STANDARDIZATION OF AUTOMATED SUPPORT FOR ISD AND SAT REQUIREMENTS

Dr. H. Barbara Sorensen
Armstrong Laboratories
Brooks Air Force Base, TX

and

Frank W. Goddard and James M. Ross
Dynamics Research Corporation
Wilmington, MA

Abstract

The computer age has brought forth an abundance of automated tools for hosting training development and management functions. Virtually all of these systems were designed and built to meet service-specific Instructional Systems Development/Systems Approach to Training (ISD/SAT) requirements. Many of these automated training tools are narrow in scope, while others contain comprehensive training support capabilities. Nearly all the tools operate independent of each other and have no data integration capabilities or integration plans. Consequently, most automated tools require extensive data handling by users or special interface modules to transfer training data and analysis products from one system to another.

When viewed from a life-cycle perspective, whether from the acquisition of a defense system or the development of a professional/career management system, the ISD/SAT process has extensive functional breadth and depth. Literally hundreds of training development and management functions and sub-functions need to be performed to properly specify, acquire, field, and sustain an individual weapon system, a fully ready military force, or a professional work force. With so many diverse automated tools available to meet these ISD/SAT requirements, how can a military training organization select the tool or tools appropriate to meet their specific needs?

This paper describes the findings of the Automated-Training Evaluation, Acquisition, and Management program (A-TEAM), which is a Joint Service initiative to demonstrate the feasibility of integrating a set of service-specific training development and management tools into a joint service training development capability. Research and analysis by the multi-service A-TEAM membership examined issues such as:

1) ISD/SAT Models. Could a "master list" of ISD/SAT processes and procedures be derived from existing service-specific and DoD models that would provide a comprehensive foundation for comparing automated training tool capabilities?

2) Training Data Elements. Do DoD Standard Data Elements adequately accommodate the extensive cross-service differences in technical jargon, service-specific vocabulary, data element lengths, usage and intent? Are data elements an appropriate and feasible level for making automated training tool comparisons?

3) Contractor-performed Training Developments. Can the requirements of contracted training development that is specified through use of MIL-STD-1379D, Military Training Programs, be met by these automated training tool capabilities?

4) Tool Hardware and Software Requirements. Can a candidate tool that meets an organization's training development needs be supported by the computer hardware and software capabilities of the training organization? And will the tool be supported in the future?

The A-TEAM program concluded that a way of selecting appropriate ISD/SAT tools is possible within the military training community. By correlating the automated training development processes and their data elements to the A-TEAM's training development "master list", a highly versatile means of linking training process requirements and tool capabilities was developed. Correlation results identified training processes supported by automation, training processes not supported by automation, processes in compliance with DoD and service-specific doctrine, and common footprints as to whether data interfaces between tools are possible. Implementation of the lessons learned from these results will ensure the

development of higher quality training products as well as avoid the continued development of duplicative tools and software. Current U.S. military downsizing and the related trends toward more Joint Service training (and less service-specific training) further heighten the usefulness of the A-TEAM training tool selection process and the need for further training development tool integration efforts.

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INTRODUCTION

With the current abundance of automated training development and management tools to choose from, how can a military training organization select the most suitable tool or tools for meeting their specific requirements? Standardization of tool development and usage would go a long way towards resolving the training manager's concerns when addressing this question.

Problem Definition

The current downsizing of the U.S. military and the associated cutbacks in DoD training resources ensures that the U.S. Armed Services will continue to place greater emphasis on standardized Joint Service training and training systems. Automated tools can reduce the cost and lead time associated with the analysis, design, and development of training materials. With high development and maintenance costs, Joint Service cooperation during requirements definition is essential.

Standardizing automated training development and management tools is not simply a matter of resolving hardware and software issues. Tool standardization also requires an examination and assessment of the Instructional Systems Development/Systems Approach to Training (ISD/SAT) methodological processes and procedures which are being supported, as well as an examination of the pertinent training data elements. To produce an automated training development or management tool, the developer and users must consider that tool's ability to meet a standardized list of training processes and data elements. Only then can they begin to address the issues of hardware and software technology integration.

ISD/SAT Models

The U.S. Armed Services have been successfully using ISD and SAT methods and procedures for well over twenty years in the development of training and training systems. The actual application of these methodologies has, however, been transitioning from a common set of processes into unique, service-specific processes. These service-specific training development and management processes reflect and support the unique mission, vocabulary, requirements, training philosophies, and associated documentation of each service.

The original baseline for DoD training development processes was the 1975 (and recently rescinded) Interservice Training Review Organization (ITRO) ISD Model. More recently, the contractor tasks defined within the 1990 Military Standard (MIL-STD) 1379D, *Military Training Programs*, provides an approved, Joint Service list of training development and management tasks, processes, and

products. However, the MIL-STD-1379D tasks generally identify Data Item Descriptions (DID) that contractors must produce, often in a system acquisition mode, rather than the day-to-day processes performed by military training developers and managers.

The specific ISD/SAT models used by each service include: the Air Force's ISD model (as defined primarily in AF Manual 36-2234 and the 11 volume AF Handbook 36-2235 series); the Army's SAT (as per TRADOC Regulation 350-7 and the TRADOC Pamphlet 351-series); the U.S. Coast Guard's ISD model (portions of which are described in COMDTINST 1550.9 and the Coast Guard Job and Task Analysis Aid); the Marine Corps' SAT (as per the MCCDC SAT Guide); and the Navy's ISD model (as per NAVEDTRA-130, -131, and -135).

BACKGROUND

In the early 1980's, a Defense Science Board (DSB) study emphasized the need to increase the coordination and transfer of training technologies among the Services. In response to the DSB study, the DoD sponsored a series of Joint Service programs designed to address this need. One of these Joint Service efforts was the Automated-Training Evaluation, Acquisition, and Management (A-TEAM) program.

A-TEAM Program

As a three year, proof of concept, DoD management initiative, the A-TEAM program was created to provide a standardized, integrated set of training development tools to support military training requirements. As part of this mission, the A-TEAM evaluated approaches for integrating service-specific, automated training development and management tools.

Prior to its completion in July 1995, the A-TEAM program specifically completed three key activities: (1) the development of a Master List of DoD Training Development Processes, with an automated tool which stores and aligns the capabilities of existing training development and management tools to these processes; (2) the development of a Data Dictionary which defines training data elements and aligns the information within current training development and management tools to a DoD Master List of Data Elements; and (3) a demonstration that three independent, service-specific training development tools could be integrated.

Functional Process Improvement

Comparing the capabilities of various independent training development tools without a common point-of-reference is virtually impossible. Since all military training development tools were specifically designed to support ISD or SAT processes, it was determined that an A-TEAM Master List of DoD Training Development Processes was needed. Using current service-specific and DoD-level doctrine on ISD/SAT, a proposed Master List of Training Development Processes was developed and coordinated for technical review and approval with the Joint Service membership of the A-TEAM.

The Master List of Training Development Processes evolved from service models and from the ITRO ISD Model and from the tasks described in Military Standard (MIL-STD) 1379D. The relationship between the Master List and each model was kept intact. This served two purposes: (1) to keep the integrity of the Master List of Processes audit trail; and (2) to provide a means for defining a tool's capabilities by aligning the tool's capabilities to the more familiar service-specific processes (for which it was specifically developed). All these relationships (as well as tool descriptions, hardware and software requirements, and points-of-contact) were compiled and are stored in the automated A-TEAM Process Mapper. The Process Mapper compares the capabilities of training tools across the DoD Master List and across service-specific ISD/SAT process lists. From these comparisons, the user can

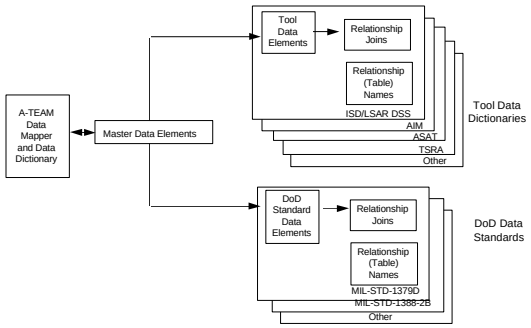
evaluate applicability of training tools' capabilities to meet the user's requirements and can assess the integration potential for a training tool, regardless of the service for which it was originally developed.

Data Element Standardization

The MIL-STD-1379D Joint Service Working Group (JSWG) is developing a training data model with fully attributed, standardized training data elements. Some, but not all of these data elements have been submitted for DoD approval. Without a standard list of data elements, the names, definitions, and lengths of common data elements can differ from tool to tool. Such a situation compounds the already significant degree of difficulty involved in sharing similar training data between different training tools.

Using guidelines from DoD Directives 8320.1, *DoD Data Administration*, and 8320.1-M-1, *Data Element Standardization Procedures*, and working in close coordination with the MIL-STD-1379D JSWG, the A-TEAM developed an automated management tool called the A-TEAM Data Dictionary and Data Mapper. The need for a "Master Data Element" baseline to link other data dictionaries resulted in adopting MIL-STD-1379D data elements. Ideally, the Defense Data Repository System (DDRS) should provide the "Master Data Element". However, there were too few data elements during the A-TEAM time frame. Currently, the Data Mapper maintains a list of 1449 Master Data Elements for Military Training. The Master Data Element list has been aligned to three service-specific training tools' data dictionaries and two Standards, as shown in Figure 1. Additionally, the Data Mapper houses data elements from two other training tools not yet linked to Master Data Elements. Armed with this information, a software developer can determine if a training tool contains the specific information and structure required to meet the trainer's requirements.

Figure 1 - Data Mapper & Dictionary Structure

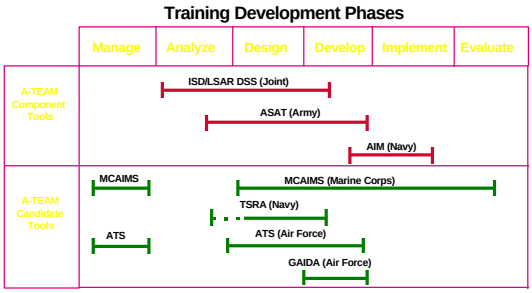


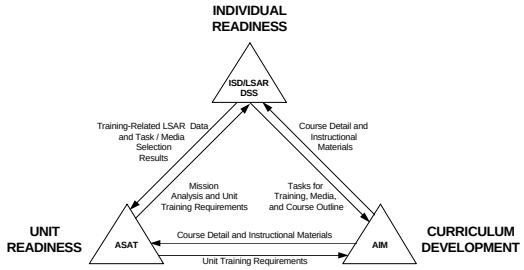
DISCUSSION

Existing Training Development Tools

At the outset of the A-TEAM program, three training development tools from three different Services were identified as the A-TEAM Component Tools and designated for development of prototype data interfaces. These tools were the Air Force's Joint Service Instructional Systems Development/Logistic Support Analysis Record Decision Support System (ISD/LSAR DSS), the Navy's Authoring Instructional Materials (AIM), and the Army's Automated Systems Approach to Training (ASAT). Throughout the life cycle of the A-TEAM program, many other automated tools were assessed for A-TEAM inclusion. As Figure 2 shows, many of these tools perform various functions within the five phases of ISD/SAT, however, no tool provides a comprehensive cradle-to-grave capability.

Figure 2 - ISD/SAT Comparison of Training Tools





Each of these tools accomplishes its intended goals, whether its job and task analysis, curriculum development, or other ISD/SAT functions. Historically, there was little intent to interface tools programatically or through a data interface to provide a more comprehensive capability. This situation left many potentially overlapping capabilities between existing tools, as shown in Figure 2.

Automated training development tool integration and standardization activities must occur from two different perspectives: integration of existing automated tools, and development of enhanced and new tools.

Integrating Existing Tools

One of A-TEAM's major goals was proving that service-specific training tools could exchange data, regardless of the operating environment. To demonstrate this point, the A-TEAM chose: the ISD/LSAR DSS on the PC-DOS platform, for its front-end task analysis capabilities; AIM on a UNIX platform for its curriculum design; and ASAT on the PC-DOS platform for its collective task analysis and training requirements definition. Figure 3 shows the functional relationships between the three service-specific tools.

Figure 3 - Training Tool Functional Integration

Prior to implementing these three prototype data interfaces and before any future interfaces could take place, a process for determining the most appropriate tools and data elements had to be followed. The A-TEAM program developed a set of procedures for establishing integration rules. These procedures are:

1) Describe and define the capabilities of each training tool.
2) Map the relationships between tools and the A-TEAM/DoD Master List of Training Development Processes.

Both of these activities can be accomplished using the A-TEAM Process Mapper. If the results of these activities correlate with another service-specific tool, then compatible data structures require investigating. Continuing the procedures:

3) Input or import the training tools' data elements into the A-TEAM Data Dictionary and Data Mapper.
4) Compare and contrast the tools' data elements to target equivalent or comparable data elements.

If the data structures are compatible, the tool can pass data through the use of specialized software interface modules or generic data import and export routines. An A-TEAM example was the data interface between the ISD/LSAR DSS and AIM. A Standard Generalized Mark-Up Language (SGML) module in the ISD/LSAR DSS tags data and creates ASCII files, which become available for import into AIM.

Development of New and Enhanced Tools

When developing new and enhanced tools, especially for the unique requirements of one Service, developers must now take a more global, DoD-wide perspective. The training tool developer should ask questions such as:

- Can other organizations or Services use this tool?
- If Joint Service processes and data elements are addressed early in the tool's design, can it be used by the other Services without significant modification?
- What references can accommodate the training development and management needs of the other Services?

The answer to this last question goes well beyond the scope and activities of the A-TEAM program. The DoD Directives 8320.1 (1991), *DoD Data Administration*, and 8320.1-M-1 (1993), *Data Element Standardization Procedures*, provide the policies and procedures for data element standardization. The research involved in developing the Process Mapper and the proof-of-concept tool integration efforts completed by the A-TEAM should provide a solid foundation for the completion of a DoD approved list of Joint Service training development and management processes. The A-TEAM Data Dictionary and Data Mapper efforts lay the foundation for data element standardization prior to a fully populated DDRS.

Training Tool Capabilities

Table 1, DoD Training Tools' Capabilities, displays the various tools' relationships to the A-TEAM/DoD Master List of ISD/SAT processes. At this high level, it is apparent that many tools share what appear to be very similar capabilities. This situation reveals a potential duplication of effort or, at least, a significant opportunity for data interfacing between the tools. Underlying this table are many lower-level processes. In some cases, there is an apparent duplication at a lower level; other cases reveal separate, unique processes performed only by one tool.

Table 1 - Training Tool Capabilities

DoD TRAINING TOOLS CAPABILITIES MAPPED TO TRAINING DEVELOPMENT PROCESSES												
	AIR FORCE				ARMY			USMC	NAVY			JOINT SERVICE
A-TEAM DoD MASTER PROCESS LIST	ATS	ISD/AT-DSS	GADA	MPT-DSS	AIMS-R	ASAT	SATS	MCAIMS	AIM	AIM II	TSRA TOOLS	ISD/LSAR DSS
1-0 Analyze	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
1-01 Conduct Mission Analysis	NONE	PARTIAL	NONE	PARTIAL	NONE	PARTIAL	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL
1-02 Perform Collective Task Analysis	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	NONE	NONE	NONE	NONE	PARTIAL
1-03 Conduct Occupational Analysis	PARTIAL	PARTIAL	NONE	PARTIAL	PARTIAL	PARTIAL	NONE	MANUAL	NONE	NONE	PARTIAL	PARTIAL
1-04 Perform Equipment Task Analysis	NONE	PARTIAL	NONE	PARTIAL	NONE	NONE	NONE	NONE	FULLY	FULLY	PARTIAL	FULLY
1-05 Perform Educational Analysis	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
1-06 Select Tasks	PARTIAL	FULLY	NONE	NONE	PARTIAL	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	PARTIAL
1-07 Perform Individual Task Analysis	NONE	PARTIAL	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	MANUAL	NONE	PARTIAL	PARTIAL	PARTIAL
1-08 Assess Training Technology	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE	NONE
1-09 Select Instructional Setting	PLAN	PARTIAL	NONE	PARTIAL	PARTIAL	NONE	NONE	NONE	NONE	NONE	PARTIAL	PARTIAL
2-0 Design	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
2-01 Identify Target Population	NONE	PARTIAL	NONE	PARTIAL	PARTIAL	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL	PARTIAL
2-02 Develop Learning Objectives	PARTIAL	FULLY	PARTIAL	NONE	PARTIAL	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL	FULLY
2-03 Perform Learning Analysis	PARTIAL	PARTIAL	PARTIAL	NONE	PARTIAL	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL	PARTIAL
2-04 Develop Tests	PARTIAL	PARTIAL	PARTIAL	NONE	PARTIAL	NONE	NONE	PARTIAL	NONE	PARTIAL	PARTIAL	NONE
2-05 Sequence Learning Objectives	PLAN	PARTIAL	PARTIAL	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL
2-06 Determine Instructional Strategy	PLAN	PARTIAL	PARTIAL	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	PARTIAL	PARTIAL
2-07 Select Media	PARTIAL	FULLY	NONE	PARTIAL	PARTIAL	NONE	NONE	NONE	NONE	NONE	PARTIAL	PARTIAL
2-08 Id. Trng. Sys. Modification Requirements	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL
2-09 Id. Trng. Sys. Functional Requirements	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE	PARTIAL	PARTIAL
2-10 Design Media	PLAN	PARTIAL	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	PARTIAL	NONE
3-0 Develop	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
3-01 Review Existing Instruction	PARTIAL	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	NONE	NONE
3-02 Develop Course Syllabus	PARTIAL	PARTIAL	NONE	PARTIAL	PARTIAL	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	PARTIAL	PARTIAL
3-03 Develop Lesson Plans	PARTIAL	PARTIAL	NONE	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	NONE
3-04 Develop Trainee Training Materials	NONE	PARTIAL	NONE	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	PARTIAL	NONE
3-05 Develop Instructional Media	NONE	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	NONE	NONE
3-06 Validate Instruction	PARTIAL	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE	NONE	NONE	NONE
4-0 Implement	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
4-01 Prepare for Instruction	NONE	NONE	NONE	NONE	PARTIAL	NONE	PARTIAL	NONE	PARTIAL	PARTIAL	NONE	NONE
4-02 Conduct Instruction	NONE	NONE	NONE	NONE	NONE	NONE	NONE	PLAN	NONE	NONE	NONE	NONE
5-0 Evaluate	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -
5-01 Perform Internal Evaluation	NONE	NONE	NONE	NONE	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE
5-02 Perform External Evaluation	NONE	NONE	NONE	NONE	PARTIAL	NONE	NONE	PARTIAL	NONE	NONE	NONE	NONE
5-03 Revise Instruction	NONE	NONE	NONE	NONE	PARTIAL	NONE	NONE	NONE	PARTIAL	PARTIAL	NONE	NONE

TOOL CAPABILITY CODE DEFINITIONS
FULLY - Tool can FULLY support this training development process.
MANUAL - MANUAL process that is part of tool's operating procedures.
NONE - Tool's capability of supporting this process is NONE.
PARTIAL - Tool can provide PARTIAL support of this process.
PLAN - Tool PLANs to implement support of this process.

MILITARY TRAINING TOOL NAMES	
AIM	Authoring Instructions Materials (PPP-Based)
AIM II	Authoring Instructional Materials II (Task-Based)
AIMS-R	Automated Instructional Management System - Redesign
ASAT	Automated Systems Approach to Training
ISD/AT-DSS	Instructional Systems Development/Aircrew Training Decision Support System
ATS	Advanced Training System
GADA	Guided Approach to Instructional Design Advising
ISD/LSAR DSS	Instructional Systems Development/Logistic Support Analysis Record Decision Support System
MCAIMS	Marine Corps Automated Instructional Management System
MPT-DSS	Manpower, Personnel and Training Decision Support System
SATS	Standard Army Training System
TSRA TOOLS	Training System Requirements Analysis Tools

CONCLUSIONS

In conclusion to this article and the proof-of-concept efforts undertaken with the A-TEAM program, the following results are proven answers to the four questions raised in the Abstract.

1. At a high level, a DoD Master List of Training Development Processes was successfully developed and is being maintained with the A-TEAM Process Mapper. The capabilities of training tools have been aligned to this automated Master Process List and allow training developers and managers with a means to compare tools with

each other and with the processes of each Service's ISD/SAT model.

2. Using data elements as a starting point for comparing training tools is inappropriate, as such a comparison is more effectively accomplished by starting at the process level first. Data element comparisons across potentially interfacing training tools are possible and strongly recommended if the process comparison determines a strong potential for data integration. However, recent efforts by the MIL-STD-1379D JSWG have often experienced difficulties in achieving agreement and approval on fundamental considerations such as defining a data element, designating a data element's Joint Service name, and determining its maximum character-string length.
3. The members of the MIL-STD-1379D JSWG have worked very closely with the A-TEAM Program. The joint efforts of these groups in defining training data elements and the A-TEAM's success in using this information to integrate its three component tools has clearly demonstrated that contractors can meet their MIL-STD-1379D training development requirements through the use of separate integrated training tools, in spite of their unique service applications.
4. By developing training tools in compliance with a Master Data Element List, there is considerable potential to share training data and automated tools from different training environments. In many cases, developing a software Conversion Module, which imports/exports ASCII SGML files, has been demonstrated as a means to populate one tool's database with equivalent information from another training tool.

The training organizations of each Service are interested and enthusiastic in establishing cooperative interservice working arrangements. They have repeatedly demonstrated this attitude with software developers, by their active participation in Joint Service efforts such as the A-TEAM program, and the MIL-STD-1379D JSWG. Additionally, the individual Services have increased their efforts to encourage multiple-service participation in the design and development of any new training development and management tools. The Services recognize that the occurrences of Joint Service training will increase in the immediate future. In an increasing Joint Service training environment with cutbacks in already scarce resources, the ability to share and re-use existing training data and systems is clearly in the best interests of all military training organizations.

An additional opportunity to share training information and tools may exist for the U.S. Armed Services within other federal government organizations and from other external organizations. Trainers and training managers from many diverse, non-DoD organizations have monitored the efforts undertaken by, and, in some instances, actively participated in the A-TEAM program. These organizations included: the Department of Energy (DOE); the Internal Revenue Service (IRS); the Federal Aviation Administration (FAA); the Defense Intelligence Agency; the Federal Deposit Insurance Corporation (FDIC); and the University of Southern California (USC). Many of these organizations have similar training concerns. Although beyond the A-TEAM scope, the potential to bring in the tools and experiences from these and other, non-DoD training organizations should not be overlooked.

ABOUT THE AUTHORS

Dr. H. Barbara Sorensen leads the Acquisition MPT Technology Team at the U.S. Air Force Armstrong Laboratory (AL/HRT), Brooks Air Force Base, TX. She has a Ph.D. in Instructional Design and Computer Technology; an M.S. in Educational Psychology, Measurement, and Statistics; and over 18 years of experience in training systems and software engineering. She is the program manager of several Manpower, Personnel, and Training (MPT) integration projects.

Mr. Frank Goddard is the Automated - Training Evaluation, Acquisition, and Management (A-TEAM) and Joint Service Instructional Systems Development/Logistic Support Analysis Record Decision

Support System (ISD/LSAR DSS) Program Manager at Dynamics Research Corporation, Wilmington, MA. He has an M.B.A. from New Hampshire College, a B.S. in Mechanical Engineering from Georgia Institute of Technology, and over 10 years experience in Logistics Support Analysis, Training Development, and Decision Support Systems.

Mr. James M. Ross is a Senior Training Analyst at Dynamics Research Corporation, Wilmington, MA, and the principle investigator for the Joint Service Training Development Process Mapper of the Automated-Training Evaluation, Acquisition, and Management (A-TEAM) program. He has a B.S. in Education from Westfield State College and 14 years experience in the performance of ISD/Systems Approach to Training (SAT) and training systems analysis.

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