Status Report on the JLC Panel on Automatic Testing

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Introduction

This paper discusses the background behind the establishment of the Joint Logistics Commanders Panel on Automatic Testing (JLC-AT), the current panel structure in relation to the Joint Logistics Commanders and the ongoing actions of the panel to solve joint service problems and issues in automatic testing.

Background

In March 1978 a formal project was established by all the services and five industrial associations (Aerospace Industries Association-AIA; Shippers of America-SCA; Electronic Industries Association-EIA; National Security Industrial Association-NSIA; and Western Electronic Manufacturers Association-WEMA). This project, which was an extension of an earlier Industry Ad Hoc Automatic Test Equipment (ATE) Project for the Navy, was formally identified as the "Industry/Joint Services Automatic Test Project" and was chartered to review how the services were buying Automatic Test Equipment, and to make recommendations to the services on how to improve that process.

The project was organized into three committees with seventeen task groups. Committee I (Advanced Testing Technology) addressed Software, Automatic Test Generation, BIT/Design for Testability, Non-Electric Testing, New Technology, Microprocessors, Advanced ATE Technology Interfaces, and Metrology and Calibration. Committee II (Acquisition Support) addressed Systems Engineering, Education and Training, ATE Language Standardization and Test Program Sets. Committee III (Management) addressed ATE Acquisition, Maintenance Planning and Support Concepts, Resource Management, and Benefits Analysis. On 22 March 1978, in parallel with the start of the industry Joint Services Automatic Test Project, the Joint Logistics Commanders (The Commanders of Naval Material Command (NMC), Department of the Army Development and Readiness Command (DARCOM), Air Force Logistics Command (AFLC), and Air Force Systems Command (AFSC)) approved the Charter establishing a Joint Commanders Panel on Automatic Testing. This panel had as its mission to:

A. Develop methods of reducing hardware, software, and manpower costs associated with automatic testing for support of weapon systems.

B. Devise policies, plans, and procedures in the use of automatic testing hardware and software to improve operational readiness of weapon systems.

C. Facilitate exchange among the Services and OSD of technical, managerial, and operational information on automatic testing hardware and software as it applies to the support of weapon systems.

Broad guidance was provided to address all aspects of automatic testing i.e., on-line testing, off-line testing and weapon system testability. In general the panel was to: 1) generate policies and procedures on a service-wide basis to optimize definition, application and support of automatic testing hardware and software in the system acquisition management process. 2) Develop system engineering and logistics tools, techniques, and guidelines which enhance the application of automatic testing in the design and support of weapon systems and subsystems. 3) Coordinate R&D planning and execution in testing technology and associated software to minimize duplication of effort and produce a program to achieve common testing technology objectives.

This JLC and industry effort was a herculean task, which included 275 experts from 86 industrial organizations and 11 colleges and universities, 225 service advisors, and representatives from other government agencies such as the National Bureau of Standards. In toto, the project represented approximately 45 man-years of effort. The final report (Figure 1), which was published in June 1980, identified 110 recommendations in 11 problem areas. These recommendations covered organizations, people and funding; military equipment design; specifications, directives, controls and deliverables; nonelectric test development; test program set development and management; automatic test technology; data banks and models for life cycle cost; logistic support analysis and technology assessment; system software development and maintenance; metrology and calibration; training; and maintenance shop productivity.

Figure 1. FINAL REPORT: INDUSTRY/JOINT SERVICES AUTOMATIC TEST PROJECT JUNE 1980
The recommendations identified in this final report were endorsed by the Joint Logistics Commanders and became the starting point for current activities in the JLC-AT panel.

**Current JLC-AT Panel - Objectives**

The mission and broad guidance directed to the panel translates into seven objectives:

- Improve the management of ATE development and acquisition, and institutionalize and integrate these improvements into the weapon system management process.
- Enhance the readiness of weapon systems and automatic testing systems by applying design for testability.
- Improve the communication and exchange of information among the services and industry in the areas of management, acquisition, testing technology, and training.
- Improve productivity and quality through more effective application of automatic testing technology.
- Assure development, transition and application of advanced testing technology to testing problems.
- Enhance standardization of service automatic testing programs, including the development of appropriate standards and specifications.

Achievement of these objectives is paramount if the services are to provide the most economical and supportable weapon systems. Traditionally, the cost and complexity of our weapon systems have driven us to the need for expensive, technically complex and hard to support test equipment. We expect the weapon system cost and technical complexity to increase and as a result the test system as well. Therefore, we must attack the testing problem from several directions. The directions we are taking are self-evident from our objectives and have three major thrusts (technology, management and communication).

Based on our present experience and projection of our future needs, it is clear that we must evolve to two levels of maintenance whenever possible. This can only be accomplished by utilizing the breakthroughs of new technologies and by better insertion of testability requirements in the weapon system and test system.

The technical thrust alone is not the solution to satisfying our objectives. We must also provide the tools and instructions necessary for managers at all levels to procure ready and supportable weapon systems. This we are doing through the development and implementation of standards, specifications, guides/handbooks, data bases and training courses.

The last and probably most important thrust is communication. The individual services are tasked with providing supportable weapon systems that satisfy their particular service mission. Accordingly, each service establishes and funds program offices and research and development programs to satisfy their unique requirements. When left alone, this process causes individual programs to encounter and solve similar problems on a recurring basis. The JLC Panel on Automatic Testing provides the forum through meetings, publications and correspondence to exchange information on current efforts, identify problems and successful approaches, and corroborate results. This forum has already been successful in preventing duplication of effort and improving the effectiveness of our scarcest resource - manpower.

**Current JLC-AT Panel - Management Structure**

The JLC organization (Figure 2) is a hierarchical structure which establishes ad hoc groups, coordination groups, task groups and panels to satisfy identified requirements. Ad hoc groups are organizations established to resolve a specific problem or conduct an assigned study. This type of group is frequently used in an exploratory manner to determine the need for a panel or group of longer duration. A coordinating group is an organization composed of personnel to insure complete interservice awareness of a specific subject. Separate coordinating groups are established for technical and policy topics. Task groups are organizations that require full time, continuing commitment of personnel. The panel is an organization composed of personnel designated to perform studies in order to develop material/logistics principles and to identify preferred concepts, policies, and system design characteristics. For simplicity, the term "panel" is often used to include all the groups defined previously.

The JLC Panel on Automatic Testing (Figure 3) is composed of an office of primary responsibility (OPR) Board, a Management Panel, and seven functional subgroups. The OPR Board consists of a single member...
from each of the JLC organizations. The OPR is the Deputy Chief of Naval Material in NMC, the Program Manager level in DARCOM and the Deputy Chief of Staff level in AFLC and AFSC. The Management Panel consists of a primary and alternate member from each of the JLC member organizations. These members are typically from the service organization responsible for establishing and implementing automatic testing policy. Currently, AFSC is the Chairman of the Management Panel. (For the remainder of this paper, "panel" will refer to the Management Panel.) The functional subgroups are divided into areas that best address the broad scope of this panel. They are Policy and Procedures, Test Program Sets/Software, Testability, New Technology, Off-Line ATE, Communication/Education, and Machinery Testing. Each subgroup has a chairman from one of the JLC commands who has been delegated authority by the panel to manage efforts assigned to the functional subgroup. Further, each subgroup has a network of service focal points who are assigned on the basis of technical expertise.

**Current Panel Operation - Task Establishment**

To meet the objectives of the panel, approximately 70 tasks were established. For the most part, these tasks were directly related to the Industry/Join Service Automatic Test Project recommendations identified in the 1980 report. Since the establishment of the panel, over 90 tasks have been undertaken. The amount of active tasks being monitored by the panel varies from year-to-year reflecting the current needs and emphasis of the services. Currently, the panel is monitoring approximately 45 active tasks.

The criteria for establishing active tasks are simple. First, the task must be related to automatic testing. Second, there must be a product from the task and it must be expected to provide a benefit to all the services. Third, one of the services must take responsibility for the task and must provide the funds and/or manpower needed to support the task. This last criteria is critical and one of the major differences between this JLC panel and other panels within the JLC. In the majority of the other panels, each service contributes to one lead service which then manages the total effort.

Our initial years of JLC-ATE panel operation have taught us that the dollar value needed to support all the possible tasks that could improve automatic testing was monumental, while the probability of total funding was remote. Funding shortfalls are in part due to the size of the dollar amount and in part due to the fact that many of the tasks are part of bigger individual service programs which compete for dollars within each service based on their relative priority and the needs of that service. Accordingly, the only viable approach was to recognize this process and require active tasks to be limited to those sponsored by an individual service. In this way, the majority of efforts between services can be directed toward concrete, achievable products.

A subtask description book (Figure 4) is maintained to retain corporate knowledge of panel tasks and provide status to all personnel associated with ATE efforts. This book identifies the individual task, the goals of the task, funding estimates, milestones, present status, responsible service, and individual service points of contact. The subtask description book is separated into 3 sections: active tasks, completed tasks and deleted tasks. The last category is kept to maintain a mechanism to reinstate a task should proper support become available.

![Figure 4. SUBTASK DESCRIPTION BOOK](image)

**Current Panel Operation Task Management**

As stated earlier, the panel has recently established seven functional subpanels in order to provide more effective integration and management of functionally related tasks. This is a substantial effort which is already yielding positive results. The efforts of four of these subpanels best illustrate the current operating thrust of the panel.

**Testability Subpanel**

The Testability Subpanel, headed by the Navy, reviewed fourteen separate tasks identified as testability related. Samples included the The Built in Test (BIT) Design Guide, Testability Specification, Testability Improvement Program, etc. As a result of this review, a new approach was identified which will retain only three subtasks. These tasks, Testability Management Framework, Testability Cost/Benefit Data Base, and VHSIC Testability Monitoring, capture the three necessary thrusts of the services. They provide the documentation necessary to do the job by means of Standards, Specifications and Handbooks. They provide the data necessary to prove the benefits. Finally, they provide the thrust in the latest technology (VHSIC) to insure that testability is designed into the future weapon system.

**New Technology Subpanel**

The New Technology Subpanel, also headed by the Navy, has reviewed fourteen separate tasks. As a result, they have identified many previous tasks in areas of interest which have not had sufficient funding support in relation to individual service priorities. This panel is taking a new approach by reviewing the actual Independent Research and Development (IR&D) and R&D programs currently being supported by the services. From this analysis they will define a technological profile that includes the time when the technology is expected or needed to be available for use in test systems for weapon system support. New tasks will be defined and prioritized based on these projected need dates. Undoubtedly, some of the original tasks will remain. But this new...
approach is significant in two ways. First, it is based on IR&D and R&D efforts already supported by the services. This means that the extrapolations of future technology are more likely to occur since they are not based on a good idea that did not have sufficient service support. Second, it includes a prioritization process based on historical R&D development times. This will provide better visibility on where funds should be spent first.

**Off-Line ATE Subpanel**

The Off-Line ATE Subpanel is unique in that it only has one task (Analysis of Off-Line ATE). It includes the program managers of the services off-line ATE programs. Specifically, the Air Force's Modular Automatic Test Equipment Program (MATE), the Navy's Consolidated Support System (CSS), and the Army's Automatic Test Support System (ATSS). These programs represent the individual services' major financial commitment to satisfying their testing needs. This panel meets periodically to review each other's programs. They highlight the products available and schedules for future products, the problems they have encountered and their solutions, and the reasons behind their approaches. This panel also has the visibility of all the other subpanels and can call on subpanel expertise to solve individual or joint problems or to use subpanel results.

Several significant products have already been interchanged. The MATE guides have been made available to both the Army and Navy and they in turn are using those portions that fit their programs. The MATE Life Cycle Cost Model has been completed and also made available to the services for their evaluation. This evaluation will determine if this model becomes a joint service publication. The Testability Standard developed by the Navy is being included in the MATE guides. Through efforts such as these, we can and will evolve to common standards for all services that make sense, yet still retain individual efforts for service unique requirements.

**Communication/Education Subpanel**

The Communication/Education Subpanel is a most critical subpanel. This subpanel, headed by AFLC, is responsible for planning the necessary training, information exchange mechanisms and data base needs related to ATE. As such, the subpanel now integrates the efforts of many subpanels on specific tasks. For example, the Testability Subgroup provides two testability training courses and the Test Program Sets/Software Subpanel is developing an ATLAS 716 course. Although these subpanels will continue to provide the training, the Communication/Education Subpanel will oversee the efforts necessary to make these courses widely available and continually responsive to service needs and evolving technology.

The Communication/Education Subpanel is also required to develop mechanisms that identify the subpanel products to all pertinent individuals involved in automatic testing development. One of the key products of this subpanel is the ATE Newsletter (Figure 5). This newsletter, published through the Navy, will continue to be a primary information exchange vehicle for the panel.

The thrust of the panel is positive. A comprehensive management program is in place and constantly evolving to stay responsive to service needs. The four subpanels highlighted demonstrate different approaches based on the objectives of their subpanel and the interservice relationships.

**Figure 5. ATE NEWSLETTER**

The panel's activities relate directly to reliability and maintainability. The goal of all panel activities is to improve readiness. Since the complexity of weapon systems dictates the need for automatic testing in maintenance, any improvements in the automatic testing function will also enhance maintainability. Our thrusts in this area are significant and concentrated toward two goals: 1) improving automatic testing at all levels of maintenance and 2) eliminating intermediate maintenance levels when it is possible and practicable. The four subgroups identified play the major role in meeting these two goals.

The Testability Subgroup efforts are vital to this effort. They are developing the standards, analysis tools, handbooks and training material needed to allow government personnel to correctly implement testability.

Their efforts will get at the weapon system as well as the test equipment. By correctly applying BIT, including testability contractual requirements, establishing guidelines on how to partition equipment and test points, and including testability in VHSIC, we go a long way in reducing the time to isolate faults and making repairs for both the weapon system and automatic test equipment. We also go a long way in reducing the need for intermediate maintenance.

The New Technology Subgroup represents the panel's second major activity that impacts on the R and M world. Two of the efforts they are looking at fall in the areas of Computer Aided Design (CAD) and Artificial Intelligence. These activities provide the potential to make significant inroads on how we maintain systems. They provide the tools to assist designers in including testability in the designs and then providing the drawings and parts list for that design. These computer systems will contain testability design rules and previous lessons learned and will provide layouts to the designer for review. This will allow contractors to include more testability up front in the design. In the area of Artificial Intelligence, work is occurring in ways to remember the symptom of a fault and the corrective action taken. Since the technician is faced with random faults and may not see the same fault for six months, this
research will go a long way in assisting technicians in making repairs.

The Off-Line ATE Subgroup is one of the places where the rubber meets the road. Although testability will be applied to all systems, the off line ATE programs are the driving programs and all the services are making testability requirements part of their programs. MATE, for example, is including the Testability Standard in its guides to be applied for both the weapon system and test station.

The Communication/Education Subgroup represents the last necessary link in applying testability. None of the previous efforts realize their full potential unless the tools and instructions are made available to those responsible for designing or contracting for weapon systems and test equipment. This panel fills that need by keeping track of the products being developed and identifying those products and sources to the testing community.

**JLC Panel - Industry Interface**

From its start, the JLC Panel on Automatic Testing has had a close tie to industry. The first efforts related to defining the problem and recommending solutions. The panel has continually been nibbling at those recommendations. We are now at a juncture where products are being delivered and new thrusts are being identified such as testability and integrated diagnostics. The industry interface is even more critical at this time and over the last year the panel has increased its role with industry. The panel has supported the NSIA Integrated Diagnostics and Mission Assurance Symposiums and has held several joint meetings. The NSIA has been identified as the primary industry interface to the panel on automatic testing issues. In support of this increased role, the NSIA formally changed the Automatic Testing Ad Hoc Committee into a full NSIA committee. The Automatic Testing Committee has developed working groups that match the subgroups of the panel. This interface at the working group/subgroup level will insure that the industry perspective is considered and included when it is consistent with panel objectives.

**JLC Panel-Products**

The JLC Panel has already had significant results. Four joint service guides on automatic testing have been published (Figure 6). They are the Built-in Test Design Guide, Automatic Testing (AT) Acquisition Planning Guide, Acquisition Review Guidelines for Automatic Testing (AT), and Selection Guide for Digital Test Program Generation Systems. Two reference guides on automatic testing information systems and The Sensor handbook have also been published by the panel. The Testability Standard is nearing final printing and the companion Testability Handbook is well under way. Another standard, Test Requirements Documents/Test Program Sets, is in progress. Courses on Automatic Testing Acquisition Management and Design for Testability have been developed and have been presented to over 3,000 engineers and managers. These courses have been favorably received and will continue to be offered for several years. The individual service off-line ATE programs have been coordinating their efforts and sharing products. The MATE guides and LCC model and the Testability Standard are significant examples. Others will be sure to follow leading to significant standardization when it makes sense. The panel has started the development of a new IEEE Standard 716 (C/ATLAS) course which is expected to be available in 1984. The ATE Newsletter is in its twenty-first edition with distribution to an audience of over 5,000 recipients. This newsletter will continue to be the primary source of ATE information and will be constantly expanding to satisfy the communication needs of the panel.

**Summary**

In summary, the JLC Panel has made positive progress in enhancing DOD approaches to automatic testing and interface with industry. Much more remains to be done. The panel's objectives for the future include publication of several more joint service guides and continued standards development. The panel will continue to promote dialogue among the Services and industry, expand its training activity, develop and promote the design for testability programs, and focus on applying new technology to automatic testing. We expect to continue this work for several years, to result in a structured, coordinated and integrated automatic testing environment which supports the readiness goals and DOD mission.

**Biographies**

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Colonel Howard A. Churchill is Director of Policy and Programs in the Deputy Chief of Staff for Acquisition Logistics at Headquarters Air Force Systems Command, Andrews AFB, MD. He is also the current Chairman of the Joint Logistics Commanders (JLC) Panel on Automatic Testing. He has previously served as a Deputy Program Manager for Logistics at Aeronautical Systems Division (ASD), the Air Force Acquisition Logistics Division (AFALD), Space Division (formerly

Figure 6. **JOINT SERVICE GUIDES ON-automatic testing**

Distribution to an audience of over 5,000 recipients. This newsletter will continue to be the primary source of ATE information and will be constantly expanding to satisfy the communication needs of the panel.
SAMSO), and Electronic Systems Division (ESD). He was a logistics management inspector on the System Acquisition Management Inspection (SAM) Team of the USAF Inspector General and served a tour as Joint Service Logistics Advisor to the Republic of Vietnam Joint General Staff in 1972-73. Colonel Churchill holds a B.A. degree in political science from Boston University and an M.S. degree in logistics management from the Air Force Institute of Technology and the Ohio State University. He is also a graduate of Armed Forces Staff College and the Industrial College of the Armed Forces.

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