

# **AUTOMATED MANAGEMENT OF SUBMARINE ON-BOARD TRAINING REQUIREMENTS**

**Kevin Fiedler, Katharine Golas, Ph.D.  
Southwest Research Institute  
San Antonio, Texas**

**Shawn Irish  
U.S. Navy SOBT  
Groton, Connecticut**

## **ABSTRACT**

Historically, the training time for shore-based courses provided at the Basic Enlisted Submarine School has been lengthy, and in recent years there has been a reduction in resources required to deliver this training. When sailors are engaged in shore-based training, they are not available on board the submarine to perform their duties. Also, data from the fleet indicated that much of the on-board training could be more effective (higher learning standards achieved) and efficient (less time required) than shore-based training. For these reasons, the U.S. Navy made a decision to provide more courses on board the submarine.

The U.S. Navy's Submarine On Board Training (SOBT) office manages the development and implementation of instructional courses and training products on behalf of the Submarine Force Type Commanders (COMSUBLANT and COMSUBPAC) for use on board submarine force commands. The shift from shore-based training to on-board training began about 10 years ago, and today, the SOBT office provides approximately 150 hours of Interactive Courseware (ICW), videotapes, printed workbooks, and computer-assisted instruction in the form of PowerPoint® slides. While the infusion of on-board training has been successful, it also created a management problem.

Short- and long-term management of the training requirements and course data was being tracked using many different non-standard processes, most with varying degrees of success. In early 1997, the Navy made a decision to develop a submarine force-wide tool to support the administration of training requirements and data. The tool is a Training Information Management System (TIMS).

TIMS provides information regarding training requirements (tied to training group), when the training will be conducted, the individuals who are required to attend the training, who leads and monitors the courses, the total number of training attendees, the length of the training, the media that makes up the training (both available and slated for delivery, such as emerging ICW programs), and the test data collected for training attendees. TIMS provides a system management function that allows a system administrator to update this information at any time.

TIMS is providing a flexibility that did not exist previously—most significantly, to allow training managers to automatically resequence training as schedules change. The instructors can also use TIMS to develop and edit tests from an automated question bank, view test data for each course, view and edit student data, and view question response data, all automatically.

## **ABOUT THE AUTHORS**

Kevin Fiedler is an Analyst at Southwest Research Institute. He holds a B.A. in Information Systems and an A.A. in Visual Communications. He has been involved in design and development of multimedia since 1987 and electronic performance support systems since 1992. He is the principal designer and technical lead on the TIMS project.

Dr. Katharine Golas is the Program Manager of Instructional Systems at Southwest Research Institute, where she has worked since 1988. Dr. Golas has worked in the training industry for 22 years, and specializes in the development of technologies to improve human performance. She has an M.S. and Ph.D. in Instructional Systems from Florida State University and a B.A. from Georgetown University.

Chief Machinist Mate Shawn W. Irish is a 17-year veteran of the U.S. Submarine Force, serving on four submarines in the Pacific Fleet. He was certified as a Master Training Specialist by the Navy in 1991 while serving as an instructor at the Naval Submarine Training Center in Pearl Harbor, Hawaii. He is currently serving as the Engineering and Auxiliary Systems Project Manager for the SOBT office in Groton, Connecticut. He is also the TIMS Project Manager.

# **AUTOMATED MANAGEMENT OF SUBMARINE ON-BOARD TRAINING REQUIREMENTS**

**Kevin Fiedler, Katharine Golas, Ph.D.,  
Southwest Research Institute  
San Antonio, Texas**

**Shawn Irish  
U.S. Navy SOBT  
Groton, Connecticut**

## **BACKGROUND**

Currently the tracking and manipulation of training requirement information, and the scheduling of training courses to fulfill those requirements, are done manually on board Navy submarines. Data on training requirements is extracted from numerous sources and entered into a variety of non-standard databases for the development of training plans.

Navy training requirements are standardized and rarely change. The administrative challenge is in mapping the requirements to the personnel to whom they apply, scheduling the training courses, and obtaining information from the training plans after each training session. In early 1997, the Navy made a decision to develop a submarine force-wide tool to support the administration of training requirements and data. The tool is called the Training Information Management System (TIMS).

A simple Training Planning System application was distributed to the fleet in January 1998 as an interim solution. Development of a more robust tool, TIMS, was planned in response to feedback from Rear Admiral John B. Padgett, Commander, Submarine Group Two. The Admiral was briefed on the project during a concept-of-operations discussion. He stated that a tool like TIMS would have been valuable when he was a Division Officer and Department Head on board his first two submarines.

Plans are being made for additional functionality to be included in Version 2.0 of TIMS. In many cases, attending training lectures is mandatory for all submariners, in order for them to qualify for their shipboard watchstations. Documenting the administration of training and the transfer of this information to qualification cards for each individual is still done manually. In addition, training requirement pages, which serve as lesson plans for each training topic, are not currently available in electronic format. These issues will be addressed in future releases of the TIMS application.

## **DESCRIPTION OF TIMS FEATURES**

The TIMS application provides functionality in three major areas:

- Dynamic electronic catalog of Submarine On Board Training (SOBT) products
- Tools for creating long- and short-range training plans
- Custom exam generation and management utility

On-line help and report generation are provided in all three areas.

The Navy mandates training requirements for each of the submariner training groups. The training administrators are responsible for ensuring that the training is provided on board, but few restrictions are placed on the content, source, or media used in the courses taught to fulfill those requirements. Consequently, SOBT aids the training administrators in determining the format in which various training should be provided, by developing and providing training products to fulfill many of the requirements (instructor-led courses, video, computer-based instruction, etc.). TIMS assists training administrators in managing information about SOBT training products and how they relate to training requirements, and in scheduling the required training sessions and generating reports. The TIMS application also provides functions to generate exams for student assessment and limited student data tracking.

### **SOBT Training Product Catalog**

In addition to providing performance support for training administrators on board submarines, the TIMS application assists the SOBT office in their efforts to promote the use of their training products. TIMS accomplishes this, first, by making information about SOBT training products easily accessible, and second, by enabling on-board training administrators to easily include SOBT training products for use in their training plan. This is done by allowing managers to select from a

list of products that relate specifically to a particular training topic.

The SOBT Product Catalog section of TIMS initially lists all products offered by SOBT. The list can be sorted by any of the data categories including the product title, serial number, delivery medium, length, and security classification (see Figure 1). Search criteria can be applied to any of the data categories. For example, the catalog can be limited to training products whose titles include the word "hydraulic." The list of products can then be sorted by media type. The current view of the catalog can be printed at any time, and a single action can restore the full catalog content. For each product, a description of the content of the course material can be displayed to include, in some cases, a video clip example or marketing description.

### The TIMS Training Planner

**Long-Range Training Planner.** The core functionality of the TIMS program centers around the Training Planner module. The training administrator uses the long-range training plan utility by first selecting any of the 49 submariner training groups and the year for which they wish to generate a training plan. The program displays the Navy training requirements for the training group, along with static data about each requirement, including the source of the requirement and the frequency with which the training should occur, i.e., annually, quarterly, monthly, etc. (see Figure 2). The administrator defines the long-range training plan by indicating the quarters in which the training will occur and, optionally, by selecting a SOBT product that will be used for the course. This is done by selecting from a list of products that are predefined to fulfill the training requirement (see Figure 3).

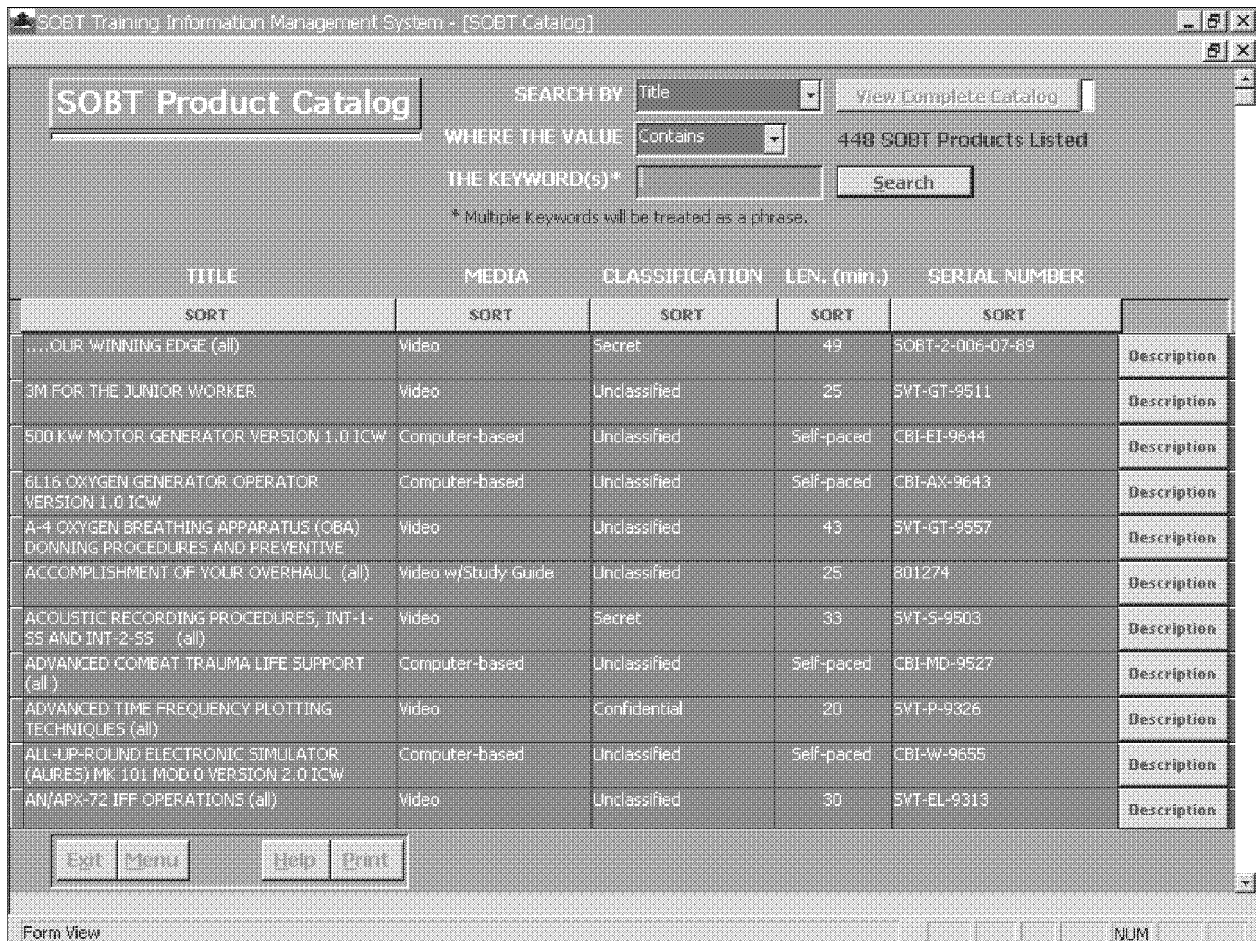


Figure 1. SOBT Catalog

SOBT Training Information Management System - [Long-range Training Plan]

**Long-range Training Plan**

TRAINING GROUP: Division: EE01

TRAINING YEAR: 1999 [Clear Settings] [Copy Settings]

SET SHORT-RANGE TRAINING PLAN FOR QUARTER: 1 2 3 4

TRAINING REQ. TOPIC	REFERENCE	SIT REQ.	TRNG. QTR	TRP	SOBT PRODUCT
SM systems	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	SM FOR THE JUNIOR WORKER [Select Product]
Battery electrical distribution	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery electrolyte agitation system	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery instrumentation	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery maintenance	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery records	Joint Training Manual	ANNUAL	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery training	Joint Training Manual	PERIODIC	<input checked="" type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery ventilation system	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery watering system	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Battery well casualties	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
CPR	Joint Training Manual	ANNUAL	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]
Electrical	Joint Training Manual	PERIODIC	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/>	[Select Product]

Form View FLTR NUM

**Figure 2. Long-range Training Planner**

If the administrator wishes to use a particular SOBT product, but does not have the product in inventory, he can instantly print the information needed to order the product from SOBT. If the administrator needs more information about a product, he can navigate directly to the catalog section of the program for reference and then return.

Select a SOBT Product to Satisfy this Training Requirement

Training Requirement

Heat stress

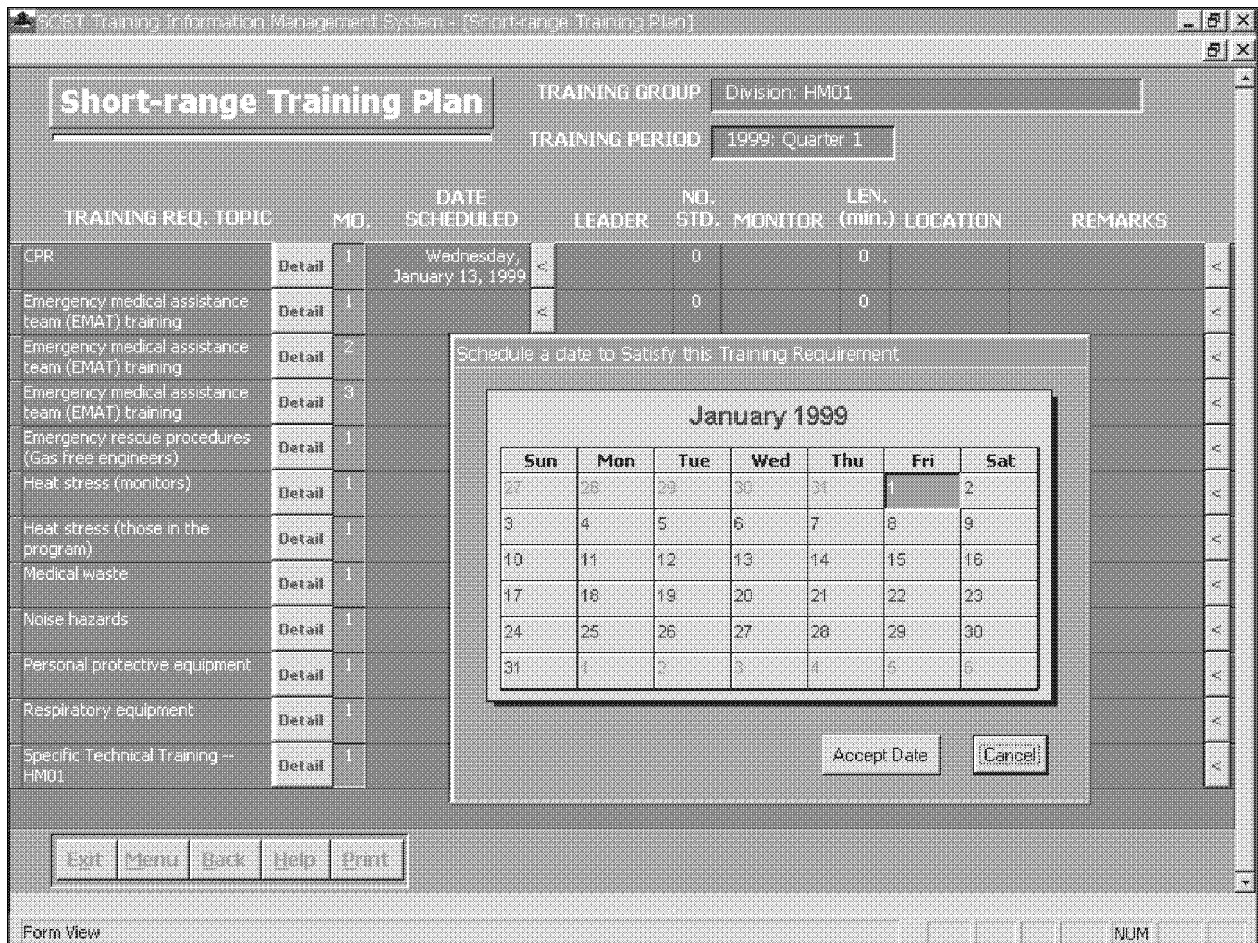
3 SOBT Products are associated with this training requirement.

- 1 DIVISION INTRODUCTION TO SUBMARINE SAFETY [all]
- PLAY IT COOL HEAT STRESS PREVENTION AFLOAT (PART TWO) [all]
- SUBMARINE FORCES AFLOAT INTRODUCTION TO THE NAVOSH PROGRAM [all]

[Print] [Clear] [Cancel]

**Figure 3. SOBT Product Selection Dialog Box**

**Short-Range Training Planner.** Short-range training plans are defined for each training group in each calendar quarter. The training administrator defines a short-range training plan by selecting the quarter he wishes to define from the long-range training plan module. A short-range plan records information about each instance of a course that is scheduled to be given, including the date when it will occur, who will serve as the course leader and monitor, the number of students, the length of the course, and the course location. The administrator can also add notes or remarks to each scheduled course. The administrator selects the scheduled date for a course from a dynamic calendar utility, which records the date in a long data format using a four-digit year and displays the full date including the day of the week (see Figure 4). Specific information about each training requirement is also provided so the administrator does not have to return to the long-range training plan for reference. As with all TIMS modules, the current plan can be printed.



**Figure 4. Short-range Training Planner with Scheduling Dialog Box**

### Training Requirements Pages

The administrator may also associate predefined Training Requirements Pages (TRP) with each training topic. A TRP serves as a lesson plan for a particular training topic. If a TRP is needed, but does not exist for a requirement in the training plan, the administrator can quickly develop one within the TIMS system. When the TRP is entered, the administrator can return directly to the long-range training plan that he was previously editing.

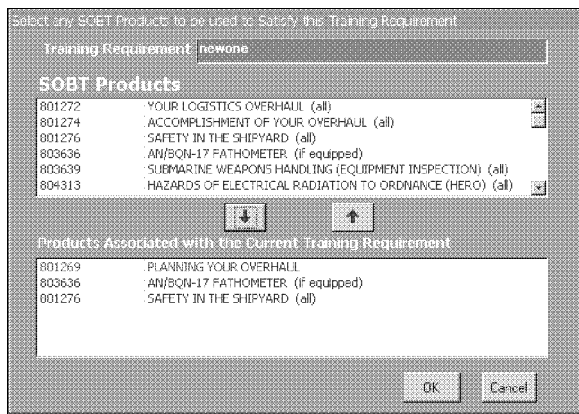
### Response Training

An important aspect of the submarine on-board training plan is that a plan is not restricted to the training requirements mandated by the Navy. The training administrators can add requirements to fulfill training

needs that they identify for their staff. The Navy refers to these custom training requirements as "response training." TIMS provides an interface for defining response training requirements that, like the TRP component, is accessible either from the main TIMS menu or directly from within the long-range training planner module. To define a response training requirement, the administrator must provide a description of the topic, the frequency with which it should occur, the type of training, and its objectives. Further, the training requirement must be associated with one or more of the training groups, and may be associated with multiple SOBT training products (see Figure 5).

Managing these many-to-many relationships has traditionally been a difficult task in manual tracking systems. Once defined, a new response training

requirement that applies to the current training group will be immediately reflected in the long-range training planner.



**Figure 5. Interface for Associating SOBT Products with a Response Training Requirement**

In addition to courses taken by submariners to fulfill training requirements, training administrators can stage ad-hoc drills to test submariners' skills and readiness. A module is provided in TIMS to record information about ship drills for both planning and reporting purposes. Information stored about ship drills includes the date of the drill, the objectives, the initial conditions, and the Navy procedures followed during the drill.

### Exam Management Utility

Another major component of the TIMS is the Exam Management Utility (EMU). The EMU allows the training administrator to create exams, manage their administration, and report exam results.

**Exam Generation and Administration.** Using the EMU, the training administrator can compile a repository of test questions covering topics that relate to a specific training group or groups. Questions from the question bank are used to construct exams for training courses. The EMU also provides planning and tracking facilities for specific instances of exams given to students, including data about the exam instance, when and where the exam is to be given, and who will monitor the exam. Tracking features include recording and storing the resulting student scores.

**Exam Reporting.** The EMU module provides reporting for exams that have been administered and recorded in the system. Reports of exam results can be generated for each student, including composite exam scores and

a breakdown of scores on individual questions. Student exam results include composite data from all students who have taken the exam to help identify problem areas for specific students and general areas that need more training attention, and to isolate problematic exam questions. This data includes the low, average, and high scores for each question and the exam as a whole.

Any problem area that is identified for a particular exam can be modified by the person who created the exam, or a specific exam question. In this way, TIMS can aid the training administrator in making exams more effective and more fair for the students, in addition to producing the exams more easily.

### NAVSEA08 Report

The most significant reporting done by the TIMS program is the generation of the NavSea08 report. Each on-board training administrator is required to submit this report quarterly to the Office of Naval Reactors quarterly. The report contains information about the execution of the submarine's training plans for the reporting period including courses administered, composite results from exams given, and ship drills executed. TIMS queries both the training plan database and the EMU database to compile the requested information, a process that has traditionally been laboriously done by hand from non-standard tracking systems.

## THE TIMS DEVELOPMENT PROCESS

### System Requirements

Requirements analysis for the TIMS project involved intensive review of the manual systems in place for planning and executing training on board submarines. Functional requirements were considered from the end user's perspective, as well as in terms of the SOBT Office's need to promote and facilitate the use of their products. End user requirements for managing training were broken down into categories of planning, scheduling, identifying training resources, archiving, and reporting data.

Platform requirements were defined by the computer facilities available to the on-board training administrators. The baseline hardware platform is a laptop personal computer (PC) running Windows 95 as a stand-alone workstation.

## **Design**

In the design phase, a review was conducted of previous efforts by SOBT staff to create a relational database to provide limited training management utilities for on-board training administrators. Desirable aspects of those efforts were adopted and modified to work with the overall TIMS design. The design of TIMS focused on two goals. First, the data design and software design were to be modular and as simple as possible to meet the functional requirements and allow for future maintainability and extensibility. Second, the user interface needed to be easy to use so that it would require little end user training and technical support.

## **Development**

Development tools were evaluated for their ability to deliver the desired functionality within the Navy's budget and for aspects of future maintainability and extensibility by Navy personnel. It was determined that the stand-alone workstation solution should scale up to a small client-server environment when local area networks are installed on board submarines in the future. Microsoft Access® was chosen by SOBT as the core development tool.

The user interface was designed to use constructs similar to data input and report forms found in other utilities that SOBT had previously provided to the on-board training administrators. This was intended to provide an immediate sense of familiarity with the TIMS interface. The user interface design had two other goals: first, to make as much data as possible available with a limited number of user interactions, and second, to seamlessly integrate SOBT product data with the TIMS training, planning, and scheduling functionality.

After the TIMS design was approved, the process of populating the baseline data was conducted concurrently with user interface and business rules code development. While the core TIMS functionality was being developed with a small set of dummy data, software filter utilities were written to import some existing data. This legacy data included some data fields that had not been tightly controlled for content. The import utilities had to identify anomalies and modify some data to work in the more restrictive TIMS data design. Other cross-reference data did not previously exist in electronic format, so utilities were provided to aid SOBT in compiling the data in the desired format. This data was later integrated with the TIMS application.

## **FUTURE DIRECTIONS**

The TIMS program is designed to be extensible, and SOBT intends for it to grow in future versions to eventually aid the on-board training administrators in all aspects of managing submariner training. The current version of TIMS, as described above, provides robust automated functionality in two major areas of training administration. Additional features may be added as SOBT gathers input from users in the field. Other major areas of training administration remain as manual systems on board submarines. SOBT intends for the TIMS to automate these processes in additional modules to be added to TIMS in the future.

### **Future TIMS Feature Enhancements**

Several features have been suggested for existing TIMS modules and are being evaluated for inclusion in future releases. One such feature is the automatic generation of Training Requirements Pages when response training topics are added to the database. Users would still be required to supply some information, but they could be automatically guided through the process, and the relationship to the new training requirement could be dynamically assigned.

As described above, the short-range training plan module records scheduling information about specific instances of training to be administered in a particular period. Related information stored in the current version of TIMS includes dates and information about resources to be employed in delivering the training, including the personnel who will be responsible for leading and monitoring the training session, and the facilities to be used. However, there is currently no provision to identify scheduling conflicts among these resources. Future versions of TIMS will include features to automatically alert administrators when they have scheduled conflicting resources, or to provide exception reports identifying any conflicts.

### **Trainee Qualification System Module**

The most significant suggestion for add-on modules to TIMS is the addition of a module to automate the administration of training qualifications for submariners. To explain the requirements of this proposed module, it is instructive to describe the Navy's training information requirements and the current manual system of maintaining this data.

Each enlisted submariner is responsible for completing all training requirements assigned by the Navy. There are two sets of training requirements: (1) Ship

Qualification requirements that all submariners must fulfill according to the *Enlisted Submarine Qualification Guide* for the class of submarine to which they are assigned, and (2) Watchstation Qualifications for the watchstations on which they will be scheduled to stand watch. Watchstation assignments are specific to each submariner's technical specialty.

The Qualifications Officer is responsible for ensuring that submariners are on track to complete their required training within the appropriate time period and to increase supervision of any who fall behind. Currently, data concerning each submariner's training requirements is maintained manually in the following manner. Upon reporting to his ship for the first time, each new submariner reports to the Qualification Officer, among others. He is given an Enlisted Submarine Qualification Card, a group of individual Watchstation Qualification Cards, and a student record disk (3.5-inch floppy diskette) to be used with Interactive Courseware (ICW) programs.

The Submarine Qualification Card lists many training requirements that the submariner must complete and identifies the completion date by which requirements must be met. For each requirement, an officer is identified whose signature is required to validate that the requirement has been met. Some training requirements are fulfilled in instructor-led courses, while others may be satisfied by completing training products distributed by SOBT. When training products are available to fulfill a training requirement, they are identified on the Submarine Qualification Card. In the case of ICW products, the submariner's test results are stored on his student disk, which can be verified by the validating officer. In all cases, the submariner's training is tested through an oral interview given by a training officer. When all requirements on the Submarine Qualification Card have been met, the submariner is given a comprehensive exam with both a written component and practical walk-throughs.

Training for Watchstation Qualification Cards is administered in a similar manner. Completing the training for a watchstation qualifies the submariner to man the watchstation unsupervised. However, watchstation training requirements qualify the submariner with the condition that he must stand watch at that watchstation with a specified frequency to maintain proficiency. If a submariner does not meet the condition, he may be required to requalify. Information about which submariners are qualified and proficient to stand watch at each watchstation is essential for scheduling.

A proposed future addition to TIMS will be a module to automate the qualification process, which will be a major upgrade to TIMS. Currently, computer workstations on board the submarine are stand-alone desktop and laptop units for use by personnel who have administrative duties. The Navy has plans to connect these workstations with a local area network (LAN) on each submarine. This infrastructure enhancement will be crucial to automating the qualification process. Consequently, the development phase in which qualification functionality will be added to TIMS will require migration from a stand-alone desktop application to a client/server program.

The paper qualification cards, currently carried by submariners in training, will be replaced by an electronic record in the TIMS database. When the submariner completes a training requirement and the completion is validated by the authorized officer, the officer will go to the nearest networked computer and run the TIMS application. The electronic qualification record for the submariner will be displayed, and the officer will log in to record his approval by attaching a digital signature. The login feature will verify that the officer has authority to sign off on that particular training requirement. Data cross-referencing identifying which officers can approve various training requirements will be maintained in TIMS by the Chief Training Administrator.

An electronic training qualification system will solve a number of problems that plague the current manual system and cause difficulty for on-board training administrators. In the current system, trainees bring their qualification cards to their supervisor at the end of each week, and he appends their physical record. The trainee's overall progress is assessed, and the trainee may be flagged for additional supervision if his progress is unsatisfactory. In the TIMS qualification utility:

- No batch recording will be necessary because each approval will be recorded at the time it is granted.
- Exception reporting to flag students who need additional supervision will be built into the system.
- Login passwords required for officers to sign off on student training will help enforce authorization rules.
- Backups of the TIMS system will alleviate loss of data sometimes caused by the loss of physical qualification cards in the current manual system.
- The sign-off process can dynamically interact with student test records in the TIMS database.

- The qualification system can dynamically interact with long- and short-range training plan data in the TIMS database.

### **ASSESSMENT OF THE TIMS PROJECT**

TIMS Version 1.0 is scheduled for implementation in February 2000 and, while the SOBT program has a formal feedback system in place for fleet response, feedback is voluntary. No formal evaluation of this version of TIMS is currently planned. Development of Version 2.0, including addition of the Trainee Qualification System module, is planned to begin in 2000.

The Navy has taken a phased approach to development and implementation of TIMS because the requirements of the program cover a number of related manual systems. Providing a simple user interface has been a primary goal because TIMS will be implemented in the field without specialized user training. As a result, the adoption of TIMS by on-board training administrators will depend, at least in part, on the consistency and ease-of-use of the interface and the on-line help features. The overall ease-of-use of the program is also important because of the need to clearly demonstrate to training administrators that the automation of their scheduling, tracking, and reporting systems will aid, rather than hinder, their daily work.