DEFENSE SYSTEMS MANAGEMENT COLLEGE

PROGRAM MANAGEMENT COURSE
INDIVIDUAL STUDY PROGRAM

CONTRACTOR TESTING AND THE ARMY

TEST AND EVALUATION MASTER PLAN

FOR FULL SCALE ENGINEERING DEVELOPMENT

STUDY PROJECT REPORT
PMC 77-2

LARRY H. JOHNSON
GS-13 DAC

FORT BELVOIR, VIRGINIA 22060

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DEFENSE SYSTEMS MANAGEMENT COLLEGE

STUDY TITLE:

Contractor Testing and the Army Test and Evaluation Master Plan for Full Scale Engineering Development

STUDY PROJECT GOALS:

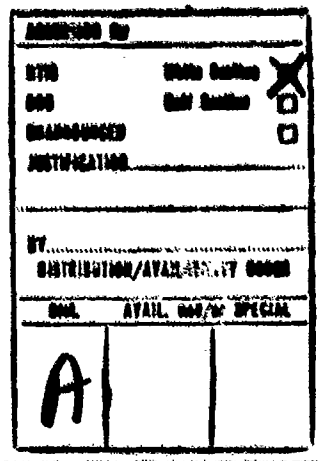
To relate contractor testing with the Project Manager's Coordinated Test Plan (CTP), to point out some typical problems encountered during the test integration process, and to offer some alternate approaches to enhance test management.

STUDY REPORT ABSTRACT:

Previous experience in the Materiel Acquisition Process has shown that development of a Master Test Plan for Research and Development poses many challenges. Because of general type guidance in RFP's and general type responses in contract proposals, a bilateral communications problem arises and the test program may or may not satisfy Government requirements.

Contractor testing plays a major role in the total test program and results of contractor tests must be utilized by Government evaluators to satisfy independent Government test objectives. If the contractor test program proves inadequate for Government needs, the test program must be modified with minimum impact on cost and schedule. Herein lies the problem.

The inherent problems related to developing a Master Plan through the RFP/proposal evaluation/contract initiation process are examined and recommendations for improving the process are offered.



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CONTRACTOR TESTING

AND

THE ARMY TEST AND EVALUATION MASTER PLAN

FOR FULL SCALE ENGINEERING DEVELOPMENT

Individual Study Program

Study Project Report

Prepared as a Formal Report

Defense Systems Management College

Program Management Course

Class 77-2

by

Larry H. Johnson
GS-13 DAC

November 1977

Study Project Advisor
CDR Jerry Chasko, USN

EXECUTIVE SUMMARY

The purpose of this study project is to highlight some of the problem areas encountered by Project Managers when formulating the Coordinated Test Plan (CTP) for his project. The Army's "integrated testing" approach has placed special emphasis on contractor testing over the last few years in lieu of independent Government testing and, consequently, the important role of contractor testing has moved to the forefront.

Experience has shown that bilateral communications problems often materialize during the RFP/proposal evaluation/contract initiation process and present unwarranted challenges for the Project Manager. The contractor must transform RFP test requirements into a proposed test program for Source Selection Evaluation Board (SSEB) evaluation and integration with Government test objectives in the CTP. Any weaknesses or deficiencies in the contractor test plan must be resolved with minimum effects on program cost or schedule and herein lies the problem.

Constructive recommendations for improving the test coordination process are presented with emphasis on RFPs, contract proposals, proposal evaluation, personnel continuity and managing the test program.

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INTRODUCTION

Purpose of the Study Project

The author has been associated with testing of Army materiel for approximately eighteen years, seventeen years in a Government test laboratory and one year in a Project Management Office. This experience in the Materiel Acquisition Process has shown that development of the Master Test Plan for the Engineering Development acquisition phase often poses numerous challenges. Normally it becomes an iterative process within narrow bounds because of unfavorable effects on project cost and schedule.

The primary purpose of this study project is to highlight some of the problems that the Materiel Developer (Project Manager) has typically encountered in the past when attempting to integrate contractor testing with Government test objectives during preparation of the Test and Evaluation Master Plan for Full Scale Engineering Development. The secondary purpose is to present a series of constructive recommendations for future development efforts in the hope that "lessons learned" from the past may be beneficial in the future.

Scope of the Study Project

This paper presents a discussion of procedures previously utilized by Army projects for developing their Master Test Plan, some of the problems encountered and apparent underlying reasons for these problems. In

conclusion, constructive suggestions are submitted for consideration by future program managers. Suggestions presented herein represent collective opinions of experienced personnel in the field and should improve the Master Test Plan and the materiel acquisition process if properly applied.

Discussion is presented on the Department of Defense and Department of Army directives and regulations which provide guidance for the preparation and contents of the Program Master Test Plan as a part of the overall "Single Integrated Development Test Cycle Policy in Development Test and Evaluation of Army Materiel."[8] Second, interest is focused on that portion of the Master Test Plan which covers contractor testing of components, subsystems and systems, how the Government utilizes contractor test results, and some of the challenges for obtaining definitive test plans in development contracts.

Specific Goals of the Study Project

The specific goals of this study project are:

A. To show the significant role and importance of contractor testing during Full Scale Engineering Development.

B. To show how contractor testing interfaces with Government tests in the Master Test Plan.

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[8]This notation will be used throughout the report for sources of quotations and major references. The first number is the source listed in the bibliography. The second number is the page in the reference when applicable.

C. To point out some of the problems typically encountered by Project Managers when definitized contractor testing was not part of the basic contract.

D. To determine if guidance provided to contractors for preparation of contract proposals has generally been sufficient in the past or should the Government Request for Proposals (RFPs) be more specific.

E. To determine if, in general, descriptions of the test program in contract proposals provide sufficient detail for proposal evaluation and understanding of each level of testing (system, subsystem, component, environmental qualification, etc.).

F. To determine if the contractor's test program in the contract proposal should be in AR 70-21[9] format and of sufficient detail for incorporating directly into the program manager's Master Test Plan, hereafter referred to as The Coordinated Test Program (CTP) as per AR 70-21[9].

G. To determine if the present policy of requiring contractors to submit their Master Test Plan, hereafter referred to as the Engineer Design Test Plan[7], 60 to 90 days after contract is the optimum approach.

H. To develop conclusions and constructive recommendations for improving the process on future development programs.

Methods of Research

Multiple sources of information were utilized for this study; Government directives, regulations and publications; periodicals and written literature; interviews with Government and contractor personnel who are or have previously been involved in the development of Master Test Plans;

and personal experience. Persons interviewed are not identified in this report since the nature of this study suggests no "authoritative sources" and information was obtained on a non-attribution basis.

A literature search was conducted within the available time constraint to obtain documents, reports, regulations, periodicals and other written materials related to the subject. No literature was found which addressed the specific subject of interest; however, a great deal of literature has been written about problem areas closely related to the areas of concern and some are referenced herein.

Informal interviews were conducted with experienced test personnel in several Government and contractor Project Management Offices and functional laboratory personnel who have been instrumental in the development of contractor Engineer Design Test Plans and Government Coordinated Test Plans for several programs. Representatives from twelve Army programs in various stages of development were interviewed and the results of those interviews are summarized herein.

SECTION II

BACKGROUND

Requirements for the Master Plan

Department of Defense Directive 5000.3, Test and Evaluation[6], provides the basic guidance for the Master Test Plan.

> "The DOD Component will prepare as early as possible in the acquisition process, and prior to initiation of Full-Scale Development, an overall test and evaluation plan to identify and integrate the effort and schedules of all T&E to be accomplished and to insure that all necessary T&E is accomplished prior to the key decision pointss".[6,6]

The Department of the Army promulgated the DOD policy through AR 1000-1[10] and AR 70-10[8] and issued detailed instructions for implementation of the T&E Master Test Plan Policy through AR 70-21[9].

Testing is conducted to demonstrate how well the materiel system meets its technical and operational requirements; provide data to assess developmental and operational risks for decision making; verify that the technical, operational and support problems identified in previous testing have been corrected; and to insure all critical issues to be resolved by testing have been adequately considered. All testing is of interest starting with contractor bench testing and going through controlled tactical exercises by the User.[10,5]

During the full-scale development phase and prior to the first major production decision, the Development Test accomplished shall be adequate to insure that engineering is reasonably complete; that all significant design

problems (including compatibility, inter-operability, reliability, availability, maintainability (RAM), and supportability considerations) have been identified; and that solutions to the above problems are in hand.[10,5]

Thus the importance of a thorough, well managed and coordinated Development Test Program is highlighted by the Department of Defense and the Department of the Army in their basic policy guidelines.

Previous ISP studies have been conducted to investigate the success and problems associated with implementing the aforementioned test policy regulations and it was generally concluded that:

A. Interface problems were encountered between the Materiel Developer and the Operational Tester in the early implementation phases of AR 70-21[9]; however, these problems are being resolved through education, personnel turnover and experience.[14]

B. Implementation of the Master Test Plan (Single Integrated Development Test and Evaluation) Concept has been successful within the Army and highly beneficial to new programs which have utilized it from inception or from early stages of development.[13]

Requirements for the T&E Master Plan have therefore been clearly established and implemented within the Army.

Relationship of Contractor/Government Testing

As previously noted, DOD Directive 5000.3[6] requires preparation of a Coordinated Test Plan for Engineer Development prior to DSARC II and, consequently, prior to selection of a prime contractor for system development.

The Coordinated Test Plan is normally prepared by the system's Project Management Office during the Validation and Demonstration (Advanced Development) phase with inputs from the Operational Tester, the Army Test Evaluator, and other agencies involved in the test program. Since a prime contractor for development has not been selected at that time, the Project Manager's Office provides input to the Coordinated Test Plan to show the categories and time phasing of contractor testing he will require during Engineering Development. For purposes of illustration and discussion, a typical Coordinated Test Plan (CTP) outline for the development of a missile system may include general categories of tests as indicated in Figure 1. Tests indicated in Figure 1 will be utilized to show the relationship between contractor and Government testing.

Since the original CTP is prepared without contractor involvement, it is necessary to update the CTP to include contractor testing after the contractor is selected. More will be said on this subject later.

I. Development Tests (DT-II)

A. Component Tests

1. Breadboard Tests
2. Prototype Development Tests
3. Environmental Qualification Tests
4. Reliability Tests

B. Safety Tests

C. Electromagnetic Radiation Tests

D. Countermeasures Tests

E. Human Factors Tests

F. Missile System Flight Tests

1. Development Prototype Tests
2. Tactical Prototype Tests
3. Environmental Qualification Tests

G. Environmental Storage (Long-term) Tests

II. Operational Tests (OT-II)

Figure 1. CTP Outline for Missile System Development

Considerable literature has been published over the years concerning how to plan and manage test programs for materiel acquisition; however, the literature generally addresses testing at the total system level with very little discussion about testing at the component and subsystem levels. These tests are very much a part of the contractor's test program and represent major thrusts in the development testing. Component and subsystems tests are major contributors to the future successes and/or failures in the program.

Until recent years, the Army test policy for Engineering Development strongly supported independent Government development testing as well as independent operational testing. Under the old policy, little emphasis was placed on the details of contractor testing since the Government obtained the data necessary for system evaluation from the independent Government tests. More recently, however, the Army test policy has changed toward "Single Integrated Development Testing".[11] This concept is intended to reduce developmental test time, test hardware, test costs and eliminate redundant testing by integrating contractor and Government testing into a composite test program. The materiel developer can thus verify that a new weapon system meets all of its performance requirements with a minimum of testing.

The Single Integrated Development Test policy essentially eliminates independent Government testing and stresses independent Government evaluation. This approach permits an independent Government evaluator to monitor both contractor and Government test programs and evaluate the system from the results of the combined test programs; however, the contractor tests

must satisfy Government test objectives as well as contractor test objectives.

With the increased emphasis on contractor testing, the contractor's test plan becomes a major consideration in the materiel developer's Coordinated Test Plan.

Under the Single Integrated Test Policy, all of the Development Tests (DT-II) except the Environmental Storage Tests (see Figure 1) would typically be conducted by the contractor and monitored by the Government. The contractor is consequently conducting the major portion of the Engineering Development Tests.

It is not uncommon for contractor testing to be conducted at a Government test facility since contractors often do not have adequate facilities for testing hazardous components or for missile flight tests, etc. This facilitates test monitoring by independent Government evaluators and gives the Government more confidence in reported test results than might otherwise be expected. To some degree this satisfies the previous independent test philosophy objectives with minimum test hardware, cost and time. However, the contractor is responsible for the planning, conduct and evaluation of his tests regardless of where the tests are conducted. As a result, the contractor test plans must be coordinated with concerned Government agencies to insure that all of the required test objectives are addressed in the plan and that the tests are properly designed to satisfy those objectives. Herein lies a problem. If the contractor's test plan must satisfy the objectives of all concerned Government agencies and become

a major part of the materiel developer's Coordinated Test Plan, the coordination must be accomplished without significant impact on the contract cost and schedule. This can become quite a challenge.

The relatively new Single Integrated Test approach employed by the Army has thus made the contractor's test program the heart of the Development Tests (DT-II) and the Coordinated Test Plan.

Requirements for Contractor Testing

DOD guidance for Major System Acquisition process indicates:

> "Contractors shall be required to submit firm proposals for full-scale engineering development and initial production upon completion of the competitive demonstrations and shall be provided with the factors, criteria and conditions to be used by the DOD in the evaluation and selection of a system for full-scale engineering development. Specifications and standards and a contract data list shall be identified and tailored by the contractors for application to the system proposal for full-scale development on the basis of the demonstration and validation results."[5,9]

The materiel developer implements the DOD guidance by issuing a Request for Proposal (RFP) for Engineering Development to all contractors who successfully participate in the Demonstration and Validation Program. The RFP includes all of the guidance required in DOD 5000.2 plus a general description of the test program as approved in DSARC II. Excerpts from a typical RFP are presented in Appendixes A and B to illustrate the type of guidance provided to contractors for preparation of their proposals. It may be noted that the RFP excerpts provide considerable guidance on testing philosophy but very little information on Government test requirements which must be integrated with contractor objectives and satisfied by contractor

testing. Herein lies a potential problem area which will be addressed later in this paper.

Normally, the RFP requires that the winning contractor submit his Engineer Design Test Plan (as described in Appendix B, Data Item Number DI-T-1901[7]) within sixty to ninety days after contract initiation for coordination with Government test agencies and approval. When approved, the contractor's test program automatically becomes part of the materiel developer's Coordinated Test Plan.

The coordination and approval cycle for the contractor's test program may or may not be an easy task. If the contractor has not interpreted the RFP requirements properly such that his test plan does not satisfy the Government test objectives, the iterative process of amending the contractor's test program begins. As previously noted, this iterative process must be accomplished within limited bounds and without significant effects on contract cost or schedule.

Thus the requirements and guidelines for contractor testing are established and levied on each of the bidding contractors for Engineering Development.

SECTION III

OBSERVATIONS AND DISCUSSION

Review of the Present Situation

The present trend within the DOD seems to emphasize a "disengagement" policy for Project Managers which allows contractors to pursue and propose innovative solutions for the materiel needs. In summary, the Project Manager should not be so directive that he inhibits the contractor's ability to develop the weapon system. At what point then should the Project Manager start to direct? He cannot relinquish his program responsibility. As noted by the Logistics Management Institute:

> "In common with the way a general manager must operate, the program manager relies on others to do the work. But he cannot escape the responsibility for the result. If he is responsible, he must be satisfied that what is done in his program makes sense to him and is consistent with his plans. If he cannot be persuaded that it is right for his program, he must direct it to be done the way he wants.
>
> Much has been written about the role of industry and the relationship that should be obtained between the defense program manager and his industry counterpart. Much has been said about "disengagement" - getting out of industry's hair and letting them do the job they have contracted to do. The goal is laudable and, the way it is stated, the idea is entirely consistent with good management concepts. But the ultimate responsibility for a successful program rests squarely on the Service and on the military program manager as its agent. The program manager cannot disengage in any literal sense. He must manage contracted work in just the same sense as he manages all other parts of his program. More precisely, in this case he manages the contractor management of his program. It is not a question of whether he manages; it is only a question of how he manages - or mismanages."[12,5]

The point to be made is: the contractor(s) must be given the freedom they need to develop the weapon system and the associated test program(s); however, the Project Manager must ascertain if the proposed test program(s) sufficiently satisfy the major Government test objectives - performance, safety, reliability, etc. Alternatives available to the Project Manager are primary issues and are addressed in this study project.

How are Coordinated Test Plans for weapon systems developed? As previously noted the Project Manager develops the Coordinated Test Plan for his program by integrating test plans and requirements from the contractor(s) and Government test agencies.

The RFP is the vehicle by which the program manager conveys his test requirements to contractors who in turn respond with contract proposals. Through the "Source Selection Evaluation" process a contractor is then selected for Engineering Development and his proposed test program becomes part of the project Coordinated Test Plan.

So what is the problem? The problem is that after the contract is signed and the Project Manager learns more and more details about the contractor's test program, he often learns that the contractor's test program is not what he had envisioned and does not satisfy the Government's need. In other instances, the source selection board may recognize that the contractor's proposed test program does not totally satisfy the need; however, the proposal may still be considered "responsive" to the RFP. Procurement regulations and procedures do not readily facilitate resolution of this problem without "leading" the contractor (which is not allowed).

Some of the major concerns expressed by persons interviewed during this study were:

1. The required test effort needs to be clearly defined in the RFP. The objective of the RFP is to provide bidders with adequate information and guidance in a clear and logical manner to elicit proposals containing all the information needed for objective evaluation. The quality of the RFP guides and directs the type of proposal responses to be received; consequently, contract proposals cannot be expected to satisfy all of the Government's test objectives if the RFP is not definitive.
2. Test Programs presented in contract proposals are described in general terms which can often be interpreted differently by Government and contractor personnel. Many times it is not learned until after the contract is signed that the contractor's test program does not include everything the program manager thought it included. If the Project Manager takes action to correct the deficiencies in the test program, the contractor often claims that the increased effort is "out-of-scope" for the contract and the Project Manager suddenly finds himself bargaining from weakness. Changes to the test program can significantly affect cost and schedule. The intent here is not to imply negligence on either the part of the contractor or the Project Manager, but to point out that there has been a communications problem in the past. This problem will not just go away with time. It must be recognized and dealt with properly.

3. We need better management discipline, from the Project Manager standpoint, in the contract/procurement process. It may take a little longer to sign the contract, but the track record of increased cost and management headaches resulting from poorly defined contracts indicate that time spent on the front end of the program to get a good contract is time well spent and will more than pay for itself during performance of the contract.

Many times management is in too big of a rush to get out the RFP and to sign the contract once the proposals are received. The attitude is that details of the test program can be worked out later. But as expressed by one author (a Government contractor) -

> "The old expression that "haste makes waste" was never more true than in the front end of an R&D Program. The usual reaction of a program manager who knows that money is time and people is to squeeze them both, ultimately making the mistake of assuming too much. He assumes that a technique that worked on one project will work on another, perhaps taking a component or subsystem from a sister project without bothering to test it. And when he goes into production, the questions he glossed over during R&D come back to haunt him".[2,7]

The message here is: take time before signing the contract to clarify the contractor's proposed test program, to understand it, to agree or disagree with it, and to be confident that the Government test objectives will be achieved.

4. In the competitive arena of bidding for Government R&D contracts where cost is a prime determining factor, contractors by necessity limit their test program to meet the minimum requirements of the RFP (as they understand it). Again the need for clearly defined RFP requirements is stressed. There is a relatively high probability that the

contractor and the Project Manager will have different interpretations of "minimum RFP requirements."

5. We often get caught up in "money problems." Testing is expensive and contractors can only do so much with the available money. We often find ourselves trading off testing to get the cost down to "sell the program". Such decisions come back to haunt us later at major decision points down stream when we have to explain why sufficent testing was not accomplished during the program.
6. There seem to be discontinuities between the SSEB evaluation, negotiation agreements and the contract. First, personnel serving on the SSEB will be more highly motivated to "do a good job" if they know that they will be responsible for the program later on. Project Manager personnel should be utilized to the maximum practical extent on the SSEB. It would also help if the SSEB Chairman were a member of the Project Manager's team. We need more continuity between the SSEB and the project management team. Second, issues which the SSEB members noted, and thought were resolved during negotiations, somehow did not get into the contract. The SSEB members need to participate in contract negotiations to assure that all critical issues are resolved and affected in the contract. In summary, without the right people on the SSEB, contract quality often gets traded-off and the result is a vague contract which is difficult to manage.
7. Some Government personnel over emphasize the "disengagement" policy as noted earlier and use it as an excuse to stay out of the contractor's

business, let him propose program objectives as he perceives them, and approve the proposal as submitted. The opinion of this author, however, is that such a policy results in less management and more mis-management. The tax payers deserve and expect more for their money. The Project Manager must retain the responsibility of management, for in the end, he is the one held accountable for program results.

Have Contractor Master Plans Been Adequate in the Past

As one might expect, the quality of Contractor Master Test Plans in the past has ranged from very poor to very good. The quality of the plans seems related to several factors such as:

1. How well requirements were defined in the RFP.

2. Communications between the Government and contractor personnel during the Validation/Demonstration phase about R&D test requirements.

3. Whether the bid for R&D is sole-source or competitive.

4. Whether or not the contractor has previously conducted R&D programs for the Army. Testing requirements for the different services vary somewhat because of the varied operational environments in which the weapon systems must be operated and supported. Contractors who have been involved in previous Army programs generally have a better appreciation and understanding of Army peculiar test requirements.

Considerable literature has been written about the frustrations of the RFP - proposal cycle and hopefully this attention will result in better

Government/contractor communications in the future. For example, BG Esposito,[3] USAF Director for Procurement Policy, OASD (I&L) recognized these problems and emphasized concise but adequate instructions in RFPs. He emphasized that all levels of management should assume a major role to bring about change in the acquisition business. LTG Stewart, U. S. Air Force Systems Command, reinforced the need for change when he wrote:

> "The prototype programs emphasizing streamlined management, procurement and development approaches, provide the kind of environment in which imaginative ideas can surface, be applied and tested. A good place to begin improving the acquisition process is clarification and simplification of requests for proposals (RFPs), which would provide opportunity to overhaul the source selection process."[4]

How important is the Contractor Master Plan and what are its benefits? Planning is coming to grips with the hard details of program execution. It involves the examination and reexamination of the problems which are anticipated and the alternative ways in which these problems might be solved. Peter Sandretto[1] in his book "The Economic Management of Engineering" wrote:

> "After all has been said and done about systems to control engineering costs and performance, after the decision is made to embark on a project, it is the project plan prepared before starting the work that determines to a major extent the outcome of a project in terms of time, cost and technical performance."[2,9,1]

Sandretto also pointed out that there is an almost unilateral lack of realization that the project plan can and does steer the project away from disaster if properly planned and followed. Evidence of this lack of realization (from both the Government's and contractor's point of view) is all too evident when development programs get into trouble as a result of inadequate or insufficient testing. As previously noted, the contractor's test plan becomes the heart of the Project Manager's Coordinated Test Plan.

The importance of this plan cannot be overemphasized. Some contractor Master Plans have been adequate in the past; however, the "batting average" needs to be improved.

SECTION IV

SUMMARY

Summary of Conclusions

The following conclusions are drawn as a result of this study:

1. The DOD and DA directives and regulations have clearly established the requirement and issued guidelines for preparation of the program manager's Coordinated Test Plan.
2. Program managers are following the official guidance and preparing Coordinated Test Plans to include contractor and Government tests with integrated test objectives as applicable to minimize test hardware, cost and schedule.
3. Under the Single Integrated Test Policy, contractor testing has become the heart of the Coordinated Test Plan. This fact has and still is causing some difficulties. RFPs and contracts are sometimes vague and general in nature and the program manager doesn't realize until he is well into the contract that the contractor's test program is inadequate or does not satisfy all of the Government test objectives.
4. The RFP - proposal-contract process leaves a lot to be desired. The problems are complicated by many factors and there does not appear to be a simple solution; however, constructive recommendations are included in this report.

5. The importance of the Master Test Plan needs to be stressed at all levels of management (Government and contractor) to assure that it receives proper priority and that the plan is followed once it is established. A poor plan may very subtly allow the development to head for disaster from which recovery will be very costly in both time and money. On the other hand, an orderly, well constructed test plan will assist in identifying problem areas early in the program when recovery is not so costly. It will provide necessary data to the program manager so that he can make rational trade-off decisions between cost, schedule and performance as the development program progresses.

6. Development and testing make up an iterative process where the contractor designs his hardware, evaluates the performance, makes changes as necessary and re-tests for performance. DOD policy trends seem to imply Project Manager "disengagement" which allows the contractor to pursue innovative solutions for weapon system needs. However, the program manager cannot ignore the fact that he is ultimately responsible for system development and that at some strategic point in time he must bring the innovative process under his control and lead the development into production. The Coordinated Test Plan should clearly identify that strategic point in the development program and clearly define follow-on testing which must be successfully accomplished to demonstrate acceptable cost, performance, safety, reliability, maintainability, etc.

Recommendations

As a result of this study and the conclusions presented herein, the following recommendations are submitted for consideration:

1. That program managers take the necessary time to develop an RFP which clearly states the minimum test requirements and identifies Government test objectives. A recommended approach would be to include potential R&D contractors in the CTP coordination process during the Validation and Demonstration phase, to develop a relatively detailed Coordinated Test Plan, and to include the CTP in the RFP. Utilizing this approach, the contractor(s) should clearly understand the Government's test objectives and minimum test requirements. As a minimum, it is recommended that the CTP contain formal contractor component qualification, system performance/reliability tests, environmental qualification tests as applicable and independent Government tests including sample sizes, test conditions and general test procedures. This allows contractor(s) the flexibility to conduct necessary hardware design selection and development testing prior to formal qualification: it provides him the information necessary to schedule and budget hardware and support costs required for the "total" R&D test program: it is also consistent with the current trend in DOD policy.
2. That Project Manager personnel occupy key positions on the Source Selection Evaluation Board (SSEB). Persons are more highly motivated when they realize that they will be managing the program in the future and any mistakes or deficiencies they accept on the SSEB

will be their headaches in the future. (There needs to be continuity between the contract selection and contract performance.)

3. Project personnel who serve on the SSEB should participate in contract negotiations to assure that their inputs get into the contract. Negotiating personnel who do not understand the relevance or importance of technical detail are more likely to overlook or eliminate important aspects of the SSEB evaluation.
4. Do not hurriedly put an RFP out for consideration, rush the evaluation, or sign a contract which has not been throughly considered. Along the same line, do not sign a contract that has deficiencies with the idea that problems will be worked out later. It is not a simple matter to correct deficiencies once a contractor and all of his sub-contractors have been "turned on" and it will invariably increase cost. Time taken at the beginning of the program to get contract matters in order will save even more time during contract execution and result in an earlier completion date with fewer management headaches.
5. Baseline Development Specifications for all configuration items should be developed during the Validation/Demonstration phase and included in the RFP. As with the test plan, generating Baseline Development Specifications after contract initiation may result in considerable problems, require that some tests be repeated, and delay progress of the Program.

In summary, define clearly what you need before you sign the contract and accept nothing less. Plan and manage the total test program, don't let it manage you.

APPENDIX A

EXCERPTS FROM A TYPICAL

REQUEST FOR PROPOSAL FOR ENGINEERING DEVELOPMENT

C-27 MASTER PROGRAM SCHEDULE

Attachment 30 is the Governments Master Program Schedule (MPS) which depicts certain key milestones. The contractor shall provide with his proposal an expanded MPS which clearly portrays scheduled time for accomplishment of all tasks required by this RFP and including the reviews required by J-4 and the contractor proposed performance milestones C-36. The contractors proposed Master Program Schedule shall support delivery of hardware as specified in paragraph H-2,f., and the functional and allocated base line specifications as specified in Section F, 0001AF2.4.1.4.2 and Data Item DI-E-1104A, sequence numbers 009 and 00B.

0001AE (U) Test & Evaluation

0001AE1 Development Test (DT):

DT will consist of the following Phases: Engineering Design Test - Contractor (EDT-C), Engineering Design Test - Government (EDT-G), Prototype Qualification Test - Contractor (PQT-C), Prototype Qualification Test - Government (PQT-G), and Production Validation Test - Contractor (PVT-C) as defined in AR 70-10.

The contractor shall submit a Contractor Master Test Plan to the Government in accordance with DI-T-1900. This test plan shall be an update of the preliminary Contractor Master Test Plan submitted as a part of the proposal and shall present a general description of each major test indicating hardware quantities and utilization, test objectives, data requirements, test sites, list of GFP, special test equipment, and contractor support as applicable for each major test. The Contractor Master Test Plan shall present sufficient detail to indicate that the contractor has planned a test program which will enhance development on a timely basis and demonstrate hardware performance and reliability at all assembly levels. Log books shall be provided with all test items for configuration identification in accordance with DI-E-1101B. Maximum utilization of Government test facilities is required unless proven to be uneconomical. The contractor shall furnish and maintain special test equipment to support the test program.

0001AE1.1 Engineering Design Test (EDT):

The contractor shall plan and conduct an orderly test program starting with component selection and evaluation and progressing through total system demonstration. This test program shall demonstrate that the system's performance meets the requirements of MIS 23103. The contractor's detailed test plan shall include as a minimum the following areas: structural, electrical and performance characteristics of components, subassemblies, assemblies, and total system; human factors engineering; safety; reliability and maintainability; mutual interference; countermeasures; and nuclear/electromagnetic radiation. The contractor shall conduct tests, maintain all development hardware, analyze data and correct deficiencies.

0001AE1.1.1 Component/Subsystem Performance Test (EDT-C):

The contractor shall plan and conduct performance tests on selected piece parts including component, subassemblies and assemblies of each end item. Each generation of hardware shall be evaluated under expected operating conditions to include nominal as well as selected natural and induced environments as identified in the Environmental Criteria specified in MIS 23103. After designs for hardware have been selected, critical components shall be delivered to the Government for evaluation. These components are identified as Contractor Furnished Equipment (CFE) elsewhere in the SOW. In addition, the contractor shall place in bonded storage an adequate quantity of engineering critical components (of the configuration of the 10th serially numbered guided flight missile) necessary for the contractor to test and evaluate performance degradation under the items critical environment(s) for the purpose of establishing SHELF LIFE base line data.

0001AE1.1.3 Missile Flight Tests (EDT-C):

Missile flight tests shall be conducted starting as early as practical and continue through Engineering Development (ED) to demonstrate hardware performance as predicted from component/subsystem performance tests and at all operating conditions delineated in MIS 23103. Missile flights will be initiated as early as practicable during ED and continue in a logical, sequential manner to demonstrate the performance characteristics under varying operational modes. Flight tests shall be conducted as the configuration progresses toward final design and shall demonstrate performance and reliability. The effects of selected natural and induced environments shall be investigated during the flight test program to obtain confidence that the hardware will pass the subsequent System Qualification Tests (para 0001AE1.4). All technical requirements shall be demonstrated. The contractor shall include data requirements and accuracy requirements in the test plan. All missile flights shall be conducted at a Government furnished test facility.

0001AE1.3 Component Qualification Test (PQT-C):

The contractor shall plan and conduct an orderly test program on components selected during EDT to demonstrate performance and reliability of the design in simulated and actual operational environment. The contractor shall update the Component Qualification Test Section of the Contractor Master Test Plan to identify the components which will undergo qualification test and shall submit the revised plan to the Government in accordance with DI-T-1900 at least 30 days prior to initiation of the Component Qualification Test Program. This test program shall be to determine if the components meet their performance requirements while operating under or after being subjected to the environmental extremes necessary for system functions as identified in MIS 23103. A sequential type test program shall be employed utilizing minimum sample sizes and a typical environmental sequence as will be encountered in operational use. Test results will also be evaluated to determine reliability data including failure rates, parameter variations with environment, mode of failure and life expectancy with regard to anticipated operating conditions.

0001AE1.4 System Qualification Test (PQT-C):

The contractor shall plan and conduct an orderly test program on assemblies selected during EDT to demonstrate performance and reliability of the design in simulated and actual operational environment. The contractor shall update the System Qualification Test Section of the Contractor's Master Test Plan to identify the assemblies (missiles, launchers, ground support equipment, etc.) which will undergo qualification test and shall submit the revised plan to the Government in accordance with DI-T-1900 at least 30 days prior to initiation of the System Qualification Test Program. Tests shall be conducted to determine if end items meet their performance requirements while operating under or following exposure, as appropriate, to a reasonable combination of environments specified for the system. End items utilized in this test shall consist of hardware configurations which demonstrated acceptable performance in the Component Qualification Test, para 0001AE1.3. A sequential environmental test approach shall be utilized. The performance requirements and environmental levels are defined in the environmental criteria of MIS 23103. This test shall consist of a minimum of 24 missiles (8 each for the High, Ambient, and Low Temperature sequence). Data generated during this program will also be utilized to determine system reliability. Deficiencies discovered during this test phase shall be corrected by the contractor prior to hardware being released for subsequent Government test. Test shall be conducted at a Government furnished test facility.

APPENDIX B

Data Item Descriptions:

DI-T-1900	Coordinated Test Plan
DI-T-1901	Engineer Design Test Plan
DI-T-1903	Part, Component or Subsystem Plan(s)

from the Department of Defense AMSDL, Acquisition Management Systems Data Requirements Control List.[3]

DATA ITEM DESCRIPTION	2. IDENTIFICATION NO(S).	
	AGENCY	NUMBER
1. TITLE Coordinated Test Plan	Army	DI-T-1900

3. DESCRIPTION/PURPOSE

The Coordinated Test Plan presents a general outline for a total test for a weapon or equipment system, for the testing and evaluation conducted during development to assure that an item meets Army requirements, AR 70-10, para 1-1. This will be used in preparation of detail test plans, schedules and procedures.

4. APPROVAL DATE
15 Dec 69

5. OFFICE OF PRIMARY RESPONSIBILITY
USAMC

6. DDC REQUIRED

8. APPROVAL LIMITATION

7. APPLICATION/INTERRELATIONSHIP

Applicable to any system or equipment requiring test. Normally delivered in the conceptual or early definition phase for approval by the Government.
DI-S-1819, Contractor Recommended Support Plan
DI-R-1730, Reliability Program Plan
DI-R-1740, Maintainability Program Plan
DI-H-1313, Human Factors Engineering Test Plan
DI-T-1904, Integrated Test Plan
DI-A-1012, Documents Required by National Ranges
See DI-H-1312 or DI-H-1313 (when specified); DI-H-1320; DI-R-1700 or DI-R-1701 for respective program requirements of Human Factors, Safety and Product Assurance. See DI-R-1700 or DI-R-1701 for acceptance inspection test program for deliverable hardware.

9. REFERENCES (Mandatory as cited in block 10)
AR 70-10
AR 70-27

MCSL NUMBER(S)

10. PREPARATION INSTRUCTIONS

The Coordinated Test Plan shall contain plans and procedures to assure achievement of operational requirements delineated by QMR's, SDR's and Technical Requirements of the contract. It shall describe the experimental design for obtaining data, delineate functions and tolerances, and establish and explain standards, tests, associated analysis and other means for constituting adequate proof that acceptable performance, including all military effectiveness factors, can be achieved in operational use. Test plans shall cover all related equipment to be tested for determining adequacy and compatibility of the weapon (or equipment) system and shall include but not be limited to the following:

1. Tests to prove adequacy of individual parts of individual items

2. Tests to prove adequacy of subassemblies and assemblies of various subsystems of the system

3. Functional tests of various subsystems, individually and in combination, to determine effects of individual subsystems on each other in the system

4. Tests of packaged equipment to determine adequacy for transport, storage, handling, environmental conditions and other specified requirements

5. Tests to determine compliance with reliability, maintainability, safety and human factors engineering requirements of DI-H-1312, 1313; DI-H-1320 and DI-R-1700, 1701

6. Functional tests of complete weapon or equipment system to determine satisfactory operation and performance in accordance with requirements.

Preparation Instructions (Continued)

Location and duration of tests, extent of Government and contractor participation and test instrumentation required shall be indicated. Requirements for National and Service Ranges facilities and services shall be documented in National Range Documentation DI-A-1012. Use of any other Government equipment or systems required to support the tests shall be described. Procedures for processing and handling the data obtained shall reflect maximum use of Government facilities.

DATA ITEM DESCRIPTION	2 IDENTIFICATION NO(S).	
	AGENCY	NUMBER
1. TITLE Engineer Design Test Plan	Army	DI-T-1901

3. DESCRIPTION/PURPOSE

The Engineer Design Test (EDT) Plan describes the contractor's proposal for the conduct of the EDT portion of the Coordinated Test Plan DI-T-1900 (AR 70-10) for a weapon or equipment system. The purpose of the EDT is to collect design data, confirm preliminary concepts, and determine compatability of components.

4. APPROVAL DATE
15 Dec 1969

5. OFFICE OF PRIMARY RESPONSIBILITY
USAMC

6. DDC REQUIRED

8. APPROVAL LIMITATION

7. APPLICATION/INTERRELATIONSHIP

Data obtained from the EDT is used for initial design of a prototype. The EDT may include the Human Factors Engineering tests described in DI-H-1313, Human Factors Engineering Test Plan. This data item is included as a part of DI-T-1900, Coordinated Test Plan, when that data item is a program requirement.

9. REFERENCES (Mandatory as cited in block 10)

AR 70-10
AMCR 70-7

MCSL NUMBER(S)

10. PREPARATION INSTRUCTIONS

The EDT Plan for a weapon (or equipment) system shall describe the methods and techniques for obtaining data and shall establish and explain the standards, tests, associated analysis and other means that will constitute adequate proof, upon completion of the development phase, that an acceptable level of performance can be achieved by the system. The test plan shall apply to all equipment that makes up the weapon (or equipment) system. It will identify tests to be conducted for determining compliance with stated technical and operational military requirements and the individual equipment specifications. Maximum use of Government owned facilities and instruments will be stipulated.

When required, EDT Plans shall be prepared for use in the development of parts, components or subsystems to a point of qualification and use in higher assemblies within a weapon (or equipment) system. The plans shall include, but not be limited to, philosophy, method of test, schedules of performance, procedures for check out, acceptance limits for performance capabilities, requirements and characteristics, description of test equipment to be used, and list of required Government owned equipment and facilities. The plans must demonstrate confidence that areas of coverage are adequate and that data generated will assure that objectives of performance can be validated.

DATA ITEM DESCRIPTION

2. IDENTIFICATION NO(S).	
AGENCY	NUMBER
Army	DI-T-1903

1. TITLE

Part, Component or Subsystem Test Plan(s)

3. DESCRIPTION/PURPOSE

The Part, Component or Subsystem Test Plan(s) presents the philosophy, test logic, sequence and test schedules and test procedures to be utilized in the development of parts, components or subsystems to a point of qualification and use in higher assemblies within a weapon (or equipment) system. It may be used in conjunction with production and use phase tests.

4. APPROVAL DATE

15 Dec 1969

5. OFFICE OF PRIMARY RESPONSIBILITY

USAMC

6. DDC REQUIRED

8. APPROVAL LIMITATION

7. APPLICATION/INTERRELATIONSHIP

This plan provides detailed test guidance on each test contained in DI-T-1900, Coordinated Test Plan.

9. REFERENCES (Mandatory as cited in Block 10)

AR 70-10
AMCR 70-7

MCSL NUMBER/N

10. PREPARATION INSTRUCTIONS

The Part, Component or Subsystem Test Plan(s) shall include, but not be limited to, philosophy, method of test, schedules of performance, procedures for checkout, acceptance limits for performance capabilities, requirements and characteristics, description of test equipment to be used, and list of required government equipment and facilities.

The plan must demonstrate confidence that areas of coverage are adequate and that data generated will assure that the objectives of performance can be validated.

APPENDIX C

ISP INTERVIEW SHEET

Name: _____

Project: _____

Position: _____

Other: _____

1. Explain the nature and objectives of this Study.

2. Explain that this interview is on a non-attribution basis and that information provided will be used in context while protecting its source.

3. Question:

A. What is the status of your Coordinated Test Plan?

B. How detailed were your instructions in the RFP?

C. Did the contract proposals provide sufficient detail for evaluation and understanding of the proposed test program?

D. How soon after contract initiation did the contractor update his Master Test Plan?

E. Did you have any significant problems getting a coordinated position within the Army concerning adequacy of the contractor test plan?

F. Were all "end items" included in the contractor test plan (containers, maintenance and test equipment, training equipment, etc.)?

G. Were you satisfied with the contractor's test plan concerning:

(1) Component testing?

(2) Sample Sizes?

(3) Environmental testing?

(4) Qualification testing?

(5) Reliability testing?

H. If you were not satisfied with any of the above, what action was taken and what was the program impact?

I. Do you think Government instructions regarding testing were adequate in the RFP?

J. Did you think the contractors understood the RFP requirements and responded properly?

K. Do you feel that the Government's approach to the RFP/SSEB/Negotiation Process enhances or complicates the procurement process?

L. Do you have any recommendations for future procurement actions?

BIBLIOGRAPHY

Books

1. Sandretto, Peter C., The Economic Management of Research and Engineering, John Wiley & Sons, Inc., 1968.

Articles

2. Boileau, O. C., "I Dreamed We Went Nowhere in Our Solid Gold Airplane", Defense Management Journal, Vol. 12, No. 1, January, 1976.

3. Esposito, A. L., BG, "An Analysis of Frustration: The RFP Proposal Cycle", Defense Management Journal, January, 1973.

4. Stewart, James T., LTG, "Simplifying the Complicated: Source Selection Process Faces Winds of Change," Defense Management Journal, January, 1973.

Government Documents

5. Department of Defense Directive 5000.2, "Major Systems Acquisition Process," January, 1977.

6. Department of Defense Directive 5000.3, "Test and Evaluation," 20 May 1975.

7. Department of Defense Directive 5000.19L, Vol II, "AMSDL, Acquisition Management Systems and Data Requirements Control List," January, 1977.

8. Army Regulation 70-10, "Research and Development, Test and Evaluation During Development and Acquisition of Materiel," August, 1975.

9. Army Regulation 70-21, "Research and Development, The Coordinated Test Program (CTP)," May, 1976.

10. Army Regulation 1000-1, "Basic Policies for Systems Acquisition by the Department of the Army," November, 1974.

11. U. S. Army Missile Research and Development Command Regulation 70-35, "Life Cycle Testing," January, 1977.

Reports

12. Logistics Management Institute, "Introduction to Military Program Management," LMI Task 69-28, Washington, D. C., March, 1971.

13. Pritchett, James R., "A Study of the Single Integrated Development Test Cycle Policy in Development Test and Evaluation of Army Materiel," Fort Belvoir, Virginia, Defense Systems Management College, November, 1976.

14. Thomas, Robert E. Jr., "A Study of the Interface Problems Between the U. S. Army Operational Test and Evaluation Agency (OTEA) and the Army Materiel Development Community," Fort Belvoir, Virginia, Defense Systems Management School, May, 1976.