Report of the
Defense Science Board Task Force

on

TEST AND EVALUATION CAPABILITIES

December 2000

Office of the Under Secretary of Defense
For Acquisition and Technology
Washington, D.C. 20301-3140

This is a product of the Defense Science Board (DSB).

The DSB is a Federal Advisory Committee established to provide independent advice to the Secretary of Defense. Statements, opinions, conclusions and recommendations in this report do no necessarily represent the official position of the Department of Defense.

This report is unclassified.

OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

DEFENSE SCIENCE
BOARD

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE (ACQUISITION, TECHNOLOGY & LOGISTICS)

SUBJECT: Defense Science Board Task Force Report on the Test and Evaluation Capabilities

I am pleased to forward the final report of the DSB Task Force on Test and Evaluation Capabilities. This study, chaired by Mr. David Heebner, was established in response to the FY2000 Defense Authorization Act and at your direction. You tasked the Defense Science Board (DSB) to conduct an analysis on the resources and capabilities currently available at all the laboratories and test and evaluation (T&E) facilities in the Defense Department (DoD), and to look at what they may need in the future to support systems development for Joint Vision 2010 and beyond.

The Task Force also assessed the T&E facilities of National Aeronautics and Space Administration (NASA), Federal Aviation Administration (FAA), and Department of Energy (DOE). The Task Force did not find that the facilities owned, operated or shared by other agencies had impact-- either negatively or positively-- on the DoD's ability to properly test and evaluate future military systems. When opportunities exist for DoD to use facilities operated by other Departments and Agencies and vice versa, satisfactory cooperative arrangements are in place and are functioning.

In addition, the Task Force was asked to look at DoD's T&E investment strategy and its ability to properly test and evaluate future military systems, analyze the resources and capabilities of all of the laboratories and T&E facilities in the DoD and to identify opportunities to achieve efficiency and reduce duplication of effort and facilities.

This report provides the Task Force's findings and recommendations regarding the value of testing, the management of T&E resources, the quality of testing, specific T&E investments, and the use of training facilities/exercises for T&E events.

I endorse all the recommendations and propose you review the Chairman's letter and final report.

Craig I. Fields
Chairman

OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

DEFENSE SCIENCE
BOARD

MEMORANDUM FOR THE CHAIRMAN DEFENSE SCIENCE BOARD

SUBJECT: Final Report of the Defense Science Board Task Force on Test and Evaluation Capabilities

Attached is the report of the Defense Science Board Task Force on Test and Evaluation Capabilities.

The Task Force terms of references asked the Task Force to:

- Conduct an analysis of what Test and Evaluation (T&E) capabilities are needed to support systems development and T&E for JV2010 and beyond.
- Assess DoD's T&E investment strategy and ability to properly test and evaluate future military systems.
- Analyze the resources and capabilities of all of the laboratories and T&E facilities in the DoD
- Identify opportunities to achieve efficiency and reduce duplication of effort

To perform this review the Task Force considered the findings and recommendations of the previous DSB study on Test and Evaluation, dated September 1999, examined T&E facilities first hand in both eastern and western portions of the United States and also received briefings from T&E organizations.

Based on our study of the T&E community the Task Force made the following major recommendations. Additional Supporting recommendations can be found in the body of the attached report.

The most significant capability missing in the T&E community is the ability to measure the value of testing. We recommend that the Director of Operational Test and Evaluation (DOT&E) should collaborate with the Under Secretary Of Defense for Acquisition, Technology and Logistics to develop a methodology to determine the value of testing and seek a set of common metrics and objectives to measure Service and DoD performance of T&E.

The Task Force found that both the Air Force and Navy conduct aircraft flight performance testing and weapons systems testing at greatly separated facilities. More

effective and lower cost testing could be achieved by taking greater advantage of the potential uses of Edwards AFB, and the Naval Air Warfare Centers at China Lake, Point Mugu, and Patuxent River. This activity would necessarily entail the moving of certain elements of testing from one location to another but would not necessarily reduce the total levels of activity at any one location.

The Task Force recommends that DOT&E provide and execute a plan to optimize joint testing of electronic warfare at China Lake/Point Mugu, airframe performance testing at Edwards AFB and aircraft systems testing at Patuxent River. DOT&E should pursue with equal vigor and objectivity, opportunities to consolidate unnecessary duplicate/redundant test capabilities throughout the Department of Defense T&E community

The Task Force feels that test resources and facilities should be owned and managed by a unified DoD T&E Resource Enterprise under the direction of DOT&E. This T&E Resource Enterprise would fund and manage DoD T&E organizations, workforce and infrastructure by transferring the appropriate Military Services funding for investment, operations and maintenance of Major range and Test Facility Base (MRTFB) test resources and facilities to the DoD T&E Resource Enterprise.

The Task Force found each of the Services uses different financial management methods to manage the affairs of their facilities and recommends that DoD implement a common financial management methodology for all T&E facilities.

To increase the quality of testing, especially for lower-priority systems, the Task Force recommends the DoD review criteria for setting system's testing requirements and requirements for granting waivers, provide management tools to ensure adequate testing in major programs and develop a means to do joint interoperability testing on a realistic basis.

The Task Force also made specific recommendations for investments in the areas of Frequency spectrum management, Embedded Instrumentation, Realistic Targets and the use of training facilities for T&E.

The Task force would like to express its appreciation to the members and government advisors of the task force and for the extensive support of the OSD staff.

David R. Heebner

Task Force Chair

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Test and Evaluation (T&E) of weapons systems is one of the most important aspects of the acquisition process, the results of which are essential information for acquisition decision makers. T&E measures the capability of a combat system designed and developed by the laboratories, acquisition commands and contractors, against the requirement for combat effectiveness. T&E conducted throughout the acquisition process can assist in the engineering design and development process, verify technical performance of a weapon system, identify supportability objectives, determine a systems operational effectiveness and verify suitability for use in combat.

As the United States' Armed Forces evolve into the force envisioned in Joint Vision 2010 and 2020 they will take advantage of new technological capabilities to achieve new levels of effectiveness in joint warfighting. The T&E community must have the capabilities to support this evolution.

The Defense Science Board (DSB) Task Force on T&E capabilities conducted a thorough review of T&E facilities and capabilities, both current and for the future. The results of this study and the Task Force's findings and recommendations are provided in this report.

TERMS OF REFERENCE (TOR)

The DSB Task Force on T&E Capabilities was formed in response to Section 913 of the fiscal year 2000 National Defense Authorization Act. In part the Congress asked the DSB to conduct "an analysis of the resources and capabilities of all the laboratories and test and evaluation facilities in the Department of Defense." And "to conduct an analysis of what Department of Defense Test and Evaluation (T&E) capabilities are required to support systems development and T&E for Joint Vision 2010 and beyond."

The Test and Evaluation Capabilities Task Force is one part of a two-part effort, the other effort specifically addressing DoD Laboratories, and as such this T&E Capabilities report is a partial response to the Congressional request. The Task Force feels that together, the T&E Capabilities and DoD Laboratory Report fully address the requirements of Section 913.

Section 913 states that the study should "address the capabilities of the laboratories and test and evaluation facilities in the areas of air vehicles, armaments, command, control and communications, and intelligence, space, directed energy, electronic warfare, medicine, corporate laboratories, civil engineering, geophysics and the environment." Section 913 also states "the panel shall identify opportunities to achieve efficiency and reduce duplication of efforts."

The T&E Capabilities Task Force addressed the T&E aspects of air vehicles, armaments, command, control, and communications, and electronic warfare. The Task Force concluded that the other subjects had no impact - either negatively or positively – on the DoD's ability to properly Test and Evaluate future military systems. The Task Force also identified opportunities to achieve efficiency and reduce duplication of effort and facilities. The Task Force was also asked to assess the T&E facilities of National Aeronautics and Space Administration, Federal

(NASA), Federal Aviation Administration (FAA), and Department of Energy (DOE). The Task Force did not find that the facilities owned, operated or shared by other agencies had impact - either negatively or positively – on the DoD's ability to properly Test and Evaluate future military systems. When opportunities exist for DoD to make use of facilities operated by other Departments and Agencies and vice versa satisfactory cooperative arrangements are in place and are functioning.

This study will consider the findings and recommendations of the previous DSB study on Test and Evaluation, dated September 1999 in addressing the aspects of T&E directed in this TOR.

TASK FORCE COMPOSITION AND DELIBERATIONS

Mr. David Heebner chaired the Task Force. Members of the Task Force included The Honorable John Krings, Mr. Thomas Christie, and Mr. Thomas Peoples. All members, with the exception of Mr. Peoples, were members of the DSB Task Force on Test and evaluation conducted a year earlier. The Task Force Executive Secretary was Dr. John Wiles, from the office of the Director Operational Test and Evaluation.

To perform this review the Task Force examined T&E facilities first hand in both eastern and western portions of the United States, including Eglin AFB, Aberdeen Proving Ground, Edwards AFB, China Lake, Point Mugu, and the National Training Center. The Task Force also received briefings from T&E organizations to review T&E processes, policies, and operations.

FINDINGS AND RECOMMENDATIONS

The following report provides the Task Force's findings and recommendations regarding the Value of Testing, the Management of T&E Resources, the Quality of Testing, Specific T&E Investments, and the Use Of Training Facilities/Exercises for T&E Events.

The Value of Testing

The Task Force found that the most significant capability missing in the T&E community is the ability to measure *the value of testing*. The Task Force could find no measures of output value for Test and Evaluation (Operational or Developmental) at the Department, Service Headquarters, or T&E Command levels.

A consistent theme the Task Force encountered during the study is that testing is just another hurdle to be overcome in driving a program past its next milestone. The acquisition community views long periods of testing as evidence of system ineffectiveness and testing is viewed as an impediment to the system's success.

The cost of testing in a typical DoD major program is historically about 3 to 4% of the total program cost. That is relatively insignificant. With the vital issues at stake, the minimal cost and the very great value (return on test cost investment) suggests we should maximize testing to discover any weakness or flaws as early as possible. Combat is the ultimate test, finding a fault in combat is the *ultimate cost of not testing*.

Finding

No measure of T&E's value is available for review to determine the return on investment of the Test and Evaluation process.

This Task Force suggests that a serious investigation on the cost to the Government of the failure to test properly be undertaken. Currently all data and evidence is anecdotal – recommend a program such as V-22 be studied.

Recommendations

1. The Director of Operational Test and Evaluation should collaborate with the Under Secretary of Defense for Acquisition, Technology and Logistics to develop a methodology to determine of the value of testing.
2. The Director of Operational Test and Evaluation should, in concert with the Services, seek a set of common metrics and objectives to measure Service and DoD performance of T&E.

Recognizing the difficulty of this task the Task Force recommends that the Director of Operational Test and Evaluation and Under Secretary Of Defense for Acquisition, Technology and Logistics seek ways to more effectively articulate the value of the testing process, with the ultimate goal of developing quantitative measures.

Management of T&E Resources

The Task Force has highlighted five aspects of management of T&E resources: How to attract and keep good people in the T&E community, Redundancy and Duplication of T&E facilities, T&E Organizational Alternatives, concerns with Institutional versus Programmatic Funding, and the need for Standardized Financial Management Practices.

People

Today, attracting young, talented individuals into the Department's civilian and military workforce is a difficult challenge. The Defense Science Board Task Force on Human Resources (HR) Strategy dated February 2000 studied the human resources problem in depth and provided the Department with its insights and recommendations. The findings and recommendations identified in the HR report are as applicable to the T&E community as they are to DoD as a whole.

The Department must place renewed emphasis on the importance of people in enabling DoD to accomplish its mission. It cannot be assumed that the necessary human capital will be available without adequate planning and resources. Today's human resource challenges represent an urgent concern for DoD – one that deserves attention at the highest levels.

Redundancy and Duplication of T&E Facilities

Extensive reduction in test facilities and personnel has been pursued during the last five years. Notwithstanding this necessary effort, unnecessary duplication of capabilities exists in all three services. After reviewing past recommendations and subsequent actions, it appears that further consolidation of T&E resources would not only reduce cost, but more importantly would improve the quality of testing. Improving the value of testing, not reducing the cost of testing, should be the goal in all future decisions regarding consolidation of activities, investment planning and test resource management throughout the Department of Defense.

Findings

1. Aircraft flight performance testing and weapons systems testing of aircraft are done at greatly separated facilities by both the Air Force and Navy. This testing arrangement is neither effective nor efficient. More effective and lower cost testing could be achieved by taking greater advantage of the potential uses of Edwards Air Force Base (AFB), Eglin AFB, and the Naval Air Warfare Centers at China Lake, Point Mugu, and Patuxent River. This activity would necessarily entail moving of certain elements of testing from one location to another but would not necessarily reduce the total levels of activity at any one location.
2. Military service goals of independent development and testing are not supported by this consolidation activity. Political support has contributed to this separation of activities. There will clearly be significant opposition from the military services aviation test community and the political constituency that supports these disparate activities.

Recommendations

1. Provide and execute a plan to optimize joint testing of electronic warfare at China Lake/Point Mugu, airframe performance testing at Edwards AFB and aircraft and munitions systems testing at Patuxent River and Eglin AFB.
2. Pursue with equal vigor and objectivity, opportunities to consolidate unnecessary duplicate/redundant test capabilities throughout the Department of Defense T&E community. For example,
   - ?? Munitions arena test facilities
   - ?? Anechoic chambers
   - ?? Live fire test facilities
   - ?? Electronic warfare ranges
   - ?? High-speed track facilities

Organizational Alternatives

One way to improve the value of T&E in DoD is to have test resources and facilities owned and managed by a unified DoD T&E Resource Enterprise. Unwillingness of the Services to provide adequate resources for T&E and still maintain substantial redundant capabilities suggests that a change is needed.

The Task Force recommends that the DoD create a Test and Evaluation Resource Enterprise within the office of the Director Operational Test and Evaluation.

This new restructured T&E Resource Enterprise should pursue the following goals:

- ?? Insure that test planning, test execution and evaluation of test results is conducted by the appropriate military service organizations responsible for this activity.
- ?? Retain essential land, air and sea space
- ?? Insure comprehensive and consistent application of established, as well as emerging enterprise management practices
- ?? Responsibly improve DoD test capabilities
- ?? Focus, develop and improve the “value of testing”
- ?? Reduce unnecessary cost to own and operate DoD T&E resources

?? Objectively assess the impact and value of outsourcing and privatizing DoD T&E resources

Findings

1. During the briefings, trips to test facilities and conversations with T&E managers and testers, the need for consolidating the management, investment planning and budgeting of DoD test resources became obvious.
2. The Central Test and Evaluation Investment Program (CTEIP) is the only program within Office of the Secretary of Defense (OSD) and throughout the entire DoD that provides a coordinated process and corporate procedure for making joint test and evaluation investments
3. A way to manage and provide resources for T&E facilities on a basis that makes the best sense for the DoD as a whole is lacking.
4. A Defense T&E Resource Enterprise, evolved from CTEIP, will significantly improve DoD testing by optimizing test resource investments and streamlining the management of these vital assets including both personnel and facilities.
5. Centralized management of T&E will result in more effective and consistent proponency for T&E facilities and operations.

Recommendation

1. Create a DoD T&E Resource Enterprise within the Office of the Director of Operational Test and Evaluation.
    a. The DoD T&E organizations, workforce and infrastructure must be funded and managed by a restructured T&E Resource Enterprise
    b. The DoD T&E Resource Enterprise should be an OSD level organization and should operate under the direction of the Director of Operational Test and Evaluation.
    c. Exploit the CTEIP organization and process by transferring the appropriate Military Services funding for investment, operations and maintenance of Major Range and Test Facility Base (MRTFB) test resources and facilities to the DoD T&E Resource Enterprise (currently CTEIP).
    d. Test operations of the test facilities should remain under Service control.

Institutional Vs. Programmatic Funding

Next to personnel problems, the most common concern found within the test community during our Task Force data gathering was the negative impact of a shift from institutional to programmatic funding for test resource and facilities.

The creation of a Defense T&E Resource Management Enterprise could provide the necessary management to insure efficient operation, better testing and reduce or eliminate programmatic funding at many MRTFB test facilities.

Standardized Financial Management Practices

Consistent financial management practices would ease the problem of interservice range utilization and make it possible to determine the value of making changes in facilities usage. It would also facilitate more efficient operations. At present we cannot measure either input or output values. This step would make it possible to measure input values on a consistent basis.

Finding

Management of the test facilities is made unnecessarily difficult by the fact that each of the Services uses different financial management methods to manage the affairs of their facilities. The panel could find no compelling reasons for the differences it noted.

Recommendations

1. Implement a common financial management methodology for all T&E facilities.

2. Implement a system within a T&E Resource Enterprise to track the total cost of Test and Evaluation to the taxpayer.

THE QUALITY OF TESTING

The Task Force looked at the quality of testing and its affect on weapons system acquisition. Three major areas discussed in this report include the influence of acquisition reform on the quality of testing, interoperability, and examples on inadequate testing.

Acquisition Reform Influence on the Quality of Testing

The systems below ACAT1 in the priority system are being fielded without adequate testing to assure their effectiveness and utility to operating units. This is NOT to suggest that acquisition reform is a bad idea. It is to suggest that much more attention is required to the process by which T&E is carried out under acquisition reform, especially for lower priority programs.

Findings

1. Testing is not being conducted adequately — if systems are not adequately tested they enter the inventory with latent defects that can be very costly and can impact operational effectiveness.
2. A particularly shocking finding is that there is growing evidence that the acquisition system is not meeting expectations as far as delivering high quality, reliable and effective equipment to our military forces.
3. The lack of testing cannot be blamed on the lack of facilities; however, limited infrastructure is a contributor to the lack of interoperability testing.
4. There is an increasing incidence of test waivers.
5. The T&E process is not funded properly — in phasing or in magnitude
    a. Funds are not available early enough
    b. Corners are cut in the testing that is done
6. There is not enough government oversight of testing done by industry

Recommendations

1. Review criteria for setting system's testing requirements and requirements for granting waivers
2. Provide management tools to ensure adequate testing in major programs.
3. Develop a means to do joint interoperability testing on a realistic basis
4. Make maximum use of testing in existing T&E, training and other operational facilities in seeking a solution to this need.
5. Reform the acquisition process in order to support the adequate and robust T&E of new weapons systems in order to produce weapons systems that – work the first time, all the time.

Interoperability

More and more, important system attributes have to do with interoperability. Our system acquisition process is still primarily a single service responsibility. There is growing evidence that interoperability determination is not a key parameter of system adequacy even though the requirements of JV 2020 clearly make greater demands on system interoperation. There is no facility capable of doing interService interoperability testing of weapons systems and of the interactions between weapons systems and information systems.

The Joint Interoperability Test Command (JITC) is a start, but is inadequate to carry out the kind of testing envisioned by the Task Force.

Inadequate Testing

Recent experiences with weapon systems serve as evidence that our acquisition process is not delivering high quality, reliable, and effective equipment to our military forces.

It appears that we too often fail to carry out adequate testing. In those cases where the testing is adequate, we fail take the corrective actions needed based on the results of that testing. In many cases, we allow our acquisition programs to proceed to their next phases, such as moving from development or technical testing to operational testing or moving from development into production and deployment with our combat forces, when the test results we have gathered clearly indicate the systems are not ready.

The Task Force looked at several aspects of inadequate testing including the use of waivers, Army reliability testing, congressional concerns, and an Army example of the impact of under funding of T&E.

Of particular concern to the Task Force is the practice of a Service unilaterally granting a waiver for testing.

Finding

The process of handling waivers seriously undermines the T&E process – and may have already had negative impact on weapon systems

Recommendation

Regulation SECNAVINST 5000.2B should be modified to rule out waivers as a unilateral action by Service authorities.

SPECIFIC T&E INVESTMENTS

The Task Force also found the state of the infrastructure – to include physical plant, range real estate, instrumentation, data reduction and analysis capabilities, targets, personnel among other facets of test planning and conduct – in need of near-term investment and high-level emphasis in order to meet the requirements for effective T&E of future new weapons and operational concepts.

While there are clearly near term-needs in many areas, the Task Force felt that three particular activities deserved immediate, high-level attention:

?? Frequency spectrum management and investment,
?? Development and investment in embedded instrumentation,
?? Development and investment in more realistic targets,

Frequency Spectrum Management

Findings

1. T&E requires frequencies in many bands of radio spectrum for many support functions
2. Increased weapon system complexity/capability requires higher telemetry data rates
3. More complex/more capable systems requires larger geographic separation/larger number of players which requires MORE SPECTRUM
4. Spectrum continues to be lost to DoD
    a. Growing commercial interests will lead to increasing encroachment
    b. Government selling off of spectrum has already adversely impacted DoD's T&E capabilities
    c. Future outlook is for even more losses

Recommendations

1. Develop technologies/techniques to meet near term test requirements
    a. Increase numbers, skills and tools of frequency managers in T&E Organizations
    b. Increase Funding of Existing or Emerging R&D Efforts Leading to More Efficient Use of Spectrum
    c. Increase Cooperation between Spectrum Users (e.g., DoD/NASA)
2. Fund research efforts to meet long-term growth in test requirements
    a. More Efficient Use of Present Allocations
    b. Explore Use of Higher Frequency Bands for T&E Purposes
    c. Develop and Field Alternative Means of Communications
3. Work in Interagency fora to prevent further loss of spectrum essential to testing of future military systems.
4. Add a permanent member from the T&E community to the Frequency Panel of the Military Communications Electronics Board to provide guidance on frequency spectrum aspects of T&E.

5. Strengthen the voice of the T&E community in both national and international arenas where frequency spectrum policy decisions are made to ensure that adequate assessments of the impacts of these decision on our ability to thoroughly test our defense systems and ensure readiness.

Embedded Instrumentation

Findings

Embedded, Non-Intrusive Instrumentation will benefit T&E.

1. Does not alter the physical characteristics, performance or other signatures of system
2. Non-intrusive in operation of a weapon system – either in T&E, training exercises or other operations
3. Provides the capability to monitor performance, supportability, and other characteristics of system throughout entire life cycle
4. Provides more accurate, faster turnaround data during T&E or training events, permitting more rapid feedback on performance of system or of combat unit
5. Can reduce the cost of T&E, training exercises, acceptance testing, etc. if planned as part of system production process
6. Can significantly reduce opposition by training community to combined testing and training events
7. Enables interoperability and standardization of range instrumentation and modeling and simulation among test and training ranges

Recommendation

The acquisition executive should direct the inclusion of embedded instrumentation in future weapons systems. The Test and Training Steering Group should define the initial step of establishing the detailed requirements for such systems.

Invest in Targets That Adequately and Realistically Test Future Weapons

Findings

1. T&E problems caused by diminishing target resources will become critical in the near future.
2. Increased emphasis on target development is urgently needed.
3. The acquisition executive should require an OSD level target acquisition plan and provide for funding the plan in the POM.

Recommendations

1. DoD should consider much greater use of foreign aircraft and anti-aircraft systems that could be used as targets.
2. A critical review should be made of any acquisition program required to develop its own targets.
3. DoD must adequately fund target development for T&E.

USE OF TRAINING FACILITIES/EXERCISES FOR T&E EVENTS

The changing training environment will provide opportunities and incentives for combining training and test events. While there are many potential payoffs, there are also drawbacks to combining testing and training and critical considerations to be made before combining testing and training.

Finding

There is potential for high payoff from combining training and testing.

Recommendations

1. DOT&E take the initiative to establish processes and procedures with training activities to facilitate combining testing and training events.
2. Fund initiatives to improve frequency spectrum management; to provide interoperability and standardization of test and training range instrumentation/data collection and analysis systems; and to provide embedded, non-intrusive instrumentation and data retrieval systems.
3. Fund initiatives that will provide research and development investment in resources and technologies to solve common test and training requirements.

INTRODUCTION

The DSB Task Force on T&E Capabilities was formed in response to Section 913 of the fiscal year 2000 National Defense Authorization Act. In part the congress asked the DSB to conduct "an analysis of the resources and capabilities of all the laboratories and test and evaluation facilities in the Department of Defense." And to "to conduct an analysis of what Department of Defense Test and Evaluation (T&E) capabilities are required to support systems development and T&E for Joint Vision 2010 and beyond."

The Test and Evaluation Capabilities Task Force is one part of a two-part effort, the other effort specifically addressing DoD Laboratories, and as such this T&E Capabilities report is a partial response to the Congressional request. The Task Force feels that together, the T&E Capabilities and DoD Laboratory Report fully address the requirements of Section 913.

Section 913 states that the study should "address the capabilities of the laboratories and test and evaluation facilities in the areas of air vehicles, armaments, command, control and communications, and intelligence, space, directed energy, electronic warfare medicine corporate laboratories, civil engineering, geophysics and the environment." Section 913 also states "the panel shall identify opportunities to achieve efficiency and reduce duplication of efforts."

The T&E Capabilities Task Force addressed the T&E aspects of air vehicles, armaments, command, control, and communications, and electronic warfare. The Task Force concluded that the other subjects had no impact - either negatively or positively – on the DoD's ability to properly Test and Evaluate future military systems. The Task Force also identified opportunities to achieve efficiency and reduce duplication of effort and facilities.

The Task Force was also asked to assess the T&E facilities of NASA, FAA, and DOE. The Task Force did not find that the facilities owned, operated or shared by other agencies had impact - either negatively or positively – on the DoD's ability to properly Test and Evaluate future military systems. When opportunities exist for DoD to make use of facilities operated by other Departments and Agencies and vice versa satisfactory cooperative arrangements are in place and are functioning.

In order to perform this study the Task Force considered the findings and recommendations of two recent DSB studies, the report on Test and Evaluation and the report on Science and Technology Base for the 21st Century.

The Task Force reviewed the recommendations of the previous DSB study on Test and Evaluation, dated September 1999, and focused on two of the major recommendations:

- ?? DoD should develop T&E investment strategy based on inventory and future needs
- ?? DoD should meet future T&E needs through most effective and efficient combinations of national facilities

The second portion of the task, to consider the recommendations of the DSB report on Science and Technology Base for the 21st Century was conducted by a separate group and will not be commented on in this report.

To perform this review the Task Force examined T&E facilities first hand in both eastern and western portions of the United States, including Eglin AFB, Aberdeen Proving Ground, Edwards AFB, China Lake, Point Mugu, and the National Training Center. The Task Force also received briefings from T&E organizations to review T&E processes, policies, and operations.

The following report provides the Task Force's findings and recommendations regarding the Value of Testing, the Management of T&E Resources, the Quality of Testing, Specific T&E Investments, and the Use Of Training Facilities/Exercises for T&E Events.

THE VALUE OF TESTING

The Task Force found that the most significant capability missing in the T&E community is the ability to measure the "value of testing." What do you get for what you spend? Is testing worth what we spend? To answer this we must know the output of testing. The Task Force could find no measures of output value for Test and Evaluation (Operational or Development) at the Department, Service Headquarters, or T&E Command levels.

We have aggressively reduced cost, but apparent cost efficiency is not sufficient to obtain a lean and effective T&E function. We do not know how to allocate future T&E investments and expenditures without first being able to measure the output of the T&E capabilities that remain.

Examples of the benefits of testing in the civilian sector are common. Significant strides in the reliability and effectiveness of software have been made through a dedication to better testing. Half of the personnel dedicated to developing Windows 2000 were testers. Our quality of life is improving daily with the advancement of medical processes and procedures. The key to unlocking these dramatic improvements in our everyday life is testing. Early discovery of health problems through rigorous testing has become the most dominant contribution to improvement in our quality of life. We never hear the term "lean MRI" or "a simulated biopsy." We want the best tests for anything that can have a *significant impact on our future... especially our health or safety*. The value of these tests is both significant and obvious, while the cost is relatively insignificant. Seldom do we avoid or minimize any test that can have a *significant impact on our future... especially our health or safety*.

The cost of testing in a typical DoD major program is historically about 3 to 4% of the total program cost. That is relatively insignificant. Insuring that a gas mask can be stored for years and will work properly when donned by a soldier during a poison gas attack clearly has a *significant impact on our future... especially our health or safety.* The early measurement of the radar cross section of an F-117 at all angles, and frequencies during the test program had a *significant impact on our future... especially our health or safety* during the first combat flights over Baghdad. Assurance and confidence that military systems will function when needed and perform as required is a critical matter of national security and has a *significant impact on our future... especially our health or safety.*

If testing military weapons systems costs only 3-4% of the total cost of the system why do we constantly try to reduce the cost of testing? With the vital issues at stake, the minimal cost and the incredible value (return on test cost investment) suggests we should maximize testing to discover any weakness or flaws as early as possible. Combat is the ultimate test; finding a fault in combat is the *ultimate cost of not testing*.

THE SITUATION

Test and Evaluation measures the capability of a combat system designed and developed by the laboratories, acquisition commands and contractors, against the requirement for combat effectiveness, approved by the military departments, in most cases many years prior to the operational test. The metrics for a given test are reasonably well defined, and in rare cases are allowed to be adjusted to compensate for state of the art changes, only after in-depth analysis to

ensure that the most demanding requirements for a combat system are not inadvertently (or by design) reduced in order to pass the test. Typically, only non-combatants pursue reduction of test cost. It is a key element in Acquisition Reform. Program managers are constantly pressured by budgeteers and acquisition reformers to reduce test cost or shrink test programs. The F-22 test program was reduced; even the JSF test program has been reduced and the airplane hasn't even flown yet. "Lean testing" is pursued and is rewarded. Testing must be robust and thorough otherwise a false sense of confidence and security can be generated when critical tests are waived or avoided. The pursuit of the reformed acquisition goals of "faster, better, cheaper" must not compromise thorough, robust, objective testing. Field testers we visited raised this concern. If there are faults or weaknesses, and there always seem to be some, they will unfortunately be found by the unlucky warfighter during training, or even worse, during combat.

These tests could, therefore, be justly described as *Surrogate Combat*. During formation of the measures of effectiveness for individual tests there can be and frequently is, debate. Tests are designed to measure a systems ability to satisfy given metrics against the aforementioned service operational requirement. This Task Force, understanding that, took the inquiry one-step further;

?? What are the measures of the value of test and evaluation in the aggregate, by service, or by group of weapon systems?
?? How does the Department measure the value received, for the resources that are applied?

In other words, what are the outputs of our Test and Evaluation process and how are they measured?

The Task Force found no processes and no metrics to determine the return on investment of the Test and Evaluation process at the Department, Service Headquarters or Test Command Facilities. There exist extensive and varied metrics to measure the resource inputs (funding/personnel); the infrastructure, both physical size, shape and value at acquisition, but no measures of output other than an assumption that having tested and passed a given system, a reasonable man could assume it would work in a combat environment. However, more and more, as time passes, we hear of weapons systems that are not operating effectively in the combat environment or in that other surrogate combat environment, realistic training of large combat forces.

The perception consistently found among testers, test managers, and executives within the test infrastructure, was that combat was the ultimate metric. Success in combat achieved the ultimate objective for this key measure. *Surrogate Combat* in the form of an operational test was largely viewed as an analysis of a specific system, or system of systems, of technical performance in the hands of soldiers, sailors, airmen, marines.

Commercial industry has made a science of what was originally an art form in the implementation of Statistical Process Control (SPC) in factories. A case can be made that a natural outgrowth of SPC has been industry's adoption of measures such as Economic Value Added (EVA) and Shareholder Value. While SPC, EVA and Shareholder Value clearly do not apply in this circumstance, the mathematical models that have been developed to measure them may well have application to determine the value of Test and Evaluation short of the ultimate metric which is the performance of the system in actual combat, where failure results, in all cases, in the loss of lives of US fighting forces.

A consistent theme the Task Force encountered in talking to those who are in the program management side of this endeavor, is that testing is just another hurdle to be overcome in driving their program past its next milestone during their tenure. They, (and to a surprising extent the Congress) view *long periods of testing* as evidence of system ineffectiveness and see testing as an impediment to the system and their individual success. A disturbing symptom of this thinking is the relatively new practice of granting waivers to programs that permit them to forego specific testing requirements or demonstrations of key performance parameters. Providing an output measure could, in the midterm, alleviate that mindset, and in the long term help integrate operational test as a parallel, integrated and valued function throughout the System Development Process.

Finally, it should be taken into account that (Operational and Development) Test and Evaluation, *is one of the few functions that is itself without metrics measuring its performance*. Given the importance of Surrogate Combat to the lives of our fighting men and women, every effort should be made to find effective and efficient metrics to measure, quantify and disseminate the *avoided unfavorable results* that our achievement of that objective delivers.

Finding

1. **No measure of T&E's value is available for review to determine the return on investment of the Test and Evaluation process.**

This Task Force suggests that a serious investigation on the cost to the Government of the failure to test properly be undertaken. Currently all data and evidence are anecdotal – recommend a program such as V-22 be studied.

Recommendations

1. **The Director of Operational Test and Evaluation should collaborate with the Under Secretary Of Defense for Acquisition, Technology and Logistics to develop a methodology for determination of the value of testing.**

They should solicit commercial industry inputs on their methodologies for evaluation of T&E outputs.

Contractor testing, government development testing and military service operational testing contribute significantly to the discovery of problems, the assurances of solutions and prevention of significant failures during both training and combat. The value of this process must be measured and used to justify, defend and intelligently increase funding for this vital activity.

DoD solicitation of commercial industry should focus on companies in automotive, chemical and information technology markets in order to benefit from their experience in compiling of testing outputs on critical factors such as safety, reliability and system or product performance. In this way a non-aerospace and defense view of methodology could be obtained.

Initial penetration of the commercial realm could be achieved by contacting senior staff at respected Advanced Management Programs, closely associated with industrial sectors, such as those at Carnegie-Mellon, Duke and Stanford Universities.

2. **The Director of Operational Test and Evaluation should, in concert with the Services, create a set of common metrics and objectives to measure Service and DoD performance of T&E.**

Recognizing the difficulty of this task the Task Force recommends that the Director of Operational Test and Evaluation and Under Secretary Of Defense for Acquisition, Technology and Logistics seek ways to more effectively articulate the value of the testing process, with the ultimate goal of developing quantitative measures.

MANAGEMENT OF T&E RESOURCES

A. PEOPLE

Today, attracting young, talented individuals into the Department's civilian and military workforce is a difficult challenge. At the same time, the shape of the workforce is changing. There is a new "total force" that includes military, both active and reserve, civilian, and private sector personnel – all making contributions to the Department's mission. During the course of this study the Task Force learned that the issue of human resources – how to attract and retain personnel with the motivation and skills to serve and lead in civilian and military capacities – is one of the most significant concerns of the T&E community.

Cooperative utilization of the experienced testers throughout the Department of Defense is absolutely necessary to ensure the quality of our fielded weapons systems. The Defense T&E Resource Enterprise proposed later in this report would provide the mechanism to recruit, train and utilize a core of experienced and new testers. The human intellectual assets owned by this Enterprise would be more valuable than any of the test facilities.

The Defense Science Board Task Force on Human Resources Strategy dated February 2000 studied the human resources problem in depth and provided the Department with its insights and recommendations. These findings and recommendations are applicable to the T&E community as they are to DoD as a whole.

The Human Resources Task Force identified three overarching issues that have an important impact on maintaining the high quality force that the Department has today and needs in the future.

- ***The American public is increasingly less involved and less inclined to serve in the Department of Defense.*** The American public is increasingly disenchanted with the virtues of public service, both civilian and military. While the Department cannot single-handedly change public attitudes, it can play a leadership role and take steps to engage the American public in better understanding DoD's roles and missions in the future.
- ***A strategic plan is needed for future human resource requirements for a fully integrated DoD force.*** Without an overarching framework that identifies human resource needs, strategies, and policies, the Department is at risk of falling short in shaping the quality and skilled workforce needed. DoD needs to elevate strategic planning for human resources department-wide a do so in a way that integrates all elements of the "total force."
- ***The Department does not have the authority and tools necessary to integrate the management of its human resources.*** The Secretary of Defense needs the authority to size and shape the entire DoD workforce. Moreover to meet the needs of the 21st century force, the Department needs flexible force-shaping tools that allow for different career patterns, compensation expectations, education, training, and motivations in different occupations.

As an overall principle, the Human Resources Task Force believes that:

- ?? Government personnel should pursue only those tasks that are essential to the business of governing.
- ?? Military personnel should be involved in those tasks that only the military can do, recognizing there are some functions in which both military and civilian personnel should be involved.
- ?? Civilian personnel should perform all other government tasks.
- ?? The private sector should be called upon to support those functions that it can do best.

The Department must place renewed emphasis on the importance of people in enabling DoD to accomplish its mission. It cannot be assumed that the necessary human capital will be available without adequate planning and resources. Today's human resource challenges represent an urgent concern for DoD – one that deserves attention at the highest levels.

B. REDUNDANCY AND DUPLICATION OF T&E FACILITIES

Extensive reduction in test facilities and personnel has been pursued during the last five years. Notwithstanding this necessary effort, unnecessary duplication of capabilities exists in all three services. After reviewing past recommendations and subsequent actions, it appears that further consolidation of T&E resources would not only prove to be less costly, but more importantly would improve the quality of testing. Improving the value of testing, not reducing the cost of testing, should be the goal in all future decisions regarding consolidation of activities, investment planning and test resource management throughout the Department of Defense.

Four of the major flight test facilities visited by the Task Force have significantly underutilized capabilities. The future of manned and unmanned aircraft flight testing is shifting from the airframe to the avionics. The capabilities at Edwards Air Force Base (Air Force Flight Test Center (AFFTC)), Patuxent River Naval Air Station (Naval Air Warfare Center, Aircraft Division (NAWCAD)), Eglin Air Force Base (Air Force Air Armament Center (AFAAC)) China Lake/ Pt. Mugu Naval Air Station (Naval Air Warfare Center, Weapons Division (NAWCWD)) are following this shift. The modeling and simulation, test and information processing and hardware/software in the loop testing done at these four bases does not require unique geographical or environmental conditions. Flight testing, however, is very dependent on natural conditions. Edwards has the best natural conditions for experimental, research and development flight testing in the world. The Navy does aircraft electronic warfare, munitions and most of its operational testing on the west coast. The Air Force does its electronic warfare, munitions and most of its operational testing on the Gulf (east) coast. The Navy does its airframe performance testing on the east coast. The Air Force does its aircraft performance testing near the west coast. The China Lake/Pt. Mugu complex has electronic warfare and munitions testing capabilities equivalent to Eglin AFB. The combination of Edwards AFB and China Lake/Pt. Mugu along with the regional, multiservice supporting test facilities and resources represents the best natural facility for joint, optimized testing of manned and unmanned air vehicles. Fallon Naval Air Station and Nellis AFB (both in Nevada) are the prime facilities for tactical warfare development and electronic warfare training and testing.

Airframe development flight testing has always been a challenge at Patuxent River. Airspace is extremely limited and restrictive. Winter conditions in the Chesapeake Bay restrict high-risk flight testing survivability. Poor in-flight visibility in the summer impacts experimental and early

development flight testing. Significant investment in very high response rescue resources creates limitations due to availability and reliability. Extensive catapult and arresting test resources suggests that this activity be accomplished at Patuxent in foreseeable future.

The synergism of joint (Air Force, Navy and Marine) aircraft testing at the optimum combined natural facility for the testing of both airframe and avionics supports the philosophy of the Joint Strike Fighter Program, the largest defense procurement program in history. The critical deficiencies that exist in interoperability and interdependency, "System of Systems" testing, requires regional multi-service test facilities. Proximity to Nellis, Fallon, and National Training Center (NTC) provides an opportunity to "test and train the way we will fight."

The relocation of non-duplicated capabilities from Patuxent River and Eglin AFB, and China Lake/Pt. Mugu should be assessed on the basis of the value of testing now and in the future. High value facilities (e.g. Eglin's Climatic Test Chamber) and recent major investments (NAVAIR facilities at Patuxent River) appear unreasonable to relocate. However, significant upgrades and major improvements should be closely evaluated in the future. When locating the majority of flight testing in a desert environment, there remains a requirement for alternative environments to test weapons system performance in all environmental conditions. This dictates that alternative capabilities must be retained.

Findings

1. **Aircraft flight performance testing and weapons systems testing of aircraft are done at greatly separated facilities by both the air Force and Navy. This testing arrangement is neither effective nor efficient. More effective and lower cost testing could be achieved by taking greater advantage of the potential uses of Edwards AFB, Eglin AFB, and the Naval Air Warfare Centers at China Lake, Point Mugu, and Patuxent River. This activity would necessarily entail moving of certain elements of testing from one location to another but would not necessarily reduce the total levels of activity at any one location.**
2. **Military service goals of independent development and testing are not supported by this consolidation activity. Political support has contributed to this separation of activities. There will clearly be significant opposition from the military services aviation test community and the political constituency that supports these disparate activities.**

Recommendations

1. **Provide and execute a plan to optimize joint testing of electronic warfare at China Lake/Pt Mugu, airframe performance testing at Edwards AFB and aircraft and munitions systems testing at Patuxent River and Eglin AFB.**

It is anticipated that this initiative will have to be directed at the OSD and Service Chief of Staff levels.

2. **Pursue with equal vigor and objectivity, opportunities to consolidate unnecessary duplicate/redundant test capabilities throughout the Department of Defense T&E community. For example,**
    - **Munitions arena test facilities**
    - **Anechoic chambers**

- **Live fire test facilities**
- **Electronic warfare ranges**
- **High speed track facilities**

Summary

Congressional and OSD concern regarding duplication/redundancy in test capability is well founded. During the briefings and visits, by this Task Force it was quite apparent that within and between services there is unnecessary duplication/redundancy even when taking into consideration necessary reserve capacity.

While the goal of reducing unnecessary duplication/redundancy is cost reduction, an even more important goal of improvement in testing can be achieved by optimizing capability through consolidation. The findings and recommendations presented in this report deal with four aviation test facilities. After eight years of studies and downsizing exercises, the major areas of redundancy and duplication are well documented, however, they still exist.

Co-locating Air Force and Navy (and Marine) aviation performance testing provides common test facilities for testing the common Joint Strike Fighter. Joint testing and interoperability testing, two areas needing considerable improvement, can also be improved through this consolidation. In addition to providing improved efficiency of flight test operation and electronic warfare testing the focus of those activities, for a Joint Weapons System Program, will require that command and control information system interfaces be tested on a concurrent basis. Providing for this capability at the Edwards/China Lake/Pt. Mugu complex will lead to significantly better testing, efficient operations (less need to move aircraft coast to coast) and the ability to plan the overall test operations on a time and space efficient basis.

C. ORGANIZATIONAL ALTERNATIVES

The DSB T&E Task Force has come to the same conclusion as have many of the congressional responses in the past. The value of T&E is finding flaws or weaknesses as early as possible during development at the lowest reasonable cost. One way to improve the value of T&E in DoD is to have test resources and facilities owned and managed by a unified DoD T&E Resource Enterprise. Unwillingness of the Services to provide adequate resources for T&E and still maintain substantial redundant capabilities suggests that a change is needed.

The underutilization of existing T&E facilities is largely a matter of current demands on a near-term basis, not a lack of a long-term need for access to airspace and controlled operating environments essential to adequate testing of new weapons systems and air vehicles. Therefore, simply saying "Close This Facility or That Facility" is not the right answer.

The majority of the members of this DSB T&E Study Task Force participated in a previous T&E Study (Defense Science Board report on Test and Evaluation, dated September 1999). During the briefings, trips to test facilities, and conversations with T&E managers and testers, the need for consolidating the management, investment planning, and budgeting of DoD test resources became obvious.

The fundamental concern of T&E facility managers is how do they get enough money and manpower to continue their operations. They compete with other activities within their Services for resources, and with other activities both within their Services and outside for "business"

support. This does not lead to long range business planning and, it is not possible for them to make investment decisions based on future utilization or business-like return on assets analyses. They have little control over the "business" they manage and are subject to highly variable budgeted support. Since the manager of test resources has little opportunity to actually "create" new business, it becomes questionable as to whether these resources and facilities can or should be operated like a "for profit" business. Finally, they cannot make real (enforceable) commitments to Program Managers, nor can they measure the output value of the services they provide. Centralized, consolidated management of T&E facilities within the Department of Defense could overcome many of these serious problems.

During the previous DSB T&E study mentioned above, the Task Force received thoughtful inputs on ways to structure a "unified DoD T&E corporate management." These inputs were developed by experienced T&E professionals who offered objective views based on their experience as Test Directors and Comptrollers of major test facilities. They developed a model for optimizing common functional test facilities and potentially assessing the impact of unnecessary test capability duplication. The Task Force sees in this work the promise of more efficient and affective management of T&E Resources across the Services and a mechanism to greatly improve proponency for Test facility improvement and the effectiveness of Test Operations.

During this DSB T&E Study the Task Force received a briefing that describes the Central Test and Evaluation Investment Program (CTEIP) managed and operated by the Director of Operational Test and Evaluation (DOT&E) in OSD. In June of 1999, a reorganization of responsibilities for Test and Evaluation within the Office of the Secretary of Defense resulted in a considerable expansion on the responsibilities and functions of DOT&E. The preponderance of OSD test and evaluation resources now comes under the purview of DOT&E, including the oversight of test ranges facilities and investments. As part of this change, DOT&E assumed responsibility for planning, programming and budgeting of the CTEIP. Not only does the CTEIP provide a corporate means to leverage test investments for the Services and Defense Agencies, but its objectives are complementary with many of the initiatives DOT&E has identified as critical to improving and modernizing our T&E infrastructure. With its emphasis on such efforts as improving test deficiencies, promoting increased use of Modeling and Simulation, creating common instrumentation, and developing capabilities to test information systems, the CTEIP is clearly focused on developing the test capabilities required to meet the test challenges of the next century.

> *"... the CTEIP is specifically chartered to focus on obtaining the best return on test investments and to make the best use of scarce test assets (both funding and facilities). The CTEIP continues to be the only program within the Office of the Secretary Of Defense and throughout the entire Department Of Defense that provides a coordinated process and corporate procedure for making joint test and evaluation investments." …*
>
> — CTEIP 2000 Annual Report

> *"CTEIP projects are selected by a process that insures the active participation of all concerned parties and fosters a robust competition for limited funds through a Needs and Solutions process joint CTEIP projects are selected from*

candidates submitted from the Services and Defense Agencies or developed from OSD initiatives."...

— CTEIP 2000 Annual Report

Findings

1. **During the briefings, trips to test facilities and conversations with T&E managers and testers, the need for consolidating the management, investment planning and budgeting of DoD test resources became obvious.**
2. **The CTEIP is the only program within OSD and throughout the entire DoD that provides a coordinated process and corporate procedure for making joint test and evaluation investments**
3. **A way to manage and provide resources for T&E facilities on a basis that makes the best sense for the DoD as a whole is lacking.**
4. **A Defense T&E Resource Enterprise, evolved from CTEIP, will significantly improve DoD testing by optimizing test resource investments and streamlining the management of these vital assets including both personnel and facilities.**
5. **Centralized management of T&E will result in more effective proponency of T&E facilities and operations.**

Recommendation

1. **Create a DoD T&E Resource Enterprise within the Office of the Director of Operational Test and Evaluation.**
    a. **The DoD T&E organizations, workforce and infrastructure must be funded and managed by a restructured T&E Resource Enterprise**
    b. **The DoD T&E Resource Enterprise should be an OSD level organization and should operate under the direction of the Director of Operational Test and Evaluation.**
    c. **Exploit the CTEIP organization and process by transferring the appropriate Military Services funding for investment, operations and maintenance of MRTFB test resources and facilities to the DoD T&E Resource Enterprise (currently CTEIP).**
    d. **As a preparatory step, the Office of DOT&E should sponsor careful analyses of the potential for improved efficiency and cost effectiveness that can result from the new management structure.**
    e. **Test operations of the test facilities should remain under Service control.**

T&E Resource Enterprise

The Task Force recommends that the DoD create a Test and Evaluation Resource Enterprise within the office of the Director Operational Test and Evaluation.

The first step is to exploit the existing CTEIP. The CTEIP should be transformed into the DoD T&E Resource Enterprise. All DoD funding that supports investment, operations and maintenance, development and management of Major Range and Test Facility Base (MRTFB) facilities and resources should be transferred to the current CTEIP Program Element (PE). Military Service personnel currently involved in these activities within the services should be consolidated and reassigned to the DoD T&E Resource Enterprise. Military Service and OSD personnel responsible for test resource and facility operations and maintenance would remain at the MRTFB facilities they are currently assigned.

The creation of a DoD T&E Resource Enterprise is a major challenge. Not all consolidations inside or outside the government are done efficiently and successfully. For this enterprise to succeed and achieve its goals, outside professional consulting services may be needed to make this restructuring effective. This is a unique opportunity to improve the way this vital activity is planned, programmed and budgeted.

The second step is to implement the plan developed by the OSD study group. This plan consists of a unified T&E structure that includes a number of enterprise management elements. Starting from the premise that separate Service funding and planning is no longer affordable and effective, the major objective of the T&E Resource Enterprise is centralized planning and funding with distributed execution. Five primary enterprise elements: Technical Development, Operations Management, Operations & Maintenance, Enterprise Management and Site Support would leverage shared expertise, greater volume procurement, common knowledge systems and contemporary enterprise management efficiencies. This planning included an organizational framework and an implementation strategy.

The DoD T&E Resource Enterprise should be "owned" and managed by the Director of Operational Test and Evaluation. The Secretary of Defense recently transferred the preponderance of OSD test and evaluation resources including the oversight of test ranges facilities and investments as well as the CTEIP, to DOT&E. The DOT&E is the senior official in the Department of Defense for all test and evaluation issues. A single source of authority and responsibility for planning, programming, budgeting and operation with a common visible financial management system and a robust process to jointly identify test resource investments is long overdue.

This new restructured T&E Resource Enterprise should pursue the following goals:

- ***Insure that test planning, test execution and evaluation of test results is conducted by the appropriate military service organizations responsible for this activity.***
- ***Retain essential land, air and sea space***
- ***Insure comprehensive and consistent application of established, as well as emerging enterprise management practices***
- ***Responsibly improve DoD test capabilities***
- ***Focus, develop and improve the "value of testing"***
- ***Reduce unnecessary cost to own and operate DoD T&E resources***
- ***Objectively assess the impact and value of outsourcing and privatizing DoD T&E resources***

The restructured T&E Resource Enterprise must have the following attributes:

?? ***Simplified management structure with clear lines of accountability***
?? ***Common financial system***
?? ***Test resource modernization through consolidation and cost recovery***
?? ***Common and consistent application of best enterprise management practices***
?? ***Enhanced partnership with industry including full exploitation of outsourcing and privatization opportunities***
?? ***Integration of DoD with other government agency T&E resources***

D. INSTITUTIONAL VS. PROGRAMMATIC FUNDING

Next to personnel problems, the most common concern found within the test community during our Task Force data gathering was the negative impact of a shift from institutional to programmatic funding for test resource and facilities.

Acquisition Reform suggests that the military weapons system program being tested should pay for testing and that the military services and the DoD should not subsidize test facilities and resources. The test facilities and resources should operate like a *business* with funding only from the weapons system program being tested. Test facilities should maintain, operate, invest and expand by managing the revenues received from their government program "customers." In many cases they are expected to expand their marketing to provide testing services to the commercial sector.

Operating a test center *is not a business*. There is no opportunity to develop more "market share" or expand the "customer base." The delay of one or two major tests can cause a major financial crisis at any DoD test facility. There are sophisticated management systems that can insure efficiency in organizations that cannot be managed like a business. Necessary public services must be subsidized but need not be inefficient.

In keeping with this thinking, DoD's major T&E ranges operate under a DoD-wide funding policy that requires weapons programs to reimburse a portion of the costs while the Military Services provide institutional funding to finance the remainder of the costs. Since 1990 the Services have significantly reduced their institutional funding so that the current annual funding is about $1B per year below the 1990 amount after adjusting for inflation. This is about a 32 percent reduction at a time when workload has remained relatively robust. The cumulative reduction is about $8B from 1990 to 2000. As the institutional funds have been reduced, weapon programs have had to pay more of their scarce funds as the test centers search for ways to support critical T&E.

During facility visits made by this Task Force and through briefings received by this Task Force we found that there is fragile support for testing, as demonstrated in the F-22 and JSF program. In both cases, the first response by program management within the DoD to offset recent increases in program cost was to reduce the testing in both programs. The same organization that suggests that testing should be managed like a *business*, without subsidy, solves design cost overrun problems by reducing the test budget that is the only future source of revenue for the test community. Cutting the test budget of the F-22 and JSF does not have a measurable impact on *reducing* the future cost of operating the test ranges and facilities at Edwards or Patuxent River. Less program test budget translates into less revenue for the test center. This creates a *higher* cost per test event.

The creation of a Defense T&E Resource Management Enterprise could provide the necessary management to insure efficient operation, better testing and reduce or eliminate programmatic funding at many MRTFB test facilities.

E. STANDARDIZED FINANCIAL MANAGEMENT PRACTICES

Consistent financial management practices would ease the problem of interservice range utilization and make it possible to determine the value of making changes in facilities usage. It would also facilitate more efficient operations. At present we cannot measure either input or output values. This step would make it possible to measure input values.

Currently, top-level management of DoD's T&E capability is provided by the Reliance/Executive agent structure as shown in the following figure (Figure 1). This structure overlays the DoD T&E Command structure.

After three years of T&E Executive Agent existence, there are still three separate service investment priority lists. Each service has a different financial management system for T&E. The TOA (total obligation authority) for T&E investment in each service has never been changed as a result of any Reliance recommendation or T&E Executive Agent decision. OSD's CTEIP (Central T&E Investment Program), is the only investment funding that is specifically directed to investments that benefit multiple service applications. The TERIB, a board of T&E's most senior executives, prepares extensive investment plans that are rarely, if ever, approved, and a T&E program office (JPO T&E) exists with no acquisition or management authority.

The DOT&E command structure has little or no impact on T&E operation and maintenance budgets or funding, by far the greater portion of overall T&E funding.

The DoD T&E organizations, workforce and infrastructure should be funded and managed by a restructured T&E Resource Enterprise.

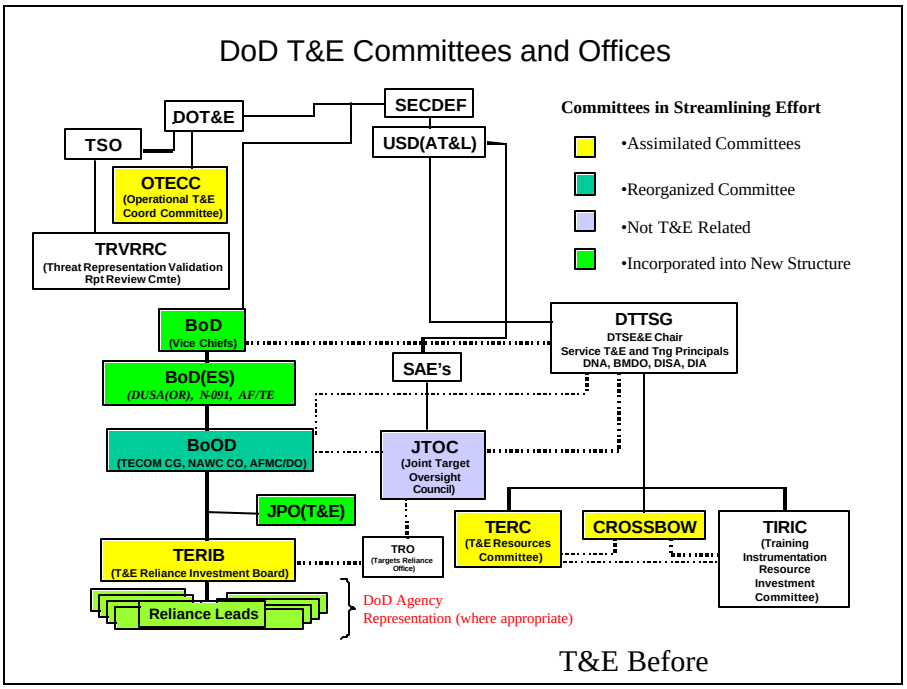

Figure 1

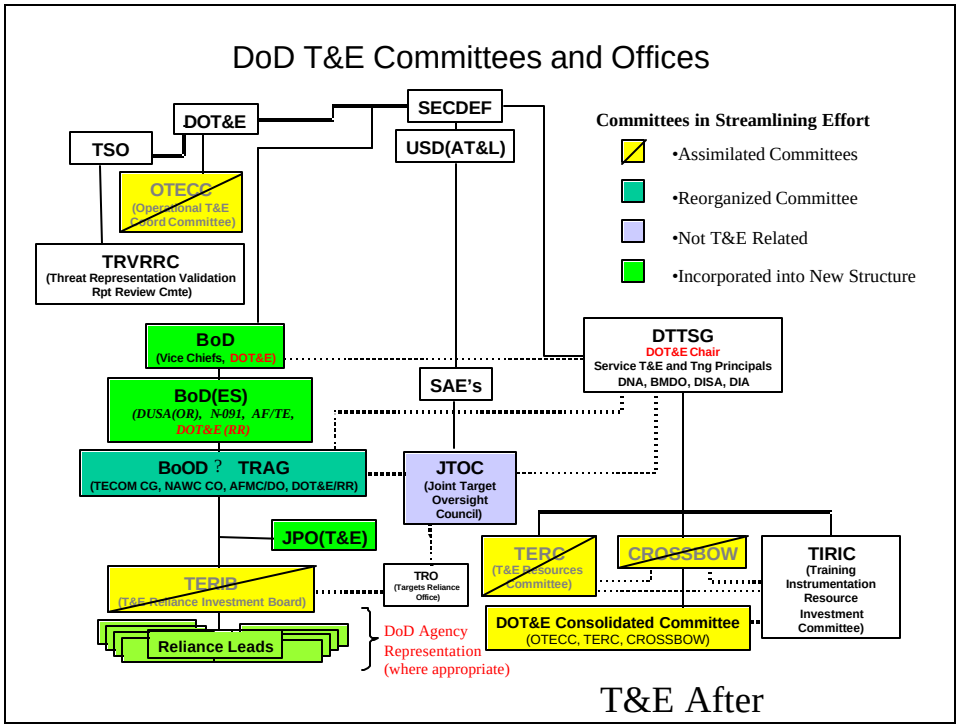

Figure 2

Finding

Management of the test facilities is made unnecessarily difficult by the fact that each of the Services uses different financial management methods to manage the affairs of their facilities. The panel could find no compelling reasons for the differences it noted.

Recommendations

1. **Implement a common financial management methodology for all T&E facilities.**

2. **Implement a system within a T&E Resource Enterprise to track the total cost of Test and Evaluation to the taxpayer.**

THE QUALITY OF TESTING

A. ACQUISITION REFORM INFLUENCE ON THE QUALITY OF TESTING

The systems below Acquisition Category (ACAT) I[1] in the priority system are being fielded without adequate testing to assure their effectiveness and utility to operating units. This is NOT to suggest that acquisition reform is a bad idea. It is to suggest that much more attention is required to the process by which T&E is carried out under acquisition reform, especially for lower priority programs.

The lower priority programs (and usually less well funded programs) have been under continuing pressure to reduce cost without impacting program schedule. In many cases the only solution to this problem is to decrease the number of test articles in the program, omit steps in the testing process, use more Modeling and Simulation (M&S) even if the M&S is not truly representative of the subject system, arrange for waivers to simplify testing and avoid trouble spots, etc.

Even for the ACAT I programs there is growing evidence that testing is not being done adequately. There are a number of examples of systems that proceeded into the next steps of the development and acquisition process without having the level and scope of testing that would have prepared them adequately for the next steps. There are even examples that were in operational use that exhibited failures (unexpected behavior) because parts of their operational envelopes were not explored during the acquisition process.

These examples raise some questions:

- ?? How do we determine how much and what kinds of testing are adequate for a military system?
- ?? Who has the authority to set the standards?
- ?? Who has the responsibility (accountability) for satisfactory operation of the systems in the hands of operational forces?

We have made significant progress embedding commercial-off-the-shelf (COTS) software in our weapons and information systems. But, we have not made equivalent progress in testing the adequacy of performance of COTS software in those systems

[1] ACAT designations for defense acquisition programs are determined by their projected costs – either RDT&E or procurement. For example, ACAT I programs – also known as Major Defense Acquisition Programs (MDAPs) -- are those estimated by the USD(AT&L) to require $335 million (FY 1996 $) for RDT&E or more than $2.135 billion (FY 1996 $) for procurement. Lower level ACAT (ACATs II, III & IV) designations are based on on a graduated scale of decreasing costs and result in decision authority being delegated to lower levels. There are four Acquisition Categories (ACAT):

1. ACAT I (usually Major Defense Acquisition Program (MDAP))
2. ACAT IA (usually Major Automated Information System (MAIS))
3. ACAT II (usually major systems)
4. ACAT III (all other acquisition programs)

A fuller description of ACATs can be found in Annex B.

Findings

1. **Testing is not being conducted adequately — if systems are not adequately tested they enter the inventory with latent defects that can be very costly and can impact operational effectiveness.**
2. **A particularly shocking finding is that there is growing evidence that the acquisition system is not meeting expectations as far as delivering high quality, reliable and effective equipment to our military forces.**
3. **The lack of testing cannot be blamed on the lack of facilities; however, limited infrastructure is a contributor to the lack of interoperability testing.**
4. **There is an increasing incidence of test waivers.**
5. **The T&E process is not funded properly – in phasing or in magnitude**
    a. **Funds are not available early enough**
    b. **Corners are cut in the testing that is done**
6. **There is not enough government capability for oversight of testing done by industry.**

Recommendations

1. **Review criteria for setting system's testing requirements and requirements for granting waivers.**
2. **Provide management tools to ensure adequate testing in major programs.**
3. **Develop a means to do joint interoperability testing on a realistic basis.**
4. **Make maximum use of testing in existing T&E, training and other operational facilities in seeking a solution to this need.**
5. **Reform the acquisition process in order to support the adequate and robust T&E of new weapons systems in order to produce weapons systems that work the first time, all the time.**

B. INTEROPERABILITY

More and more, important system attributes have to do with interoperability. Our system acquisition and testing process is still primarily a single service responsibility. There is growing evidence that interoperability determination is not a key parameter of testing adequacy even though the requirements of JV 2020 clearly make greater demands on system interoperation.

There is only one facility in the United States capable of doing joint interoperability testing however, it is specialized in information systems and not nearly as well used as it could be.

There is no facility capable of doing interservice interoperability testing of weapons systems and of the interactions between weapons systems and information systems. The recommendations expressed in “Management of T&E Resources, paragraph B Redundancy and Duplication of

T&E Facilities" would significantly improve interoperability and interdependency testing of aviation systems. It could start with Joint Strike Fighter, the largest most common and most joint program in history.

The Joint Interoperability Test Command (JITC) is a start, but is inadequate to carry out the kind of testing envisioned here.

C. INADEQUATE TESTING

Waivers

Waiver Process

Directives and instructions governing the DoD acquisition process require the conduct of an OT&E before full-rate production to evaluate a system's operational effectiveness and operational suitability as required by congressional statute (10 USC §2399). These documents further specify that, at the conclusion of such testing, the Director of Operational Test and Evaluation shall prepare a report stating whether the results of that OT&E confirm that the items or components *actually tested* are effective and suitable for combat. [italics added].

In addition, DoD 5000-2R requires that the developing agency "formally certify that the system is ready for the next dedicated phase of operational test and evaluation to be conducted by the DoD Component operational test activity. The developing agency shall also provide software maturity criteria and performance exit criteria necessary for certification for operational test."

The Navy's implementing instruction for this DoD regulation, SECNAVINST 5000.2B, introduces a waiver process that allows systems to proceed to this required period of OT&E, known within the Navy as operational evaluation (OPEVAL), even though the system fails to meet the performance exit criteria necessary for certification. In addition, this waiver process prohibits the Navy's Operational Test Agency (OTA), OPTEVFOR, from including waived items in its resolution of a system's Critical Operational Issues (COIs) in evaluating its operational effectiveness and suitability. This process appears to contravene the statutory requirement to report on the effectiveness and suitability of the system *actually tested*.

Types of Waivers

SECNAVINST 5000.2B establishes criteria as the "minimum required for certification of readiness to commence OPEVAL." Among those criteria are:

> "All DT&E objectives and performance thresholds have been met, or are projected to be at system maturity, and results indicate that the system will perform successfully in OT&E and will meet the criteria for approval at the next program decision milestone (e.g., full-rate production on completion of OPEVAL)."

Furthermore, DoD 5000.2-R requires the developing agency to identify the testing to be performed in OT&E [OPEVAL] in a Test and Evaluation Master Plan (TEMP) with details in an Operational Test Plan, both of which are approved by DoD's Director of Operational Test and Evaluation.

SECNAVINST 5000.2B allows waivers to both of these key requirements.

There are two kinds of waivers:

1) Waivers from compliance with the criteria for certification [of readiness for OPEVAL]

2) Waivers for deviations from the testing requirements directed by the TEMP."

Examples of Waiver Process Used in Current Programs

a) F/A-18E/F Super Hornet

For the OPEVAL of the F/A-18E/F Super Hornet, the CNO approved 49 waivers of which OPTEVFOR determined that 23 were relevant to OPEVAL. Waived items relevant to OPEVAL included known problems at the time with:

- Stores (5 items)
- Cockpit integration (4 items)
- Targeting FLIR performance (3 items)
- Radar performance (3 items)
- Performance in carrier operations (2 items)
- Radio mechanization (2 items)
- Miscellaneous (4 items)

In accordance with SECNAVINST 5000.2B, the OPTEVFOR Report of the Super Hornet's OPEVAL did not consider any of the waived items in his resolution of the COIs. Of particular note, several of the items were waived because they had demonstrated poor reliability during DT&E and were planned to be modified or replaced in future production. As a consequence of the CNO waiver, failures associated with such waived items and associated repair times were removed from the data base used by OPTEVFOR in its evaluation of the key suitability requirements – reliability, maintainability, and availability. Several of the waived items caused numerous failures and required large amounts of time for inspections and/or repairs during OPEVAL.

In addition, much of the maintenance on waived items was performed by the F/A-18E/F contractor rather than by the OPEVAL test team. As viewed through SECNAVINST 5000.2B, this is not a violation of the 10 USC §2399 prohibition of contractor participation in OT&E, since these items had been waived and therefore were not part of OPEVAL. This interpretation is difficult to reconcile with the statutory requirement to report on the operational effectiveness and suitability of the system *actually tested* – which appears to imply that all of the equipments and subsystems actually incorporated as part of the system under test are to be included in the analysis and reporting.

b) V-22 Osprey

At the time of the Operational Test Readiness Review, data collected to-date showed that the V-22 had failed to meet established thresholds during DT&E for overall reliability Mean Time Between Failure (MTBF) as well as false alarm rate of the Built-In Test (BIT) system as shown in Table 1. The program manager predicted at the time that, despite modifications incorporated into the low-rate initial production (LRIP) aircraft to be used in OPEVAL, the V-22 would fail to achieve the required thresholds on these key parameters in OPEVAL.

	Threshold	Status at end of DT&E	PM's Prediction for OPEVAL
MTBF	1.4 hours	0.64 hours	1.0 hour
False-Alarm Rate	25 %	88 %	78 %

Table 1: Reliability Thresholds

Despite these shortcomings from the "minimum [criteria] required for certification of readiness to commence OPEVAL," the program managers requested and obtained approval for waivers to both reliability and false alarm rate so that the V-22 could proceed on schedule to OPEVAL.

In addition, the CNO approved numerous waivers of the second kind – deviations from the testing requirements directed by the TEMP. Many of the waived items address specific capabilities required by the Joint Operational Requirements Document (JORD) or required subsystems not incorporated in the aircraft used for OPEVAL, but which are planned for future production lots. Example items include:

- ?? Aircraft not cleared for operations in icing conditions
- ?? Aircraft not cleared for air combat maneuvering
- ?? Inadequate cargo handling system
- ?? Radar altimeter not effective during forward-hook and dual point external loads, thus preventing night operations with such loads
- ?? No ground collision avoidance and warning system
- ?? Inadequate cockpit/cabin NBC overpressure protection

In accordance with SECNAVINST 5000.2B, OPTEVFOR's analysis to resolve COIs and evaluate the operational effectiveness and suitability of the V-22 will not use the waived items.

Finding

The process of handling waivers seriously undermines the T&E process – and may have already had negative impact on weapon systems

Recommendation

Regulation SECNAVINST 5000.2B should be modified to rule out waivers as a unilateral action by Service authorities.

D. ARMY RELIABILITY TESTING

Recent experiences with Army acquisition systems serve as evidence that our process is not delivering high quality, reliable, and effective equipment to our military forces. While the examples cited here and in the following table are Army programs, indications are that similar problems exist with the programs of the other services.

It appears that we often fail to carry out adequate testing, and in those cases where we do, to take the corrective actions needed based on the results of that testing. In many cases, we allow our acquisition programs to proceed to their next phases, such as moving from development or technical testing to operational testing or moving from development into production and

deployment with our combat forces, when the test results we have gathered clearly indicate the systems are not ready.

The following table presents data gathered by ATEC during various operational test activities involving a wide range of Army programs, from the Acquisition Category (ACAT) 1D Javelin down to the ACAT 4 Quick Erect Antenna Mask (QEAM) Program. The data show that, in the last several years, Army systems failed to meet even 50% of their specific reliability requirements in 80% of those tests.

Table 2: Supporting Army OT&E Reliability Test Data

System	Test Type	Test Dates	Parameter[2]	Test Duration (hours)	Require-ment (hours)	Point Estimate (hours)	ACAT Level
Met Requirements							
IFLIR –- M2A3 BFVS IBAS CIV	LUT 2	Aug-Oct 98	 MTBOMA MTBOMA	 2180	 340 320	 509 **509**	3
JAVELIN Command Launch Unit Basic Skills Trainer	Field Data To Support Material Release	Various	MTBOMF MTBOMF	190 1244	129 110	**190** **138**	1D
JSTARS CGS	ORDT	Jan-Feb 99	MTBSA	440	48	**220**	1C
Did Not Meet Requirements							
JSTARS CGS	IOTE	Mar-Apr 98	MTBSA	400	48	10	1C
DUECE	FOTE	Apr-98	MTBSA	200	53	37	3
HF NOE COM	IOTE	Apr-May 97	MTBMAF	183	141	61	3
ISYSCON	IOTE- II	Sep-Oct 98	MTBSA	650	157	59	3
ISYSCON	IOTE- I	Feb-Mar 98	MTBSA	773	157	22	3
ATNAVICS	IOTE-1	Feb-99	MTBOMF	181	220	16	3
ATNAVICS	IOTE-2	Jul-99	MTBOMF	319	220	29	3

[2] Reliability Parameters

System	Test Type	Test Dates	Parameter[2]	Test Duration (hours)	Require-ment (hours)	Point Estimate (hours)	ACAT Level
IFLIR - M1A2 SEP TIS + DAHA CITV + CID	FOTE 3a	May-Jul 99	MTBOMA MTBOMA	275	340 320	275 69	3
JTIDS, Class 2M	IOTE	Nov-96	MTBOMF	270	323	23	1D
JTIDS, Class 2M	LUT	Dec-97	MTBOMF	877	323	51	1D
AN/TYQ-69	IOTE	Aug-Sep 97	MTBOMF	1145	385	52	3
JTIDS	IOTE	Nov-96	MTBOMF	270	393	25	1D
JTIDS	LUT	Dec-97	MTBOMF	877	393	146	1D
3 KW Generator	IOTE	May-99	MTBOMF	316	500	158	3
SCAMP	IOTE	Nov-98	MTBOMF	563	600	13	3
SMART-T	IOTE	May-Jun 98	MTBOMF	1508	700	43	1
QEAM	User Test	Aug-97	MTBOMF	631	745	315	4
DVE	FOTE	Mar 97-Mar 98	MTBOMF	699	900	175	3
FBCB2 (Appliqué)	LUT	Aug-96	MTBEFF	6360	910	167	1
FBCB2 (V2 Enhanced)	LUT	Aug-96	MTBEFF	1953	910	385	1
BCIS	LUT	Jun-96	MTBEFF	1698	1242	28	2

[2] Reliability Parameters

MTBOMA: Mean Team Between Operational Mission Abort
MTBOMF: Mean Team Between Operational Mission Failure
MTBSA: Mean Team Between System Abort
MTBMAF: Mean Team Between Mission Affecting Failure
MTBEFF: Mean Team Between Essential Function Failure

Clearly, such poor reliability results have had and will have an adverse impact on the performance of the equipment in the hands of the soldier and in combat. Frequently these poor results have been "showstoppers" at reviews supporting program milestone decisions and have often resulted in costly program delays, design changes and retests. On the other hand, in too many cases, programs have proceeded to the next phase of the acquisition process, despite such

poor results. Such decisions have resulted in unplanned burdens on the operational forces, in terms of increased maintenance workload and people, spare parts requirements, overall system availability, and operating and support costs.

Examination of the causes for these high failure rates in operational tests reveals that, in most cases, the systems had encountered reliability problems in earlier development testing. In fact, recent Army data show that, of those systems that failed to meet the point estimates for their critical reliability criteria required for entry into operational testing, nine out of ten failed to meet their operational requirements in operational tests. Of those programs that did demonstrate their reliability point estimates in development testing, only six out of ten successfully passed their reliability requirements in their OT&Es.

There are several contributing factors – overall poor design, unrealistic requirements, ineffective corrective actions, high risk tests, et al – to this rather dismal record. In some cases, the development testing has not been robust enough to successfully uncover design deficiencies, if they exist, or to pinpoint those areas of the operating envelope or situations where the system breaks down or is unsafe. For whatever reason – whether it be lack of resources or unrealistic schedule demands – we appear to have cut corners and sent programs into the next phase of their development and testing before they are ready. The "rush to failure" tag put on the THAAD program by the Welch committee is a good example of this problem.

Figure 3, developed by the Army Test and Evaluation Command, reflects this poor record for a broader array of programs and test events than displayed in the prior table.

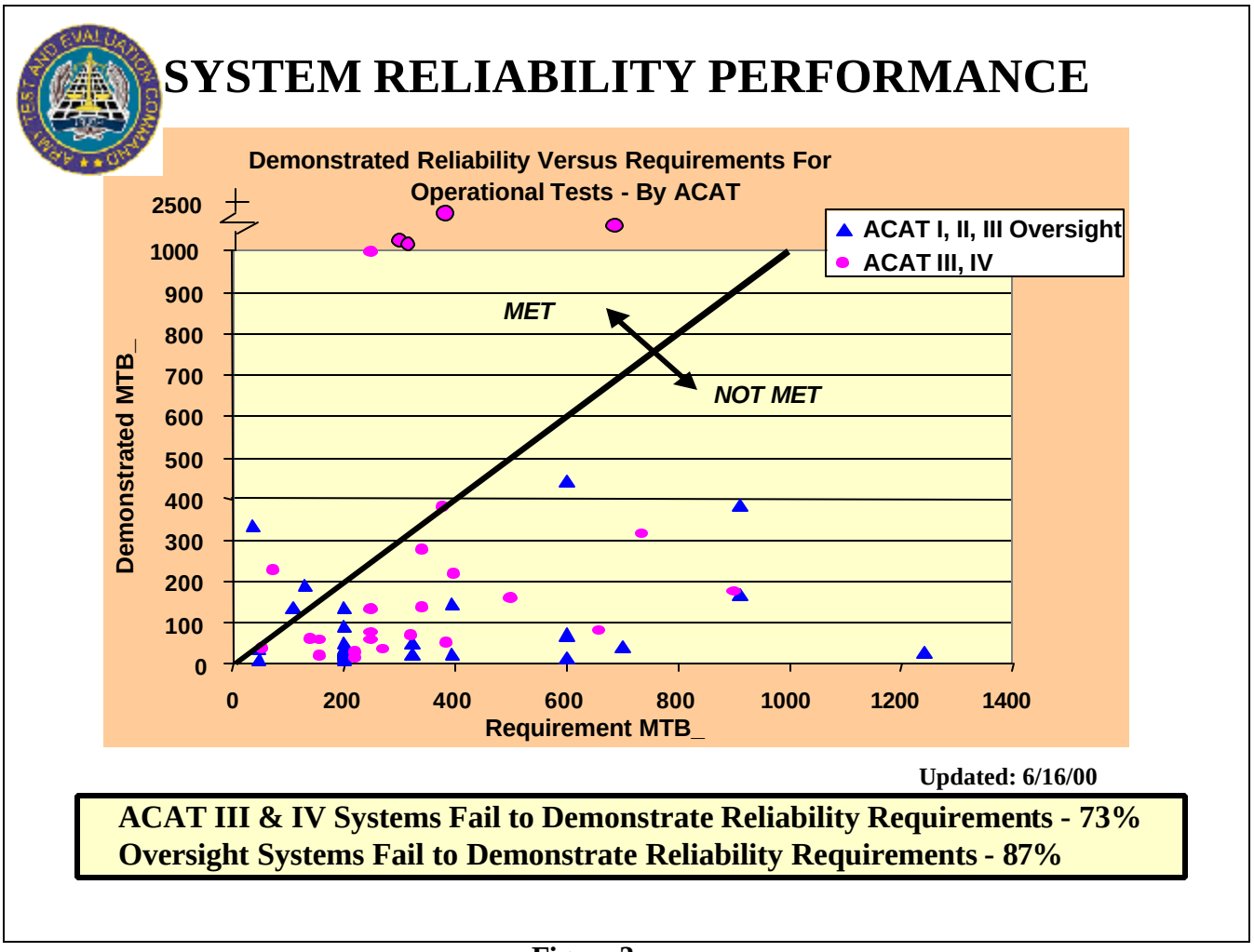

Figure 3

This Task Force acknowledges the efforts of Congress and DoD to address these shortfalls. However, there is concern that these are short-term efforts. These temporary measures to offset this problem should be followed with more permanent measures to support T&E at the Service level.

E. FUNDING FOR TESTS

The T&E process is not funded properly, in either its phasing or in its magnitude. Despite the rhetoric about early involvement of testers in programs, about testing for learning, or about discovering design and operational problems early-on, we are not allocating sufficient funds early enough to avoid costly redesigns, modifications or deferrals late in a program's life. Furthermore, programs are cutting corners in the testing that is being done.

The MV-22 Example

For example the MV-22 program severely reduced early development testing in its Engineering and Manufacturing Development (EMD) phase in order to save money and recover schedule.

The official investigation by the Marine Corps into the tragic accident that occurred during operational testing this past April makes that point in spades.

Their report, *Investigation into the Circumstances Surrounding the Class "A" Aircraft Mishap Involving an MV-22B Osprey Buno 165436 That Occurred on 8 April 2000 at Marana Northwest Regional Airport Near Tucson, Arizona*, is quite revealing in this respect. On page 74 of the report, under Section VII, Related Issues, appear the following paragraphs:

> 361. There were four developmental test flights dedicated to section operations.
>
> 362. There were **three** developmental test events flown as part of the V-22 EMD Flight Control System Development and Flying Qualities Demonstration (FCSDFQ) Test Plan investigating power settling.
>
> 363. The original FSDFQ Test Plan called for **103** test conditions to be flown. In an effort to recover cost and schedule, the conditions to be tested were reduced to **49**, focusing on aft center of gravity conditions that were thought to be most critical. Of the **49** conditions, **33** were flight-tested. The **33** flight conditions were flown at nacelle angles of 90 degrees and 97.5 degrees at 40 knots and at nacelle angles of 30 degrees to 75 degrees at 150 knots. The 16 conditions not flown were those at zero knots and twenty knots and at 40 knots and 80 knots at high gross weight.

Thus, in order to save dollars and make up for schedule slips, the important FCSDFQ testing was severely curtailed – roughly one-third of the planned test events were actually flown – and particularly critical test points were not flown at all.

Congressional Concern Voiced

The problem of inadequate funding of testing has become a Congressional issue in their deliberations on the President's FY 2001 budget request. The following extract from the report on the House Defense Appropriations Bill, for FY 2001 (page 151) addresses the underfunding of operational test activities within the services.

> *"The Committee [HAC] is concerned that the Military Departments are not adequately budgeting for operational testing. The Committee understands that severely constrained operational test budgets are forcing the Services' operational test communities to focus reporting only on the highest profile programs with small and medium sized programs proceeding into production without formal reporting from the operational test community. The Committee believes that this situation must be corrected and fully expects the Military Departments to budget adequately to ensure all programs benefit from an appropriate level of independent operational testing."*

The House in essence "put its money where its mouth was" by fully funding, for example, all 52 validated FY 2001 Air Force IOT&E requirements as opposed to the 34 test activities included in the President's Budget (PB). In short, the Air Force had left 18 test activities unfunded in the PB, more than one-third of its validated requirement for FY 2001. The final Appropriation Bill for

FY 2001 reflected the HAC's position of fully funding the Air Force's operational testing requirement.

Impact of Army Underfunding of T&E

The Army test and evaluation command (ATEC) was established in October 1999 by consolidating the Army's development test, operational test and evaluation activities. It is responsible for development testing, operational testing, live-fire testing and all evaluation within the Army.

Underfunding of T&E activities continued in the Army's POM 2002-2007 whose funding levels were based on the FY 2001 PB which itself had left significant shortfalls in meeting critical T&E requirements. Since that latter budget was submitted to Congress in early 2000, T&E requirements have increased due to the Army Transformation. While sizeable shortfalls in funding affect all of ATEC's activities with future adverse consequences, we use the Army's projected funding for operational testing as a case in point and to raise a red flag.

Within the Army, acquisition program managers fund operational testing for ACAT I systems. On the other hand, operational testing of ACAT II through IV systems is funded with resources provided by the Army to ATEC. Based on years of experience in planning and implementing operational testing for acquisition systems, some of which end up slipping their schedules, ATEC considers the minimum acceptable level of funding for ACAT II-IV systems to be 65% of anticipated test requirements.

During the POM period of FY 2002 through 2007, ATEC will be required to plan, execute and report on over 80 ACAT II-IV systems in support of acquisition program milestone decisions. This number will likely increase over time as program managers solidify their projections. The purpose of this operational testing is to ensure a unit equipped with a weapon system can accomplish assigned missions and that the weapon system is operationally effective, operationally suitable, survivable, and lethal.

The Army's POM 2002 – 2007 funded ATEC at $133 million in FY 2002 through 2007 (vice the $190 million needed to fund the 65% requirement) to plan and conduct these operational tests. This funding would have provided ATEC coverage of only 46% of the planned 80 operational tests during the POM period. The PB funded ATEC at this same level of 46% of requirements in FY 2001 and the POM perpetuated this shortfall into the foreseeable future. This shortfall would have resulted in some 30 or so ACAT II-IV system operational tests not properly funded in the coming five or six years. Either, program managers would have been forced to allocate their tight funding at the last moment to fill this shortfall or the critical testing would simply not have taken place as planned. Based on an issue paper prepared by the DOT&E and presented to the Defense Resources Board in the summer of 2000, funding was added to the Army's program to meet the 65% requirement in 2002-2007.

The Task Force strongly recommends that this additional funding be protected throughout the Army's Budget Estimate Submission (BES) and the subsequent Program Budget decision (PBD) processes leading to its inclusion in the President's Budget submission to the Congress after the first of the year. The Task Force also recommends that the OSD Comptroller take steps during his development of PBDs this fall to add funding to the various Service T&E accounts to permit them to meet their critical testing requirements.

SPECIFIC T&E INVESTMENTS

The Task Force also found the state of the infrastructure -- to include physical plant, range real estate, instrumentation, data reduction and analysis capabilities, targets, personnel among other facets of test planning and conduct -- in need of near term investment and high level emphasis in order to meet the requirements for effective T&E of future new weapons and operational concepts.

While there are clearly near term needs in many areas, the Task Force felt that three particular activities deserved immediate, high level attention:

?? Frequency spectrum management and investment

?? Development and investment in embedded instrumentation

?? Development and investment in more realistic targets

A. FREQUENCY SPECTRUM MANAGEMENT

The conduct of T&E requires the use of many bands of radio frequencies. Vital to effective T&E are those systems that provide Time, Space, Position Information (TSPI); telemetry; control of unmanned vehicles and targets; threat simulation; and safety/flight termination. All of them operate across the frequency spectrum. The demands on frequency spectrum when conducting interactive live/simulation test events are particularly great.

The increase in the complexity and capabilities of new weapon systems has resulted in a need for ever higher data rates. New systems such as unstable or fly-by-wire aircraft (F-22, JSF, etc.); advanced multi-mode, multi-band missile seekers (NMD, AMRAAM Block IV, etc.); and Joint Vision 2010 systems (UAVs, Directed Energy Weapons, Multi-Spectral Stealth etc.) are good examples. If the current trend continues, this dramatic increase in complexity will result in telemetry data rate requirements projected to grow to 78,000kbps by 2015 (as compared to 100kbps in the mid-1970s).

Other factors are creating additional demands for frequency spectrum. More complex and more capable systems also call for greater geographic separation and a larger number of test participants. This is particularly true in testing simultaneous engagements by Ballistic Missile Defense (BMD) Systems at long ranges. An increased emphasis on interoperability testing has also resulted in an increase in the number of test participants, as have the requirements for System-of-Systems testing. These demands will soon outstrip our ability to test effectively. The data requirements of the mid-1970s were such that the technology available at that time permitted 1,000 simultaneous test missions, while the projected data requirements are such that current available technology may permit the conduct of only one mission at a time in 2015.

Encroachment on DoD's radio frequency spectrum by growing commercial interests has also accelerated. For example, the commercial demand created by global cellular phones, two-way paging, direct broadcast satellite, etc., has led to the loss of 93 MHz of 583 MHz allocated to TSPI, target control and telemetry as a result of the government's sell-off of frequency spectrum used in testing. The government's auctioning of frequency spectrum appears to be continuing

with little or no effective DoD effort to protect its vital interests. To date, the test community has been able to compromise or work around each loss as it takes effect; however, starting later this year, additional major losses will begin to take effect that can not be accommodated by workarounds.

For instance, the major loss in the S-band will impact much-needed follow-on testing of the F-18E/F as well as the F-22 program, among others. Basically, fewer tests will be able to fly in a given time period and some planned multiple engagement tests may not be possible at all.

The loss of spectrum is also affecting DoD's resource enhancement program (REP). For example, one test program needed an unexpected $2 million increase in order to adjust to the impact on its Time, Space, Position, Information (TSPI) & target control missions, still resulting in a less reliable communications system for these users. We might be seeing just the tip of the iceberg of problems here. All of our telemetry, TSPI and target control infrastructure will eventually need significant modification or replacement, as the impacts of spectrum loss become evident.

The Deputy Secretary of Defense realigned spectrum management within the DOD in December 1997 in an attempt to centralize spectrum management within the DOD. The Office of Spectrum Analysis & Management (OSAM) was formed within Defense Information System Agency to coordinate and execute spectrum policy throughout the DOD. The Joint Chiefs of Staff reactivated the Military Communications-Electronics Board's Joint Frequency Panel (JFP) chaired by the Director of OSAM to foster better interaction between the spectrum policy makers and the Warfighters. Spectrum management is still very fragmented. For example, even though the Service's Spectrum Managers were co-located with OSAM they remain responsible to their Service chiefs. And, the Director of OSAM does not report to the Director of Spectrum management within ASD(C3I). Despite these provisions, one of the major users of frequency spectrum, the Test and Evaluation community, does not have clear and ready access to the decision maker and little participation in the process.

DoD must focus high-level attention in the near term on its growing spectrum management problems, both at the headquarters and the field levels. The long term impact on its vital activities, far broader than just the T&E area, of potential future encroachments should be evaluated and steps taken in inter-agency forums to at least slow down this continuing reallocation of frequency spectrum by the federal government.

Recognizing that stopping this practice may not be possible, there are several steps DoD should take in the near term in order to mitigate its adverse effects on T&E. We need to increase the numbers and skills of test range frequency managers and develop the tools to allow them to more effectively manage spectrum resources. We should also increase the funding of current and emerging R&D efforts aimed at allowing us to use our remaining spectrum more efficiently in the near term. In addition, the funds should be provided to foster increased cooperation between the various spectrum users, especially between DOD and NASA.

A number of R&D efforts are currently underway that have the potential to address some of the near term effects of spectrum encroachment, but more is needed. Some examples of programs currently underway that should help us better manage our spectrum include:

?? Advanced Range Telemetry (ARTM): This project is investigating advances in commercial telecommunications for potential technical improvements.

?? Multi-Service Target Control System (MSTCS): This project will provide a spectrally efficient and reliable RF link for all targets.
?? Advanced Range Data System (ARDS): This project will apply state-of-the-art TSPI technology to provide a data link architecture to support advanced weapon system platforms.

Clearly, we need to recognize that weapon systems will continue to become more complex and that demands for spectrum access will grow accordingly. It behooves us, therefore, to also prepare to meet our long-term needs not only for T&E purposes, but across the board, DoD should fund the research needed to make more efficient use of its present allocations, explore the use of higher frequencies for T&E usage, and develop entirely new ways of communicating in the test environment.

One such initiative is the Advanced Concept Technology Demonstration Program (ACTD) recently proposed by DOT&E. This proposal consists of a series of Advanced Technology Demonstrations (ATDs) to evaluate selected, mature commercial technologies, such as Code Division Multiple Access (CDMA), for T&E applications. Of particular interest to this program is the concept of a Real Time Telemetry Network (RTTN), which builds on technological developments in RF usage such as advanced modulation, efficient power amplifiers, and low noise receiver front ends. Other techniques for the management of baseband data (e.g., Efficient Baseband Coding, Advanced Lossless Compression) will be used, as will means to support a high speed wireless network through the use of improved wireless protocols and high speed packets.

Findings

1. **T&E requires frequencies in many bands of radio spectrum for many support functions**
2. **Increased weapon system complexity/capability requires higher telemetry data rates**
3. **More complex/more capable systems requires larger geographic separation/larger number of players which requires MORE SPECTRUM**
4. **Spectrum continues to be lost to DoD**
    a. **Growing commercial interests will lead to increasing encroachment**
    b. **Government selling off of spectrum has already adversely impacted DoD's T&E capabilities**
    c. **Future outlook is for even more losses**

Recommendations

1. **Develop technologies/techniques to meet near term test requirements**
    a. **Increase numbers, skills and tools of frequency managers in T&E Organizations**
    b. **Increase Funding of Existing or Emerging R&D Efforts Leading to More Efficient Use of Spectrum**
    c. **Increase Cooperation between Spectrum Users (e.g., DoD/NASA)**
2. **Fund research efforts to meet long-term growth in test requirements**
    a. **More Efficient Use of Present Allocations**
    b. **Explore Use of Higher Frequency Bands for T&E Purposes**
    c. **Develop and Field Alternative Means of Communications**

3. **Work in Interagency fora to prevent further loss of spectrum essential to testing of future military systems.**
4. **Add a permanent member from the T&E community to the Frequency Panel of the Military Communications Electronics Board to provide guidance on frequency spectrum aspects of T&E.**
5. **Strengthen the voice of the T&E community in both national and international arenas where frequency spectrum policy decisions are made to ensure that adequate assessments of the impacts of these decision on our ability to thoroughly test our defense systems and ensure readiness.**

B. EMBEDDED INSTRUMENTATION

Benefits of Embedded Instrumentation

Embedded, non-intrusive instrumentation installed in the system-under-test would have great benefits, as well as provide a long range overall cost savings to the DoD. These benefits include not altering the physical characteristics, performance or other signatures of systems, they are non-intrusive, and they can provide the capability to monitor performance, supportability, and other characteristics of a system throughout an entire life cycle. However, there are no DoD policies or requirements to compel programs to incorporate this capability in their systems under development or in production. And, there are other barriers to embedding instrumentation.

Barriers to Embedded Instrumentation

Clearly upfront planning and funding of embedded instrumentation in a new weapon system is necessary to incorporate these capabilities in its design, development and production phases. As with other similar efforts requiring early allocation of resources, such as more comprehensive and realistic testing early-on in a program's development, this initiative will also meet with resistance from program managers without high level direction or policy dictating its incorporation.

Some degree of embedded instrumentation already exists in many weapon systems as part of their operational data buses (e.g., the "1553 data bus") and built-in-test (BIT) subsystems. However, for the most part, they lack the means to export this information, to condition it, and to transmit it for real time operations or to store the data for post mission analysis. Furthermore, in some cases, uplinked information is also required that will interact with functions onboard a system during its testing.

In other cases, such as missiles and munitions, embedded instrumentation would need to include a complete suite of data sensors and the conditioning and transmission/storage capabilities as well as uplinked controls and data capabilities. Adding antennas to advanced systems-under-test that have stealthy features, smart skins and/or conformal surfaces will definitely adversely affect measurements for effectiveness In short, these antennas required for down-and-uplink transmissions can become intrusive instrumentation.

In addition to cost considerations, another hurdle facing any DoD-wide effort to develop and incorporate embedded instrumentation in weapon systems is the current lack of standards for

data requirements and protocols across the various test and training ranges and facilities. The current Foundation Initiative 2010 should address this critical problem.

Requirements Considerations

The requirements for such capabilities should be driven by several considerations. Incumbent on the DoD weapon system development and test and evaluation communities is the demonstration of the operational effectiveness (including accuracy) and functionality, suitability, lethality, and survivability of various classes of munitions systems that include cannon direct and indirect fire weapons, tactical missiles and rockets, sub-munitions, and smart weapons. Experimental munitions must also be evaluated during exercises such as Advanced Concept Technology Demonstrations (ACTDs) and Advanced Warfighting Experiments (AWEs). As these munitions systems become more complex, developers and testers will require substantially more data to statistically confirm and validate system performance.

A need exists for directly measuring launch and flight dynamics for tube-launched direct/indirect fire weapons, powered/thrusting, gliding sub-munitions, and missile systems and to continuously measure the internal functioning of the munition (terminal sensors, guidance, navigation, control systems, etc.) in real-time or near real-time. We lack accurate and sufficient data to support high fidelity laboratory modeling and simulation efforts that are becoming a growing component of both developmental and operational testing as well as training.

Onboard instrumentation capable of providing all the necessary data on every test article should reduce the number of required test firings and the number of firings required for safety certification and stockpile surveillance. We will need RF data transmission capabilities at various power levels depending on the specific application, multiple antenna systems to accommodate the use of Global Positioning System (GPS) as a sensor and the retransmission of all data to a ground station.

Environmental considerations will require all systems be safe for use and disposal on test ranges. As an example, the use of lithium ion battery technology over lithium metal should significantly reduce the levels of environmentally hazardous materials in test instrumentation systems. Unit production costs must be kept low enough to make its use both cost-effective and affordable in all weapon system applications, including unique single article or low quantity tests and to respond to time critical user tests and schedules.

Current Data Limitations

Currently, data on free-flight tests can only be collected by expensive one-of-a-kind telemetry measurement systems. The routine collection of data during the launch cycle and throughout the trajectory for missiles and weapons is not currently available on a cost-effective basis to support tri-Service test and training operations for programs such as the Advanced Medium Range Air-to-Air Missile (AMRAAM), AIM-9X, Joint Direct Attack Munition (JDAM), Joint Standoff Weapon (JSOW), High Speed Anti-Radiation Missile (HARM), LOCAAS, ATACMS, BAT, Javelin, THAAD, Patriot and Standard Missile.

We require four range functions for such activities:

?? Telemetry to evaluate the performance of the weapon and to provide the status of missile systems

- ?? TSPI to determine where the platform is on the range for range safety purposes and to assist in evaluating the platform's performance.
- ?? End-game scoring to determine miss distance between a missile and its target, so critical in evaluating the missile's lethality
- ?? Flight termination, used by range safety to keep a missile or target within the prescribed footprint on a range.

Currently, there is no *single*, integrated airborne instrumentation package that supports these four functions. Generally, the instrumentation systems that do exist are range specific and fairly expensive to employ. Advances in GPS technologies, such as kinematic processing and small digital translators, along with other advances in miniaturized TM components and processing electronics will make it possible to provide the following:

- ?? An interoperable instrumentation package consisting of modular components capable of providing simultaneous over-the-horizon TM, TSPI, end game scoring, and flight termination for multiple missiles/targets.
- ?? A test and training capability not limited to specific ranges
- ?? A more cost-effective GPS-based solution to end-game scoring
- ?? A Range Safety approved, dual redundant, flight qualified flight termination package that will reduce qualification costs for weapons, and decrease the "time-to-test" phase.

At the present time, there is no instrumentation system in the inventory that will perform the required functions (for both testing and training) of real-time casualty assessment (RTCA) and digital communication data collection, including the collection of digital message traffic to evaluate situation awareness, as well as fit on the dismounted soldier without adversely affecting the weight and maneuverability of the soldier; i.e., non-intrusive. To evaluate the effectiveness of the digitized dismounted soldier, a simulated RTCA battle needs to be conducted against a standard equipped soldier and data collected and analyzed that addresses such events and factors as trigger pull, target range, and munitions fire.

Examples of Relevant Investment Programs Underway

There are several programs underway that are aimed at providing embedded instrumentation capabilities in the future. The following are examples of such programs that the DoD should support and expedite:

Hardened Sub-miniature Telemetry and Sensor System (HSTSS)

The HSTSS program will develop the capability to provide continuous direct measurements and data from launch to impact of a wide variety of munitions. HSTSS will be comprised of systems that are configurable to specific weapon systems and meet multi-service requirements. Technologies involving micro-sensors, RF telemetry, flexible power supplies, data acquisition systems, and electronics packaging will be used to provide the following capabilities:

- ?? Measure and telemeter data pertaining to weapon system launch/flight dynamics and weapon system internal functions from launch to impact.

?? Survive extremely high-g launch (axial and rotational shocks) and the down range flight environments.

?? Be configured so as to fit within direct fire and artillery projectiles, sub-munitions, tactical missiles, and rockets of various designs without adversely affecting moments of inertia, center of gravity, and weapon system performance.

?? Programmable signal conditioning and processing.

?? For cannon-launched weapon systems, delayed output to permit the storage of in-bore/tube/canister acquired data for transmission after the test article has cleared the tube/canister and ionized gases.

?? Maximum compatibility with present telemetry equipment and ensure maximum compatibility with existing IRIG Standards (106-96) and range TM frequency allocations.

?? Ability to use present mobile telemetry ground stations.

Dismounted Troop Instrumentation (DMT)

DMT will interface with Land Warrior (LW) to provide RTCA during simulated battles as well as collect digital communications data during Force XXI evaluations. Target weight is 5 lbs. for the RTCA module and 2.5 lbs. for the Dismounted Field Data Collector (DFDC). Target size is the dimension of an ammo magazine. To reduce size and weight, "Chip-on-board" hybrid circuit technology with high-density packaging will be utilized.

Joint Advanced Missile Instrumentation (JAMI)

The JAMI program will develop qualified telemetry, TSPI, end game scoring and flight termination components and subsystems that can be integrated into instrumentation packages of missiles and targets for testing and training applications. JAMI will incorporate global positioning system (GPS) based technology as the TSPI and a vector scoring engine. JAMI will also address the feasibility of a solid state programmable safe and arm device.

Long Term Needed Investments

DoD programs should be directed to embed instrumentation in their system designs. This instrumentation should be interoperable and compatible with the Foundation Initiative 2010, and such training systems as Joint Tactical Combat Training System (JTCTS).

Findings

Embedded, Non-Intrusive Instrumentation will benefit T&E.

1. **Does not alter the physical characteristics, performance or other signatures of system**
2. **Non-intrusive in operation of a weapon system -- either in T&E, training exercises or other operations**
3. **Provides the capability to monitor performance, supportability, and other characteristics of system throughout entire life cycle**

4. **Provides more accurate, faster turnaround data during T&E or training events, permitting more rapid feedback on performance of system or of combat unit**
5. **Can reduce the cost of T&E, training exercises, acceptance testing, etc. if planned as part of system production process**
6. **Can significantly reduce opposition by training community to combined testing and training events**
7. **Enables interoperability and standardization of range instrumentation and modeling and simulation among test and training ranges**

Recommendation

The acquisition executive should direct the inclusion of embedded instrumentation in future weapons systems. The Test and Training Steering Group should define the initial step of establishing the detailed requirements for such systems.

C. INVEST IN TARGETS THAT ADEQUATELY AND REALISTICALLY TEST FUTURE WEAPONS

The lack of threat representative targets is one of the most significant hindrances to realistic T&E and training. The following section reviews issues pertaining to targets for Ballistic Missile Defense (BMD), targets for Anti-Ship Cruise Missile (ASCM) Defenses, targets for Navy Countermine Systems, and targets for Aircraft Weapon Systems. These four areas are not the only areas needing threat representative targets, but are illustrative of the problems with and improvements needed with targets for T&E and training.

Exploitation of Commercially Available Foreign Military Weapons as Targets and Operational Test Threats

DoD should consider the purchase of foreign weapons systems that can be used as targets. With the demise of the Soviet Union many of the potential targets that US Forces will encounter can be purchased in the global weapons market. These vehicles and systems (aircraft, tanks, communications systems, and threat munitions) are far less expensive to purchase than to simulate. In many cases their simple control systems are readily adapted to unmanned operations and can serve as both real and affordable targets. The ownership, modification and operation of these targets/threats can be affordably outsourced.

Targets For Ballistic Missile Defense (BMD) System T&E

Status of the Current Inventory

Both ground- and mobile-launched targets make up the planned and current inventory to be used in the testing of BMD systems. Among the ground-launched targets are Hera, Aries, Lance, Foreign Material Acquisition (FMA) systems, Storm and Black Brant. Of these, Hera can be equipped with any one of four front-ends to simulate both unitary and separating threats. However, Hera's two-stage booster does not match the projected threats' IR signatures and radar cross sections (RCSs). While Storm can also simulate both unitary and separating threats, the remaining ground-launched targets are unitary only.

The mobile-launched targets include the Short-Range Air-Launched Target (SRALT) and the Long-Range Air-Launched Target (LRALT). SRALT uses the same front-ends as the Hera. The LRALT booster currently fits to a single front-end. All of these targets are in relatively short supply. Present plans reflect future use of 21 Heras, 7 FMAs, 16 Lances, 11 SRALTs and 5 LRALTs.

Issues with the Current Inventory

The development and acquisition of threat representative targets in time to meet test schedules is a major risk for BMD programs. For example, SRALT is needed for much of DT/OT for the Navy Area Theater Ballistic Missile Defense (TBMD) program. However, the IR signature of the current SRALT target does not match the threat and its downrange accuracy is inadequate for at-sea testing. The TBMD Program Manager and the Ballistic Missile Defense Office (BMDO) recently awarded a contract that will correct the SRALT shortfalls, but the time may be too short for development of the target to be available for DT/OT of TBMD.

Lethality testing for the Airborne Laser (ABL) against realistic target missiles is a major issue. Non-FMA targets may not have the same materials and design to replicate laser lethality adequately. Because of funding constraints, no new targets deploying completely new boosters or front-ends can be developed and available before FY 2005. The ABL's DT/OT prior to that time will use targets already in place, precluding realistic T&E against certain threat representative targets.

Target reliability continues to hinder BMD T&E, especially multiple simultaneous engagement tests. Problems with the Hera target in early Patriot PAC-3 testing and the failure of the target system to properly deploy the decoy balloon in the 7 July National Missile Defense (NMD) test (IFT-5) are indicative of this problem. Counting the failures during PAC-3 testing, Hera has an overall record of 12 successful shots out of 15 attempts. The target launch systems used in NMD's IFT-3, IFT-4, and IFT-5 each consisted of a Multi-Service Launch System (the deployment bus) mated to a three-stage Minuteman II booster (M55A, SR-19, and M57A). The target suites flown in these flight tests were identical -- a Medium Reentry Vehicle (MRV) and Large Balloon -- and were deployed from the Multi-Service Launch System at preset times. IFT-3 and IFT-4 had no target deployment anomalies. However, the Large Balloon failed to deploy during IFT-5. The cause of the failure to deploy the Large Balloon during IFT-5 is still under investigation.

Another example of reliability problems occurred during the recent Navy Pacific Blitz exercise (a multi-ship/multi-threat operational exercise) where less than half the targets deployed as planned. Out of a total of ten TBM and AAW targets planned to be launched over a three-day period of the exercise, only three were launched on-time and in the right place. Problems included hardware failures, missiles hung on launching aircraft and targets directed into the wrong trajectories.

In the end, we may need to bear the expense of launching more than the actual number of desired targets in order to meet engagement requirements

Target Developments

Development of targets for BMD testing is driven to large degree by the INF treaty that banned certain classes of medium- to long-range missiles. Targets that fall within the banned ranges must be designed to abide by the treaty. Recycled Minuteman boosters, which are not banned under the INF treaty, are often used as target boosters for BMD testing.

The current targets are not keeping up with the evolving threat, The development and acquisition of threat-representative targets for some BMD threats are currently uncertain propositions at best. Many available foreign missiles are two-stage threats, whereas the Hera features three stages – a two-stage booster and a front-end. The number of booster stages is critically important for programs, such as the Navy Theater Wide (NTW) BMD system that initiate track on the target complex and then divert to the reentry vehicle in-flight, and for the ABL system, that engages during boost phase.

Additional effort is urgently needed provide suitable targets for boost and ascent phase systems such as ABL and NTW. The Task Force recommend that the USD(AT&L) direct the Services to undertake -- on a high priority and fully-funded basis – the development and fielding of target systems that meet requirements for booster RF and IR signatures in order to meet the T&E schedules for those programs aimed at defeating threat missile systems during the boost and ascent phases of their employment.

Targets For T&E Of Anti-Ship Cruise Missile (ASCM) Defense Systems

Status of Current Inventory of ASCM Targets

The majority of the Navy's ASCM targets are based on upgraded designs originally developed over 30 years ago. These latest versions include the BQM-34S, BQM-74E, and VANDAL (MQM-8G/ER/EER) drones. However, these latest upgrades will soon be unable to represent projected emerging threats adequately. Targets derived from actual threats are available, but only in very limited numbers. These targets include the MA-31, (based on the Russian AS-17), Harpoon and Exocet.

In addition, the VANDAL supersonic seaskimming target, converted from the 1960s vintage TALOS missile, is in short supply. The TALOS has not been produced in many years and the Navy now has only about 80 VANDALs left in its inventory. This quantity will last but a few more years for T&E purposes, assuming none are used for fleet training.

Issues and Limitations

The current targets are not keeping up with the evolving threat to surface ships, which is becoming faster and more maneuverable. For example, recent efforts to develop maneuvering targets, such as the VANDAL Extended Extended Range (EER) and the BQM 74 Universal Replacement Auto Pilot (URAP), are being outstripped by new threats. The newest threats perform maneuvers and achieve speeds that cannot be replicated.

In addition, the Navy's efforts to integrate combat systems, such as the Ship Self defense System (SSDS), require targets that accurately represent threat signatures in multiple RF and IR bands simultaneously. These requirements frequently conflict. For example, threat emitter simulators are incompatible with low RF-signature treatments on the BQM-74. Both are required to provide

representative inputs to radars and electronic support systems whose tracks are correlated within SSDS.

Because of the target limitations in speeds, maneuvers, RF and IR signatures, as well as physical dimensions, recent tests have been forced to use actual threats such as Harpoon and Exocet missiles. However, these targets are frequently older variants that do not represent the newest threats. Furthermore, they are expensive to convert to range targets. For example, range safety requires that flight termination systems be installed requiring a costly process, particularly when performed on only a few targets.

Over the past several years there have been efforts to develop a new supersonic target to replace the VANDAL inventory. Recent contract awards in FY00 to develop a new supersonic target (SSST) with an IOC in FY05 and to procure MA-31 targets to bridge the period until the SSST is introduced in FY05 will adequately address this class of supersonic seaskimming missile, *provided* that the MA-31's are delivered by the Russian government as currently contracted for.

Recently, new ASCM threat analysis indicated that the current and projected Navy target ASCM procurements would have a critical limitation to present the threat capability throughout its flight profile. The ability to address this threat presentation limitation is exacerbated by resource sponsorship issues within the Navy where there is three different funding sponsors for target procurement and target development in support of test and training.

Losses due to target reliability and target operation concept of operations continue to unnecessarily reduce the inventory of available targets. For example, the VANDAL target historically has a reliability of approximately 70% thereby requiring multiple backup targets for any particular test.

Needed Improvements

We recommend that the USD(AT&L) direct the Navy to continue to fully fund their planned ASCM program that includes the T-21, SSST and planned procurements of the MA-31. In addition, the Navy needs to develop or procure a new capability that will address recent threat limitation within the current and projected antiship target suite. This program should include a combination of continuous improvements to current targets (particularly ASCM targets), further efforts to buy sufficient quantities of foreign cruise missiles to be used as targets and, when needed, small-scale development efforts to procure limited numbers of new targets to fill gaps in the Navy's inventory.

Additionally, the Navy should rapidly replace the Self Defense Test Ship so that more advanced systems may be integrated on the new platform and the high risk to testing associated with the current hull deterioration is mitigated.

Targets For T&E Of Navy Countermine Systems

Status of Current Inventory of Countermine Targets

Most of the targets available for T&E are obsolete US mine shapes. The Navy has a few foreign threat mines that have been inerted but are otherwise operational. The Versatile Exercise Mine System (VEMS), a mine simulator, is also available for T&E.

Issues and Limitations

Old US mine shapes lack target sensors and have no processing capability. They are not threat representative sonar targets and cannot be used to test minesweeping systems or the susceptibility of Navy ships/systems to threat mines. The Navy's inventory of foreign mines can be used for these purposes, but does not include all threats of interest and is very limited in size. VEMS presents a large sonar target that is not representative of some threats, and the Navy's library of mine emulation programs does not include all viable threats. The VEMS mine simulations have not been accredited for OT&E, and the system is reputed to have poor reliability.

Needed Improvements

We need to improve VEMS in-water reliability and to accredit existing VEMS mine simulations. As information on evolving threats becomes available we need to develop new simulations. We should procure anechoic jackets so that VEMS target strength can be matched to the threat being emulated and should also procure VEMS packaged in threat shapes (e.g., Manta). A robust foreign mine exploitation program should be supported with sufficient resources to build up the inventory of high priority threat mines.

Targets For Aircraft Weapon Systems

Status of the Current Inventory of Aircraft/Missile Targets

The principal aerial targets currently in the inventories of the US Air Force, US Army and US Navy are:

- QF-4, a remotely controlled version of the F-4 Phantom aircraft;
  - The Air Force QF-4 is based upon the F-4 E/G
  - The Navy QF-4 is based upon the F-4S
- BQM-34S, an upgraded version old *Ryan Firebee* drone, in use since the Vietnam era;
- BQM-74E *Chukar* drone built by Northrup-Grumman – a smaller, slower drone used to represent an anti-ship cruise missile;
- AQM-37D, a Navy, expendable, supersonic simulated threat missile, launched from the QF-4.
- MQM-107D, a sub-scale, subsonic drone that has a wingspan of 10 feet;
- MQM-8G/ER/EER VANDAL, a Navy ramjet-powered TALOS missile converted to a surface-launched, expendable, simulated anti-ship threat missile.
- MA-31, a Russian cruise missile.

The Air Force maintains an inventory of approximately 66 QF-4s. The Air Force annually consumes about 16 QF-4s in operational losses, averaging about 3.6 missions per QF-4 loss. The Air Force estimates that there are enough F-4s available for conversion to meet their needs through 2010-2015. The Navy currently has 13 QF-4s in its inventory, but funds continued conversion of F-4S aircraft into the drone configuration over the next several years. The Navy aerial targets inventory also includes some 280 BQM-34s, 220 BQM-74s, 240 AQM-37s, 80 MQM-8 VANDALS and 8 M-31s.

Issues with Current Inventory of Aerial Targets

There are several critical issues associated with Air Force and Navy targets for aerial weapon systems. Typical is the lack of interoperability between Air Force and Navy aircraft drones. While the Air Force and Navy both use QF-4s as their only full-size aircraft targets, the versions of the QF-4 used by the two-services differ to the extent that as instrumented each can be controlled only with the control station of its Service associated test range. As a result, for example, Air Force QF-4s are flown at Tyndall AFB, but cannot be flown at the West Coast range, and similarly, NAWCWPNS-based Navy QF-4s cannot be flown on Air Force ranges.

In addition, although the unrestricted version of the QF-4s can be remotely controlled to pull a maximum of about 8.5Gs, in practice they are not routinely maneuvered aggressively during tests or training exercises. This limitation detracts from the tactical realism of T&E events in that a manned tactical aircraft would most likely maneuver more violently in a threatening scenario, such as an incoming enemy missile. Furthermore, the frequency band used for target control (around 915 MHz) is congested, with frequent interference of/from other users.

BQM-34s and other drones fly pre-programmed trajectories, again lacking aggressive, responsive maneuvering, as routinely executed by manned tactical aircraft. While a vector doppler system has been developed to provide miss distances against full scale targets (QF-4s), it is too large for use with smaller, sub-scale drones. In addition, while the vector doppler system provides accurate miss distances with non-maneuvering full-scale targets, accurate miss distance measurements of maneuvering targets remains problematic.

Available targets do not provide good representations of all threat cruise missiles, stealthy tactical aircraft and larger bomber-sized targets, although the currently perceived threat may reduce the criticality of the latter.

Needed Improvements

The Navy currently funds an active Aerial Systems Development program with about $30M per year through FY2003 that pursues the developments of a subsonic sub-scale aerial target and a supersonic sea skimming target. In addition, the Navy has programmed about $60M in FY2000 through FY2003 in Weapon Systems T&E Development/Procurement, primarily to convert F-4S's into QF-4s.

Conversely, while maintaining a reasonable procurement program to convert F-4s and to acquire drones, the Air Force has no funding for target development. This is of particular concern since, in accordance with Project Reliance determinations; the Air Force has assumed the lead role for Full-Scale Aerial Targets and for Target Control Systems, two of the areas needing development improvements.

Although the Services estimate that the F-4 inventory can supply QF-4s through about 2010, the F-4 already is unrepresentative of modern threat aircraft and to have a new full-scale aerial target available in 2010 (for example, a QF-16) RDT&E funding must be programmed in the FYDP -- and there are no signs that this is likely to occur.

Target control continues to be a significant limitation to fully exercising aerial targets in support of test and training. Historical test and training range unique development of target control systems has resulted in a lack of target interoperability between test ranges and likewise with training ranges. This condition has increased the cost of operations within the Navy, since any

design change on a target must be implemented into the various target control systems on their test and training ranges.

Under the Joint Improvement and Modernization (JIM) projects, the development of the Multi-Service Target Control System (MSTCS) is being conducted. MSTCS will move drone and target control from the congested 915MHz band to a less congested band (around 1315 MHz), add GPS capabilities, and provide the same control system at the target control ranges of each of the three Services (Tyndall AFB, White Sands Missile Range, and NAWCWPNS, Point Mugu). However, while the basic development is funded under JIM, each service is responsible for "productionizing" the equipment to fit into their drones/targets and for procuring the end items. The Air Force has not included such funds in its the FY2002 POM.

The Task Force recommends the USD(AT&L) direct the Services to fully fund, in the FY2002-2007 FYDP, a single Target Control Systems programs including the MSTCS program and in FY2004-2010 a program to replace the current QF-4 platform.

In addition to these needed development improvements, targets must be employed in a more tactically representative manner. Specifically, since manned tactical aircraft equipped with missile warning equipment routinely maneuver aggressively to counter incoming missiles, targets must be controlled to perform similar realistic maneuvering. This may require both new equipment development as well as new operational procedures for both testing and training.

Findings

1. **T&E and training problems caused by diminishing target resources will become critical in the near future.**
2. **Increased emphasis on a comprehensive target program is urgently needed, that will identify the need for target development or foreign platform acquisition.**
3. **The acquisition executive should require an OSD level target acquisition plan and provide for funding the plan in the POM.**

Recommendations

1. **DoD should consider much greater use of foreign aircraft and anti-aircraft systems that could be used as targets.**
2. **A critical review should be made of any acquisition program that develops its own targets.**
3. **DoD implement a program to insert technology into targets to reduce presentation cost by making targets more reliable and supportable to test and training.**
4. **DoD must adequately fund target development for T&E.**

USE OF TRAINING FACILITIES/EXERCISES FOR T&E EVENTS

The changing training environment will provide opportunities and incentives for combining training and test events. This section will discuss the potential payoffs, drawbacks and critical considerations of combined testing and training.

CHANGING ENVIRONMENT PROVIDES MORE OPPORTUNITIES/INCENTIVES

One of five new themes for operational test and evaluation articulated by Secretary of Defense William Perry in 1995 was the concept of conducting testing during training events. The idea of combining testing and training events is not a new idea for the Services. In the 1960s the Army's 11th Air Assault Division conducted operational evaluations of the new air mobility concept with regularly scheduled field exercises. In the 1970's there were frequent operational evaluations conducted on new equipment in the 1st Cavalry Division during training events. Both the testing and training communities were conducting evaluations of unit performance in the field, either with new equipment or without.

During the 1980s, however, a divergence in the processes of the testing and training communities began. Armed with advanced range instrumentation, the focus of operational testing shifted to structured analytical design and more extensive data collection, primarily aimed at finding the causes of operational deficiencies. Weapon performance replaced unit performance in importance.

Simultaneously, the training community was changing its emphasis away from unit evaluations and grades, to free play, feedback, learning, and after action reviews. The concept of conducting testing at training events became less feasible, both because the testers now had extensive and intrusive data collection requirements that degraded the realism of the training, and because the trainers had changed their focus from unit evaluations to discovery and correction of errors. The focus of both communities had shifted away from what had made them common in the beginning, to that of evaluating unit performance in the field.

The decline in recent defense budgets and the downsizing of military forces, along with Secretary Perry's 1995 initiative and recent OSD emphasis on early user involvement in the testing of equipment, have given the concept of combining testing and training events heightened interest. Coupled with these OSD initiatives are added incentives for the T&E community to economize and combine with training events. First, there has been an increase in T&E requirements imposed by the growing requirement to test for joint interoperability and by the complexities of the modern battlefield. Second, sensor and information technology have caused an increase in the number and complexity of C4ISR systems, which require robust test events and forces to evaluate operational effectiveness and suitability.

POTENTIAL PAYOFF FOR COMBINED TRAINING/T&E EVENTS

Reflecting these opportunities and incentives, the Services have successfully conducted several combined events in recent times. Examples include testing of the Navy's DDG-51 OT-IID2

during a Battle Group Exercise, the Marine Corps' operational assessment of AFATDS at Twenty-Nine Palms, and the Air Force's F-15C/D MIDS Fighter Data Link MOT&E during an All Service Combat Identification Evaluation Team (ASCIET) exercise at Fort Stewart. The Air Force's JSTARS is noted for its testing during wartime deployments to Operation Joint Endeavor in Bosnia in 1995 and 1996. It should be noted that during these deployments JSTARS met no T&E objectives – it is an "unqualified" success.

Operational tests seek to test a system within the context of two broad questions: first, "Is the system operationally effective" and second, "Is the system suitable for employment." These questions must be tested and answered by not only testing the specific new system, but by also testing it within the broader context of mission, organization, doctrine, support, and personnel. T&E access to larger training facilities and space, and the use of more realistic threat forces, will add to test realism and provide the broader operational context for system effectiveness evaluations.

Early user involvement in the development process, to include early testing, provides a means to modify or experiment with new concepts, as well as tactics, techniques, and procedures (TTPs). Moreover, early user involvement provides opportunities for earlier identification of system deficiencies and evaluation of the training support package or support concept.

Operational field units also bring to the table current equipment, doctrine, and TTPs, thus providing the opportunity to compare the capabilities of new and old systems. Field training exercises provide more operationally oriented critiques and evaluations, including After Action Reports (AARs), inputs from the trainers (such as the National Training Center Observer Controllers), OPFOR AARs, and real-time casualty assessment (RTCA). More importantly, this feedback is given immediately, without the time delay associated with a more formal T&E event.

POTENTIAL DRAWBACKS OF COMBINED TRAINING/T&E EVENTS

Differing philosophies and objectives can lead to conflict and compromise of a system's schedule and of the controlled structure necessary for system testing. The operational training schedule – driven by real-world commitments and competing requirements from the chain of command – is generally inflexible and not necessarily in line with system schedules and acquisition milestones. T&E requirements can take a back seat to operational priorities to maintain combat readiness. In such an environment, the T&E community is not an equal partner.

For the most part, training events teach about known information. Feedback is vital during a training event, and is often used to alter the flow of events. This philosophy is the antithesis of the test event, which starts with a hypothesis, is working with unknown information, and seeks repeatable test trials and events. As the T&E community adapts to the priorities of the training exercise, it must often live with less data, less statistical confidence, and the introduction of unplanned variables. The quality of the data may become a secondary consideration.

Data collection (such as videotape retrieval) and contractor support – frequent characteristics of test activities – can be intrusive to the training unit and cause disruptions to the normal tactical flow of events. The mere presence of non-tactical support contractors can change the training environment from tactical to administrative, adversely affecting the training. Conversely, observer controllers at training exercises can skew test results by artificially inflicting casualties on a unit to force a particular training event such as medical evacuation, or to force the unit to

demonstrate continuity of command when leaders become casualties. Events can be halted and "re-cocked" if the training value has deteriorated. Such events, while necessary for training, can be detrimental to operational testing.

Finally, the Commander's interest in training and the readiness of his personnel and units will motivate a strong interest and involvement in the evaluation of the training exercise/test. This interest may conflict with the need for independent analysis provided by the operational tester.

CRITICAL CONSIDERATIONS FOR COMBINED T&E/TRAINING EVENTS

There are many similarities that argue for moving toward a middle ground in combining training and T&E events. Both are simulated combat operations that take place in a field environment, usually in the presence of a thinking enemy. If the operational test community would focus on the unit performance in the field, accepting some reduction in the amount and precision of the system data collected, and if the training community can accept some degree of unit evaluation during the event, then the two communities should be able to profitably combine their efforts, and save scarce resources. Combining the two events demands careful attention to satisfying the objectives of each. This is a difficult task, requiring early and close cooperation between the testers and the trainers, and some mechanism for resolving the inevitable disputes.

A clear chain of command, coupled with cooperative informal relationships up and down the chain, are essential to tailoring each other's events to meet its objectives. The operational tester must be clear about exactly what they are seeking from a training event, and must be in constant communication with the trainers to insure that the event will provide it. Conversely, the trainer must be aware of exactly what the tester is trying to do, and try not to structure training objectives that will conflict or obscure the test objectives.

Clearly developed TTPs, technically mature hardware and software, robust support packages, and well-trained units are requirements for both the operational test event and the training event. This degree of technical and support maturity requires successful Developmental Testing (DT) and clearly defined criteria for entry into operational testing. The immature system risks abandonment by the trainers if it does not work, or if it is unreliable and not properly supported.

These principles were successfully demonstrated by the Army's Combat Aviation Training Brigade and Operational Testing and Evaluation Command in 1990 during the Dual Station Unit Fielding and Training Program (DSUFTP) for the Kiowa Warrior, an interim armed reconnaissance helicopter. DOT&E determined that the same training exercise could be used as the Initial Operational Test and Evaluation (IOT&E) for the helicopter, to avoid the costs of conducting a second test.

OSD developing and formalizing processes for combining training and T&E will capitalize on its own initiatives to conduct more combined events and on opportunities and benefits spelled out in preceding paragraphs. Without such high level attention and direction, these opportunities and benefits are not likely materialize in the foreseeable future.

At the same time, initiatives to improve range instrumentation and data collection, particularly in the area of embedded instrumentation, will provide both the test community the tools it needs to insure analytical structure while minimizing the impact on operational training as well as providing the users with a means of monitoring the performance of its equipment throughout its life cycle. The need for better spectrum management affects both operational tests and field

exercises, as testers and operational forces compete for limited, and dwindling, available frequencies and bandwidth.

Finding

There is potential for high payoff from combining training and testing.

Recommendations

1. **DOT&E take the initiative to establish processes and procedures with training activities to facilitate combining testing and training events.**
2. **Fund initiatives to improve frequency spectrum management; to provide interoperability and standardization of test and training range instrumentation/data collection and analysis systems; and to provide embedded, non-intrusive instrumentation and data retrieval systems.**
3. **Fund initiatives that will provide research and development investment in resources and technologies to solve common test and training requirements.**

ANNEX A.

Terms of Reference

THE UNDER SECRETARY OF DEFENSE

3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION AND
TECHNOLOGY

02 FEB 1998

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference -- Defense Science Board Task Force on Defense Test and Evaluation Capabilities

You are requested to form a small Defense Science Board (DSB) Task Force on Test and Evaluation (T&E) capabilities. The Task Force should conduct an analysis of what Department of Defense Test and Evaluation capabilities are required to support systems development and T&E for Joint Vision 2010 and beyond. This study will consider the recently completed studies by the Defense Science Board Task Force on Test and Evaluation and on Defense Science and Technology Base for the 21st Century.

In the Science and Technology Base Study, the DSB recommended that OSD and the Services should enhance the productivity of the Service laboratories and centers by organizational and especially physical consolidation. In the T&E study, the DSB recommended that "DoD should develop a T&E Facility investment strategy, based on the inventory and future needs, to assure ability to meet DoD T&E needs through the most effective and efficient combination of all national facilities." Both studies recognized the challenges of ensuring a sufficiently talented and trained government staff. Similarly, Section 913 of the National Defense Authorization Act directs the Secretary of Defense to convene a DSB Task Force to analyze the resources and capabilities of all laboratories and test and evaluation facilities and to identify opportunities to achieve efficiency and reduce duplication of efforts.

Joint Vision 2010 provides an operationally based template for the evolution of America's Armed Forces. It is intended to leverage technological opportunities to achieve new levels of effectiveness and joint warfighting. Further, we wish to emphasize 2010 and beyond, since some required T&E capabilities will take several years to develop. Additionally, it is appropriate for you to assess our investment strategy in T&E capability and our anticipated ability to properly test and evaluate future military systems. In that assessment, please consider all national test and evaluation capabilities including, for example, those operated by NASA, FAA, and DOE.

The Under Secretary of Defense (Acquisition, Technology and Logistics), the Director, Defense Research and Engineering, and the Director of Operational Test and Evaluation will collectively co-sponsor separate laboratory and test and evaluation capability task forces. The Congress requested "an analysis of the resources and capabilities of all of the laboratories and test and evaluation facilities of the Department

of Defense...." Accordingly, please coordinate with Dr. Walt Morrow who will serve as the Chairman of the Laboratory Task Force. A single report, incorporating the efforts of the two task forces will be submitted to the Secretary of Defense and Congress not later than August 1, 2000. Mr. David R. Heebner will serve as the Chairman of the Test and Evaluation Capabilities Task Force. Dr. John Wiles, from the Office of the Director of Operational Test and Evaluation, will serve as Executive Secretary. LTC Scott McPheeters, USA, will serve as the Defense Science Board Secretariat Representative.

The Task Force will operate in accordance with the provisions of P.L. 92-463, the "Federal Advisory Committee Act," and DoD Directive 92-463, the "DoD Federal Advisory Committee Management Program." It is not anticipated that this Task Force will need to go into any "particular matters" within the meaning of Section 208 of Title 18, U.S. Code, nor will it cause any member to be placed in the position of acting as a procurement official.

ANNEX B.

Mandatory Procedures for Major Defense Acquistion Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs

THE FOLLOWING DESCRIPTIONS OF ACAT PROGRAMS ARE TAKEN FROM DOD REGULATION 5000.2-R., PARAGRAPH 1.3.

SUBJECT: MANDATORY PROCEDURES FOR MAJOR DEFENSE ACQUISITION PROGRAMS (MDAPS) AND MAJOR AUTOMATED INFORMATION SYSTEM (MAIS) ACQUISITION PROGRAMS

1.3 Categories of Acquisition Programs and Milestone Decision Authorities

Upon initiation, size and complexity shall generally categorize acquisition programs. The categories are:

1. Acquisition Category (ACAT) I (usually MDAPs)
2. ACAT IA (usually MAISs)
3. ACAT II (usually major systems)
4. ACAT III (all other acquisition programs)

A complete description of each ACAT follows.

1.3.1 ACAT I

ACAT I programs are MDAPs or programs designated ACAT I by the MDA. An MDAP is an acquisition program that is not a highly sensitive classified program (as determined by the Secretary of Defense) and that is: (1) designated by the Under Secretary of Defense (Acquisition and Technology) (USD(AT&L)) as an MDAP, or (2) estimated by the USD(AT&L) to require an eventual total expenditure for research, development, test and evaluation (RDT&E) of more than 355 million in fiscal year (FY) 1996 constant dollars or, for procurement, of more than 2.135 billion in FY 1996 constant dollars (10 USC §2430).

ACAT I programs have two sub-categories:

1. ACAT ID, for which the MDA is USD(AT&L). The "D" refers to the Defense Acquisition Board (DAB), which advises the USD(AT&L) at major decision points.

2. ACAT IC, for which the MDA is the DoD Component Head or, if delegated, the DoD Component Acquisition Executive (CAE). The "C" refers to Component.

The USD(AT&L) designates programs as ACAT ID or ACAT IC.

1.3.1.1 Delegation of Milestone Decision Authority for ACAT I Programs

All ACAT I programs fall under the responsibility of the USD(AT&L). The USD(AT&L), at any time, may delegate Milestone Decision Authority of an ACAT I program to

the DoD Component Head who may redelegate to the CAE. If the USD(AT&L) redesignates a formerly ACAT ID program as an ACAT IC program, the following direction shall apply:

1. Exit criteria (see 3.2.3) established by the USD(AT&L) prior to the delegation of decision authority shall be maintained in effect unless the USD(AT&L) concurs with any changes;

2. The CAE shall approve Acquisition Program Baseline (APB) (see 3.2.2) changes, including updates for threshold breaches, and provide a copy of the new APB to USD(AT&L);

3. Acquisition strategies (see 3.3), including CAIV objectives (see 3.3.4) and LRIP quantities (see 1.4.4.1), established by the USD(AT&L) prior to the delegation of decision authority shall be maintained in effect during the phase for which approval was given, unless the USD(AT&L) concurs with any changes. When the next milestone approaches and an updated acquisition strategy is prepared for the next phase of the ACAT IC program, it shall not be subject to USD(AT&L) approval;

4. The OSD Cost Analysis Improvement Group (CAIG) need not conduct Independent Cost Estimates for ACAT IC programs unless specifically requested by USD(AT&L). This request usually accompanies the designation of the program as ACAT IC.

1.3.2 ACAT IA

ACAT IA programs are MAISs or programs designated by the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (ASD(C3I)) to be ACAT IA. A MAIS is an AIS acquisition program that is (1) designated by the ASD(C3I) as a MAIS, or (2) estimated to require program costs in any single year in excess of 30 million in FY 1996 constant dollars, total program costs in excess of 120 million in FY 1996 constant dollars, or total life-cycle costs in excess of 360 million in FY 1996 constant dollars. MAISs do not include highly sensitive classified programs (as determined by the Secretary of Defense). For the purpose of determining whether an AIS is a MAIS, the following shall be aggregated and considered a single AIS: (1) the separate AISs that constitute a multi-element program; (2) the separate AISs that make up an evolutionary or incrementally developed program; or (3) the separate AISs that make up a multi-component AIS program.

ACAT IA programs have two sub-categories:

1. ACAT IAM for which the MDA is the Chief Information Officer (CIO) of the Department of Defense (DoD), the ASD(C3I). The “M” (in ACAT IAM) refers to Major Automated Information System Review Council (MAISRC).

2. ACAT IAC, for which the DoD CIO has delegated milestone decision authority to the CAE or Component CIO. The “C” (in ACAT IAC) refers to Component.

The ASD(C3I) designates programs as ACAT IAM or ACAT IAC.

The DoD Component is responsible for notifying the USD(AT&L) or ASD(C3I) when cost growth or a change in acquisition strategy results in reclassifying a formerly lower ACAT program as an ACAT I or IA program.

1.3.3 ACAT II*

ACAT II programs are defined as those acquisition programs that do not meet the criteria for an ACAT I program, but do meet the criteria for a major system, or are programs designated ACAT II by the MDA. A major system is a combination of elements that shall function together to produce the capabilities required to fulfill a mission need, including hardware, equipment, software, or any combination thereof, but excluding construction or other improvements to real property. A system shall be considered a major system if it is estimated by the DoD Component Head to require an eventual total expenditure for RDT&E of more than 135 million in FY 1996 constant dollars, or for procurement of more than 640 million in FY 1996 constant dollars, or if designated as major by the DoD Component Head (10 USC §2302(5)). The MDA is the DoD CAE.

* Not applicable to ACAT IA programs.

1.3.4 ACAT III

ACAT III programs are defined as those acquisition programs that do not meet the criteria for an ACAT I, an ACAT IA, or an ACAT II. The MDA is designated by the CAE and shall be at the lowest appropriate level. This category includes less-than-major AISs.

Definitions:

1. Major Automated Information System (MAIS) Acquisition Program. An AIS acquisition program that is (1) designated by ASD(C3I) as a MAIS, or (2) estimated to require program costs in any single year in excess of 30 million in fiscal year (FY) 1996 constant dollars, total program costs in excess of 120 million in FY 1996 constant dollars, or total life-cycle costs in excess of 360 million in FY 1996 constant dollars. MAISs do not include highly sensitive classified programs (as determined by the Secretary of Defense). For the purpose of determining whether an AIS is a MAIS, the following shall be aggregated and considered a single AIS: (1) the separate AISs that constitute a multi-element program; (2) the separate AISs that make up an evolutionary or incrementally developed program; or (3) the separate AISs that make up a multi-component AIS program.

2. Major Defense Acquisition Program (MDAP). An acquisition program that is not a highly sensitive classified program (as determined by the Secretary of Defense) and that is: (1) designated by the Under Secretary of Defense (Acquisition and Technology) (USD(AT&L)) as an MDAP, or (2) estimated by the USD(AT&L) to require an eventual total expenditure for research, development, test and evaluation of more than 355 million in fiscal year (FY) 1996 constant dollars or, for procurement, of more than 2.135 billion in FY 1996 constant dollars (**10 USC 2430**[i]).

3. Major System. A combination of elements that shall function together to produce the capabilities required to fulfill a mission need, including hardware, equipment, software, or any combination thereof, but excluding construction or other improvements to real property. A system shall be considered a major system if it is estimated by the DoD Component Head to require an eventual total expenditure for RDT&E of more than 135 million in FY 1996 constant dollars, or for procurement of more than 640 million in FY 1996 constant dollars, or if designated as major by the DoD Component Head (10 USC 2302(5)ii).

---

[i] Title 10, United States Code, Section 2430, Major defense acquisition program defined (these amounts have been increased pursuant to the statutory notice provided to Congress)

[ii] Title 10, United States Code, Section 2302(5), Definitions