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DEFENSE SCIENCE BOARD

**REPORT OF TASK FORCE ON
TEST & EVALUATION POLICIES**

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FEBRUARY 17, 1977

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DEFENSE SCIENCE BOARD

**REPORT OF TASK FORCE ON
TEST & EVALUATION POLICIES**

**OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D.C.**



OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

February 17, 1977

MEMORANDUM FOR THE SECRETARY OF DEFENSE

THROUGH: THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

The attached report of the Defense Science Board Task Force on Test and Evaluation Policy was prepared at the request of the Director of Defense Research and Engineering. The Task Force was chaired by Dr. Eugene G. Fubini and included members from industry and the Office of the Deputy Director (Test and Evaluation), ODDR&E.

An earlier Defense Science Board Task Force on Test and Evaluation, established in 1972, had summarized and delineated general guidelines for Department of Defense review and monitoring of the test and evaluation aspects of development programs. The current Task Force concentrated on T&E policies. To do its work, and reach its conclusions, the Task Force examined a small group of representative programs which have had attention to test and evaluation from the office of the Deputy Director for Test and Evaluation, (DD/T&E), and drew upon the extensive experience of its members with a wide range of defense systems.

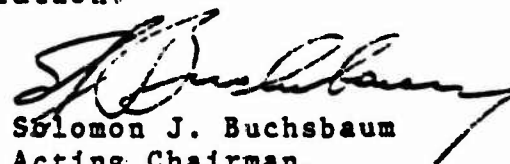
In the present review of T&E policies and directives, the Task Force concluded that T&E is a fundamental and integral part of current system acquisition procedures. Further, they find little or no overtesting being done; what testing is done contributes to the improvement and verification of system performance.

I wish to call to your attention two recommendations of the Task Force:

(1) Risk assessment; the Task Force believes the responsibility for overall risk assessment goes beyond the evaluation function assigned to DD(T&E), and belongs with an executive with broad responsibilities in the area of acquisition and evaluation.

(2) The Task Force recommends that the office and functions of T&E at the OSD level report to the same Executive.

The report has been approved by the Defense Science Board and I recommend it for your consideration.


Solomon J. Buchsbaum
Acting Chairman,
Defense Science Board



OFFICE OF THE DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

20 December 1976

MEMORANDUM FOR THE CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Final Report of the Task Force on Test and Evaluation Policies

On April 13, 1976, Dr. Currie asked me to undertake the responsibility of chairing a DSB Task Force to reopen the earlier Task Force's investigation of T&E and to focus on T&E policies and procedures that will assist in making efficient and effective use of T&E activities. Since that time, the Task Force has been organized and six weapon systems have been examined. From the examination of these systems and from the experience of its members, the Task Force has developed a set of recommendations relative to T&E policies and organizations.

The conclusions and recommendations on T&E are stated in the context of the acquisition process because the Task Force viewed the T&E as a fundamental and integral part of that process. The conclusions and recommendations represent a general consensus of the Task Force members.

We enjoyed working with General Lotz and his staff and look forward to receiving comments both from the Board and members of DDR&E who will review this report.

E. G. Fubini
Eugene G. Fubini
Chairman, Task Force on
Test and Evaluation Policies

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ACKNOWLEDGMENT

The Chairman wishes to thank the many individuals and their organizations who contributed to this study. This report could not have been prepared without their full cooperation and participation. First, I would like to express my gratitude to the members of the DSB Task Force (see page iv) and their parent organizations for their invaluable efforts. They contributed a great deal of their own time and talents to this effort and their suggestions and recommendations for improved T&E policies are appreciated.

It would be impossible individually to acknowledge the many military and civilian government and contractor staff, who spent hours with the DSB Task Force members discussing all aspects of T&E policies and procedures as they relate to the various weapon systems examined. However, I would like to express my warm gratitude to LTG Walter E. Lotz (Ret.), ODDR&E DDT&E, for his encouragement and support, and to Mr. Howard Kreiner of ODDR&E and Dr. Joseph Navarro and Miss Jean Taylor of System Planning Corporation who have helped not only in the management of this work, but also contributed many suggestions during the conduct of this study.


E. G. Fubini
Chairman

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I. INTRODUCTION AND SUMMARY

A Defense Science Board Task Force on Test and Evaluation was established in 1972 at the request of DDR&E to develop guidance on test and evaluation through examination of a group of representative weapon systems acquisition programs. The Report of the Task Force on Test and Evaluation, published April 2, 1974, discussed a number of issues that are appropriate for all weapon systems acquisition programs, and are generally matters of basic policy, namely:

- Reliability
- Computer software
- Human factors
- The "T&E Gap"
- Functional specifications versus design specifications
- Offense/defense testing
- Portable instrumentation
- Ship testing
- Test planning

Since then a feeling of concern has arisen relative to:

- Is testing taking too much time?
- Are we overtesting?
- Is all of the testing worthwhile?
- Are we establishing another bureaucracy?

Therefore in April 1976, Dr. Currie, DDR&E, established this Task Force to reopen the earlier investigation, concentrating on programs which have had the benefit of attention to test and evaluation through the Office of the Deputy Director for Test and Evaluation, DD(T&E).

The Task Force was specifically requested to conduct its investigations to determine:

- "a. Are there policies, directives, or definitions whose enunciation and application could have improved our ability to specify, test and verify adequate performance and reliability of systems to the DSARC in time to influence major program decisions? How can we best modify current policies to improve the motivation of contractors and Service developers to achieve and demonstrate adequate reliability?
- b. Have the Services and OSD, under current directives, delineated testing requirements to make the most efficient use of development funds, consistent with obtaining enough information for effective decision making? Is current practice in T&E such as to delay program completion unnecessarily?
- c. Are present T&E procedures properly designed to give the DSARC the information necessary:
 - 1. To determine the probable degradation in operational usefulness if the tests do not indicate full compliance with the specs.
 - 2. To determine at least in qualitative terms the technical (as contrasted with operational) risk introduced by a decision to go ahead in the presence of a test that is either incomplete or whose results are in part unsatisfactory.
 - 3. To determine what additional T&E or developmental steps should be introduced in the program to obtain the best trade-off between earliest operational use and satisfactory operational performance.
- d. Are the current organizational relationships among the Independent Service test organizations, their parent Services, and ODD(T&E) such as to realize the maximum degree of cooperation? What actions or modifications of policy, procedures, assigned responsibilities or terms of reference could improve these relationships?"

As a foundation for the work done by this second Defense Science Board Task Force on Test and Evaluation, pertinent sections of the July 1970 report to the President and the Secretary of Defense on the Department of Defense by the Blue Ribbon Defense Panel were re-examined,

and the Department of Defense Directives 5000.1 and 5000.3 and the Department of Defense Instruction 5000.2 were again reviewed.

It is the Task Force's view that the DSARC process is sound and these documents, which define the DSARC process, provide the point of departure from which to respond to Dr. Currie's questions.

Test and evaluation are fundamental and integral parts of the acquisition process. Therefore, the Task Force viewed the test and evaluation policies and procedures as a necessary part of the acquisition process rather than considering test and evaluation in isolation.

To provide perspective for assessing the effect that present Department of Defense test and evaluation policies and procedures may have had on the acquisition process, the Task Force examined weapons or support systems which by the structure of their time phasing should have been influenced, in part, by current Department of Defense test and evaluation practices. It should be noted that the present Department of Defense policies on test and evaluation have not been in effect long enough to permit them to be used for the entire acquisition cycle of any major system.

At the present time there are 85 major and 18 less than major programs monitored by the staff of DD(T&E) at the OSD level. At the Service level, the Army and Navy have approximately 200 programs each, and the Air Force, 100 programs; eighty percent of these are minor programs. Thus DD(T&E) monitors approximately twenty percent of the programs; these programs represent about two-thirds of the total RDT&E dollar value. The Task Force considered six of the major systems: UTTAS, MICV, F-16, A-10, CAPTOR and NATO PHM. The systems were selected from the three Services and from among those development programs that have been conducted in part under the present T&E policies and procedures. It is important to note that the Task Force reached the conclusions stated herein on the basis of their own personal experiences with a wide range of defense systems as well as by examining the above six systems.

The Task Force found that the system elements, DSARC and the Office of Deputy Director (Test and Evaluation), function reasonably well. There appears to be little or no overtesting done under the directives; what testing is done contributes its full value to the improvement and verification of system performance. The activities of the DD(T&E) result in review sufficient to add to the completeness and quality of system testing. The relationship between DD(T&E) and the independent Service test agencies appears workable and reasonably efficient. This is not to say that individual instances of oversight or difference of opinion may not arise, but no alternative arrangement appears to give promise of avoiding all such instances. DD(T&E) appears to apply, within understandable limitations, the kind of precepts evolved in the report of the predecessor DSB Task Force on Test and Evaluation published in 1974, along with a series of guidelines applied to various types of systems published by the DD(T&E).

The system serves the evaluation function adequately by providing a solid basis for a decision to proceed when the test results are generally satisfactory.

The problems of evaluation are more complex when results are less clear cut. Reasons of fund limitations, or schedule pressures which cannot be overridden, may limit the amount of testing to less than enough to get a clear-cut result. Often, the desired testing is completed in all major respects, but the test events reveal a need for time consuming and costly correction of deficiencies. If, as we have observed to occur, the funds and schedules are not flexible enough to accommodate a standdown in development or production activities while all such problems are completely resolved and retested, a difficult situation arises because the DSARC requires a thorough risk assessment before proceeding to the next milestone or before sending the developer back to rearrange his schedule, and apply for the increased funds to support the action. The risk assessment must take into account such test results as are available.

However, to be useful, such a risk assessment requires a review of those test results in both technical and operational terms. It also requires a review of complex technical issues, taking into account costs to proceed or to delay, the military or national urgency associated with the program, and assessment of the effects of success or failure in accomplishing correction of deficiencies on costs of ownership and operation of the system. These matters are the subjects of responsibilities across the full membership of the DSARC. The present DD(T&E) staff is not large enough or diverse enough to conduct this risk assessment. Neither are the DSARC principals, in a review meeting, in a position to do the painstaking and time consuming research and analysis for a defensible risk assessment.

DD(T&E) can and does contribute to risk assessment by requiring specification of goals and thresholds and by performing a technical assessment of the test results. The DSARC needs to improve its procedures for obtaining the total risk assessment.

To extend these observations, the following specific conclusions have been drawn, and from these, recommendations are derived.

II. CONCLUSIONS

1. Unfortunately, economic, political and institutional forces brought to bear during the planning phase of a new system, such as the Decision Coordinating Paper (DCP) phase, cause it to be committed to an "all up, success oriented" plan which tends not to allow for either cost increases or schedule extensions required to cope with the problems that are recognized during test and evaluation.

2. Operational requirements are translated by the developing agency into contractual specifications. Development testing is designed to assure that the contractual specifications have been met. If the operational requirements have not been faithfully translated into contractual specifications, or additional concepts have been introduced by the developing agency, testing may reveal that contractual specifications have been met but the hardware does not meet the operational requirement at the time and under the conditions of the test.

Operational testing is conducted to determine whether the system fulfills the desired functions in an operational environment. Because the operational environment (e.g., threat) may change between the time the contractual specifications are set and the system is tested operationally, the system may not be suitable for the new environment. Thus, whereas contractual specifications may not change, the operational environment may change, and a disconnect may exist between development testing (DT&E) and operational testing (OT&E).

3. Test and evaluation are in fact continuous, and when properly applied, start with the concept and extend at a minimum into early deployment. Development test and evaluation and operational test and evaluation are conducted for different reasons and normally under different authority. Interaction of operational test and evaluation and development test and evaluation is not institutionalized. The Task Force believes that a means should be sought to promote interaction, particularly feedback from the OT&E to the developer. Interaction among development test and evaluation, operational test and evaluation and close contact with the user pays very important dividends in terms of money, time, and operational suitability. These savings are missed if shallow overlapping or sharp points of demarcation exist.

4. With regard to total risk assessment, implementation of an adequate technique is essential, but not yet accomplished. The DD(T&E) makes his contribution by requiring specification of thresholds and evaluation of test results. The broader considerations are not formally integrated into the technical assessment.

5. The so-called Test and Evaluation Gap¹ continues to exist. With a gap that may be as much as two to three years, there can be serious effects on program cost and schedule and consequent effects on the continuity of contractor and Service management personnel.

6. Within the current test and evaluation procedures and practices, little or no overtesting is being generated. Some redundancy does still exist among tests done for different purposes and there should be efforts to reduce this. The important observation is that the T&E

¹The T&E Gap is the time interval between the end of development and the beginning of production caused by the testing requirement.

approach now used ensures that problems are found and identified early enough to preclude or ameliorate later serious problems and subsequent program delays.

7. Although the present test and evaluation directives are clear in their intent, there are increasing examples of circumstances which tend to reduce or to avoid compliance. It is understood that budget constraints, congressional involvement, foreign sales, operational requirements, and threat changes can cause realignment of the acquisition process for any system. Circumvention of the directives in a few projects erodes the commitment to test and evaluation. This can have a serious negative effect on the overall acquisition process. Therefore, special procedures will have to be evolved to deal with cases requiring altered application of the directives.

8. The system elements, DSARC and DD(T&E), function reasonably well in the acquisition process. The importance of the T&E function is increasing in such matters as system compatibility, interoperability, reliability, maintainability, and logistics. Furthermore, these areas are receiving more organized scrutiny from differing points of view as a result of the emphasis on T&E.

9. There may be a potential to reduce the large demands of reliability and maintainability testing if the various agencies responsible for such testing could develop coordinated and integrated test plans. That is, factory chamber testing, development testing under operational conditions, and operational testing all provide opportunity for collecting R&M data. At present, these tend to be conducted independently. Operational testing provides the most realistic environment for R&M testing and should be most heavily weighted for evaluation purposes.

III. RECOMMENDATIONS

1. Success Oriented Acquisition Process

Department of Defense Directive 5000.1 (III.C.4) states:

Schedules and funding profiles shall be structured to accommodate unforeseen problems and to permit task accomplishment without unnecessary overlapping or concurrency.

Despite this Directive, the Task Force finds that plans for the development of weapon systems are always based on success, and rarely leave time and resources to accommodate failures. The normal development process always encounters problems which appear during the testing phase. It is clear to the Task Force that the money and time necessary for the correction of these problems revealed by test and evaluation will not be provided for in the development plans unless a DCP and its amendments are considered unacceptable in any DSARC unless such provision has been made. The Task Force recommends that the DCP directives be modified accordingly. The responsibility for the release of the funds and time so provided should rest with someone other than the developing agency.

2. Operational Requirements Versus Contractual Specifications

At each major milestone, the DCP should provide evidence that a formal review by the Service has been conducted to ensure that the operational requirements are adequately represented by the contractual specifications for the subject program.

3. Risk Assessment

Risk assessment is essential for a proper DSARC deliberation. Test and Evaluation can and must make contributions to the overall risk assessment; the Task Force does not believe that DD(T&E) as now chartered should be assigned the full risk assessment. We think the responsibility for presentation of an overall risk assessment to the DSARC should rest squarely on the shoulders of the Acquisition Executive. We expect that the Acquisition Executive will find it necessary to institutionalize these risk assessments through suitable practices and procedures.

We observe that the charter of DD(T&E) permits the utilization of independent technical support as necessary to assist in the thorough assessment of the technical and operational risks as shown by the test results. The Task Force endorses the DD(T&E) practice of obtaining such assistance and urges that it be broadened.

4. T&E Gap

As stated in Conclusion 5, the Task Force finds the T&E Gap continues to exist. Normally no gap should be allowed to exist unless, during "Risk Assessment" planning, it can be shown that discontinuity would create lower total costs than some reasonable level of redesign, reflt, etc., created by OT&E phases. We re-state the alternatives for avoiding the gap that were proposed by the DSB Task Force on Test and Evaluation:

1. Plan at the start of engineering development for additional R&D hardware, to be R&D funded and built for IOT&E and for an additional phase of testing to cover the T&E gap. Paragraph 5 of DoD Directive 5000.3 recognizes that additional phases of OT&E may be needed prior to availability of production hardware. In this case, every effort would be made to production tool each subsystem as soon as it could be qualified. In this way, the R&D would gradually evolve into the production configuration.

2. Plan the development and OT&E phases so that DT&E and IOT&E hardware is funded with R&D. Early in the DT&E effort, defend long lead time production funding and seek production funds for low rate pilot production. Again, emphasize early conversion to production configuration so that the evolving configuration hardware will be available to continue the OT&E immediately after the IOT&E. The testing would be continuous, and at a point where all the qualified subsystems were in production, the follow-on OT&E would be initiated.

5. Departures From Directives

In some cases, as stated in Conclusion 7, intentional departures will be made from the DoD Directives of the 5000 series. In these cases, which are unavoidable, the Task Force recommends that the DCP include a set of test and evaluation procedures and schedules, which will be binding on these programs and monitored by the T&E entities. The DCP should also contain a statement of the reasons for departure from the Directives.

6. T&E Independence

To ensure the continuing independence of the T&E function, it is recommended that the office and functions of T&E at the OSD level be assigned to the Acquisition Executive as soon as this office acquires a formal structure.

Appendix A

Task Force Terms of Reference



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING
WASHINGTON, D. C. 20301

13 APR 1976

Dr. E. G. Fubini
Suite 1200
1901 North Fort Myer Drive
Arlington, Virginia 22209

Dear Gene,

A few years ago, DDR&E asked you to lead a DSB Task Force to examine representative programs to help us improve our test and evaluation activities, and to get the highest payoff from them. Your report, and the ancillary guidelines on specific weapons systems which resulted from your study, have served those purposes.

I believe that it would now be of great benefit to reopen your earlier investigation, concentrating on programs which have had the benefit of attention to T&E through the Office of the Deputy Director for Test and Evaluation. Our hope, as before, is that you will assist us to make the most efficient and effective use of our test and evaluation activities.

To conduct this investigation, I propose again to establish a Task Force under your chairmanship as a part of the Defense Science Board. I request that you assemble a select group to conduct the study. Please conduct the study in close consultation with Lt. Gen. Walter E. Lotz, Jr., USA (Ret), my Deputy for Test and Evaluation. General Lotz will provide Mr. Howard W. Kreiner of his staff to act as Executive Secretary to your Task Force, and will arrange for professional staff assistance through a contractor.

Your Task Force should conduct its investigations to determine:

- a. Are there policies, directives, or definitions whose enunciation and application could have improved our ability to specify, test and verify adequate performance and reliability of systems to the DSARC in time to influence major program decisions? How can we best modify current policies to improve the motivation of contractors and Service developers to achieve and demonstrate adequate reliability?

b. Have the Services and OSD, under current directives, delineated testing requirements to make the most efficient use of development funds, consistent with obtaining enough information for effective decision making? Is current practice in T&E such as to delay program completion unnecessarily?

c. Are present T&E procedures properly designed to give the DSARC the information necessary:

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3. To determine what additional T&E or developmental steps should be introduced in the program to obtain the best trade-off between earliest operational use and satisfactory operational performance.

d. Are the current organizational relationships among the independent Service test organizations, their parent Services, and ODD(T&E) such as to realize the maximum degree of cooperation? What actions or modifications of policy, procedures, assigned responsibilities or terms of reference could improve these relationships?

I expect that about seven months will be needed to address those questions. During this period members of my staff will work directly and closely with you in order to insure that the Task Force is working on the most important issues and that the Department is getting full benefit from early results of the Task Force's efforts.

Sincerely,



Malcolm R. Currie