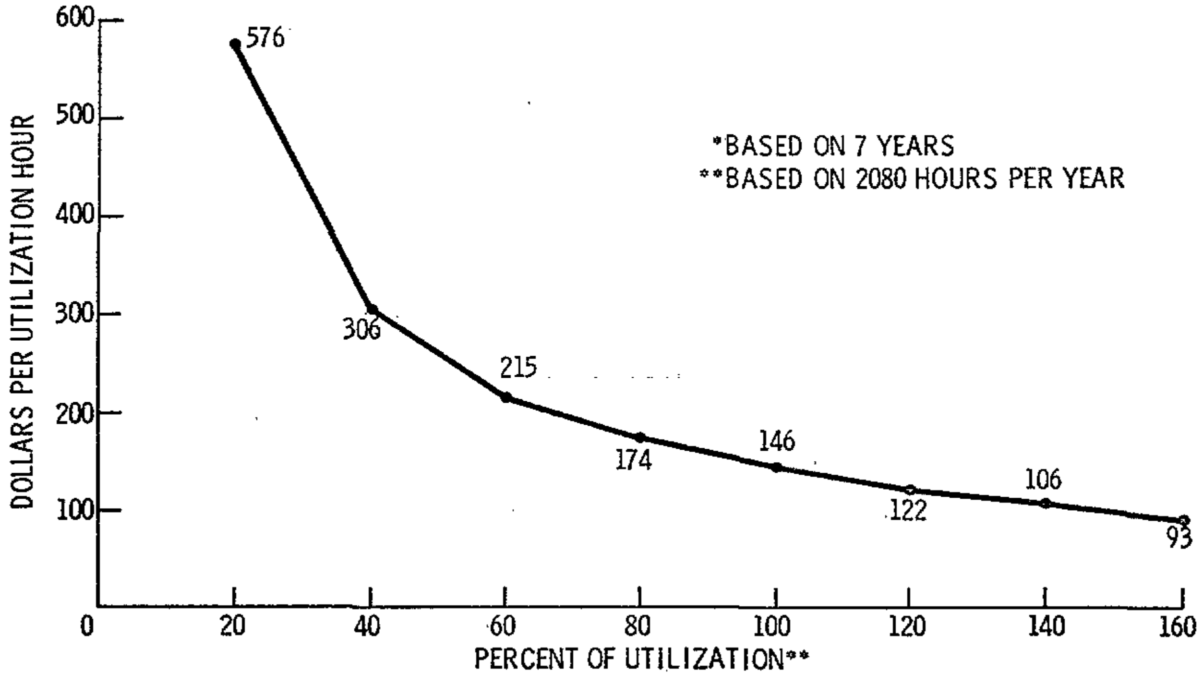

Figure 2. Theoretical Cost Per Utilization Hour, Device 2F64
(Amortization*-Personnel-And Parts Costs)

this we observe a series of exercises. During the first two hour block of time we note that one operator, without the aid of an instructor, uses one small component of the trainer to practice one part of his overall team task. During a second block of time on the same trainer, we observe a full team, with the aid of a skilled instructor and a detailed exercise plan, practice a highly realistic mission using the full simulation capabilities designed into the trainer. Under the current measurement program both exercises are treated as equivalents in calculating the achieved utilization rate of the trainer.

Information on the characteristics or patterns of trainer utilization is not being systematically collected, analyzed and displayed. This information is needed if the various decision makers, from Chief of Naval Operations to the squadron training officers, are to work together to upgrade the quality of trainer utilization.

As a result of a growing interest at Chief of Naval Operations and Commander in Chief, U.S. Atlantic Fleet in measuring trainer utilization patterns, the Naval Training Device Center has undertaken at the request of Chief of Naval Operations a study entitled "Pilot Study to Develop Measures of Cost and Training Effectiveness of Selected Cognizant Symbol "20" Training Devices." As a result of this study, measures will be recommended for use in collecting information for an expanded fleetwide data bank on trainer utilization practices. One year of utilization data is now being stored on ADP cards. However, information on the style of use is not included. The system to be proposed will focus on data depicting how the trainers are being used, not merely the achieved utilization rate. Standard reports will display this utilization data, and special studies of the data will be made upon request.

Approximately 30 different measures of utilization style are being considered. One of the proposed measures is the Theoretical Cost Per Utilization Hour. (See figure 2). Equipment amortization, personnel, and certain parts costs are used as variables in calculating this figure. As an example consider the cost factors associated with Device 2F64, an ASW Helicopter Weapon System Trainer at Naval Air Station, Key West. If this trainer were staffed for and operated at the rate of 20%, then the cost would be approximately $576 per utilization hour. However at 60% utilization, this cost would drop to $215 per hour. At 100% utilization, that is 8 hours a day, 5 days a week, the cost would be $146 per utilization hour.

It is apparent that the utilization rate is a major factor in the cost effectiveness of a trainer utilization program. In this instance it can be seen that the cost per utilization hour drops rapidly as utilization increases from 20% to 60%; and then drops gradually as higher utilization rates are achieved. Economic operation of this trainer, in terms of cost per utilization hour, will result when utilization rates of 60% or more can be achieved.

Another proposed measure is the Magnitude of Exercise Planning Effort. With it, we attempt to identify the extent of planning that has been accomplished to support the use of the device as an instructional tool.

Figure 3 depicts four forced choices that are being used in scoring exercises in terms of magnitude of planning effort. Each exercise receives one basic point, and one additional point for each of the items in column B that describe the planning effort for that exercise. For instance, a trainer exercise might be conducted according to (1) a detailed written plan, (2) the plan being one in a defined set of exercises programed in a curriculum, (3) with operationally defined student terminal behavioral objectives, objectives stated in such a way that you can measure the success

MAGNITUDE OF EXERCISE
PLANNING EFFORT

	A	OR	B
1. PLANNING FORMAT:	LIMITED OR NO WRITTEN PLAN..........		DETAILED WRITTEN PLAN
2. EXERCISE SEQUENCE:	INDEPENDENT EXERCISE..		ONE OF A DEFINED SET OF EXERCISES
3. TRAINING OBJECTIVES:	NOT STATED OPERATIONALLY.........		OPERATIONALLY DEFINED
4. PLANNING SOPHISTICATION:	ON-THE-JOB PREPARATION		PREPARATION BY MULTI-DISCIPLINARY TASK GROUP

Figure 3. Magnitude of Exercise Planning Effort

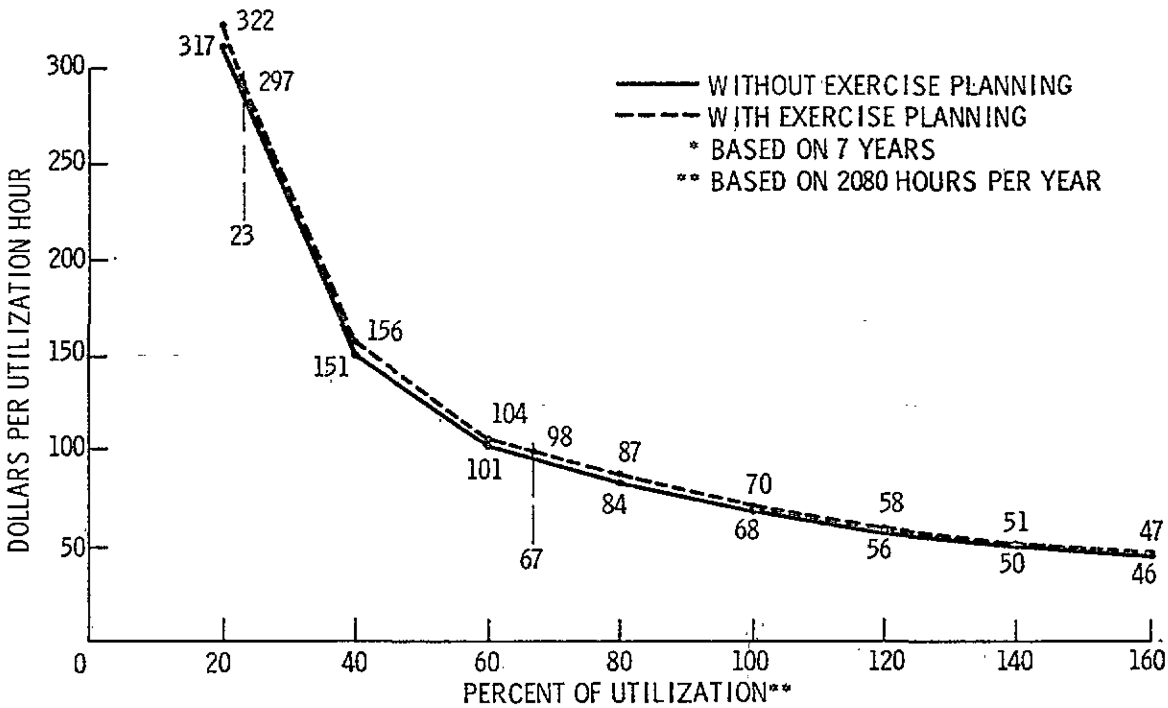

Figure 4. Theoretical Cost Per Utilization Hour, Device 21B20A
(Amortization*-Personnel-Parts-Exercise Planning Costs)

of a student in achieving these objectives. This exercise would be classified as a four point exercise, one basic point plus three additional points for additional planning effort.

Notice that an additional point could have been accrued under item (4), Planning Sophistication, if the exercise planning had been performed by a multi-disciplinary task group, including the local command. The use of the multi-disciplinary task group in planning simulator utilization is a recent innovation in Navy training. Characteristics and potentials of this practice will be explored later in this paper.

Other measures or patterns of utilization being evaluated concern characteristics such as: the type and number of commands using the device, the percent of potential users actually using the device, average hours per user, types of exercises and hours per type, instructor qualifications, curriculum requirements, exercise complexity and the causes of cancelled exercises. In all, thirty or more descriptive measures are being tried and evaluated for usefulness. The set of conclusions and recommendations must await the completion of the study.

One thing is clear. Navy Training Commands are being supplied with some of the most potent, complex and expensive training equipment ever conceived. Deciding how to employ this equipment in a training situation, is no longer a simple task. It is a complex professional task. In many instances the skills of the engineer and fleet personnel must be supplemented with the skills of the psychologist, training specialist, and others if a reasonable return is to be achieved from the investment made in these trainers.

When innovation is desired, or when a large amount of planning effort is required, we have found that it is economically and technically feasible and desirable to contract for application planning services.

Dunlap and Associates, under a contract with the Bureau of Naval Personnel, recently developed a comprehensive set of exercise plans and strategies of instruction for use in the Surface Ship ASW Attack Trainers, the 14A2 series devices. General Dynamics, Electric Boat Division, under a contract with the Naval Training Device Center, recently completed a set of exercise plans and a strategy of instructions for use with the Submarine Advanced Submerged Control Trainers, Devices 21B20A and 21C5. This information was provided in the form of an instructor's handbook. Dr. Jerry Lamb, Head of Electric Boat's Human Factors Division, was manager of this project, and will present a paper to this conference on observations made within this program.

Contractors seeking to supply the Navy with Trainer Application Planning must staff the jobs with the types and quality of talent needed. The staffing of a project is critical. The Electric Boat project team included the following: (1) Human factors specialists with competencies in task analysis techniques, learning theory, and measurement, (2) An engineer with extensive active duty nuclear submarine experience, and who was familiar with fleet operating procedures (3) A system engineer with special knowledge of the hydrodynamic behavior of submarines, and (4) a training specialist with fleet experience as an instructor on submarine control trainers.

This team achieved a productive working relationship with LCDR T. Noland and the other instructors in the Advanced Submerged Training Program at the Naval Submarine School. These were the instructors that would be the users of the end products of the contract. All materials and strategies of instruction were field tested by Navy as well as contractor personnel at intermediate stages of development. Modifications were made as required.

The types of services and material provided by the contractor were as follows: First, a task analysis was made of the functions performed by the ships control party, with emphasis on the emergency decision making tasks of the officer of the deck and diving officer.

Second, a matrix of training objectives was prepared. These objectives were written in performance terms and defined the required terminal behavior or skill level needed in the safe operation of a submarine.

Third, rationale for trainer use was developed. Rules of thumb suggested types of goals that could be achieved in the trainer, and methods for achieving these goals within the trainer.

Fourth, a one hour diagnostic exercise was prepared. Six casualties were imbedded into a simulated submarine patrol. Scoring was designed to identify three levels of team performance in handling each of the six casualties.

Fifth, support for classroom instruction in advanced submerged control was provided in the form of 43 overhead transparencies and a 74 page text on submarine casualties, their effects upon the hydrodynamic characteristics of submarines, the vessels' recovery capabilities , and recommended procedures for recovery. Every word of this text was carefully reviewed by submarine school personnel. This material is being used as a handout during the classroom phase of the Advanced Submerged Control Course.

Sixth, a matrix of 25 exercises was defined and tested. These exercises were divided into three levels, corresponding to the levels in the diagnostic exercise. The third level of exercise requires the student team to respond to primary casualties compounded by secondary casualties, and complicated by ongoing tasks in a tactical situation, and the use of efficient post recovery procedures.

Seventh, an evaluation exercise, equivalent to the diagnostic exercise, was prepared for use during the last hour of the course. It is used to measure the degree to which the terminal behavioral objectives have been met, and to make visible to the students the amount of progress made during the course.

Eighth, following the development of these exercise plans, a three day working seminar was conducted with instructor personnel on the device, to consolidate the innovations that resulted from the contractor and school personnel working together on this project. The instructor's handbook, containing all exercise planning materials, was carefully reviewed.

What has been the impact of this project on the utilization style of Device 21B20A? Many factors work together to cause changes in utilization rates and styles. Therefore, it is difficult to isolate the effect of a single factor. In this instance, certainly the interest and effort of the instructors to improve their Advanced Submerge Control Course was a major force in the changes that have occurred in the utilization patterns of this device.

Changes did occur following the introduction of the exercise planning materials.

First, the school did adopt the materials. Second, as shown in figure 4, the cost of task group type exercise planning added very little to the overall cost of owning the device. Note that the bottom line indicates the cost per utilization hour without exercise planning, and the top line indicates the cost with exercise planning.

Third, the trainer utilization rate increased dramatically following the introduction of the exercise materials. It appears that these materials were a major cause of the increase. During the four months prior to the use of these materials, the average utilization rate was 23%. During the four months following the introduction the utilization rate jumped to 67%, almost three times the earlier rate.

Fourth, with increased utilization, the cost of training dropped from $297 per utilization hour to $98 per utilization hour, a major improvement in the economic operation of the trainer.

The process of using a multi-disciplinary task group, combining the skills and resources of the contractor and school personnel to develop comprehensive exercise planning materials, may be one of the most significant ways to increase the cost effectiveness of the training device program. The development of a data bank on current trainer utilization styles will help program managers identify how devices are now being used. With this information, situations in which device utilization patterns can be improved, will be identified.

The use of the multi-disciplinary task group will be one way to plan for more effective utilization of both existing and new devices. Concerning complex devices we have noted that the schools usually do not have the time, nor other resources required to conduct in-depth planning. Contractors and the Naval Training Device Center cannot produce these plans and gain their adoption. This planning requires the combined effort of the contractor, the Naval Training Device Center, and the schools, with sponsorship at the Chief of Naval Operations/Bureau of Personnel level.

Hopefully, the process of exercise planning that emerged during the development of the Instructor's Handbook for Advanced Submerged Control Training, will lead the way to the development of similar support packages for other major trainers. As a result of these application support packages, and as a result of increased planning for how to use specific devices to achieve instructional goals, significant increases in the cost effectiveness of these training devices can be achieved.