THE NECESSITY OF PERFORMING PROPER TRAINING SITUATION ANALYSIS BY ENGINEERING PERSONNEL

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Weapon systems today are more costly and complex than any weapon system developed throughout history. The simulation of these weapon systems involves the expenditure of millions of dollars because of the complexity of design and development. A new training device cannot be created in a vacuum if it is to be cost effective and still meet the needs of the customer. It is imperative that, prior to the contracting cycle the NAVTRADEVCEN (Naval Training Device Center) perform a TSA (Training Situation Analysis).

The TSA represents a procedure for determining the need for training equipment in some identified training situation and, if such equipment is indicated, for developing the training equipment requirements, and the translation of those requirements into functional characteristics of training hardware.

The history of the TSA at NAVTRADEVCEN goes back into the late 1950's when the process was established for a logical sequence of events that should be accomplished prior to the procurement of a training device. During the first five years, the TSA was never firmly defined or implemented. However, in 1963 a contract was awarded to Dunlap and Associates Inc. to develop a technique known as TAP (Training Analysis Procedure). The TAP evolved from the TSA and included the TSA as a part of the final report. After the Dunlap study was completed a NAVTRADEVCEN Instruction was issued which established the members and procedures of the TSA. The TSA team is composed of personnel from the Requirements Department, Human Factors Laboratory, Training Application Division, and the Engineering Department. Each member of this team plays a vital role in the success, or failure of a project, and is responsible for executing the analysis and preparing the TSA report. The contracts that have been awarded to date, by NAVTRADEVCEN, concerning the approaches that should be taken when performing a TSA, have been almost entirely directed toward the Human Engineering aspect.

The procedures the project engineer should follow in his performance as a member of the TSA team has not been well established. Upon receiving an assignment to prepare a technical approach, provide cost and lead time estimates, and accomplish numerous other tasks within a very limited amount of time, the project engineer must use his ingenuity to accomplish the assigned tasks in the absence of specific guidelines. Numerous avenues of approaches are available and the project engineer's immediate concerns are: what information is required, what information is available, who has the proper information, how does he obtain the information, what trips should he make, etc. These and numerous other questions must be answered in order to complete the project engineer's portion of the TSA.

To accomplish the required engineering effort of a TSA, a systematic approach to the overall task must be utilized. An approach that is used in performing TSA's for Surface Warfare Trainers is divided into three phases: Phase I, In-House Research and Analysis; Phase II, On-Site Investigation and Analysis; and Phase III, In-House Conclusions. It should be noted that the Land and Air Warfare Trainer Departments do not follow the identical procedures as the Surface Warfare Trainer Departments in performance of TSA's. After receiving an assignment and attending meetings with other TSA team members to ascertain what is to be developed, based upon interim Military Characteristics, Specific Operational Requirements, etc., the first task of Phase I is to acquire as much information as possible about the system to be developed. An extremely high percentage of the techniques used to develop a new system have some elements in common with devices previously developed or research studies that have been conducted. Thus, the best place to obtain information is from the NAVTRADEVCEN Technical Library using KROS-TERM Ready Reference Engineering Data System (KROS-TERM Abstracts), or the Defense Documentation Center, Alexandria, Virginia, which performs searches in related topics. If the equipment to be simulated or stimulated is operational or near the operational phase, the various procuring activities can supply most of the data required. Another very important source of data is other project engineers who have developed similar devices.

After a thorough analysis of all data available, the project engineer is ready to develop a preliminary technical approach based upon information known to date. The technical approach consists of a block diagram of the entire system, basic signal flow between each subsystem, gross computer requirements (bit size, speed, memory, etc.), a list of equipment, preliminary cost estimate, and a basic description of the functional characteristics of each subsystem block. Upon completing the technical approach, the project engineer establishes a check list of questions to be answered during Phase II. Throughout this phase, close coordination is maintained between all members of the team. The performance of the above task completes Phase I.

Upon completion of Phase I, the team is ready to perform the site investigation and analysis. Technical Report NAVTRADEVCEN IH-37 "Introductory Course on Training Situation Analysis Procedure" sets forth the instructions concerning the procedures and interviewing techniques to be employed during the team's visit. The project engineer has a vital interest in obtaining data of three major spheres: (a) installation and site data, (b) trainee data, and (c) instructor data.

It is essential that installation and site data be obtained during this phase and liaison be established with the local NAVFAC (Naval Facilities Command), to insure that proper floor space and configuration is allocated. Without this liaison, NAVTRADEVCEN could develop a trainer requiring a certain size and configuration building and the building being developed by another command could be constructed that did not meet NAVTRADEVCEN requirements. Thus, size of trainee area, instructor area, and trainer simulation equipment area is of vital importance to both NAVTRADEVCEN and NAVFAC. The ideal situation occurs when the TSA team can visit the site and make input to the BESEP (Base Electronic Systems Engineering Plan), prepared by NAVFAC prior to construction of the building delineating the required square footage needed for the trainer equipment. If the building construction is complete, the architectural drawings should be examined, or measurements taken of doors, passageways, rooms, stairwells, ceiling clearances, etc., in order that the hardware, or test equipment can be developed within these limitations. Other items of installation and site data which should be investigated are electrical power, water, air-conditioning, humidity, access to building, and security.

The magnitude of trainee data will depend upon the training device to be developed. However, the following data should be obtained, if possible.

1. List of trainee problem exercises: This list includes the action and interactions of the trainee during an exercise. A copy of the curriculum and/or lesson plans should be obtained.

2. List of trainee equipment used in exercise: This list will include items from major systems such as radar or sonar to minor items such as status boards.

3. List of specific controls on each equipment that is required to be activated for training objectives: This list is composed of controls, in order of decreasing priority, that must be activated to meet the training objective.

4. List of operational equipment characteristics pertinent to training problem(s): This list will include such items as signal to noise ratios, speed vs. noise curves, speed vs. altitude curves, media characteristics, etc.

5. Degree of accuracy and tolerance required in each activated instrument and control: The minimum degree of accuracy that will accomplish the training objective should be obtained. Accuracy that does not contribute to the overall objective, or accuracy that is lost due to one subsystem providing very accurate inputs to another system that at best requires only gross inputs, can result in large amount of funds being expended for minimal gain in accuracy.

6. Man/Machine problem interface: This data is needed by the project engineer to preclude a design of hardware which would prevent the trainee from accomplishing the training objective.

The amount of instructor data needed will also depend upon the trainer to be developed. Following is a guideline of the type of information which should be obtained:

1. List of equipment required in instructor(s) area: Number and type of instructor consoles, monitoring equipment (CRT, TV, projectors, etc.), teletype units, status and plotting boards, storage space, filing cabinets, and communication equipment are examples of the numerous items which could be required.

2. List of instructor inputs prior to start of problem exercise: This list contains the action that the instructor(s) must initiate prior to starting a problem. Must the instructor insert all parameters, or is it desired that the whole sequence of problem start up be automatic?

3. List of instructor inputs during problem exercise: A determination will be made from this list if the instructor is an active participant in the problem, or performs only monitoring functions. This information will be utilized to design the controls and indicators for the instructor's console, necessary to monitor and control the problem exercise.

4. Evaluation criteria for each student station and group performance: The evaluation criteria will be utilized to develop the necessary equipment to aid in problem critique. This section will delineate whether or not a need exists for the recording and playback of the problem, type of critique display, etc.

When answers to these questions and lists of data, as outlined above, have been obtained, the project engineer has completed Phase II.

"Phase III, In-House Conclusion" is a continuation of the evaluation of the information obtained during the on-site investigation. In view of this new information, numerous revisions may be required in the basic technical approach. Each item of the proposed trainer is reviewed, various technical approaches are investigated, and trade off analysis are made to insure that the optimum approach is taken. Finally, the project engineer completes his assignment by preparing and releasing the technical approach (conceptual or detail). This technical approach contains block diagrams, cost and lead time, degree of risk, compatibility, manpower consideration, reliability and maintainability, and supporting research.

While it may seem unnecessary for NAVTRADEVCEN to perform this laborious process after having completed many TSA's, and having answered the questions outlined above each time, it should be emphasized that each training situation is different in some respect and the difference must be identified as early as possible. Cited below is only one example of where a TSA, not only made a major change in the initial requirement of the customer, and what was received by the customer as an end product, but in the process reduced the cost of the trainer from $3,700,000 to $1,300,000 or a saving of $2,400,000.

A few of the changes made as a result of performing the TSA on the Marine Tactical Data System Trainer are:

1. Prior to TSA: Realistic radar simulation (i.e., noise, altitude aspect, shadowing effects, weather, etc.) was required.

   After TSA: Because trainees were already qualified radar operators, the degree of realism necessary in simulating the degradation effects encountered in actual operational radar systems was not required.

2. Prior to TSA: Realistic ECM simulation was required.

   After TSA: ECM simulation requirements reduced to several types of generalized jamming effects emanating from three pre-selected sources.

3. Prior to TSA: IFF fade required.

   After TSA: Not only was IFF fade eliminated, but no IFF video required.

4. Prior to TSA: Automatic performance evaluation required.

   After TSA: Because of the instructor to student ratio it was determined that evaluation of trainees would be based on observations of performance by the instructor, using a checklist.

As stated above, these are but a few of the changes that were made because of the TSA. The most significant item of this TSA was the amount of funds saved and the time required to complete such a task. A complete record of the man-hours expended during the TSA were recorded by the TSA Chairman. A total of 855 man-hours, four trips to California, five trips to Washington, D.C., and non-related device contractor assistance of $12,778 were expended. Subtracting the contractor expenditure and travel cost from the $2,400,000, each man-hour expended during the TSA was worth over $2,788.

Millions of dollars can be saved in the simulation of these weapon systems if a TSA is performed correctly and in a timely manner. Numerous new trainers are required each year. The Naval Training Device Center completes many TSA's in various levels of detail. However, many trainers are developed without the benefit of a TSA having been performed, due to the relative short time available, and not having the right personnel available when needed. Yet, to obtain a cost effective trainer the TSA must be performed. To fill the void when NAVTRADEVCEN is unable to perform the TSA, industry may be called upon to complete this vital task. Sufficient latitude is now available whereby during the Contract Definition Phase, industry can be paid to perform TSA's. Regardless of who completes the task, it must be done to obtain a cost effective trainer.