

**CHANGING CULTURE THROUGH TECHNOLOGY:
REENGINEERING THE WARFIGHTER'S MAINTENANCE
TRAINING CONTINUUM**

Jerry W. McLemore
Naval Aviation Maintenance Training Group
Pensacola, Florida

and

Linda J. Brent, Ed.D. Director
L3 Communications
Link Simulation and Training
Orlando, Florida

ABSTRACT

In the early 1990s, the Navy's Aviation Maintenance community began reengineering their training processes to provide a definitive training continuum that integrates fleet and schoolhouse resources while systematically infusing technology into the maintenance-training continuum. The result of this "reengineering" process is the Aviation Maintenance Training Continuum System (AMTCS) Program, an integrated training system of hardware, software and training management tools specifically designed to capitalize on current technology capabilities while providing for future growth to maintain currency. A primary goal of the AMTCS Program is to use leading edge technology to provide quality training materials to support "Just-in-Time" training throughout an individual Sailor's/Marine's career. This is accomplished by managing training through: a) the development of master task lists that incorporate data by individual skill and knowledge requirements necessary to maintain specific platforms/systems or execute the duties required of specific billets; b) an assessment tool to evaluate individual cognitive capabilities; c) training data to support task remediation; and (d) a comprehensive training management concept. This training system has been implemented in several weapon systems communities and is in the process of implementation in other communities. Its impact on the readiness and war fighting capabilities of the personnel served is being documented.

This paper will focus on several key aspects of the AMTCS Program. First, it will describe the programmatic complexities experienced in implementing a large-scale training system that significantly modifies the current Navy/Marine Corps aviation maintenance training culture. Second, it will define the key elements of the training system and the unique implementation requirements for the system. Third, it will describe specific lessons learned relative to cost, schedule, and system implementation based on its integration across multiple weapons platform communities. Lastly, it will describe the evaluation metrics collected during the initial implementation phase of the program and the programmatic and policy implications for future technology infusion initiatives.

ABOUT THE AUTHORS

Jerry McLemore has over thirty-five years experience in Naval Aviation Maintenance. He retired in 1986 as an Avionics Master Chief Petty Officer having served at both organizational and intermediate level of maintenance activities, as a technician and supervisor. He is currently a Navy Training Specialist and has been directly involved in training program management for over 16 years. He has a BS in Mathematics from the University of Texas at Austin and a MS in Education from the Memphis State University.

Linda J. Brent, Ed.D. has over 15 years of extensive experience designing, developing, implementing, and managing training and simulation systems. She has published research articles in the field and has made numerous presentations at international, national and state level conferences and association meetings. Having received her doctorate at the University of Rochester, she is currently the Director of the Training Systems Business Unit for L3 Communications, Link Simulation and Training.

CDR Mark E. Karr is NAVAIR's AMTCS Assistant Program Manager. He has a BS in Computer Science from North Carolina State and a Naval Post Graduate School's Masters in Material Logistics.

John R. Fuller is NAVAIR's Training Systems Manager for Maintenance Computer Based Training. He has a BA from Williams College and a MS from the University of Arkansas.

CHANGING CULTURE THROUGH TECHNOLOGY: REENGINEERING THE WARFIGHTER'S MAINTENANCE TRAINING CONTINUUM

Jerry W. McLemore
Naval Aviation Maintenance Training Group
Pensacola, FL

Linda J. Brent, Ed.D.
L3 Communications
Orlando, FL

CDR Mark E. Karr
COMNAVAIRSYSCOM
Patuxent River, MD

John R. Fuller
COMNAVAIRSYSCOM
Patuxent River, MD

BACKGROUND

In the early 1990's, it became evident that significant changes in training processes were essential if Fleet training requirements were to continue to be met in the face of dwindling resources. "Right-sizing", Base Realignment and Closures, and budget cuts impacted resources in a manner not experienced since the 1970s. To prevent the "Hollow Forces" of that time, innovation and utilization of new "enablers" such as technology became essential to ensure future training requirements were satisfied. The Chief of Naval Operation's (CNO) "Just-in-Time" training initiative laid the foundation upon which to build. Formal training was restructured in an initial step to transition from providing every Sailor and Marine the complete package of skills and knowledge required to maintain a specific platform, regardless of experience and length of service obligations, to a package providing skills and knowledge training at the time it was required in the individual's career. Under this redefined training structure (Figure 1), general knowledge and skill training requirements are provided within "Core" and "Strand" courses at centralized "A" schools. Specific knowledge and skill training requirements are provided within "Initial" and "Career" courses taught at fleet concentration area "C" Schools. While this resulted in some immediate savings, it did not address the total training requirement: specifically, the continuing training or "In-Service Training" requirements

provided by Fleet activities. This "In-Service Training" provides training for tasks not covered in the formal schoolhouse; tasks that are difficult to comprehend; and remediation for the loss of skills and knowledge resulting from the natural mental and psychomotor skill degradation process. As critical as In-Service Training was to the development of a complete technician, it lacked standardization across communities and suffered from a lack of quality training materials in the majority of communities. To address these elements of a comprehensive training program, savings from the initial initiative were reinvested to support further refinement of the training continuum.

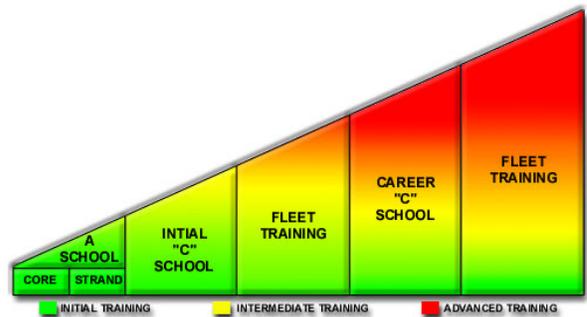


Figure (1) Post-1994 Training Continuum

AVIATION MAINTENANCE TRAINING CONTINUUM SYSTEM

Efforts to define the total training continuum requirements began in earnest in the mid-1990s with the establishment of the CNO's Computer-Based Training Systems Initiative (CBTSI). The goals of this initiative were to: (1) merge all elements of the existing training program into an integrated training continuum to ensure training on required skills and knowledge is available at the time in an individual's career they were required; (2) reduce or eliminate redundancies by designing the continuum to encourage reutilization of resources in the formal schoolhouse and in the Fleet; (3) provide the resources necessary to standardize Fleet In-Service Training for consistency, accuracy and educational content for the skills and knowledge NOT covered in a formal environment, difficult to understand, or subject to degradation due to limited utilization; and (4) incorporate the necessary technology "enablers" across the training continuum. To validate the program's attainment of its goals, a tool to gather metrics and present them to the individual and managers in a logical, timely manner was required. With these lofty goals, AMTCS was formally launched in FY-96 with limited individual component development for Concept Exploration.

AMTCS TOOLS

If one thinks of AMTCS as an umbrella, it has 5 basic and distinctly related elements: a basic foundation, CBT materials, a management tool (ASM), data, and a presentation medium (ATD) (Figure 2).

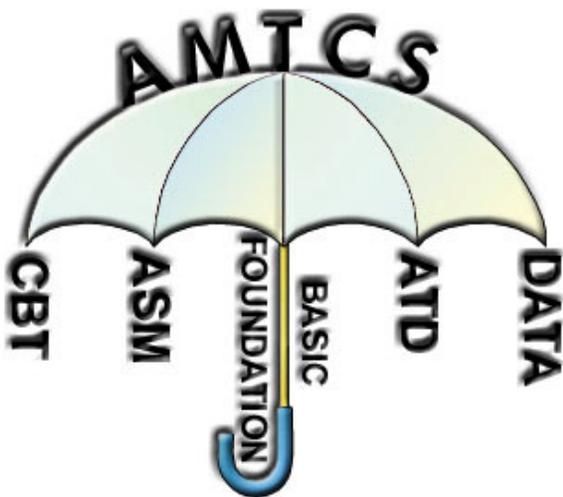


Figure (2) AMTCS Components

Basic Foundation

While AMTCS did restructure the training continuum, the basic tools, while modified to meet today's realities, have remained in place. Initial and advanced knowledge and skills; weapon/billet specific, on-site shop training; and mentoring are as critical to the development of maintainers today as they were in the past.

Computer Based Training (CBT)

Aviation maintenance training's initial foray into this area in the mid-seventy's was an unqualified failure and left a very bitter taste in the community members' memories. Until the AMTCS Program was initiated, insertion of CBT in the aviation maintenance community was sporadic at best and based upon an individual program manager's decision. Under the AMTCS umbrella, CBT is an integrated element of the training continuum.

AMTCS Software Modules (ASM)

The ASM provides the ability to manage the vast amount of data generated by the AMTCS Program at the local level. It provides the training and maintenance communities with unique leveraging opportunities that were never previously possible while providing the flexibility to encompass new requirements as they are identified. These modules host standardized data to support community-specific platforms and/or weapons systems, billet, and site-specific requirements. Additionally, ASM provides the means to access individual technician knowledge and skills at any point in their career, provides "canned" and AD-HOC report generation, provides the ability to link to ICW supporting a specific task, and presents the individual data to the technician and managers in a fashion defined by the user. Finally, the ASM maintains raw data that will enable training management to evaluate training effectiveness throughout the continuum using empirical data, something that is sorely lacking in the current training system and holds one of the greatest promises for improved efficiencies in the future.

DATA

The data hosted within ASM include weapon specific task and supporting elements {(Master Task Lists (MTL)}, site specific task and

supporting elements {Unit Task List (UTL)}, Command, personal, individual, feedback, and administrative data. These data are individualized via a series of filters within the ASM to make it meaningful for the individual and supervisors. Additionally, these data can be sorted in a cumulative manner to support board assessments of community readiness through training.

AMTCS Training Device (ATD)

The medium by which all the elements of the AMTCS are fielded is the AMTCS Training Device (ATD). These devices are COTS based and, once integrated with the other AMTCS tools, form the final link in the Training System. ATDs include electronic classrooms for the formal schoolhouse and Fleet Training Devices for deployed activities. The key requirement is the ability to reutilize all the AMTCS tools in either environment, thus ensuring both efficiencies of scale as well as consistency in training materials. Cross-utilization of materials and equipment has been designed into the program.

PROGRAMMIC ISSUES

Culture

In the mid-1970s, the Naval Aviation Maintenance Training Community began its first foray into the use of CBT by reengineering its initial training from group-paced to self-paced. While the concept held great promise, technology was not capable of supporting the initiative and the community did not fully understand the design requirements for a quality CBT product. As a result, the initiative met a rapid demise. The experience left a legacy of distrust of this training media as a valid maintenance training tool. As a result, the introduction of CBT in the classroom was automatically eliminated from the media analysis element of training program design for the next two decades except for small, independent efforts. This led to sporadic CBT development and implementation without the benefit of centralized guidance. However, the reality of declining resources forced the issue in the early to mid 1990s. Right sizing, Base Realignment and Closure, and declining resources dictated an absolute requirement to reexamine old biases in view of current resource realities. However, the 1970s effort coupled with job security concerns

and the fear of, and resistance to, change presented a major challenge to program sponsors and managers.

Realizing that technology could hold the key to reconciling increasing requirements with declining resources, the issue of cultural reluctance to accept technology-based initiatives in the aviation maintenance training community had to be addressed. The initial step in addressing cultural issues was the formation of Integrated Program Teams (IPT) that ensured all the major players were active participants in requirement definition, program design, and development. IPT membership consisted of training professionals representing the Resource Sponsor, Training Support Agent, Original Equipment Manufacturer, Industry, Type Commanders (Active and Reserve), USMC, and training commands. By ensuring all parties were represented and their concerns addressed from the beginning, program "ownership" was spread across all parties, from Resource Sponsor to the end user. This spread also ensured that management support was evident to field level activities. This management support was absolutely critical to the health and welfare of the program. Key managers became the advocates for the program, providing the guidance necessary, through persuasion preferably but through direction when necessary, to ensure the program stayed on course.

Mission Creep

As the program began to field its initial products and as a visionary management continued to expound the virtues of AMTCS to an expanding audience, the excitement grew as the program's potential began to be recognized. The phrases "Hummm, what if" and "Wow, now if it would only" were commonplace. Recognizing the potential of many of these comments, and seeking to ensure program acceptance while overcoming cultural reluctance, every effort was made to modify the AMTCS tools "on the fly" to accommodate the most promising of suggestions. As a result, the program began to experience requirements growth at an exponential rate. The program's success and acceptance exceeded all expectations, but this very success soon began to threaten its ability to be implemented within the constraints of the big three: Cost, Schedule, and Performance.

Funding

AMTCS was initially funded via the recapitalization of savings from the restructuring of the formal training community. However, the available funding only addressed approximately 25% of the actual requirement, necessitating prioritization of requirements from the beginning. This shortfall automatically set the stage for some dissatisfaction as the customer began to embrace AMTCS products and began to realize that everything they desired, now that they had assumed ownership, exceeded available funding.

Cost

Normally, cost is translated into dollars. While that is the case for AMTCS, there are costs that are hidden from the casual observer. Sailors and Marines expended a great deal of effort in the development of supporting data for the AMTCS. The ASM program is only an empty shell without requisite data to manipulate. Creation of Master Task Lists and Supporting Elements required the dedication of Subject Matter Experts already overtaxed due to declining manpower availability in the face of increasing mission requirements and "right-sizing". It is a testimony to these "hidden resources" that the data necessary to field AMTCS materialized. This is in no way intended to decrease the importance of industry or management to the process, only to point out that the true cost of the program is not measured in dollars and cents, but in the commitment displayed by the unsung and invisible resource of the Navy and Marine Corps, and the individual Sailor and Marine.

Now for the "normal" definition of cost. As noted previously, the funding allocated for the program was only enough to whet the appetite for more. This "more" led to mission creep that drove up costs exponentially. Benefits from AMTCS far outweigh the costs, but cost is a driving force in the procurement and fielding of any product.

Schedule

Schedule impacts were felt from all conceivable, and often unconceivable, arenas. Lack of current Industry Subject Matter Experts to develop CBT, and government Subject Matter Experts to review these products impacted the timely completion of

courseware. Additionally, lack of understanding by Industry relative to the scope of AMTCS and by the government in the level of effort required to meet program objectives, led to overly aggressive schedules. Additionally, changes in the threats that a weapon system was designed to counter necessarily resulted in modification of the weapon system to counter the emerging threat. These emerging requirements altered the development requirements of the courseware and data. Concurrent development efforts are challenging when within a single activity, but between Weapon System Primes and Courseware Primes, it approaches the impossible. As the program has matured, so has the team members' knowledge of the resource requirements, time constraints, and other factors that impact schedule. With this gain in knowledge, the ability to recognize pending schedule impacts has grown as well as the ability to manage risk mitigation.

Another major impact on schedule was the miscalculation of the amount of data that would have to be developed to support the AMTCS program being housed within ASM. As an example, there are in excess of 3 million "records" in the F/A-18C/D Master Task List. Development of these data would not have been possible without dedicated professionals, as they had to identify the data, and then input the data into the ASM shell. Complicating matters further were ongoing efforts to modify ASM to accommodate emerging requirements. This concurrent effort, data base design and data content, resulted in more than one "rework" of the data by the SMEs.

Finally, the ASM was probably the major element impacting the fielding of the fully functioning AMTCS initiative on schedule. As has become increasingly and painfully clear, development of software is only the beginning. Maintenance of software, or the simplest of modification, can have devastating effects on the program. "Fixing" one problem often leads to the creation of another, usually in the most unlikely of locations. This can lead to a seemingly unending battle to continually "fix" a software program. The end result, of course, is that schedule is impacted as these "bugs" are placed on a Most Wanted poster.

Performance

If evaluated against the original performance requirements, AMTCS has exceeded the expectations of most participants. As noted previously, mission creep has revised these performance requirements significantly. However, even with the increased requirements, customer ownership of the program's elements has grown to the point that the fleet user is eagerly awaiting full implementation with an expectation that future enhancements will address their total requirement.

External Interfaces and Influences

The requirement to interface with existing databases has been a real challenge to the program. Key to the long term success of the program is the ability to share data with existing databases such as CNET's Standard Training Administration Support System (STASS), SPAWAR's Naval Aviation Logistics Computer Information System (NALCOMIS), and CNET's Navy Training Management and Planning System (NTMPS). These are basic requirements that cross not only community boundaries but Resource Sponsors and Support Agents. The lack of a comprehensive network infrastructure in the Fleet further complicates matters. While the advent of NMCI may help resolve some issues, it brings to the table its own set of challenges.

AMTCS STATUS

Currently organizational level courseware has been developed, or is in development, for all USN and USMC platforms except for the H-46 (scheduled for FY-02). CBT for selected intermediate maintenance training tasks supporting ordnance, support equipment, and engine test cells has been placed under contract. Courseware has been fielded in the F-14, F/A-18, E-2, C-2, E-6, and H-60 communities at this time. Additional courseware will be released for Fleet use as it is completed, and upon request of the appropriate Type Commander.

MTLs were completed for all weapon specific, organizational level maintenance requirements by the end of FY-01. A MTL for the "Intermediate" level of maintenance is in development and will be completed by mid FY-02.

ASM has passed its initial functional evaluation and is currently released as Version 1.1.02. Version 2.0 is scheduled for release in mid FY-03.

ATDs have been fielded to support the deployment of courseware as requested by the Type Commanders.

ASM has been integrated with all other AMTCS elements and fielded in selected F-14, F/A-18, E-2/C-2 WINGS and Fleet Replacement Squadrons. Deployment in the entire community will be phased-in based upon guidance received from OPNAV and the appropriate Type Commander. Full-scale implementation is not projected to occur prior to the release of Version 2.0.

AMTCS Life Cycle Support (LCS)

LCS for the AMTCS Program has been a concern from its conception. While CNO is the Resource Sponsor for all elements of the AMTCS Program, each element of the program has unique LCS requirements and was addressed in a different fashion.

LCS for the basic foundation component of the AMTCS Program is provided by the same activities and processes that supported these components prior to reengineering and the infusion of technology.

CBT materials were projected to be stable once developed, and require modification primarily when weapon systems changed to meet new threats or to replace aging components that were no longer supportable. In these cases, LCS is provided via the existing Engineering Change Proposal (ECP) processes. ECPs are developed by the weapon system's platform and courseware is included as a logistics element in the planning and costing of the ECP. Thus, once delivered, the courseware would become the responsibility of the platform to maintain for currency and validity. A small in-house maintenance team was established to provide upgrades that were not the result of platform ECPs.

The ASM's LCS is provided via the OEM, NUWC Keyport, using standard configuration management practices. ECPs are generated when the requirement is identified, submitted for approval and funding via the Training Support

Agent, COMNAVAIRSYSCOM PMA205. Requirements are generated at the user level and forwarded via the chain of command, or at the OEM to meet emerging requirements that are global in nature such as the move to a Web environment. Since ASM is a Government Off-the-Shelf (GOTS) program, LCS and maintenance will be a major factor. History clearly points out that software failures increase with maintenance. This is due to the introduction of errors in related fields of the database that may, or may not, have been projected.

Data LCS is provided by OPNAV designated Aviation Maintenance Training Program Managers (AMTPM) for content requirements. Data are inputted by OPNAV designated Aviation Maintenance Training Program Support Activities (AMTP SAs). AMTPMs are normally Fleet Wings for the Organizational Level MTL with AMTP SAs being the schoolhouse that provides the formal training on the platform in question. The AMTPM for Intermediate Level MTLs is Naval Air Maintenance Training Group Headquarters with the AMTP SAs being the formal training sites. For the “cats and dogs” that are not covered by these two categories, OPNAV will designate AMTPM and AMTP SAs as appropriate.

ATD LCS is provided by the OEM via a “Help Line”, email, and on-site visits as required. There is a single LCS maintenance activity for both Fleet and Schoolhouse ATDs.

AMTCS FUTURE INITIATIVES

STASS

The requirement to interface with STASS is driven by the requirement to share class rosters, class schedules, student status, and personnel data between two individual databases, thus preventing the need for dual data input. This requirement will be fully incorporated into the ASM prior to the release of Version 2.0.

NALCOMIS

ASM/NALCOMIS interface is essential to the gathering of data supporting the amount of time individuals spend performing a task and the number of times they have performed the task. This information, when combined with the

assessment tool within ASM, serves as an enabler for maintenance managers in evaluating their technician’s abilities.

NTMPS

The NTMPS database is a repository for data that can support management decisions impacting the entire Naval Service. By sharing data elements between the two databases, NTMPS is able to obtain individual and collective data never previously captured, and ASM gains a repository for data that would have to be transported by “sneaker net”, thus increasing its risk of being lost or destroyed. This interface serves both databases exceptionally well.

Navy eLearning

Since ASM stores the training records of individual members of a Command, and Navy eLearning provides an avenue for “Anytime, Anywhere” training, these databases make natural partners. ASM may eventually be used as an access point in the eLearning network. Specific links are being considered by both programs.

Electronic Field Service Record

The goal of single input of data is real in the ASM world. Once the Electronic Field Service Record has become a reality, data within it would greatly enhance the ASM database. A direct link may not be necessary since the same data may be obtainable from the NTMPS database. However, the options are still open as to how to obtain the data elements required.

Training Effectiveness Evaluation Training Link to Readiness (TEE TLR)

Data gathered via the NALCOMIS interface when evaluated with the “qualification status” of individuals gathered by ASM provide the first empirical opportunity to directly link mission readiness and training. Once this link is firmly established, the data within ASM can be used to support training budget issues based upon documented Fleet readiness. Though not initially forecast, this ability to realistically support training budget issues is one of the most significant that will be provided by ASM to managers within the Naval Aviation Community.

Department of Labor (DoL) and Federal Aviation Administration (FAA)

Data accumulated and managed within ASM can be used to enhance individual and management goals within the Naval Service's aviation community, but provides the individual a unique opportunity to extend the benefits of ASM into their post-military careers. Discussions are underway with DoL and FAA representatives that will permit our Sailors and Marines to receive credit for service experiences documented within ASM. This information may then be used by the individual in obtainment of DoL certification as a Master, Journeyman, or Apprentice in their trade skills; or in seeking an Airframe and Power Plants license from the FAA.

Joint Service Usage

Some AMTCS products have been developed with "Jointness" in mind. However, all products are government owned and available for evaluation of applicability to other services upon request. The Army has expressed an interest in the concept and received support for their evaluation efforts when requested.

CONCLUSION

The AMTCS concept has demonstrated exceptional potential for enhancing the careers of individual Sailors and Marines. Its continued growth will be a direct reflection of the requirements established by its users and their embracement of the concept. Along the way, we have experienced successes and fallbacks, but never lost our belief in the use of technology as an enabler to overcome the obstacles imposed by factors beyond our control. We have learned many lessons such as: (1) Set an aggressive, yet realistic, schedule; (2) Plan for setbacks and accept them without losing faith. After all, the word is "setback" not "failure"; (3) Don't be afraid to take risks, or you really will fail. Change is the only constant in the world, so to live, we must adapt; (4) Don't over promise. Words spoken become commitments. Fleet personnel expect results immediately and don't think of commitments being fulfilled after their watch as a rule. Therefore, be very conscious of your audience and ensure time frames are explicit, not implied; (5) Software is a monster waiting to be harnessed. Cinch up the saddle because software development will give you the ride of your life; and (6) Plan, then replan, and plan some more. Life is full of surprises.