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## Authoring Instructional Materials (AIM): Automated Curriculum Development

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# Authoring Instructional Materials (AIM): Automated Curriculum Development

Jerry L. Vogt  
Eleanor R. N. Robinson  
Barbara E. Taylor  
Wallace H. Wulfeck II

Approved by  
Edwin G. Aiken

Released by  
B. E. Bacon  
Captain, U. S. Navy  
Commanding Officer  
and  
J. S. McMichael  
Technical Director

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<p>The Navy faces a number of problems in managing the design, development, and maintenance of its curriculum materials. Many of these problems can be solved by the introduction of a set of computer-based tools for automating the curriculum development process. The AIM project is building these tools by applying the recent advances in instructional science, educational psychology, computer-assisted drafting and publishing, and computer science and technology. These tools will eventually allow Navy curriculum developers to efficiently produce standardized training materials that are technically accurate, to maintain this technical accuracy by easily updating the electronic data bases underlying the course materials and to distribute rapidly these text and graphic training materials over local and wide-area networks.</p> <p><i>Approved for public release; distribution is unlimited.</i></p>			
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## **FOREWORD**

This report documents the progress made to date in the Authoring Instructional Materials (AIM) project. This work was funded as part of the Advanced Development Project entitled Authoring Instructional Materials (Program Element Number 63720N, Work Unit Number R-1772-ET003). The project originated in response to an operational requirement promulgated by the Chief of Naval Education and Training entitled Authoring Instructional Materials (AIM) System (OR-Z-0992).

The AIM project has developed prototype software tools for Navy curriculum developers and has integrated these tools with off-the-shelf hardware and software. These prototype tools assist in the production of both graphic and textual curriculum materials. This report describes how these software tools were developed and used at several Navy training test sites. Based on user feedback, these tools are being revised and integrated into a more complete, operational system capable of not only curriculum analysis, design, and development, but also life-cycle maintenance.

This report is intended primarily for the training community in the Department of the Navy.

**B. E. BACON**  
Captain, U.S. Navy  
Commanding Officer

**J. S. MCMICHAEL**  
Technical Director

## SUMMARY

### Background

Several factors are leading the Navy to make the design, development, production, and maintenance of curriculum materials more efficient and cost-effective. These factors include the following:

- The Navy conducts more than 7200 courses over a wide geographical area, and this leads to difficulty in sharing resources and thus to duplication of effort.
- Experienced personnel, both the enlisted technical experts and the civilian educational specialists, are not readily available for the curriculum development process.
- Instructors are often not given the training or time to become proficient in the educational design of curriculum materials, and so the instructional quality of Navy training material could be improved.
- The development standards change frequently, and surface level details are emphasized. Even when standards are stable for some time, they do not fully describe what to do to develop effective instruction.
- The curriculum planning, development, and maintenance process is a complex one with extensive record-keeping requirements.
- The managers and developers in Navy training activities have few up-to-date office automation tools to use to do their jobs more easily and efficiently.

### Purpose

The overall goal of Authoring Instructional Materials (AIM) is to provide automated tools for the analysis, design, development, production, and maintenance of curriculum materials. We first worked on increasing the efficiency of curriculum writers by automating much of the mechanics of document preparation, and this report describes our progress. We also outline our plans for enhancing the quality of instruction in subsequently available tools that will be part of AIM.

### Approach

The approach of the AIM project was one of rapid prototyping, which involved putting computer systems and the prototype software tools into the hands of Navy curriculum developers as soon as possible. Two test sites were established during the first year of the project, and additional sites have been added each year so that there are currently 10 sites, including Naval Training Center, Great Lakes; Naval Submarine School, New London; and the Trident Training Facilities in Bangor and Kings Bay.

The AIM prototype software, designed and developed in-house by the AIM project team, assists Navy curriculum developers in the preparation of training documents to support

the Navy standards, MIL-STD 1379C and DoD-HDBK-292. The AIM software modules help to produce personnel performance profile (PPP) tables and training path system (TPS) documents for analysis and design, and in the output of instructor guide and trainee guide materials. Thus, the AIM software automates much of the mechanics of the document preparation necessary for curriculum development.

The AIM software operates in a hardware environment that consists entirely of off-the-shelf (non-developmental) hardware items: a UNIX workstation/server, a laser printer, ASCII video terminals, Ethernet and telecommunications equipment, graphics and text (OCR) scanners, XT- or AT-level PCs (such as the Zenith Z-248), hardcopy color output devices (8-pen color plotters and 35mm film recorders), and other associated components. Within this hardware environment, we also made available several off-the-shelf software tools, such as text editors, paint programs, and computer-assisted drafting (CAD) programs (CADKey and TekniCAD) for color graphics production.

### **Initial Tests and Status**

The AIM prototype software is currently in use at each of the AIM test sites and has been used to date to produce approximately 64 courses, totaling about 500 weeks of instruction. Some representative courses are Electrician's Mate "A" School, Heat Stress "F" School, Mess Management Specialist "C" School, and Propulsion Engineering Basics. AIM test sites generally report time savings of from 20 to 50 percent to produce better and more consistent instructional materials. We learned much about the user interface and functional requirements of this prototype software during its iterative development, and these lessons learned are being applied to current AIM software development.

### **Next Steps**

The Navy faces a number of challenges in meeting the requirements of producing and managing its classroom training materials. To meet these demands, the prototype AIM software is undergoing substantial revision into a production-level system. This more complete system will support all of the Navy's core curriculum development components, such as both analysis/design paths (PPP/TPS and manpower, personnel, and training analysis report, MPTAR), student achievement testing, and automatic generation of tracking documents. Moreover, because of its underlying relational database, the production-level AIM will facilitate maintenance of curriculum materials over their long life time. Thus, the eventual AIM system will allow Navy curriculum developers to efficiently produce standardized training materials that are technically accurate and consistent, to maintain this technical accuracy by updating the electronic databases underlying the course materials, and to distribute these text and graphic training materials over local and wide-area networks.

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## **Introduction**

### **Problem and Background**

Training and education in the U.S. Navy is a massive undertaking, and technology is being applied to make Navy training more efficient. Several characteristics of Navy training and education are important to the automation of the curriculum development process. This discussion will concentrate on technical training in the Navy, since that type of training accounts for the vast majority (about 90%) of Navy training. In a typical year, over 300,000 enlisted personnel are involved in formal training, and this figure includes about 100,000 recruits going through recruit training.

### **Numerous Widely Dispersed Courses**

One of the most striking features of Navy training is the very large number of courses that are spread out over virtually the entire country and all of the Navy's regular ports. As of mid-1986, 7200 classroom courses were conducted in shore-based education and training activities (Taylor, Ellis, & Baldwin, 1988), and about 200 classroom courses are being added every year. Some courses are eliminated but, because courses are often equipment specific and ships have a long, useful life, courses tend to remain in the Navy training system for a long time. These courses range in length from a few days to over 12 months, with the vast majority lasting from two to four weeks. The budget for operating this shore-based training establishment exceeds \$1 billion each year; therefore, making the training and education process more efficient could have dramatic cost savings.

One of the consequences of this highly dispersed training environment is the difficulty in sharing resources--both training resources and the technical design data on which the training materials are based. When old courses are revised or new ones are developed, many of the parts tend to be custom designed rather than reused from earlier, similar courses. This resource sharing problem actually has three parts:

1. Curriculum developers do not have access to existing training materials.
2. Even with access, the materials do not reside in any sort of database to ease the task of locating the reusable units such as safety lessons, basic drawings, etc.
3. Curriculum developers have no means of modifying training materials that are close to what they want without redoing the whole set of documents.

### **Scarce Personnel**

A second feature of Navy training is the difficulty in obtaining the experienced personnel that are needed to develop proper training materials. To develop good training material, at least two types of experts are needed: experts on technical content (experienced officers and senior enlisted personnel) and experts on the educational design and development of course materials. Both types of experts are in short supply at Navy training activities. Experienced officers and senior enlisted personnel are very much in demand to man the Navy's fleet of almost 600 ships. And the Navy's civilian educational specialists are difficult to hire, train, and retain.

The effects of this scarcity of experts are shown in the variable technical quality of the training materials and the insufficient attention sometimes paid to the educational aspects of the curriculum materials. These quality control problems were noted in a GAO report (GAO, 1984) that examined apprentice level training for several enlisted ratings that were characterized by the static nature of the technical content. That is, the GAO investigators avoided content areas that were frequently in a state of flux because of the high-technology equipment used. They found that training, even with stable content, often contained extraneous, unnecessary information and left out job-specific tasks. The GAO investigators recommended that more attention be paid to the front-end analysis and design of curricula to ensure that the training materials contain only the information necessary for competent job performance and thus keep down the cost of training materials preparation.

### **Curriculum Development Expertise Requires Training and Time**

A third characteristic of Navy training policy is that, while some special training is considered necessary for an individual to become an instructor in a school, little is available for curriculum development. As part of the regular ship-to-shore rotation, an experienced technician will be assigned to a training command for two to three years with a few weeks of instructor training school and perhaps (but not usually) a week or two of instruction in curriculum development. After some short period of supervision by the senior instructors, the technician is considered ready to assume the regular responsibilities of teaching, which may include spending a good deal of time developing, revising, and maintaining course materials.

Thus, technical experts often are not given the training or time to become more sensitive to the educational demands of the job. Especially as the equipment becomes more complex and sophisticated, the memory and problem-solving skills required for good job performance become more and more difficult to teach. This sometimes results in curriculum materials of variable quality. A recent systematic examination of the quality of instruction in Navy classrooms showed that, for instance, over 50 percent of the training objectives were inappropriate for future job requirements (Taylor et al., 1988). Other ways of improving classroom materials and practices were also noted.

### **Frequently Changing Standards**

A fourth feature of Navy training is that the standards for developing instructional material have frequently changed. By standards, we refer to the proceduralized guidelines that specify what tests, graphics, student materials, instructor guides, etc. should be produced and how they should be developed. These standards drive both in-house and contractor-developed training materials, seem to be drastically modified every 3 or 4 years by the Navy, and have changed some 100 times across all of the military services since the end of World War II (Montemerlo & Tennyson, 1976). Thus, curriculum developers often lack adequate time to become expert in using one set of standards. Even when the standards remain static for a few years, they only indicate what to do, not how to do it--much less how to do it *well* (Montague, Wulfek, & Ellis, 1983).

## Complexity of Instructional Planning and Development

Another characteristic of Navy training is the complexity of planning and developing curriculum materials in a systematic manner. Currently, the Navy uses MIL-STD 1379C for specifying contract deliverables and the *Handbook for Training Materials Development* (DoD-HNDK-292) as guidance for Navy personnel. The handbook consists of over 500 pages in 2 volumes and contains over 50 complex multipage flowcharts, some of which are more than 10 feet in length. The handbook provides direction on how to develop curricular materials and the extensive supporting documentation that must be generated to support the development of even a small (two to three day) course. One of its effects is to require a large amount of record keeping for the people developing and managing instructional documents.

This systems approach to training and instruction (referred to as Instructional Systems Development, ISD) usually consists of Analysis, Design, Development, Implementation, and Evaluation phases. The ISD approach emphasizes (1) specific behavioral objectives that define exactly what the student is expected to be able to know or do at the end of instruction, (2) links from these objectives to tasks that are required for the job, and (3) ways of verifying that the student has in fact acquired that skill or information. The process typically starts with an Analysis phase in which the curriculum designer interviews or observes expert job holders or looks at the design of equipment. This phase produces an inventory of job tasks--that is, an exhaustive list of the skills and knowledge that are required for the job. In the Design phase, which follows, the tasks to be trained are selected, converted into learning objectives, and sequenced into a particular type of instruction.

In the current Navy ISD method, there are two paths for gathering the necessary information for the Analysis and Design phases.

1. **PPP/TPS.** This path starts with the production of personnel performance profile (PPP) tables. A PPP table is a "minimum listing of all knowledge and skills required to operate and maintain a system, subsystem or equipment, or to perform a task or function" (DoD-HNDK-292, p. 5-3-1). These tables are produced by means of generic, task analysis model statements provided in the handbook, with the appropriate level of detail for that job or rating added by the curriculum developer. These PPP tables then feed into the training path system (TPS), which is a system for selecting, at the proper level of training (from apprentice to expert), the PPP tasks that will be part of the course of instruction under development. The criteria for PPP task selection is guided by the handbook, which also provides steps for converting the tasks into behavioral learning objectives, both course-level learning objectives and detailed topic learning objectives, and then sequencing this material into a course outline.

2. **MPTAR.** The other Analysis and Design method offered in DoD-HDBK-292 is the manpower, personnel, and training analysis report (MPTAR), and this method requires a similar set of steps. The MPTAR starts out with the job task analysis summary, which provides a complete inventory of all tasks performed on the job. The second step is the job training task list, which lists the subset of the job task inventory that is to be performed by the trainee. Two manpower reports (manpower planning data and manpower summary) provide the number and type of personnel required to do the job. The job training analysis

matrix provides a matrix breakdown, by subsystems and equipments, of the skills required. The final section of the MPTAR is the training analysis summary, and this document uses the output of the previous ones to produce course and topic learning objectives in a course outline structure.

During the ISD Development phase the actual training materials, for both the trainee and instructor, are produced. According to the handbook, the material is based on the topic learning objectives but with more detail and with an overview, examples, practice, summary, and tests. The handbook specifies the development of instructor and trainee guide materials, and testing materials for the assessment of students.

The final ISD phase is Implementation and Evaluation, where the instructors are trained, and the materials used and revised as necessary. Although the handbook specifies less for this phase than for the previous phases, this phase is often one of the most time consuming, since courses will be taught for many years, during which time the equipment and its operating/maintenance procedures will be upgraded and changed numerous times. Curriculum materials maintenance and revision is an immense problem for any large organization such as the U.S. Navy.

As others have noted, the ISD approach is also generally followed in more traditional instruction (Montague, 1979). What the systems approach adds to less formalized instruction is descriptive detail and the possibility of better quality. This systems approach may seem straightforward enough, but, for courses of any length at all, the management and development tasks needed to document and complete the training materials are quite imposing. For instance, a course with 200 hours of relatively uncomplicated classroom instruction (five to six weeks), with perhaps 1000 objectives, will typically take from 10,000 to 20,000 hours for development and at least 18 months for completion.

During initial revision and subsequent maintenance of the course content, it is often necessary to change the material to reflect updated equipment, policies, or procedures, and moreover to trace those changes all the way back to the analysis and design work. Clearly, this sort of audit trail is crucial in identifying any parts of the curriculum development process that may be deficient and is also necessary for person-hour accounting, budgeting, and scheduling. However, revision and course maintenance tracking has been done almost entirely without the benefit of automation, and current manual methods may average as much as \$40,000 per year for a representative 10-week course.

### **Limited Office Automation**

The managers and developers in Navy training activities have few up-to-date office automation tools to do their jobs more easily and efficiently. This almost total absence of computer-based tools to assist in the complex and time-consuming tasks of curriculum development and maintenance slows down the development and maintenance of training materials. Moreover, the complete design and logistics process is becoming more computer-based under Computer-Aided Acquisition and Logistics Support (CALs), the DoD-wide initiative to provide for the electronic, digital delivery of engineering information for new weapons systems from contractors to government. Thus, the need for automated tools for

curriculum development will become even more crucial. Among other things, the lack of office automation in curriculum development has resulted in training materials that do not reflect the technical changes in fleet equipment and in instructional graphics that are difficult to produce and change.

### **Purpose**

The overall goal of AIM is to provide the Navy with automated tools for the design, development, production, and maintenance of curriculum materials. Computer-based tools will allow scarce subject matter and instructional design experts to produce high quality instruction efficiently. This report describes our status in automating the mechanics of document preparation, thus increasing the efficiency of curriculum writers. We also outline our plans for enhancing the quality of training materials in planned software tools for AIM.

### **Approach**

In this section we will outline our approach, identify test site involvement, and describe the developmental hardware configuration.

### **Rapid Prototyping Methodology**

Our approach in this project was one of rapid prototyping -- that is, putting computer systems and the prototype software tools into the hands of Navy curriculum developers as soon as possible. This process involved an iterative design and development process in which the application software was installed, tried out by the users, modified on the basis of problems and suggestions, and then installed and tried out again. This interactive development contrasts with the more traditional, top-down, structured approach where all user requirements are specified in the first phase of the approach, and only then does the software programming begin. A rapid prototyping approach often leads to software being fielded when not yet in standard working condition, but this approach allows the final functionality needed for the application to be more completely specified and good software engineering principles to be followed in the development of the final, production-level software.

### **Test Sites**

From the very beginning, we involved actual Navy training activities with day-to-day responsibilities for the design, development, revision, and maintenance of training course materials in the project. To this end, several test sites that represent the different types of Navy training activities were selected to evaluate AIM's effectiveness (Fig. 1). In FY85, the Training Systems Development Department, Naval Education and Training Support Center, Pacific (NETSCPAC) and Engineering Systems School, Service School Command, Naval Training Center (NTC) Great Lakes became the initial test sites. In FY87, a system was installed at the Fleet Training Center (FTC) San Diego; and the system at NTC Great Lakes was expanded to other parts of Service School Command.

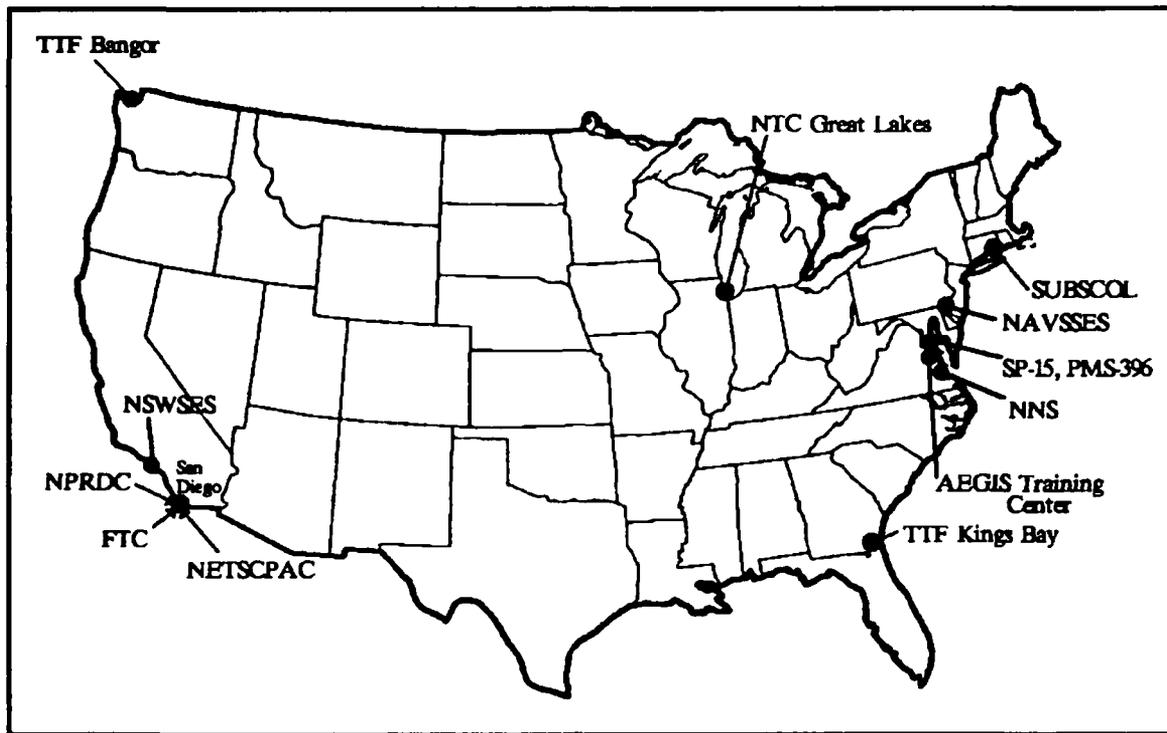


Fig. 1. AIM Test Site Locations

In late FY87, an AIM test site was established at Newport News Shipbuilding (NNS), where the AIM system was provided to a NAVSEA contractor to investigate the interface of the AIM prototype software with an integrated logistics support database on a large IBM mainframe computer. In this effort, the training developers worked with the logistics engineers to extract the necessary training information from the standard logistics support analysis record (LSAR) data bases and then to use this information in curriculum development. This effort will continue through FY89.

In early FY88, AIM test sites were also established at the Navy Submarine School (SUBSCOL) New London and the Trident Training Facility (TTF) Kings Bay, GA. Further test site expansion also occurred as a result of discussions with OP-11 and Strategic Systems Programs (SP-15). AIM systems were installed and are now in use at other Trident-related activities: TTF Bangor, and SP-15 and PMS-396 offices, Washington, DC. Test sites were also established during FY88 at AEGIS Training Center, Naval Ship Weapons Systems Engineering Station (NSWSES) Port Hueneme, and Naval Ship Systems Engineering Station (NAVSSES) Philadelphia.

## Hardware and Systems Integration

The installation of the AIM software at each test site required the acquisition, support, and integration of the necessary off-the-shelf hardware and software.<sup>1</sup> These acquisition decisions were made to satisfy current and emerging standards in DoD and Navy computing. These standards included UNIX,<sup>2</sup> a non-vendor-specific operating system; transmission control protocol/internet protocol (TCP/IP), a set of DoD communications standards; and portable operating system interface for computing environments (POSIX), a federal information processing standard for software applications portability. Also the CALS intertranslatability specifications for text (Standard Generalized Markup Language, SGML) and graphic (Interim Graphics Exchange Standards, IGES) were considered (MIL-HNDK-CALS Draft, 1988). The hardware (Fig. 2) was chosen competitively to meet these requirements.

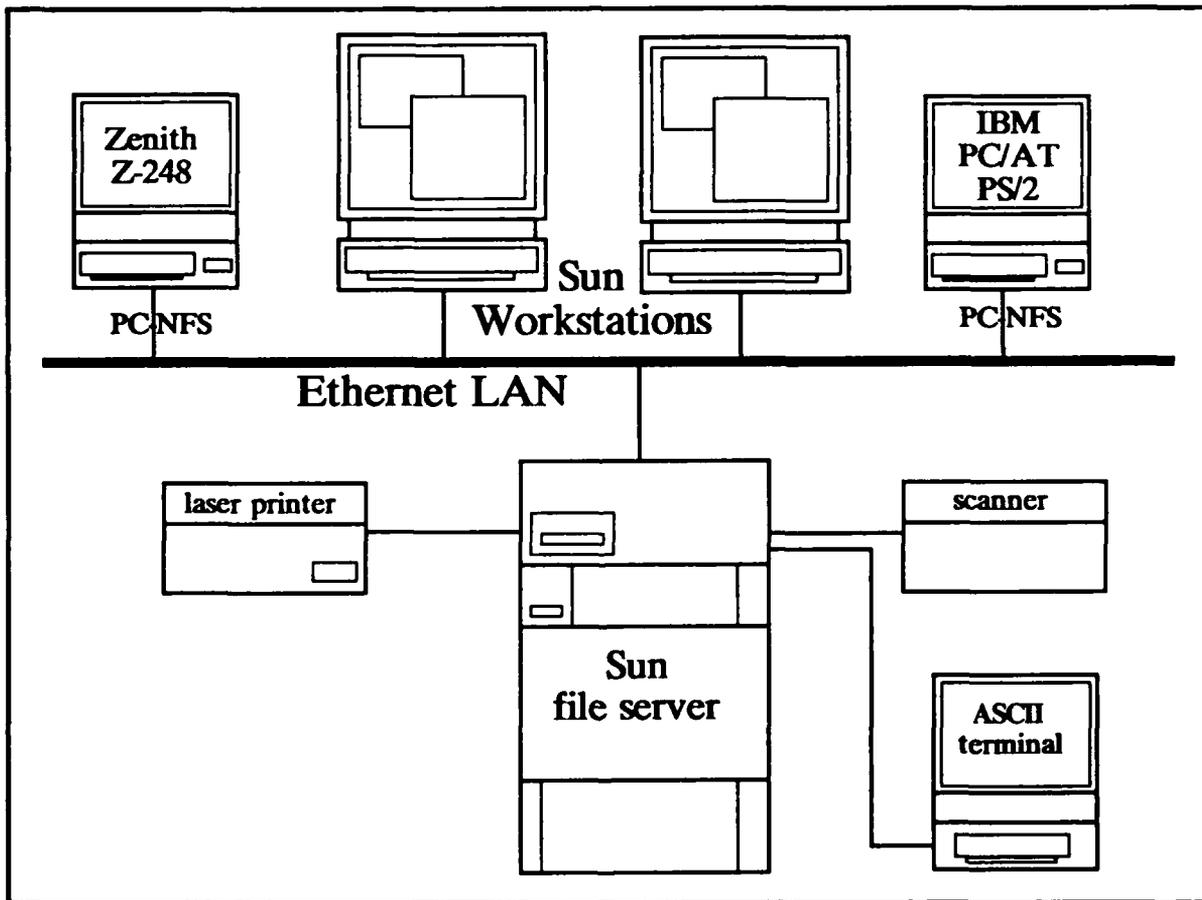


Fig. 2. Typical AIM System Configuration

1. Identification of specific hardware and software systems is for documentation only and does not imply any endorsement.

2. UNIX is a trademark of AT&T Bell Laboratories.

The AIM prototype software was designed and developed in-house by the AIM project team to assist Navy curriculum developers in the preparation of training documents to support the Navy's standards (MIL-STD 1379C and MIL-HDBK-292) for curriculum development. The hardware consists entirely of off-the-shelf items: Sun Microsystems UNIX workstations/servers, a laser printer, ASCII video terminals, Ethernet and telecommunications equipment, graphics and text (OCR) scanners, XT- or AT-level PCs (such as the Zenith Z-248), hardcopy color output devices (8-pen color plotters and 35mm film recorders), and other associated components.

The off-the-shelf software consisted of text editors, paint programs, and computer-assisted drafting (CAD) programs (CADKey and TekniCAD) for color graphics production. Additionally, some systems integration work was required at each test site, including integrating these computer systems through networking, with both local area networks (LANs) and wider ranging connections, such as DDN (Defense Data Network)/MILNET.

### Status

This section describes the software system architecture as it evolved from prototype to its current state. Use of this prototype software at the test sites for the production of course materials is given. Also, a brief overview of the work underway on expanding the software capabilities is provided.

#### Prototype AIM Software Capabilities

The AIM software was designed to help Navy curriculum developers in the preparation of training materials to support the Navy's standards. Contractors deliver curriculum materials according to the standards for military training programs (MIL-STD 1379C), and the Navy training activities use the additional guidance given in the military handbook, DoD-HNDK-292. Each AIM software module supports and automates much of the document preparation for curriculum development (Fig. 3).

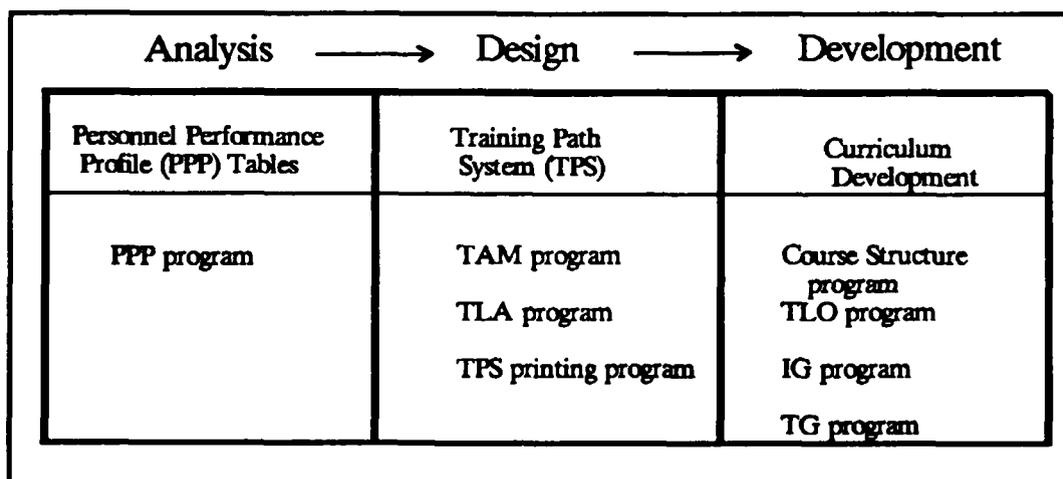


Fig. 3. AIM Prototype Software Supporting MILSTD 1379C

In the first years of the project, we completed the major part of determining the actual operational procedures used to produce Navy instructional materials. These data were used for the development of the prototype authoring system and for the design of the overall automated system. In FY86, the primary components of the prototype system that were completed, including software for development of PPP tables and of the instructor guide and the trainee guide. In FY87, the prototype software system was expanded to provide for the capability of producing some of the TPS documents and for completely formatted trainee and instructor guide documents. Also, basic user documentation and on-line help functions were added. In FY88, we began work to expand and revise these components into a production-level system with all of the major components of MIL-STD 1379C, and with maintenance and revision capabilities. The completely integrated software system is being developed primarily by a software support contract that was awarded in FY88.

A brief description of the capabilities of the AIM prototype software follows. (See DoD-HNDK-292 for a more complete functional description of the Navy curriculum development process.)

**User manual.** Allows curriculum developers to learn the AIM programs in a self-paced mode. The manual guides the users through the basics of the UNIX system and each of the curriculum development programs.

**PPP program.** Assists curriculum developers in the development of PPP tables. For system, subsystem, and equipment PPPs, the program uses the model statements from DoD-HNDK-292 so that "boilerplate" PPPs are automatically generated; for background and task/function PPPs, the basic table structure is created but the user must fill in the details.

**Table assignment matrix (TAM) program.** Assists curriculum developers in the general organization of the course to be developed and in the development of TAM tables. After asking general questions about the level of training, this program allows the users to choose PPP tables for this course.

**Training level assignment (TLA) program.** Assists curriculum developers in the development of TLA tables. The program allows users to select PPP line items to be included in the course development and assigns a training level based on the user's response to a series of questions.

**TPS printing program.** Allows curriculum developers to edit and print out the entire training path system, including the introduction and training objective statements.

**Course structure program.** Allows curriculum developers to modify the automatically generated course structure, which is then used in the programs listed below.

**Topical outline program.** Allows the curriculum developers to create and edit the topical outline for a course.

**Topic learning objectives program.** Allows curriculum developers to create the course learning objectives and to modify the topic learning objectives (TLOs) generated from the TLA program.

**Instructor guide program.** Allows curriculum developers to enter material necessary for the Instructor Guide, including the front matter, back matter and an automatically generated table of contents.

**Trainee guide program.** Allows curriculum developers to enter material necessary for the trainee guide, including the front matter and an automatically generated table of contents.

**Master materials list (MML) program.** Allows curriculum developers to create and edit the master materials list.

**Graphics generation and text-graphic integration.** The CAD programs (TekniCAD and CADkey) have IGES (Interim Graphics Exchange Standards) translators, which allow translation of the graphics into and out of neutral formats. Thus, a drawing created on one software system can be viewed and modified in the other. These CAD graphics files can also be translated, through in-house developed graphic filters,<sup>3</sup> into Postscript or Sun raster files for black-and-white output or for page-by-page integration with the text material being generated on the Sun systems. There are also utilities to translate graphics files from TIFF (tag image file format) to Sun raster and to allow the inclusion of Sun raster files with the textual material. Another capability under development allows the production of 35mm slides from the CADkey or Sun raster format.

## **Results**

Some of the production using the AIM software is listed in Table 1. To date, the AIM software has been employed to help produce approximately 64 courses, totaling about 500 weeks of instruction. AIM test sites generally report time savings of from 20 to 50 percent, with better and more consistent instructional materials resulting from this system. Some representative courses that have been produced are listed below, and the overall use of the prototype software is given in Table 1.

- Electrician's Mate "A" School
- Tactics and Maneuvering Fundamentals
- Heat Stress "F" School
- Mess Management Specialist "C" School
- Weapons Technician "C" School
- Propulsion Engineering Basic Course
- Gas Turbine Mechanical and Electrical Courses
- FFG-7 Class Waste Heat System Maintenance
- Cargo/Weapons Elevator Maintenance

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3. Copies of these software documents may be requested from the authors.

<b>Test Site</b>	<b>Number of Courses</b>	<b>Weeks of Instruction</b>
NTC Great Lakes .....	20 .....	398
NETSCPAC .....	21 .....	76
FTC San Diego .....	15 .....	19
SUBSCOL .....	3 .....	4
TTF Kings Bay .....	1 .....	2
TTF Bangor .....	4 .....	2

Table 1. Test Site Production

While working with users at each of the test sites, we learned much about the user interface and functional requirements of this software during its iterative development. This process thus helped us determine the format for screen displays, strategies for on-line help, style of user manuals, and the underlying database structures necessary for reliable, reusable, maintainable software. All of this information was then used in the design specifications for the new complete, integrated system (see last section).

### **Discussion: Prospects for AIM and for Better Training**

We started this report by describing the current problems that the Navy faces in curriculum development for its classroom courses. Now we will examine how the implementation of an integrated AIM system can help solve these Navy problems: a large inventory of courses developed by scarce personnel and taught by instructors not familiar with the demands of technical training; a complex curriculum development and maintenance process that is guided by changing production standards and that provides few electronic tools. These characteristics about the Navy's approach to training materials development will likely remain part of the way that the Navy does business, even 20 years from now. But many of these problems could be eased by the use of automated tools for curriculum development such as those that will be included in the overall AIM system.

**1. Dispersed courses connected electronically.** The Navy teaches over 7200 courses among its widely scattered shore-based schools. By networking various training activities over dial-up phone lines or the Defense Data Network, people who are developing curriculum materials at widely scattered training activities will be able to trade information and to access remote and local databases of technical information and course materials. Thus, instructional materials will become more standardized and the process will become far more efficient. Establishing this sort of electronic user community for various specialties and interest groups within the Navy should greatly reduce the duplication of effort and probably will save millions of dollars.

**2. More effective use of scarce personnel.** The Navy does not have enough technical and educational experts to adequately design, develop, maintain, and teach the classroom training materials. AIM will provide tools that allow for the more efficient capture of subject matter expert knowledge and skills, and thus these scarce technical experts will be better used. By giving technical and educational experts better tools for curriculum development, they will have much better control and influence over the delivery of instructional materials to the students.

**3. Automated tools reduce expertise needed for curriculum development.** Military curriculum developers are not usually given the training or the time to acquire the educational expertise necessary for developing effective technical instruction. The current prototype AIM software helps to automate the formatting and production requirements, and later, more capable versions will provide embedded training on the procedural guidelines of DoD-HNDK-292 and guidelines for good educational practice. Thus, personnel who have limited experience with instructional design will be able to design and develop more effective and efficient training materials.

**4. Software designed for changing standards.** In the past 40 years, the Navy's procedural guidelines for curriculum development have changed many times, and the software architecture underlying AIM is designed to be able to cope with surface-level changes. By separating the data from the format and by creating databases that underlie the curricula and its technical content, AIM will allow developers to access and share resources even as standards change. This separation of data and format will be increasingly important as contractors start to deliver, along with new weapons systems, text/graphics/design databases in digital format. Under CALS, these text and graphics files must be packaged in a neutral, device-independent format.

**5. Software tracks complexity of instructional development.** The curriculum development process is a complex and time-consuming one; the Navy guidelines (MIL-STD 1379C and DoD-HDBK-292) are lengthy and complicated documents; the handbook is in two volumes totalling over 500 pages. The AIM curriculum development tools can help manage this process by tracking the decisions made during curriculum development and their subsequent effects. For instance, automation aids to task analysis and learning requirements specification can improve quality and increase transfer to job performance. Also, by using local area networks as well as wide area networks, and by providing specialized software programs for the management and development of training materials, AIM can make the complex work environment much more manageable.

**6. Better office automation environment.** Navy curriculum developers have few office automation tools to accomplish the tasks of instructional development. The AIM software tools will create a "networked publishing environment" and with graphics and text tools, the actual developers will be able to produce more effective and efficient curriculum materials. The AIM software includes such programs as drafting programs for technical illustration, a set of lower-level writing tools (spell checkers, synonym databases, and sentence level prose processors) integrated into a specialized document preparation package for Navy training materials development.

## Next Steps

The Navy faces a number of challenges in meeting the requirements of producing and managing its classroom training materials. To meet these demands, the prototype AIM software is undergoing substantial revision into a production-level system. This more complete system will support all of the Navy's core curriculum development components, such as both analysis/design paths (PPP/TPS and MPTAR), student achievement testing, and automatic generation of tracking documents. Moreover, because of its underlying relational database, the production-level AIM will facilitate maintenance of curriculum materials over their long life time. Thus, the eventual AIM system will allow Navy curriculum developers to efficiently produce standardized training materials that are technically accurate and consistent, to maintain this technical accuracy by updating the electronic databases underlying the course materials, and to distribute these text and graphic training materials over local and wide-area networks.

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