Journal of

test and evaluation

Volume V Number 2 April/July 1984

Official Publication of the International Test and Evaluation Association (ITEA)

JOTE Objectives

The Journal of Test and Evaluation (JOTE) is the official quarterly publication of the International Test and Evaluation Association. ITEA, a non-profit organization, was founded in 1980 and is dedicated to advancing the development and exchange of technical information in the field of test and evaluation of systems, subsystems, and components for defense, industry, and consumer products. The Journal of Test and Evaluation is one of ITEA's principal means of accomplishing these educational goals.

Therefore, the objective of ITEA's Journal of Test and Evaluation is to provide a forum for the exchange of mutually beneficial information that could improve existing methods, encourage a higher level of testing in the development of new products, and encourage test standards for national and international acceptance. In promoting this exchange of information and ideas among professional test and evaluation personnel, JOTE also seeks to promote the stature of test and evaluation as a profession.

Papers for publication in JOTE are accepted on the basis that they address subjects related to test and evaluation such as techniques, process, fundamental concepts, unique facilities, simulations, specific programs, management of T&E, criteria, the 'ilities, and evaluation. Submission of news articles of interest to the T&E community is also welcomed and encouraged.

While JOTE exists to serve as a forum for T&E professionals, statements of fact or opinion remain solely those of the authors and are not endorsed by any government agency, industry, or non-profit organization, including ITEA, unless specifically so stated.

If you have a paper or news article for publication in JOTE, please contact Dr. Allen R. Matthews, ITEA Operating Headquarters, P.O. Box 603, Lexington Park, MD 20653 (301/863-6556).

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The Journal of Test and Evaluation is published quarterly for the International Test and Evaluation Association by MATTCON, Inc., 107 Rolling Court, Lexington Park, MD 20653. Formerly ITEA Newsletter Volumes I-IV.
Publication Schedule: JOTE is distributed in January, April, July, and October by ITEA Operating Headquarters, P.O. Box 603, Lexington Park, MD 20653. The Journal is an official ITEA publication mailed to U.S. members in accordance with the regulations of U.S. Postal Service non-profit mailing privileges and first class surface or air mail to foreign addresses.

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PUBLISHER'S REMARKS

Facilities for T&E are a key element within the Department of Defense to achieve cost-effectiveness for both the development and the weapon system acquisition processes. This fact is widely recognized with new policies emphasizing that special facilities are required for both OT&E and DT&E. The DOD has and continues to take positive steps to develop and utilize all T&E resources.

OT&E must be conducted in an operational environment. But DT&E must also be conducted in a simulated operational environment. How is this paradox accomplished without involving threat simulation, excessive cost, and repetitious tests?

A corrective answer to improve both processes could be to increase the use of simulation that may be either: (1) computer mathematical models, (2) synthesis or hybrids of hardware and mathematical models, or (3) just plain instrumented operational training exercises after safety is assured. Unfortunately, operational exercises without adequate instrumentation tend to yield qualitative data with limited hard data. Simulation with real-time transmission of actual engineering test data could clarify this problem.

Use of simulators can also lead to validation of production runs when properly correlated as is being done in some cases such as among missile production acceptance tests. Simulators for T&E are merely precursors that further demonstrate system capabilities for total war game simulators. Each simulator application has its merits and can be used for all functions including T&E, definition of operational tactics or employment, and evaluation of life cycle threat effectiveness.

Integration of the above requires a focused effort in applications engineering that would consolidate facilities and other resources to accomplish T&E, in-service engineering, and maintenance engineering. This concentration would, therefore, include various activities such as software maintenance, field and depot support, DT&E and OT&E, engineering cognizance, system engineering, and others that directly affect operational capability of the current inventory.

Currently, DT&E information is acquired for use by the R&D laboratories and the acquisition process. The MRTFB resources were primarily developed for the conduct of DT&E but are also used for OT&E, training, and development of operational employment tactics. The latter is now emphasized and could be expanded further under the concept of applications engineering.

The DT&E process has often identified limitations and capabilities early in the acquisition process, but various technical, management, political, and economic trade-offs continue the acquisition process. The final test during OT&E is often decisive. Unfortunately, this total process emphasizes performance but does not adequately address the 'ilities such as testability, reliability, or logistic support. Prior comprehensive studies of the type of the 1970 Blue Ribbon Panel addressed T&E but often combined DT&E (called functional or technical) with OT&E under the one title of OT&E as shown in Appendices A through H as well as in the final report by the Panel. Note that the Panel's Recommendation I-6 specified a DEPSECDEF responsible for evaluation including: (a) comptroller, (b) program and force analysis, (c) T&E, (d) defense contract audit agency, and (e) defense test agency. It appears desirable to have a special study of DT&E emphasizing the use of simulation techniques to achieve improved DT&E performance along with the integration of related functions.

In order to do elements of the above, the T&E Communications Network as outlined in JOTE articles (January 1984) could be utilized. The T&E Network would fit into the current and extensive C^3 studies while ultimately integrating into a precise National C^3 war game network that would permit dynamic war management. Responsibility and authority could be unified for T&E, training, logistics, and operations.

Modern technology provides not only the key to technological warfare but warfare systems acquisition management. The baseline to warfare management is in the arena of T&E, training, logistics, and operational exercises. The major problem is apparently overall warfare management which needs both advanced technologies and resource management. For example, remote T&E simulation via satellite relay would greatly enhance existing T&E facility capabilities and contribute to precise operational simulation.

It is hoped that T&E can obtain not only technological advancement in facilities but provide an insight into the technique for operational management and effective use of forces. Just as in the case of built-in test equipment for maintenance, a special perhaps integrated subsystem could be added to provide real-time performance monitoring of systems with satellite communication to centers of T&E, training, logistics, and operations. A minor hardware subsystem of this type could also increase the cost-effectiveness of T&E as well as training, logistics, and operations.

The proposed T&E subsystem would not only provide performance and 3-D position data, but when integrated with BITE and status data, provide target and damage reports with world-wide telemetry. The T&E subsystem hardware is functionally necessary and cost-effective to future systems while providing essential T&E, acquisition, and operational information.■

– Dr. Allen R. Matthews

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PRESIDENT'S CORNER

In the first Journal publication, I discussed several ITEA professional advancements. In addition to the new Journal, ITEA has also arranged two major technical symposia for 1984. Both the classified Workshop and the unclassified National Symposium are announced in this issue. These meetings will further expand ITEA's objectives and are respectively oriented to the themes of: (1) Advanced Threat Simulators for Air Defense and (2) The Impact of High Technology on Test and Evaluation.

I want to emphasize that the scope of these meetings include: T&E issues, case studies of major missile and aircraft T&E programs, survivability, integrated system test, and workshops on intelligence plus utilization of simulators. There is also emphasis on T&E for ship and space systems with specific review of T&E for telecommunications and information systems. A major tutorial program on software T&E will be presented by members of academia.

As this issue goes to press, our organization continues to experience a steady growth in memberships (individual and corporate), numbers of chapters, and services to the T&E community. On behalf of your Board of Directors, I sincerely appreciate the dedication and commitment of all members and associates who made these gains possible. During the next few months we will be developing alternative plans for ITEA Corporate and Chapter operations to support continuation of these healthy trends.

Therefore, I suggest that our Chapter presidents focus on those critical issues that should be incorporated into these planning documents and be prepared to represent Chapter views at the Annual Membership meeting to be held this year during the 1984 ITEA Symposium in November.

Charles K. Watt, National President of ITEA and Acting Director of Defense Test and Evaluation, Office of Secretary of Defense, shown in attendance at April George Washington Chapter Luncheon.

We fully expect this year to be a major transition period for ITEA requiring a number of tough decisions. As members and friends of ITEA, let us hear your views on future objectives. I have requested that our Senior Vice President Bradford S. Granum and Executive Director Dr. Allen R. Matthews coordinate this effort and submit a full report on near term and long term plans at the November 1984 Annual Membership Meeting. ■

EDITORIAL

Robert L. Parris
Member, ITEA Board of Directors

Today we live in a dynamic world that will undoubtedly change radically over the next ten years even under the best of conditions. This dynamism is fueled both by significant advances in technology and by the uncertainties and instabilities in the world's environment. Both pose grave dangers to our security and the security of our allies as well as the free world. The close of the 1970's was a major milestone marking the end of a full generation of Soviet technological and military progress. Their trend of increasing capabilities will surely continue into the future.

Dr. Richard DeLauer, Under Secretary of Defense for Research and Engineering, in recent statements before Congress earlier this year, said, "The basic goal of our international cooperation and technology initiatives is for friendly and allied forces of the U.S. to attain, through equitable burden sharing, the necessary military readiness, sustainability and interoperability to defend our respective nations and preserve peace throughout the world." He further stated, "What is different today is that vastly greater threats now demand cooperation and efforts to achieve combined effectiveness in ways which could not have been foreseen when Congress enacted the DOD Charter into law. At the same time, technology and advances in management now offer opportunities which previously appeared beyond our grasp. These include chances for joint activities to help significantly in offsetting the dangerous superiorities which continue to confront us -- and our allies." Continuing, he stated, "We also cannot neglect test and evaluation ... much more needs to be done in establishing common standards in the test area -- to advance technical compatibility and interoperability."

It goes without saying that a specific goal of international cooperation is an environment which fosters maximum use of combined technological and industrial capabilities. The U.S. has and is continuing to improve its technical exchanges with many nations throughout the world. More may be needed. In providing for our security we cannot match our adversaries, ship for ship, plane for plane, or tank for tank. If we are to counter their superiority in numbers, it must be with superiority in quality. Even recognizing that there is a point where technology may be overcome by pure numbers, our response should not be to match them, item for item, but make each individual item qualitatively superior. Central to this is the identification, utilization, and sharing of attendant test resource requirements to insure such qualitative items.

Although not responding to his direction but certainly in keeping with the spirit of Dr. DeLauer's statements, a proposal was made at the May 1984 special meeting of the ITEA Board of Directors that we sponsor the publication of an unclassified document on the Free World's ranges, test facilities, equipment, and capabilities. Much is known about our own facilities, but little has been published under one cover, delineating the capabilities of other nations of the world in this key area. Considering both ITEA's goal of providing the exchange of ideas and information in the field of test and evaluation and the fact that the "I" in ITEA states an international objective of our Association, the time may be ripe for just this kind of an effort.

The thrust of the May proposal was to use the good offices and membership of ITEA to research, develop, and publish a Free World Test Range Reference for both weapons and space systems. At question is the need, benefit, and utility of such a document. I think the time is at hand. Your thoughts and opinions are solicited.■

AUTOMATIC TESTING OF MICROPROCESSORS IN RADIATION ENVIRONMENTS

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ABSTRACT

A system for the acquisition of real-time failure data has been designed for in-situ total ionizing dose testing of large-scale integrated circuits. System selection considerations are discussed. Data acquisition and analysis features are described using the Intel MCS-51 microcontroller family as an example.

INTRODUCTION

Testing any piece-part for ionizing radiation hardness requires an approach which ensures that the part will be exercised in a manner and environment that adequately characterize the dose at which the device would fail in its application. To provide meaningful failure data to developers of military systems, we exercise and monitor the device under test (DUT) while it is being irradiated. This avoids the errors introduced by annealing of the radiation damage in the time it would take to transport the DUT to a test machine. One problem which arises in the evaluation of microprocessors, however, is the design of a program efficient enough to exercise the DUT thoroughly in a short period of time (<5 s). The shorter the time, the better precision one has on the failure dose.

A microprocessor can be characterized by the voltages at a set of its electrical connection pins at specific observation times. This collection of voltages is called the state vector of the device at the specified observation time. In testing the MCS-51 microcontroller we have chosen a state vector consisting of the address (11 lines) and data (8 lines) and the program store enable strobe line. This state vector is sampled at a peripheral firmware storage chip. Choice of the peripheral chip as the sampling site rather than the DUT is dictated by our need for the in-situ radiation testing. The state vector is observed once during each of the DUT's memory access cycles. The MCS-51 memory access cycle is six oscillator periods, and our test is run with a 12-MHz oscillator. By gathering this type of data, we may be able to identify the area of the processor which fails.

LOGIC ANALYZER SUBSYSTEM

The Nicolette-Paratronics NPC-764 logic state analyzer (LSA) was chosen for data acquisition because of its unique programmability. It is designed around an IEEE-488 bus over which data can be stored on mass storage (Figure 1). Test sequencing can be programmed on its integrated microcomputer system. Commands may be sent over the IEEE-488 bus in ASCII mnemonic via the microcomputer's bus controller. The microcomputer operating system is CP/M, and the bus controller firmware is included in the system's input/output read-only memory. Our test software is written in assembly language to facilitate efficient access to the IEEE-488 bus, and a library of IEEE-488 bus process drivers was developed to facilitate test program design. Each process driver module may be included in any test sequencing program and called as a subroutine.

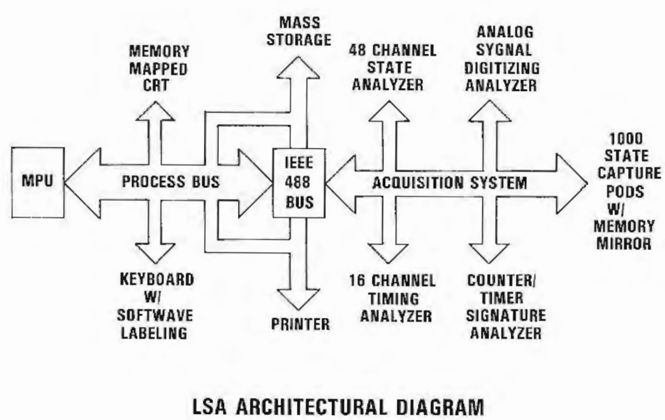

Figure 1. LSA Architectural Diagram

The LSA can be thought of as a peripheral of the integrated microcomputer. Communication with peripherals, including the LSA, is straightforward using the process drivers (Figure 2). An RS-232 port is available on the NPC-764, and data transmission over the RS-232, as well as receipt of external control signals, may be included in the test sequence program via instructions to the LSA.

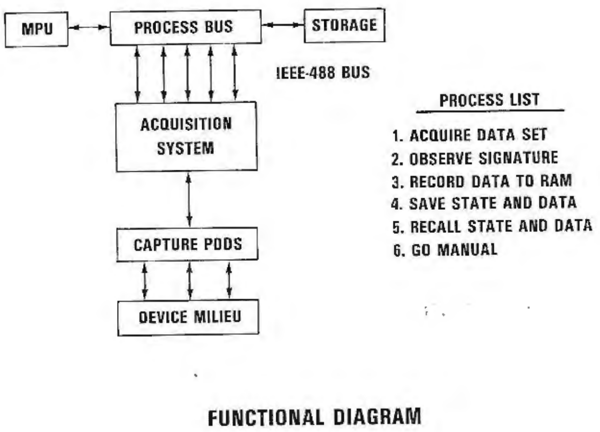

Figure 2. Functional Diagram

DATA COLLECTION

Data are collected in sets of 1000 state vectors by the LSA. The acquisition of each set is triggered by the appearance of a reset state vector at the collection site. The NPC-764 provides a derived signature unique to distinct data sets. When the signature of a current set is compared with the preirradiation signature, a single bit error can be identified in any of the 1000 state vectors. After any failure, the test sequence program will cause the NPC-764 data set to be saved on flexible disk over the IEEE-488 bus.

The current state of the NPC-764 is saved with the data set. Under test sequence program control, the researcher may select to resume testing of the DUT with the fail data set as reference. For example, he may elect to alternate between the original data set and the fail data set. This allows the researcher to observe device recovery behavior.

A state vector must be chosen for each new device to be tested. A problem arises because internal buses cannot be accessed in most microprocessors and microcomputers. The design of firmware to cause internal registers to be transferred via the accumulator to the external bus, or the choice of a clock to trigger the acquisition of the state vector may multiply the information available in the data sets.

RADIATION HARDNESS TESTING

We hope that recording enough data under various environmental and recovery state conditions will allow the researcher to focus in on the weakest area of the chip. This could point the chip manufacturer toward possible design changes. Before the introduction of automatic test software into the device test field, the typical hardness test consisted of recording the dose level at which functional failure occurred. Recovery times were only sometimes recorded. This type of failure data was not indicative of specific internal failure areas. However, it indicated only the relative merit of various processing approaches, as represented by the various products and manufacturers. The data were used at the system design level to select device families or manufacturers whose parts would ensure system survivability.

The advent of automatic testing allows the researcher to expand the type and amount of data to be gathered. We may include tests of specific internal device capabilities. In testing microcontrollers we may observe that failure occurs during a specific command subset. The integrated circuit designer could use these data to modify his design rules to achieve better hardness using the same process line.

The characterization of a device as radiation hardened is only of concern to a limited market sector. Since there has been only small demand for hardened parts, there has been little economic incentive for manufacturers to change process lines to increase hardness. Design rule modifications suggested by expanded test data may allow changes in design to be made at the reticle rather than the process line, achieving increased hardness with significantly less cost. The increasing use of data acquisition techniques to identify design changes which increase reliability or survivability with a minimum of cost impact is clearly desirable.

ABOUT THE AUTHOR
RONALD C. ALEXANDER

Mr. Alexander received his BS in Mathematics from the University of the State of New York in 1978 and his BS in Electrical Engineering from the University of Portland in 1979. From 1973 to 1977, he served on submarines in the Atlantic. During 1979, while at the Bonneville Power Administration (BPA), he developed a Nuclear Power Plant Utilization Simulator for use on the BPA's CDC Computer. Since beginning with the Department of Defense in 1980, he has developed numerous automatic test procedures using Hewlett-Packard ATS-1000 test systems at Naval Undersea Warfare Engineering Station (NUWES), Keyport, WA, and in 1981 developed the NUWES ATS-1000 Users Course. Since 1982, Mr. Alexander has been working in the Large-Scale Integrated Device Evaluation Group of the Transient Radiation Effects and System Generated Electromagnetic Pulse Branch at Harry Diamond Laboratories, Adelphi, MD. ■

THE EVOLUTION OF INFORMATION SYSTEMS

Charles K. Watt

Office of the Secretary of Defense

ABSTRACT

Information is a vital resource that is becoming an essential element of success in most organizations. Effective management of this resource is closely linked to computing and telecommunication advances being implemented in a variety of environments. This article provides an overview of the information system evolution and highlights needed solutions for future systems.

MANAGEMENT INFORMATION SYSTEMS

Historically, information systems have not necessarily been computerized; however, recent computing technology advances bring automation within the reach of most managers. Therefore, almost all information systems now utilize some form of computing power, are distributed to support the various hierarchial organizational levels, and are directed toward structured tasks. Such tasks usually have standard operating procedures, decision rules, and predefined information flows. For the purpose of this article, these describe the general framework for a traditional Management Information System (MIS).

Determining measures for successful design of an MIS can be difficult in that there is no general agreement on standards within the community of experts. An interesting description of what to avoid during the design phase is provided by Ackoff [1]. He describes five common and erroneous assumptions underlying the design of most MIS's as:

1. Give managers more information.
2. The manager needs requested information.
3. Give the manager the information he needs, and decision making will improve.
4. More communications mean better performance.
5. The manager does not have to understand how the MIS works, only how to use it.

Most managers can probably relate to the above without further explanation. However, the dilemma for designers is finding the balance between user needs and desires, given the variety of cognitive styles prevalent at various levels in the management structure. The instability of decision rules for many organizations certainly adds to this frustration. Perhaps the traditional concept of applying our youngest and brightest to the critical design phases merits reevaluation. The obvious question is: Can one design a highly interactive system without experience with the most difficult variable (a successful manager)?

Given this backstop, designers continue to build systems utilizing a variety of parameters. These are usually based on the many theories written about factors that impact MIS success. A summary list that is common to the maze of articles recently written on this subject is as follows:

1. The system must be designed to meet management objectives and goals at all levels of the organization.
2. Organizational responsibilities and information needs must be identified and provided in the system design, i.e., type decisions, relations, information flow, etc.
3. The system must provide necessary elements of information, control and measurement.
4. Data processing and information systems must be developed to a level of sophistication consistent with the organization's present and future requirements, i.e., provisions for evolutionary growth.
5. A MIS development plan and resource requirements plan are fundamental elements.
6. A framework for implementation and support is essential.

Unfortunately, these also represent a highly idealistic approach that is extremely difficult to implement. For example, how does a system realistically meet management objectives and goals at <u>all</u> levels of the organization? Perhaps for small organizations this is a relatively simple process. However, in large organizations the delta in complexities at various levels may create very fuzzy logic flows. Thus, the compendium of information structure may vary considerably.

More flexibility is being provided for information system designers in that technology now provides numerous opportunities for alternative solutions. Once again, caution should be taken to preclude traditional systems being replaced too quickly with primitive concepts. The basic premise of managers being in control and understanding the process must not be lost in this somewhat evolutionary transition process. It is suggested that a framework be established for the transition process similar to that proposed by Keen and Morton [2]. They merged Anthony's categories and Simon's classification of problem solving into a two-dimensional framework.

Anthony contends that "only by focusing on the decision first and then defining the information required to support it, is it possible to see which data are worth collecting and where the collection and maintenance process should take place." I fully support this concept and recommend it be utilized as the forcing function to separate user desires and requirements. This will assist in precluding system overload during the initial design phases. Simon's definition of the three phases of problem solving (Intelligence, Design and Choice) adds another dimension to the simplistic structured and unstructured terms. He describes these phases as follows:

1. Phase I (Intelligence) - searching the environment for conditions that call for a decision.

2. Phase II (Design) - Inventing, developing, and analyzing possible courses of action.

3. Phase III (Choice) - Selecting a course of action.

A fully structured problem is one in which all three phases may be defined by algorithms or decision rules. Conversely, an unstructured task would have neither of the three phases defined. A semistructured task would have one or two of the phases left in the manager's hands with the remaining phases having enough structure for effective computer support. This framework is especially important to the design of more advanced systems such as decision support. These "expert systems" are a natural evolution of MIS's with the primary building blocks including the application of artificial intelligence, software engineering, computer architecture, and very large-scale integration [3].

DECISION SUPPORT SYSTEMS

As previously implied, decision support shifts the tasking by reducing the unstructured process constraints. This requires a detailed understanding of decision making in organizations that may have highly structured procedures documented but utilize many unstructured (expert knowledge) processes in decision making. Before such a process can be improved it must be defined and analyzed, focusing on how managers actually behave. Their cognitive style, comparative pattern models, and individual areas of expertise form a complex environment. Therefore, general problem-solving strategies are often used to deal with complex problems with analogy, redefinition, alternative strategy, quantitative judgement, and intuition being among the many processes utilized in this form of decision making.

Decision support systems (DSS) have become an increasingly important part of the information system evolution. Decision support usually implies the use of computers to:

1. Assist managers in the decision making process when dealing with semistructured tasks;

2. Support, rather than replace managerial judgement; and

3. Improve the effectiveness (right choice) of decision making rather than the efficiency [3].

By interacting with computers in a machine-assist mode, decision makers increase their capacity to act as well as improve their analogical thought processes. This requires that the computer serve the user versus the user having to adapt to particular computer characteristics. Bonczek describes such a computer-based aid to the decision maker in his language classification scheme for directing computation and data retrieval [4]. At one extreme of the compendium of languages, the user explicitly specifies all computations. At the other extreme the user merely states the problem to be solved in terms of the data desired. Between these two extremes is a variety of languages that permit the user to invoke a specific model from a group that has been predefined to meet the anticipated needs of the users. Recent developments in computer science and studies in the cognitive styles of decision makers provide considerable improvements in the customization of human-computer interactions. However, the fusing of these processes to other elements of a DSS continue to challenge designers. Bonczek postulates facets of the decision maker and establishes a relationship to decision support systems. He places the human decision maker in an information-processing role that requests and receives aid from a computerized information processor. He describes the possible behaviors of the computerized system as being determined by: (1) a Language System (LS), (2) Problem-Processing System (PPS) and, (3) a Knowledge System (KS). The basic DSS function is to take LS syntax (problems) and KS representation rules and produce information that supports a decision process.

There are a number of key variables that influence successful implementation of a DSS. Lucas provides a useful conceptual framework for comparing design activities with critical implementation factors [5] and [6]. Those primary variables critical to successful implementation include:

1. Technical characteristics of systems such as accuracy, reliability, process time, user interface, terminals, etc.

2. Client actions such as management support and user involvement.

3. Attitudes toward systems--both general and specific.

4. Decision style--characteristic way an individual approaches a decision problem.

5. Personal and situational variables, such as age, education, experience level, etc.

System designers have limited influence over many of these variables; however, they can and must maintain a close relationship with the user. Given the estimated growth of the DSS industry (over 500% annually), continued muddling through strategies are not viable options for future systems [7]. In order to effectively advance the previously described decision support theory, information management should be considered as an organizational problem. Particular attention must be given to how science deals with data by utilizing transportation theory. The aim of the knowledgeable organization must be to generate knowledge that reduces information, and information which in turn compresses data [8]. A successfully implemented DSS has the potential to meet this challenge.

Although current state-of-the-art expert systems are powerful, most are highly specialized for narrow fields and are not flexible. They require pre-existing data on knowledge bases that are linked to establish rules. The data bases in these systems may also contain errors due to the slow and inconsistent human interaction. However, knowledge-engineering is rapidly evolving as a discipline in itself as new systems emerge utilizing next-generation computing and top-down processes. Pehaps a major contributor is that, as a society,we are moving away from an economy based on the manufacture and dissemination of goods to one based on the generation and dissemination of information and knowledge. This implies utilization of some form of distributed data processing. The transaction can be completely processed by a local processor or only partially processed and sent to another processor for completion. Local processors may use any combination of minicomputers and microcomputers, depending on the levels of distribution and configuration. In that user data requirements are primary design drivers, a qualitative method for determining degree of processor distribution is functional clustering and linking of user application groups. A more quantitative approach is to arrange the locations of processing and data into groups such that each group has a high level of autonomy and a low level of interdependence with other groups. As previously stated, particular attention must be given to data structure. A basic design question that usually must be addressed is what type of bridge can realistically be built between the old file world and the new data base? This may be difficult in that primitive information systems are little more than sophisticated file systems. They were designed for one application or a closely related group of applications instead of representing the inherent properties of their data and did not have a common and controlled approach to data manipulation.

Finding the location of data can also range from very simple to highly complex. A simple method is for the user to define the location of the data when making a request. A slightly more complicated approach is for the user to specify information about the data from which their location can be simply determined. Locating data can become more complex in horizontal distribution when the user does not know where the data are located. This requires some form of catalog or directory which lists all fields that are used, their definitions, how and where they are used, and who is responsible for them.

With this data processing evolution, the meshing of computer and communication equipment has become so pervasive that specialists have coined new words such as teleprocessing. This term implies the combined use of communication facilities and data processing equipment. Dominant among the many elements supporting this definition are technological advances that have tended to blur the traditional lines of demarcation between communications and processing and recent decisions at the National level involving the industry "giants" in these fields.

Today, an abundant supply of 16-bit microprocessors with minicomputer-like instruction repertoires are available,and powerful new 32-bit microprocessors have been introduced as "micromainframes" to signify they have the processing capacity for jobs previously requiring 32-bit minicomputers or 32-bit mainframes. Until these more powerful microprocessors appeared, there was little incentive to program in a high-level language. Applications tended to be modest in size and volume, the desire being to maximize speed and minimize memory requirements. Different assembly languages for different microprocessors met these criteria. With the more powerful microprocessors that extend address capabilities to millions of bytes of RAM, high-level languages are being used to a much greater extent. It is not likely that these microprocessors will compete to replace minis and maxis; however, software transportability is rapidly becoming a reality as design emphasis shifts to high-level language program mobility. Fundamental to computing advances are networks through which computers can share each other's resources as though they were parts of the same machine. These systems must be able to translate protocols of other computers and networks. Therefore, computers with different architectures must have translation programs so that software written for one computer can operate on others in the networks. New compilers are expected to be relied upon to apply knowledge about data structures, control structures, optimization, and parallel hardware to translate software for computers with different architectures. Given these objectives, software systems will become larger and more complex. This clearly suggests that more attention must be given to automated software tools and techniques.

LOCAL AREA NETWORKS

In a relatively short time, local-area networks have gained acceptance and are now utilizing gateways to form highly flexible interconnected systems. Most modern offices have a multiple of processing and data base functions tied into a common data bus or some form of local-area network. However, this evolution is not without major problems. The fitting together of the automated business puzzle continues to be a complex and slow process.

Perhaps the most significant short-fall is that there is no fully supported standard for local-area networks. Without such a standard, the traditional problems of network structure, protocols and other critical design issues rapidly become unmanageable. Several attempts have been made to develop a network architecture standard. At the lower levels of networking, some of the larger and more well-known systems have similar functions; however, the protocols often differ in several ways [9]. The net result is that there are still many terminals being produced that are incompatible without special interface units. IEEE proposed 802 local-area network standards provide some promise in that a number of terminal manufacturers are developing chip sets compatible with these standards. The three access method standards being proposed by IEEE are: (1) carrier-sense mutliple-access with collision detection, in which any device may attempt to send a message, but will wait before trying again if its transmission collides with that of another device; (2) the token bus, in which devices may only transmit if they are in possession of a distinctive bit pattern; and (3) the token ring, in which machines are connected in series rather than in parallel along a bus [10].

Given these system integration problems and the proliferation of equipment found in many offices, it is somewhat understandable that a number of users continue to be frustrated. In addition to problems in sharing data between different types of equipment, functional limitations are often prevalent on equipment manufactured by a single company. Therefore, the traditional building block approach of expanding a simple system into a knowledge based information system continues to be a problem. This does not mean that such a system could not be tied into a mainframe; however, the economics of such an alternative may not be attractive. Fortunately, this situation is changing in that some mainframe manufacturers are beginning to market office-automation systems compatible with their large computers to avoid downstream compatibility problems. In other cases, gateways are being built between networks to pass essential information. Most of these systems on-line today consist of simple query response modes versus a fully automated information exchange.

These issues are all very real and difficult, but perhaps the most challenging problem that has heretofore not been effectively solved is information security. Securing an information system can be very expensive even if constrained to critical priority circuits. This coupled with electromagnetic emissions have thus far been major inhibitors to full utilization of office automation in the Department of Defense. In the commercial marketplace information protection is an equally serious problem that has not been solved to date.

Current requirements for more effective information management in almost every aspect of our society clearly demand that emerging technology provide transparent networks. The "wired-city" concept of everyone using terminals for reading the news, shopping, banking, obtaining education and health-care services, and receiving daily mail is rapidly becoming a reality. Varied corporations, government agencies, financial institutions, universities, hospitals and other medical establishments, and law enforcement criminal justice communities are using information management systems routinely. The question of how best to provide information to management at various levels in the hierarchy remains open to a number of alternatives.

CONCLUSIONS

There is no doubt that advanced technologies have begun and will continue to revolutionize the utilization of information systems. The trend is more automation, distributed in nature, with considerable intelligence residing in a variety of terminals. At the chip level, cheaper integrated circuits will continue to replace some elements of costly software. The takeover of software functions by hardware should help programmers concentrate on development of high-level language programs that are shorter, more efficient, and easier to write, compile, and debug. These coupled with memory and storage advances will greatly enhance the information system evolution. However, technology advances alone will not solve the multiplicity of issues described in this article. Standards and security problems require innovation and careful attention. Human-computer interactions in semi-structured problem solving require further research of both decision making processes and data-base advances. Expert systems are just beginning to be understood in areas where knowledge is well defined. Technologies have not mastered the more complex human brain transformation process. Meanwhile, intelligent terminals, minicomputers, and distributed processing hardware and software are reaching the marketplace in vast numbers. It would be easier to consider only the future; however, blending the old and new is the challenge facing most designers. This is especially difficult in that many of the older systems have their roots in the world of primitive on-line processing systems.

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ABOUT THE AUTHOR

Charles K. Watt currently serves as Acting Director Defense Test and Evaluation in the Office of the Under Secretary of Defense for Research and Engineering. Prior to his recent assignments, he successfully held executive level positions in the Department of the Navy and private industry. His experience in management and development of major weapon systems spans approximately 24 years. He is a frequent lecturer and publisher of technology advancements and their impact on test and evaluation. ■

KEY PERSONALITIES

ROADRUNNER CHAPTER OFFICERS

Dr. Patricia A. Sanders (Roadrunner Chapter President) is a Technical Advisor in the Directorate of Anaylsis, HQ Air Force Operational Test and Evaluation Center (AFOTEC). She has seven years experience in test and evaluation and holds a Ph.D. in mathematics from Wayne State University.

James J. Sikora (Roadrunner Chapter Vice President) is the Vice President, General Test and Evaluation for the BDM Corporation. He has over 15 years of operational test and evaluation experience on Air Force, Army, and Joint Test Programs. Currently, he is supporting the HQ AFOTEC and Air Force Flight Test Center (AFFTC) test program areas.

Silvio G. Dell'Angela (Roadrunner Chapter Secretary) is a member of the technical staff, TRW Defense Systems Group, responsible for supporting the analysis and evaluation of the C^3 Countermeasures (C^3CM) Joint Test Force. A retired LT COL (USAF), he has over 10 years of test and evaluation experience, primarily in the area of jam resistant communications and intelligence gathering systems.

LT COL Dar Johnson (Treasurer of the new Roadrunner Chapter) is Chief of the Space and ICBM Branch in the Directorate of Logistics, HQ AFOTEC. He is responsible for the test and evaluation of space and ICBM systems availability, reliability, maintainability and logistics supportability. He has over 13 years of test and evaluation experience in DT&E, IOT&E, and FOT&E.

TIDEWATER CHAPTER NOMINEES FOR OFFICE

Ed Sierra served as a Naval officer for 23 years. His involvement in T&E started in the early '60s in the atmosphere nuclear test program; in the '70s as the Ops and Plans Officer for the MEECN Systems Engineer and in the '80s at OPTEVFOR. He is a charter member and has served as Treasurer and as Plans Officer. He is presently employed with TRACOR, Inc. as Program Director of the Chesapeake, VA facility.

John Zetes served as Sonar Officer and qualified as Chief Engineer in the nuclear submarine USS BERGALL, while on active duty. He is President of ANEVAL, Inc. and Executive Vice President and Director of Sea Services Technologies Corporation. He is a graduate of the University of Washington with a BS degree in Physics which he earned through the Naval Enlisted Scientific Education Program.

KEY PERSONALITIES continued on page 16.

A USER-ASSISTED AUTOMATED TEST (EXPERIMENTAL) DESIGN

COMPUTER PROGRAM TO AID IN THE DEVELOPMENT OF SYSTEM TESTS

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ABSTRACT

Testing, whether in the laboratory or in the field, requires a great deal of planning to maximize results and minimize time and resources. This paper describes the current capabilities of the User-Assisted Automated Test (Experimental) Design (AED): Version III software program and its application in the planning of simulations and laboratory or field tests of complex systems. The AED program allows the user to plan a test program in a most cost effective manner by creating full factorial or fractional factorial test (experimental) designs without requiring extensive knowledge of experimental design theory and mathematics. The output of the program is a list of observations (trials) to be performed given a selected experimental or test design.

INTRODUCTION

One of the common objectives of research on complex systems is to determine the factors (independent variables) that produce a certain result and the relative importance of these factors on system performance. Test resources required to adequately study these systems rise drastically as the number of factors considered in the study increase. Many system test problems contain large numbers of potential factors. Classical means of experimental design (Cochran & Cox, 1957 and Kempthorne, 1952) provide solutions to these problems but require extensive calculation if suitable designs cannot be found in the literature.

Since a particular test program can be directed toward answering a variety of questions, different types of experimental designs may be needed depending on a particular set of circumstances. To alleviate these problems and allow the user to examine various experimental design options, an automated computer program was developed to allow the formulation of full factorial or fractional factorial experimental designs.

The User-Assisted Automated Experimental Design Computer Program is a valuable tool that assists in structuring experimental designs for use in simulation, laboratory testing, or operational testing. It is useful in many areas of system performance testing besides the human factors area for which it was originally developed, and its use avoids the inefficiencies of hit-or-miss approaches. The output of the program is a list of observations (trials) to be performed given a selected experimental or test design.

EXPERIMENTAL DESIGN

One of the first steps in any research program is the definition of a problem to be solved. A preliminary study is started to identify the problem bounds and associated parameters. Before a formal experimental procedure can begin, an investigator must narrow the list of potential factors by considering such criteria as:

1. Information gained from related research.
2. Rational analysis.
3. Practical constraints of time and money.
4. Customer interest.

Once the factors of least interest have been eliminated from the list of potentials, one of several experimental design strategies might be implemented depending on the particular experimental situation remaining. If only a few factors remain (normally ≤ 3), the investigator can try varying one factor at a time keeping all other factors constant. This inefficient strategy is the one employed in many experiments (Diamond, 1981).

If a reasonable number of factors remain (3-6), with a lot of variability and uncertainty expected from the response of these factors, a set of experimental designs called full factorials can be employed. A full factorial experiment is an experiment in which all levels or settings of each factor of the experiment are combined with all levels of every other factor. A full factorial not only allows the estimation of the response of any one particular factor (main effect), but it also allows the estimation of the effects of an interaction of two or more factors.

A full factorial experiment is useful when an investigator requires that:

1. Every main effect of every factor be estimated independently of every other factor.

2. The dependence of the effect of every factor upon the levels of the other factors (the interactions) be determined.

3. The effects be determined with maximum precision.

Table 1 shows an example of an experiment with three factors at two levels. This example is taken from an Air Force Aerospace Medical Research Laboratory study of the MISVAL program. The term "MISVAL" designates the Missile Launch Envelope Technology Development Program being conducted by the Air Force Wright Aeronautical Laboratories at Wright Patterson AFB, Ohio. The definitions of factors and levels used in the examples are not considered necessary to convey the intent of the examples.

Table 1. MISVAL Example

FACTOR	LOW LEVEL	HIGH LEVEL
MLE CONCEPT	FAAC CONCEPT	GD CONCEPT
PILOT FUNCTION	FUNCTION 1	FUNCTION 2
MISSILE TYPE	AIM-7F	AIM-9F

If an experiment has N factors and each factor may assume one set of P levels, there is a total of P^N combinations. Combinations are often referred to as test (experimental) units, observations, trials, or vectors. The eight ($2^3 = 8$) combinations of these factors that would comprise a full factorial experiment for the MISVAL example are given in Table 2.

Table 2. Full Factorial Experiment

EXPERIMENTAL UNIT	MLE CONCEPT	PILOT FUNCTION	MISSION TYPE
1	FAAC	1	AIM-7F
2	FAAC	1	AIM-9F
3	FAAC	2	AIM-7F
4	FAAC	2	AIM-9F
5	GD	1	AIM-7F
6	GD	1	AIM-9F
7	GD	2	AIM-7F
8	GD	2	AIM-9F

Table 3 shows the number of observations required in a full factorial design for experiments with 2 to 10 factors with each factor at 2 or 3 levels. Note that the number of observations required rises drastically as the number of factors and/or levels increases.

Table 3. Full Factorial Experiment Size

N Number of Factors	P=2 Levels Per Factor	P=3 Levels Per Factor
2	4	9
3	8	27
4	16	81
5	32	243
6	64	729
7	128	2187
8	256	6561
9	512	19683
10	1024	59049

Although large numbers of factors are commonly encountered in real-world simulations or field problems, the conduct of complete full factorial experiments for problems involving large numbers of factors are very costly in time, manpower, and other test resources. For example, human factors experimentation is an especially critical area of research, because the experimenter must consider not only the factors in the system being studied, but also the variations introduced by the presence of a human subject. To account for these perturbations, the experimental procedure must be run many times (replications) with several different subjects to remove effects caused by the subjects and to identify variations caused by the parameters being studied. Since this procedure requires a large number of experimental observations, it may not be feasible to conduct a study because of cost and available time.

If the number of factors is so large that a full factorial design proves uneconomical, an experimental procedure employing screening designs can be used. The screening procedure is one whereby an investigator starts with a relatively large number of factors and by performing a small number of trials, can determine that some of the factors are of little significance. These factors can then be eliminated or screened from further consideration, and another experiment can be designed from the remaining factors.

The set of experimental designs known as fractional factorials performs this type of screening process. A fractional factorial is a portion or fraction of a full factorial experiment. Fractional factorial experimental designs represent a special class of reduced data collection designs that allow the investigator to perform a smaller number of observations than would be required in full factorial experimental procedures. If an investigator does not require the level of detail of a full factorial experiment or is faced with time or budget limitations that prohibit a full factorial experiment, fractional factorial designs should be used, e.g., (Aume, Mills, Gillio, Sebasky, and Wartluft, 1977).

In a fractional factorial design, certain effects cannot be separated from other effects. This is the price that is paid for reducing the number of experimental observations. Main effects or interaction effects that cannot be separated are said to be aliased or confounded. Fractional factorials attempt to alias main effects and first-order (two-factor) interactions with higher-order (three or more factor) interactions. The primary assumption in the use of a fractional factorial experiment is that higher-order interactions are insignificant. Therefore, the response of an experiment can be attributed to main effects or first-order interactions. If the assumption that higher-order interactions are insignificant is not valid for a particular experiment, a fractional factorial design should not be used. In the area of human factors experimentation, the assumption that higher-order interactions are insignificant is reasonable (Simon, 1973). Thus fractional factorial designs can be used resulting in a significant reduction in the number of experimental observations required.

SUMMARY OF CAPABILITIES

The User-Assisted Automated Test (Experimental) Design (AED): Version III computer program (System Development Corporation, 1983 (a) and (b)) incorporates all of the design strategies discussed in the previous section. Following is a summary of the present capabilities of the current version of the program.

1. Designs for both full and fractional factorial experiments involving 2, 3, or 5 levels for each factor.

2. Designs for mixed level experiments in which some factors involve 2 levels and the remaining factors involve 3 levels.

3. Designs for the determination of quadratic effects involving 2 level factorial designs with additional trials added (Central Composite Designs).

Only a minimum knowledge of experimental design computational procedures is required of the program user. The computer program can be and has been used as a tutorial and teaching aid. The primary intent is to develop the computer program such that it can be readily applied by the engineering community that is involved with performing simulator and operational field testing of systems.

ACKNOWLEDGMENTS

This program was developed for the Air Force Aerospace Medical Research Laboratory (AFAMRL) under Contract F33615-79-C-0505 with System Development Corporation (SDC). Partial funding support for this program was obtained from the Aircraft Observables/Analysis Branch (ASD/ENAMA) via the EF-111 SPO laboratory director funds (AFAMRL/CC), WPAFB.

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KEY PERSONALITIES (CONT.)

John Peterson completed 28 years in the Navy as a Surface Warfare Officer. He served at OPTEVFOR as head of the sonar section where he supervised operational testing and evaluation of surface and submarine sonar systems. He next served as the Navy's Deputy Director, Test and Evaluation Division (OP-983). He is currently a senior analyst at Analysis and Technology, Inc.

Greta Scanlon has served as Chairman of the Tidewater Chapter's Membership Committee. She is a graduate of Pennsylvania State University, with a BS in Mathematics. She is currently employed at Analysis and Technology, Inc. as a Senior Analyst with the MK 48 ADCAP Torpedo Program. Greta has been a member of ITEA since 1981. ■

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In addition to the four case studies, BDM will present a session on "Test and Evaluation Information Systems," and Georgia Institute of Technology will present a one-day tutorial on their Software Test and Evaluation Project (STEP). These additional topics are expected to be especially useful to attendees.

Last year's symposium was a tremendous success. Guest speakers like Senator David Pryor and Deputy Secretary of Defense Paul Thayer added immeasurably to the quality of the program. This year's program promises to be even better.

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PROGRAM EVENTS

MONDAY - NOV 5, 1984

0800 Registration
1000 Exhibits Open
1130 Luncheon Keynote Address
1300 Session I - Test in support of Advanced Aircraft Systems
Chairman - Robert Lamb, Boeing
1700 Adjourn
1800 Reception in Exhibit Hall
2000 General Membership Meeting

TUESDAY - NOV 6, 1984

0830 Session II - Ship system of the 80s, the CG-47 AEGIS Cruiser
Co-Chairmen - RADM Donald P. Roane, USN
Mr. Gene Clark, RCA
1200 Luncheon - Guest Speaker -
Dr. Allen R. Stubberud, Chief Scientist, USAF
1330 Session III - Space
Transportation System Analysis & Test
Chairman - COL Lawrence Griffin, Space Command
1730 Adjourn
1800 Reception in Exhibit Hall
1830 ITEA Annual Banquet
Guest Speaker -
2100 Election Returns - Live large screen TV/cash bar

WEDNESDAY - NOV 7, 1984

0830 Session IV - T&E of Modern Telecommunications #5 Digital Switch System
Chairman - Mr. Karl Martersteck, Bell Labs
1200 Luncheon - Guest Speaker
1330 Session V - Test & Evaluation Information Systems
Chairman - Dr. Dan McDonald - BDM
1630 T&E Issues - President, ITEA
Dr. Charles K. Watt
1800 Exhibits Close

THURSDAY - NOV 8, 1984

0800 Session VI - Tutorial Program - Software Test and Evaluation Project (STEP)
Chairman - Dr. Richard DeMillo, Georgia Tech.
1200 Lunch
1300 Session VI - STEP Continues
1700 Symposium Adjourns

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ASSOCIATION NEWS

EXECUTIVE DIRECTOR

General: ITEA continues to develop as a highly successful non-profit professional organization with emphasis on education in T&E. President Charlie Watt provides outstanding leadership and management. He is strongly supported by the officers, Executive Board (EB), Board of Directors (BOD), Senior Advisory Board (SAB), Committees, Chapters, symposia teams, and Executive Director as well as members. ITEA has a very effective team in place throughout the United States and is achieving the objectives of the Articles of Incorporation - 18 January 1980. ITEA is now planning additional emphasis on international membership and activities.

Membership: This is the baseline of all operations since members conduct foundation activities such as educational meetings and provide papers for publication. The chart on the next page provides good visibility of membership composition and geographic distribution. Note that dues-delinquent members are, in accordance with the Bylaws, considered members for a period of one year and are, therefore, included in the totals. ITEA has a new membership increase of approximately 40 during the past three months with additional payment of over 65 delinquent dues. To this include a corporate membership for AT&T Bell Laboratories in Holmdel, New Jersey. The total membership is now approximately 650 with approximately 150 delinquent in dues. Two dues invoices have been sent first class mail, and a final notice will be sent soon. Membership attrition in former years has been 5 to 10%, so it is anticipated that at least 85 members will soon pay their 1984 dues. The annual benefits to members far exceeds the dues cost which is equal to the purchase of one textbook.

Chapters: The chart also provides visibility of the ITEA chapter structure. The new Roadrunner Chapter in Albuquerque, New Mexico makes 10 chapters of which 9 are very active. The following pages provide highlights of chapter activities which includes numerous key speakers on timely subjects.

BOD: The last meeting was held on 10 May 1984 in Washington, D.C. The meeting was conducted by Chairman, Charlie Watt, and lasted for 3½ hours. Primary subjects covered were the Officer reports, July Workshop, November Symposium, JOTE, and Executive Director's report. The BOD reviewed membership and finances, approved the Roadrunner Chapter in good standing, and proposed International T&E Facility publication. Nominees for three routine BOD vacancies in 1984 were reviewed. It has since been determined, in accordance with the Bylaws, to have the Annual Membership Meeting during the November Symposium and to induct electees at that time. Therefore, a membership election will be formally conducted by mail in the near future. Chapter Presidents are invited to submit in writing by 19 July 1984 the names, biographies, justification, and nominee concurrence direct to the Chairman of the Nominations Committee, Dr. Daniel F. McDonald, Senior Vice President, The BDM Corporation, 7915 Jones Branch Drive, McLean, Virginia 22102. BOD meetings are held bimonthly in Washington, D.C. ITEA cannot pay members travel cost due to budget limitations. BOD members are required to chair committees and render other services to ITEA.

Executive Board: Last meeting was held 14 April 1984 at ITEA Operating Office. Meetings are held bimonthly staggered with BOD meetings. EB reviewed subjects as in BOD meeting in preparation of problem definition and progress reports for the BOD. Duty assignments were made of near and far term planning for ITEA. Budget was reviewed. Meeting lasted for 5½ hours to review details including organization and management of ITEA.

Financial: The State of Maryland has granted state sales tax exemption to ITEA. This saves 5% of some costs which amounts to approximately $200 annually for purchases in Maryland. Every effort is being made to operate cost-effectively and stay within budget. The primary source of income is membership dues supplemented by proceeds from symposia and donations. Primary costs are routine operating expenses and publication of JOTE. ITEA needs more advertising in JOTE to reduce the net cost and perhaps yield a return to ITEA. The 1983 Symposium Proceedings continue to sell with 90 (500 printed) copies still available for purchase at $25 each from ITEA Operating Headquarters. The JOTE has been reduced from 64 to 32 internal pages and the April/July issue combined in order to reduce costs. Excellent financial management is possible due to the outstanding budget plan and financial records maintained by the Treasurer Carl C. Smith, Jr.

Publication: This issue of JOTE is scheduled for publication in June (preceding the July Workshop); the next issue, for October (preceding the November Symposium). If additional advertising were obtained, another issue in August would be considered. An adequate supply of good papers has been available thanks to the concentrated efforts of John V. Bolino and others. ITEA members are expected to submit papers and may have them published immediately or after a reasonable delay to accommodate "theme" or "subject" issues. ITEA is planning to publish a Membership Directory at a nominal fee to members. This Directory would be a annual publication and would save space in JOTE previously used for "New Members". ITEA currently publishes meeting announcements. ■

ANALYSIS OF CHAPTER MEMBERSHIP AND MAILING LIST

AS OF 30 MAY 1984

EXISTING CHAPTERS

	Members			Non-Members			
Name (Permanent)	'84	'83	Sub-T	"B"(3)	General	Sub-T	Total
1. S. Maryland	13	5	18	3	15	18	36
2. George Washington(1)	127	26	153	7	125	132	285
3. Tidewater	34	10	44	6	26	32	76
4. Channel Island	40	17	57	7	12	19	76
5. S.CA. Saddleback(2)	34	16	50	6	12	18	68
6. New England	26	16	42	1	29	30	72
7. New Jersey Coast	26	4	30	0	41	41	71
8. Central Coast	25	0	25	0	12	12	37
9. Lone Star	29	0	29	0	5	5	34
10. Roadrunner	30	3	33	0	9	9	42
TOTAL	**384**	**97**	**481**	**30**	**286**	**316**	**797**

(1) Reduced for Candidate Chapters I, J, N. (2) Reduced for Candidate Chapter 2R.

CANDIDATE CHAPTERS

	Members			Non-Members			
Name (Temporary)	'84	'83	Sub-T	"B"(3)	General	Sub-T	Total
B. Eglin	6	2	8	1	16	17	25
C. Seattle	2	0	2	1	11	12	14
D. Dallas/Ft. Worth	4	3	7	1	2	3	10
E. WPAFB	1	1	2	0	25	25	27
G. Huntsville	6	0	6	1	15	16	22
H. EPG	1	0	1	0	4	4	5
I. San Diego	8	3	11	1	18	19	30
5J. EAFB/China Lake	3	1	4	0	13	13	17
K. HAFB/White Sands	9	5	14	0	14	14	28
L. Yuma PG	1	0	1	1	12	13	14
M. Dugway PG	0	0	0	0	6	6	6
5N. El Segundo	14	3	17	0	33	33	50
P. Sun Coast (Tampa)	1	0	1	0	1	1	2
Q. Conn./Rhode Island	3	2	5	0	11	11	16
2R. Aberdeen PG	8	3	11	1	9	10	21
S. Denver	2	1	3	1	7	8	11
T. Detroit	0	0	0	0	6	6	6
TOTAL	**69**	**24**	**93**	**8**	**203**	**211**	**304**

SUMMARY

	Members			Non-Members			
Geographic Areas	'84	'83	Sub-T	"B"(3)	General	Sub-T	Total
1. Existing Chapters	384	97	481	30	286	316	797
2. Candidate Chapters	69	24	93	8	203	211	304
3. At Large	46	26	72	8	177	185	257
TOTAL	**499**	**147**	**646**	**46**	**666**	**712**	**1358**

(3) "B" is Prefix for prior members having known address with over 1 year delinquent dues.

CHAPTER NEWS

ROADRUNNER CHAPTER FOUNDED IN ALBUQUERQUE

FOUNDING OFFICERS

Pictured from left to right are: Dr. Patricia A. Sanders, Chapter President; James J. Sikora, Vice President; Silvio G. Dell'Angela, Secretary; and LT COL Dar Johnson, Treasurer.

ROADRUNNER: *(Chapter #10 founded 19 April 1984 at Kirtland AFB, NM. Contact: Chapter President Dr. Patricia A. Sanders, HQ, AFOTEC/OA, Kirtland AFB, NM 87117.)*

ITEA welcomes the Roadrunner Chapter located in the great Southwest - a chapter with a name as colorful as its picturesque locale. The roadrunner is the state bird of New Mexico and symbolizes the Southwestern United States.

The nucleus of this new chapter comes from Kirtland AFB where the chapter's founders are involved in programs underway at the Air Force Operational Test and Evaluation Center. This chapter's potential for significant contribution to ITEA's goals as a professional organization is readily apparent, and we are very happy to have our membership rounded out by the addition of this new chapter in the Albuquerque, NM area.

The Roadrunner Chapter's first and founding meeting was held on 19 April 1984 at the West Officers Club at Kirtland AFB under the leadership of **Dr. Patricia A. Sanders of AFOTEC/OAY, Kirtland AFB.** In attendance were eight existing members of ITEA, 12 new applicants, and a number of potential members. The new chapter elected the following officers:

President:	**Dr. Patricia A. Sanders, AFOTEC/OAY**
Vice President:	**James J. Sikora, BDM Corporation**
Secretary:	**Silvio G. Dell'Angela, TRW**
Treasurer:	**LT COL Dar Johnson, AFOTEC/LGM**

Not to lose time in preparing this chapter for full scale operation, the following chairmen were also elected:

Program Chairman:	**Erich H. Balzer, BDM Corporation**
Membership Chairman:	**CAPT Paul Dundas, AFOTEC/TEK**

Long and short-term goals of the chapter were discussed as well as functions to be performed, chapter meeting format and frequency. The goals of the chapter include an open exchange of T&E information among members, furthering T&E education through guest speakers, encouragement of students in the T&E professions, and social events. It was decided that a questionnaire would be mailed to the chapter members for their input in helping define goals for the chapter. Discussion of the questionnaires will be the main agenda item for the next meeting scheduled for 31 May 1984.

Having developed an agenda for the next meeting, the new Chapter President **Dr. Sandera** adjourned the first meeting of the chapter.

We eagerly await future meetings and activities by this fledgling chapter and encourage the Roadrunner Chapter to continue as energetically as they have begun.□

SOUTHERN MARYLAND: *(Chapter #1 founded 4 March 1981 in Lexington Park, MD. Contact Chapter President Frank A. Phillips, NATC - CT 27, Patuxent River, MD 20670.)*

President: Frank A. Phillips □

GEORGE WASHINGTON: *(Chapter #2 founded on 6 March 1981 in Washington, DC. Contact: Chapter President Edward D. Connor, 9310 Arabian Avenue, Vienna, VA 22180.)*

President:	**Edward D. Connor**
Vice President:	**Max R. Claiborne**
Secretary/Treasurer:	**Bradford S. Granum**

George Washington Chapter held its regular luncheon meeting 12 April 1984 at the Army-Navy Country Club. A record number of attendees heard **Commodore Bob Kelly (shown below) of the Office of the Director of Naval Research, Development, Test and Evaluation** discuss naval T&E. After his remarks, **Commodore Kelly** entertained questions from the audience. Other honored and distinguished guests included **Dr. Allen R. Matthews, Executive Director of ITEA,** and **Charles K. Watt, acting Defense Director of Test and Evaluation** and current **President of ITEA.**

Commodore Bob Kelly

The Chapter's luncheon meeting on 16 May 1984 at the Army-Navy Country Club featured **Mr. Walter W. Hollis, Deputy Under Secretary of the Army for Operations Reasearch. Secretary Hollis** discussed directions in OT&E that he perceived in the future with emphasis on the Army. Among other comments, he predicted a closer relationship between the Army's Independent Evaluation organization and the Army's various analysis and modeling organizations. Among attendees were **ITEA Directors Charles K. Watt, Bob Parris, Dan McDonald, Brad Granum, and Phil Dickinson,** the latter of whom introduced the new commander of the Army OT&E Agency, **Major General Bill Tuttle.**

The chapter is currently taking nominations for officers with election to be held in July.□

TIDEWATER : *(Chapter #3 founded on 15 June 1981 in Chesapeake, VA. Contact: Chapter President John A. Devlin, 448 Chisholm Drive, Virginia Beach, VA 23452.)*

President:	**John A. Devlin**
Vice President:	**William L. Breed**
Secretary:	**John W. Peterson**
Treasurer:	**Norman A. Anderson**

The 1984 program continued with the February meeting which featured **Mr. Chuck Eldred of the National Aeronautics and Space Agency. Mr. Eldred** addressed Test and Evaluation in the Space and Shuttle Programs.

March brought **Major General Thomas L. Craig, USAF, Deputy Chief of Staff, Requirements, Headquarters Tactical Air Command** as the featured speaker. **General Craig** presented his views of the Tactical Air Command's Employment of Test and Evaluation.

At the April meeting, **Dr. Phillip Dickinson, Chief Scientist, United States Army Operational Test and Evaluation Agency** was the guest speaker, addressing the subject of continuous test and evaluation.

The May meeting featured **Commodore John C. Weaver, USN, Assistant Chief of Staff for Material, Commander Naval Air Forces Atlantic Fleet.** He spoke on Naval Aviation - Testing Philosophy.

The following slate of officers was recommended by the nominating committee for election at the June meeting:

President:	**Edward P. Sierra**
Vice President:	**John A. Zetes**
Secretary:	**John W. Peterson**
Treasurer:	**Greta S. Scanlon**

Tidewater's scheduled guest speaker for June will be **Mr. Charles K. Watt, ITEA President.** Since June is the Chapter's third anniversary, a brief ceremony honoring the chapter founders has been planned.□

CHANNEL ISLANDS : *(Chapter #4 founded on 20 October 1981 at Point Mugu, CA. Contact: Chapter President Sargit S. Chima, Surface Warfare Evaluation Division (6230), Pt. Hueneme, CA 93043.)*

President:	**Sargit S. Chima**
Vice President:	**Willis S. Stewart**
Secretary:	**Gerald J. O'Connor**
Treasurer:	**Noel E. Van Slyke**

To gear up for the active new year ahead, the Channel Islands Chapter Council met in January to discuss the ensuing year's activities and lay the foundation for a successful 1984 for the chapter.

The first general meeting in February featured **Mr. Richard Botzum, Project Engineer at Northrop Corporation - Ventura Division** speaking on the topic "50 Years of Target Drone Aircraft." **Mr. Botzum**'s personal involvement in the early years of target drone development made it possible for him to provide attendees with a fascinating insight into some of the early T&E programs with pilotless aircraft.

The key speaker at the Chapter's March meeting was **LCDR Les Carey, USN VX-4 at Point Mugu. LCDR Carey** spoke on the F/A-18 Hornet T&E Program providing attendees with videos from many of the test flights and a presentation that covered the mission, capabilities, and T&E issues during recent fleet tests.

Chapter President Sargit S. Chima from Naval Ships Weapons System Engineering Station, Port Hueneme was the featured speaker at the April meeting speaking on "Combat System Extraction and Recording." The presentation used the CG-47 AEGIS Program as an example and explored the need for data for various users (i.e. programmers, system engineers, integrators, and analysts).

The May meeting placed another chapter member in the spotlight with **Mr. Fred Moeckel of Naval Ship Weapons System Engineering Station at Port Hueneme** speaking on "The Navy's SMART (Shipboard Multipurpose Analysis and Reduction Tool)." **Moeckel** gave an interesting overview of SMART, a computer program used with the HP-9000 microcomputer to reduce and analyze LINK-11 data onboard surface combatants during testing and Mobile Sea Range operations.

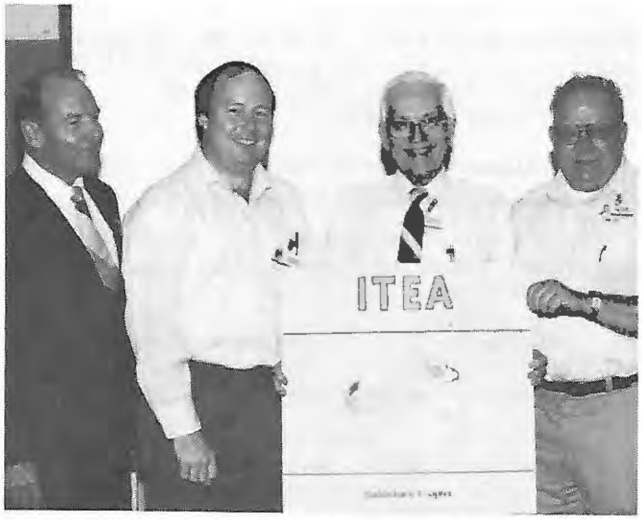
Future plans for the Chapter include a trip for members to Vandenberg AFB to tour facilities, including the Space Shuttle, MX, and NASA operations. The Chapter's neighbor, the newly formed Central Coast Chapter, is providing assistance with the arrangements for this planned outing. □

SO. CA. SADDLEBACK: *(Chapter #5 founded on 15 February 1982 in Anaheim, CA. Contact: Chapter President Frank G. White, Interstate Electronics Corp., P.O. Box 3117, D/4750, Anaheim, CA 92803.)*

The following new officers (shown in photo at top right) were officially installed during March 1984:

President:	**Frank G. White**
Vice President:	**Harold Stancil**
Secretary:	**Harold Stanley**
Treasurer:	**Bill Lish**

The March meeting was also highlighted by a program on Developing Quality Software. The speaker was **John Hackney, Supervisor of the Software Verification and Validation Branch at Interstate Electronics.** He described the steps in Software Development Methodology and Software Quality Assurance Techniques.



Pictured from left to right are Harold Stanley, Secretary; Frank White, President; Harold Stancil, Vice President; and Bill Lish, Treasurer.

A special membership drive is currently underway. The possibility of assisting interested individuals in the Los Angeles area in forming a Los Angeles Chapter was discussed.□

NEW ENGLAND: *(Chapter #6 founded on 19 August 1982. Contact: Chapter President Dr. Shashi Phoha, the MITRE Corporation, P.O. Box 208, Bedford, MA 01730.)*

President:	**Dr. Shashi Phoha**
Vice President:	**Robert L. Hamilton**
Secretary:	**William M. Stein**
Treasurer:	**Frank J. Lynch**

The featured speaker at the 7 May 1984 meeting of the New England Chapter of ITEA was none other than ITEA's **Executive Director Dr. Allen R. Matthews** (shown below). **Matt's** presentation was titled "Principles of Test and Evaluation" and covered the organization, process and technology of T&E. His talk also included the scope and composition of T&E, evolutionary trends, the new DOD Directive 5142.2 establishing a Defense Director of OT&E, and anticipated future actions.

Dr. Allen R. Matthews
Executive Director, ITEA

The meeting was held at The MITRE Corporation, Bedford and was well attended by ITEA members and guests. Attendees came from MITRE, the Air Force System Command's Electronic Systems Division, and from other local industries and consulting firms.□

NEW JERSEY COAST: *(Chapter #7 founded on 17 October 1983 at Fort Monmouth, NJ. Contact: Chapter President Richard Gale, TRI-TAC Office, OUSD (C3I), Fort Monmouth, NJ 07703.)*

President:	**Richard J. Gale**
Vice President:	**Seymour Krevsky**
Secretary:	**Dr. Maury M. Irvine**
Treasurer:	**Thomas J. Brincka**

The New Jersey Chapter hosted a combined luncheon with SOLE, AFCEA, AUSA, and other professional societies and associations on 16 March 1984 at the Fort Monmouth Officers Club with guest speaker **General Donald R. Keith, Commander, DARCOM**, who spoke on "The NDI (Non Development Item) Challenge." **General Keith**'s presentation as well as the combined participation of the other resident societies at Fort Monmouth produced an outstanding and very successful meeting that truly demonstrated ITEA's goal of interaction among T&E professionals.

A luncheon meeting is scheduled for 31 May 1984 at the Fort Monmouth Officers Club. The guest speakers will be **Mr. Thomas Libby, AEGIS Project Test Development Director, Naval Sea Systems Command**, and **Mr. Adam Miklovis, Manager of Advanced Naval Systems, RCA. Messrs. Thomas and Miklovis** will speak on "AEGIS Ship Combat System- a Test and Evaluation Overview."

Messrs. Thomas and Miklovis' presentation will describe the development of the AEGIS Combat System with emphasis on the approach and conduct of test and evaluation.□

CENTRAL COAST: *(Chapter #8 founded 9 December 1983 at Vandenberg AFB, CA. Contact: Chapter President COL Dennis E. Beebe, USAF, 6595 Missile Test Group, Vandenberg AFB, CA 93437.)*

President:	**COL Dennis E. Beebe**
Vice President:	**Eugene E. Clary**
Secretary:	**Dr. James A. Means**
Treasurer:	**Kenneth F. Ramsey**

The Central Coast Chapter has been very busy in the past few months strengthening its organization and creating the fundamental documents governing the chapter's operation. Finalizing the chapter's constitution has been a top priority item to comply with Vandenberg's requirement for the Central Coast Chapter to operate as an organization on the Base. February and March meetings were largely devoted to that task.

On 27 April 1984 a formal luncheon was held at the Vandenberg AFB Officers Club with guest speaker **Major General Peet Odgers, Commander of the Air Force Flight Test Center, Edwards AFB** addressing chapter members and guests.

General Odgers gave an impressive presentation on the "Flight Testing Evolution" replete with film and slides. The short film showed some of the catastrophies that have occurred in the test programs at Edwards over the years. The current programs at Edwards were amply illustrated in the series of slides that followed. It was clear from the presentation that the Air Force has significantly improved its ability to execute the discipline of T&E. **General Odgers** is also clearly an advocate of the Joint Test Team concepts, currently being used at Edwards. The virtues of AFOTEC and the new OSD "Purple Suit OT&E Organization" stimulated numerous questions from the audience on T&E.□

LONE STAR: *(Chapter #9 founded 27 January 1984 at Fort Hood, TX. Contact: Chapter President Dr. Virgil A. Henson, Jr., 603 Skyline, Killeen,TX 76541.)*

President:	**Dr. Virgil A. Henson**
Vice President:	**Lawrence S. Tiller**
Secretary:	**Gayle S. Shull**
Treasurer:	**COL Edward B. Derr**

The Lone Star Chapter sponsored a luncheon on 18 April 1984 at the West Fort Hood Club with **Dr. Marion L. Williams, Chief Scientist for the Air Force Operational Test and Evaluation Center, Kirtland AFB and member, ITEA BOD**, as the guest speaker.

Dr. Williams pointed out to his audience of professionals from the Army's test and evaluation community that the Air Force was heavily emphasizing "early testing and evaluation."

"Our solution to early evaluation is to become involved as soon as the new system hits the paper." **Williams** explained.

The Air Force Operational Test and Evaluation center, according to **Williams**, currently manages more than 100 major programs including the Peacekeeper MX Missile System, Space Shuttle, B-1 Bomber, and Anti-Satellite System.

Dr. Williams was the Lone Star Chapter's first professional guest speaker for this new chapter formed in February.■

NOTICE TO CHAPTERS

Send written chapter news to be received at ITEA Operating Headquarters by the 15th of scheduled month of publication. Use format above including transition from last publication, specific activities, and planned activities.

- EDITOR

ITEA WORKSHOP

JULY 17-19, 1984

THEME

Advanced Threat Simulators
for Air Defense

LOCATION

Defense Systems Management College

Fort Belvoir, Virginia

CHAIRMAN:

MR. BRADFORD S. GRANUM
VICE PRESIDENT, ITEA

PROGRAM CHAIRMAN:

MR. DAVID E. POWELL, JR.
CROSSBOW-S COMMITTEE CHAIRMAN

Plan Your Attendance Now

ITEA

CLASSIFIED WORKSHOP

POINT OF CONTACT - ROBERT L. PARRIS

(703) 893-1212

ITEA WORKSHOP

WORKSHOP OVERVIEW

The dynamic growth and modernization of our adversaries' military systems has enabled them to structure and position their forces for offensive use on short notice. Consequently, the need for the most comprehensive information possible on the mission, capabilities and deployment of these forces is greater than ever. The Advanced Threat Simulator Workshop will address one very important aspect of these capabilities . . . the new Surface-to-Air Missiles (SAMs); why they present such a serious threat to our Air Defense Forces; and the programs underway that are planned to counter this threat. Specifically, this workshop will address the need for Advanced Threat Simulators which can emulate, replicate, or otherwise simulate the characteristics of their Surface-to-Air Missile complex and thereby allow us to test our airborne weapon systems to define their effectiveness. In particular, it will provide a forum for improved information exchange among those responsible for assessing/defining the threat, establishing requirements, developing the equipment and testing the end product. The exchange will be based on a top-down perspective as viewed by the top officials dealing with these issues. This perspective will focus on each of the major areas providing substantive information on plans and issues with respect to Advanced Threat Simulation. Formal presentations covering a 7 to 10 year time frame will be followed by working sessions to address separately each area noted. Although the theme of a particular working session will be focused (i.e., testing, threat, etc.), representatives from each community will participate in all sessions to encourage synergism. Each working session will develop a summary to include comments, identify problems/issues plus recommendations, and suggest topics for future ITEA classified meetings. These summaries will be presented to all attendees at the general session on the last day.

WHO SHOULD ATTEND THIS WORKSHOP

This workshop will be useful to those involved in any aspect of air defense including requirements analysis, systems engineering, research, development, production, test and evaluation, program planning and budgeting. It will be particularly useful to those working in any area of system simulation and related fields of test and evaluation.

TUESDAY - JULY 17, 1984

9:00 a.m. **Registration**

10:00 a.m. **Welcome** - Bradford Granum, Chairman
ITEA Threat Simulator Workshop

10:15 a.m. **Overview of Major Issues**

Charles K. Watt
Deputy Director, DDT&E (Strategic, Naval, and C^3I) and Chairman, Executive Committee on Air Defense Threat Simulators

10:45 a.m. **Overview of CROSSBOW-S Program**

David E. Powell, Jr., Chairman
CROSSBOW-S Committee

11:30 a.m. **Lunch - Fort Belvoir Officer's Club**

1:00 p.m. **The Advanced Surface-to-Air Missile Threat**

Dr. Rankin A. Clinton, Jr., Director of the Missile Intelligence Agency

1:45 p.m. **Overview of Army Aviation Program and Test Requirements**

BG Wayne Knudson, Director of Force Requirements and Army Aviation Officer, Office of the Deputy Chief of Staff for Operations and Plans, Department of the Army

2:30 p.m. **Overview of Naval Aviation Program and Test Requirements**

Commodore Robert J. Kelly, Director, Tactical Air, Surface & Electronic Warfare Development Division, Office of the Chief of Naval Operations, Department of the Navy

3:15 p.m. **Break**

3:45 p.m. **Overview of Air Force Aviation Program and Test Requirements**

MG George L. Monahan, Jr., Director, Development and Production, Office of the Deputy Chief of Staff for Research, Development and Acquisition, Department of the Air Force

5:00 p.m. **No - Host Reception** - Sponsored by the George Washington Chapter, ITEA

Fort Belvoir Officer's Club

WEDNESDAY - JULY 18, 1984

8:30 a.m. **Aircraft Survivability Equipment under Development**

John M. Porter, Director, Electronic Warfare and C^3 Countermeasures
OSD/OUSDR&E

9:15 a.m. **An Integrated Systems View**

Dr. Stanley B. Alterman, Director, Strategic Aeronautical and Theater Nuclear Forces, OSD/OUSDR&E

10:00 a.m. **Break**

10:15 a.m. **Brief Presentation on Special Facilities e.g. AFEWS - NWC - Fort Bliss - Eglin AFB-etc.**

11:30 a.m. **Lunch - Fort Belvoir Officer's Club**

1:00–4:30 p.m. **Concurrent Workshops**

- **Threat Intelligence Workshop**
- **Threat Simulator Development Workshop**
- **Threat Simulator Testing Workshop**

THURSDAY - JULY 19, 1984

8:30 a.m. **Introduction . . .** Bradford Granum

9:00 a.m. **Report by Chairman, Threat Intelligence Workshop**

9:30 a.m. **Report by Chairman, Threat Simulator Development Workshop**

10:00 a.m. **Report by Chairman, Threat Simulator Testing Workshop**

10:30 a.m. **Group Discussion on Workshop Results**

11:00 a.m. **Workshop Summary & Closing Remarks . . .** Bradford Granum

11:30 a.m. **Adjourn**


PUTTING SYSTEMS TO THE TEST
.087

WHITE SANDS MISSILE RANGE RADES TESTING

(SEE PHOTO BACK COVER)

White Sand Missile Range is one of the most sophisticated test ranges in the free world. Most of the Army's air defense missile systems, dating from the Nike Ajax, have been test fired on the two million acre range. But what about evaluation of how well the soldier-crews perform with the system in the field?

According to Dr. John Lockhart, psychologist and team leader with the U.S. Army Research Institute Field Unit at Fort Bliss, little information is available for making such an evaluation. When White Sands does testing it does not usually include complete weapon system crews and command units operating in a realistic battlefield environment. It is impractical because of the cost of range time and dedicated aircraft. Also, there is no ready supply of enemy aircraft to give the scenario the needed realism of a modern battlefield.

Instead, psychologists such as Lockhart are forced to look at piecemeal data, trying to get a look at the whole picture from just the pieces. It has forced them to make assumptions which they do not like to do, especially when the guesses play a part in the life and death situations of war. Training, doctrine and tactics are based on these assumptions, and if they are wrong, it could lead to disaster on today's battlefield.

Dr. Lockhart and his team have devised a simulation system which will give scientists the needed data on troop activities such as search, detection, acquisition, tracking, lock-on and firing. The system is called Realistic Air Defense Engagement System (RADES). The data can be used to validate current training, doctrine or tactics or to develop them for new systems.

Currently Lockhart and his team are testing the RADES on range at Condrun Field, six miles southeast of the main post. The key to the system is a group of radio-controlled, propellor driven, one-seventh scale model aircraft. The models sound like chain saws but are built to resemble a variety of friendly and enemy aircraft including the U.S. F-16 and Russian MIG-27. There are also non-flying, one-fifth scale versions of the U.S. Cobra and Russian HIND-D helicopters. They are strategically placed in the test area to pop up from behind the sand dunes east of Condrun Field.

The idea is to move an air defense unit into the test area, put the soldiers on alert and have them react to any situation as if it were the real thing. Meanwhile, the institute's psychologists and the sophisticated computer system watch, record and measure the unit's actions.

The various battlefield scenarios are played out using model aircraft instead of the real thing. Initially the planes will be flown by expert radio-controlled aircraft pilots, with plans calling for eventual computer control. The hostile planes will fly using Warsaw Pact manuevers and tactics.

While no missiles will actually be fired, the troops will get some gratification if they do everything right and score a hit. The computer will keep track of all activities, and if all procedures are done correctly, it will trigger a smoke cartridge onboard the model.

Because the aircraft are subscale, the rest of the test activities can be scaled down in size. For instance, real enemy aircraft might be expected to attack at an altitude under 200 feet. Lockhart's models will fly at one-seventh that, at 25 to 30 feet off the ground. They will fly slower than real jet aircraft, but since they are closer they will have the appearance of speeding jets. Also, past studies have shown spotters usually detect aircraft at distances ranging out to 14 kilometers. Knocking this down to one-seventh scale means the team only requires a two kilometer square of airspace for its testing.

The contractor, Science Applications, Inc., and Lockhart's team performed validation testing in May. Validation testing is to followed by three years of actual testing and data gathering. Data will be collected from Redeye, Stinger, Vulcan and Chapparal weapon systems and their crews. Later, information will be gathered on Roland, Night Chapparal, Stinger-POST and Sergeant York systems and crews.

The $960,000, three-year contract with Science Applications includes the computer hardware and software, the vans and the radio-control system for the models. The computer is what really makes the system go. It will keep track of and control the aircraft, run the various battle scenarios, record crew events and do the calculations to determine if a hit was made against any aircraft.

Not only will scientists be able to evaluate how man and machine work together by using RADES, they should be able to improve the interaction. Corrections for deficiencies can be looked at in terms of crew training, system operating principles and organizational structure, in addition to possible equipment improvements. When changes are made, they can quickly be tested using RADES to insure the desired result is accomplished.

In the end the Army should have a system which provides an effective and inexpensive look at current and future air defense systems in simulated battlefield conditions. RADES will initially be used at White Sands, but can be taken to other locations to operate in other terrain and environmental conditions. ■

— U.S. Army

Background

ITEA is a non-profit corporation. It was incorporated in Washington, DC on the 18th of January, 1980. The principal organizers were Dr. Allen R. Matthews, who served as president until July 1, 1983 and is currently serving as Secretary/Executive Director, COL Floyd A. McLaurin, USAF, and COL Robert A. Klimek, Jr., USAF (Ret) who served continuously as legal counsel. The three served as the initial Board of Directors, which has since been expanded to nine and then 11 to accommodate the increased workload of members, chapters, symposia, professional groups, and publications.

The Internal Revenue Service classified ITEA as a publicly supported organization described in section 509(a)(2). Grantors and donors may rely on the determination that ITEA is not a private foundation. This status will again be confirmed as appropriate in March, 1989, subject to legal compliance as stated in the ITEA Articles of Incorporation. IRS has classified ITEA under section 501(c)(3) as exempt from federal income tax. ITEA is authorized a non-profit mailing permit and upon approved application can be exempted from state sales tax.

Purpose

From the Articles of Incorporation, as amended:

"Third: The purpose or purposes for which the Corporation is organized are: To provide an organization for individuals who have a common interest in the discipline of test and evaluation and who wish to foster, preserve, and advance the art of test and evaluation; to provide the exchange of ideas and information in the field of test and evaluation; to conduct professional meetings as well as symposia and seminars, and courses in the practice of test and evaluation; to support and promote the development and advancement of the state-of-the-art in test and evaluation in allied branches of science, technology and management; to support similar objectives in related organizations including government, industry, academia, and professional societies; to recognize the advances and contributions to testing and evaluation; to document contributions and the history of test and evaluation; and to commemorate fittingly the memory of persons who have made substantial contributions in the field of test and evaluation.

Said corporation/organization is organized exclusively for . . . educational and scientific purposes including, for such purposes the making of distributions to organizations that qualify as exempt organizations under section 501(c)(3) of the Internal Revenue Code (or the corresponding provisions of any future United States Internal Revenue Law).

No part of the net earnings of the corporation/organization shall inure to the benefit of/or be distributable to its members, trustees, directors, officers or other private persons, except that the corporation/organization shall be authorized and empowered to pay reasonable compensation for services rendered and to make payments and distributions in furtherance of the purposes set forth in the above paragraph.

Upon dissolution of the corporation/organization, the Board of Directors/Trustees shall, after paying or making provisions for the payment all of the liabilities of the corporation/organization, dispose of all of the assets of the corporation/organization exclusively for the purposes of the corporation/organization in such a manner, or to such organization organized and operated exclusively for charitable, educational, religious or scientific purposes as at the time shall qualify as an exempt organization under Section 501(c)(3) of the Internal Revenue Code/or corresponding provision of any United States Internal Revenue Law, as the Board of Directors/Trustees shall determine. Any such assets not disposed of by the Court of Common Pleas of the County in which the principal office of the corporation/organization is then located, exclusively for such purposes or to such organization as said court shall determine which are organized and operated for such purposes."

Realistic Air Defense Engagement System (RADES) Testing

White Sands Missile Range, White Sands, N.M.

(See Page 34)

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