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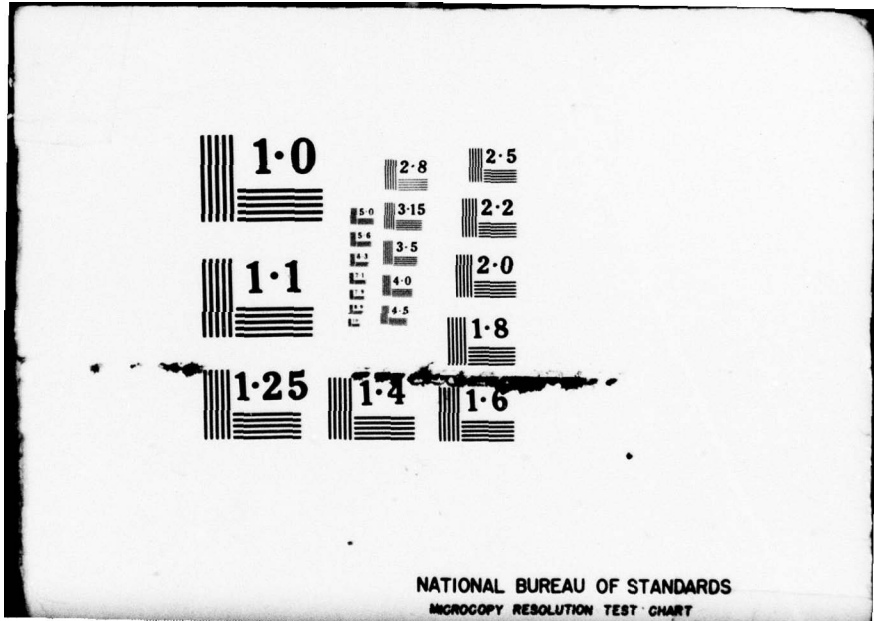
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# AUTOMATED DATA SYSTEMS (ADS) MANAGEMENT METHODOLOGY

## Vol. II: Automated Data Systems Project Evaluation Methodology

Naval Warfare Research Center

Final Report

December 1977

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By: David L. Harvey, Terrance M. Keen, Edward H. Means, William Schubert, and Graham F. Wallace

Prepared for:

Commandant of the Marine Corps  
Headquarters Marine Corps  
Washington, D.C. 20380

Attention: Chairman, "Automated Data Systems (ADS) Management Methodology" Study Advisory Committee

Contract N00014-76-C-1119

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From: Commandant of the Marine Corps  
To: Distribution List

Subj: Automated Data Systems (ADS) Management Methodology  
Study

Encl: (1) ADS Management Methodology Study

1. The Automated Data Systems (ADS) Management Methodology Study was initiated to produce a set of procedures and documentation to be utilized in the Conceptual Phase of ADS development.
2. The enclosed study has accomplished the stated objective. The methodologies proposed by the study would be beneficial to any ADS development effort. Certain portions of the study, such as the Resource Estimating Procedure, will require changes to reflect recent Department of Defense instructions.
3. The Marine Corps intends to utilize the ADS Management Methodology Study as a base for revision of current orders pertaining to ADS development. Appropriate modifications will be made to Marine Corps orders to reflect changes in policies and procedures.
4. A copy of this letter will be affixed inside the front cover of each of the subject study prior to its distribution.

  
L. F. SNOWDEN  
Chief of Staff

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## PREFACE

Analysis by the Marine Corps has indicated that the growing demand for ADS has outstripped the available management capability to support application of the existing technology. For example, the growing demands for systems documentation and analysis during ADS development may be beyond the current capabilities of the Marine Corps to support satisfactorily, because of the shortage of qualified personnel and inadequate staffing at the Headquarters level. One manifestation is that the cost and time necessary to develop and implement an ADS are consistently underestimated.

It appeared that the most immediate remedy might result from first tackling the problem of ADS development management. Current management is guided by the Marine Corps Automated Data Systems Manual (ADSM). However, specific statements of duties, tasks, operational definitions, and deliverables for individuals and work teams are not specified in the ADSM in sufficient detail to allow for a high degree of efficiency for the average developer.

As a consequence, HQMC contracted with SRI International to conduct a systems analysis study of the conventional management concepts expressed in the ADSM. The study was to develop a methodology, operational definitions,\* and a definitive statement of tasks and duties for ADS development. Benefits accruing to the Marine Corps from a successful completion of the study effort were to be both economic and operational:

1. Economic --if the efficiency of automated systems development is increased, there will be a reduction in the time and cost of developing any given ADS.

---

\*Operational Definition: An operational definition is a specification of the activities of a worker or a team in developing and using a component of an ADS development plan. Alternatively, an operational definition assigns meaning to a concept by specifying the activities and operations necessary to produce a usable component of an ADS development plan. Thus, an operational definition provides a bridge between theory and application.

2. Operational--if the effectiveness of automated systems development is improved, the systems that are developed in the future will better conform to valid mission requirements.

The specific objectives of the research were to accomplish the following:

1. Operationally define the management and analysis tasks and duties that must be performed in the preparation of an ADS Development Plan.
2. Operationally define a procedural methodology for developing ADS objectives and associated measures of objective fulfillment.
3. Develop specific methodologies needed to guide developers and decision makers for ADS systems so that the anticipated value of the proposed system can be assured and its total cost impact estimated and controlled.
4. Assist HQMC to translate the study results into procedures and policies.

The study was begun in mid-1976 and completed in late 1977. It consisted of the following five tasks:

- Task 1: Objective-Writing Methodology
- Task 2: Resource Requirements Estimating Methodology
- Task 3: ADS Action-Document Preparation Procedures
- Task 4: ADS Project Evaluation Methodology
- Task 5: Integration and Refinement of ADS Management Methodology.

The results of Tasks 1, 2, and 3 were reported on in individual Technical Notes issued during the course of the project, namely, NWRC-TN-73, "Objective-Writing Methodology for USMC ADS Development," July 1977; NWRC-TN-72, "Resource Requirements Estimating Methodology," May 1977; NWRC-TN-75, "Concept Phase Procedures and Action Documents," September 1977.

This, the project's final report, has been published in two volumes. Volume I addresses Study Tasks 1, 2, and 3 and is designed for use by originators/users in presenting the case for a proposed ADS. The material originally contained in the Technical Notes has been restructured, simplified, and oriented as much as possible to the nontechnical ADS user.

Those desiring more detailed explanations of the results of Tasks 1 through 3 are encouraged to consult the Technical Notes.

↙ This document, Volume II of the final report, synthesizes and compiles the results obtained under <sup>the</sup> Study Tasks 1, 2, and 3 in order to address the objectives of Tasks 4 and 5. It is suggested that an originator/user of a proposed ADS concept can profit from reading both volumes of the report since the evaluation criteria presented in Volume II should, if possible, be satisfied by the proposal documents treated in Volume I.

The study was conducted within SRI International's Naval Warfare Research Center, A. Bien, Director. The Project Leader was David L. Harvey. Study team members included Terrance M. Keen, Edward H. Means, William Schubert, and Graham F. Wallace.

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## SECTION 1. INTRODUCTION

Automated data systems (ADS) have become an important adjunct to effective, efficient mission accomplishment in the Marine Corps. As their great potential as management tools has become increasingly apparent, the number of proposals to develop new AD systems to solve a multitude of management problems has similarly grown. The realities of military budgeting, however, will not permit the approval and implementation of more than a few of the most promising and cost-effective among the systems proposed. Also, because some of the ADS proposals promise very large cost savings for the Corps, it is important that a rational methodology be used to evaluate and approve ADS concepts to give strong assurance that high potential developments will not be ignored or delayed, and that low potential developments will not be too readily accepted for implementation at the expense of more promising ones.

The objective of this volume is to present a rational methodology to be used for this purpose.

## SECTION 2. MARINE CORPS OBJECTIVES AND ADS

The development of Marine Corps ADS is clearly not an end in itself; rather, it is merely a means to attain some higher objectives related to the Marine Corps' basic purposes. It is important that those higher objectives be kept constantly in mind when evaluating the potential worth of a proposed ADS development.

The Marine Corps Mid-Range Objectives Plan (MMROP), dated 7 October 1975, presents a statement of the "Basic Marine Corps Objectives." The major theme is that the fundamental goal of the Marine Corps is the maintenance of a force that is ready, responsive, and willing to fight whenever and wherever called upon. Well-conceived ADS can help fulfill this goal by improving, for example, the fiscal, logistics, and personnel management functions that support the Marine in the field. Ill-conceived ADS can hurt the combat Marine by imposing unnecessary burdens on him, or by consuming resources that might have been used for something that would have helped him more.

Evaluators will often find it very difficult to relate a proposed ADS or ADS feature to these overall Marine Corps objectives because of their complicated relationships, which are often impossible to analyze; however, the attempt is likely to produce a more beneficial result than if those objectives were ignored.

### SECTION 3. DECISION-MAKING IN CONCEPT PHASE ACTIVITIES

Section 2.1 of Volume I provides an overview of the USMC ADS development process and the role of its first component: the Concept Phase. During that Phase, the idea for a new ADS is generated and may become the subject of a formal Requirements Statement (RS). After appropriate approvals, the Requirements Statement is followed by a Feasibility Study (FS), and ultimately by the ADS Development Plan (ADSDP). If the ADSDP is approved, physical implementation of the proposed system begins. This event concludes the Concept Phase and initiates the Development Phase of the development process.

The decision-making activities during the Concept Phase are the subject of the material presented in this Volume.

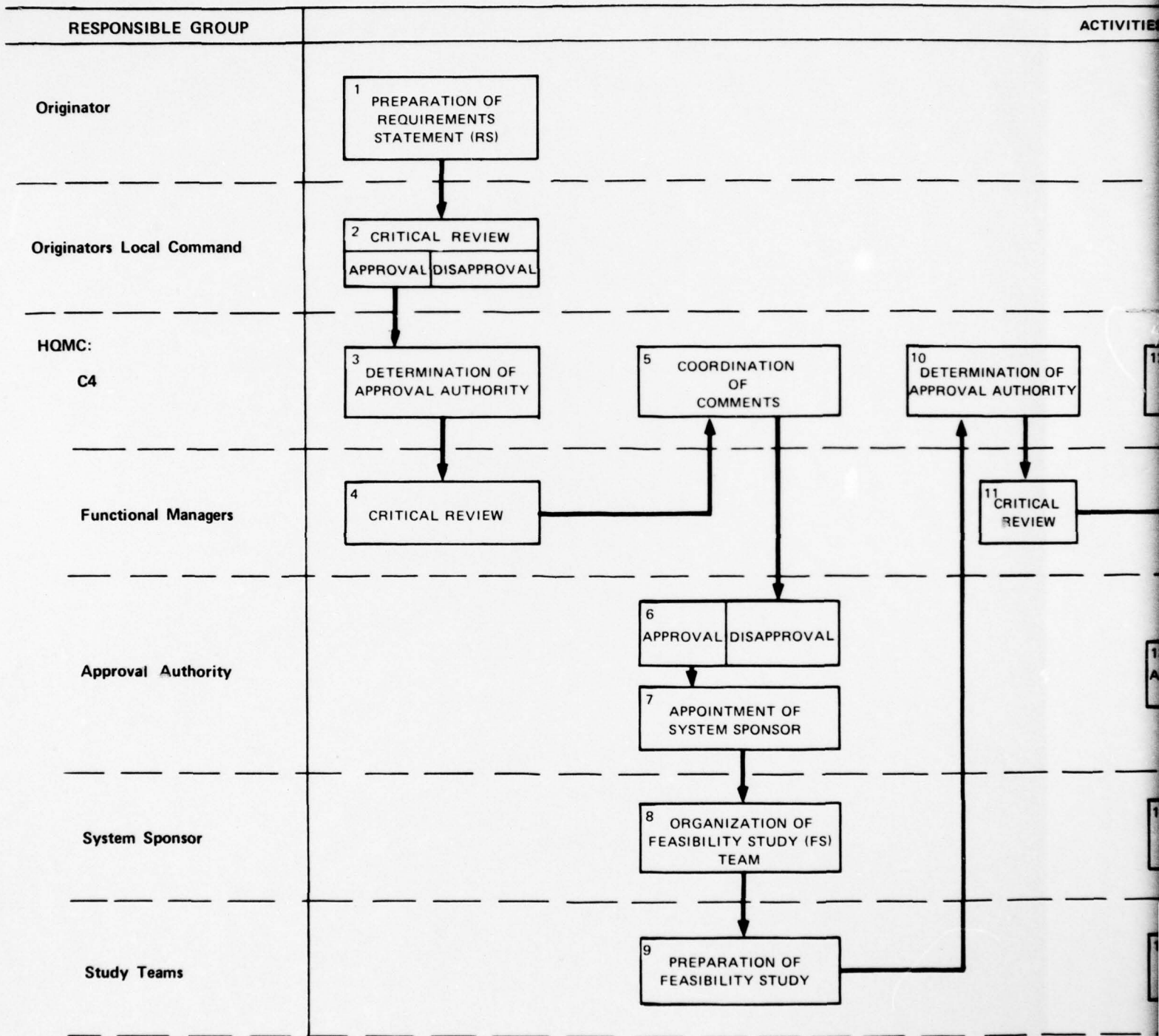
Figure 3-01 portrays all of the activities of ADS development in the Concept Phase. These activities are of three types:

- a. Activities connected with action document preparation.
- b. Activities concerned with action document review and evaluation.
- c. Action document approval/disapproval.

The first, the document preparation procedures, are treated in detail in Volume I. The primary emphasis in this volume is on the review and evaluation activities and the approval/disapproval activities.

Down the left side of the figure are shown the several groups active in the Concept Phase process. In the horizontal row to the right of each group are the development steps that group performs. These steps are carried out in the sequence indicated by the arrows connecting the boxes.

The requirement or need for a change or improvement in information processing may be first recognized anywhere within the USMC. Thus, the originator of an RS can be any person or group anywhere in the Marine Corps' organization, and the initial critical review and the approval/disapproval of the RS are performed by the originator's local command, employing normal staffing and approval procedures.



ACTIVITIES

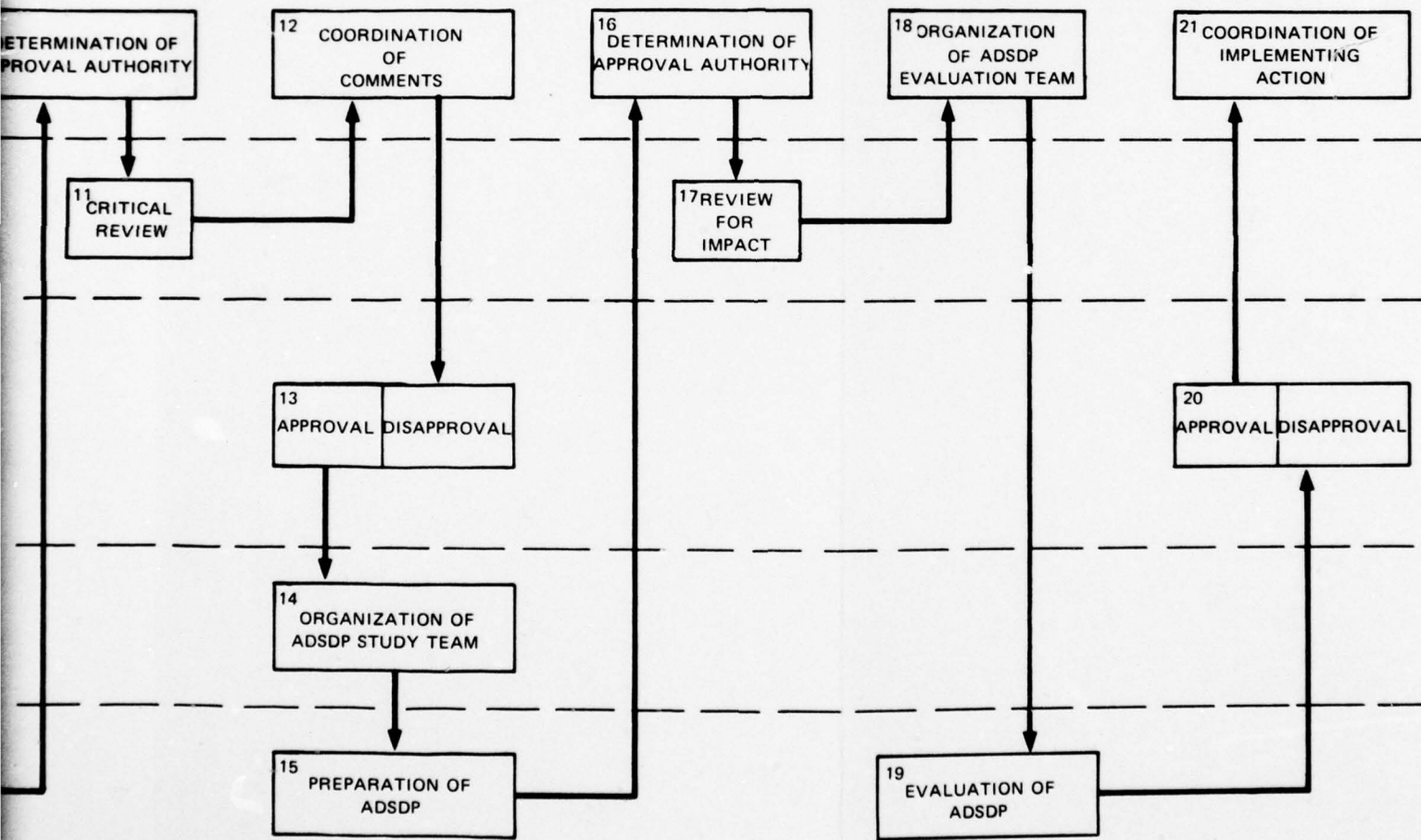


FIGURE 3-01 ADS PROJECT EVALUATION METHODOLOGY FLOW CHART

The figure shows that the C4 Division of HQMC performs a central ADS coordination function from receipt of an RS throughout the Concept Phase. That is in keeping with its assigned responsibility to coordinate computing and ADS development throughout the Marine Corps. C4 does not, however, itself approve or disapprove the action documents.

Functional Managers who might be affected by a proposed ADS are called upon at the appropriate points to review action documents that are pending approval. Such reviews are handled by the customary military staffing rather than by specially devised ADS development procedures.

At each stage of approval/disapproval the approval authority must be an office that:

- a. Has the authority to direct that the next stage of ADS development be accomplished.
- b. Controls the resources necessary to accomplish the next stage of development.
- c. Has cognizance of the subject matter of the proposed development (and all of the functional areas significantly impacted).

The outcome of an approval authority's action with respect to a document can take several forms:

- a. Unconditional approval: The document is accepted as a basis for the next development step.
- b. Approval contingent on the fulfillment of certain specified conditions: The document is returned to the preparation team with the understanding that, if the conditions are filled by the team, the document will then be accepted as a basis for the next development step.
- c. Provisional rejection: The action document and further development are rejected in their present form, but the document may be resubmitted for reconsideration after appropriate changes by the preparation team.
- d. Outright rejection: The developers are directed by the approval authority to cease expending resources on the concept development.

In all cases of rejection, the approval authority must inform the developers of its reasons for rejection.

The System Sponsor is a person charged with the responsibility of overseeing the preparation of the Feasibility Study and the ADS Development Plan. Ordinarily he is the representative of a Functional Manager. When multiple functional areas are concerned with the development, the System Sponsor is usually the representative of the Functional Manager most affected by the development.

The study teams need to have different strengths and capabilities at different points in the development cycle. Therefore, constitution of the teams will vary from activity to activity. Throughout the Concept Phase, the study teams will have strong user representation.

The following report sections describe the review and approval activities of Figure 3-01 in detail and show how the decision-maker's responsibilities interplay with those of the users/developers, who typically represent the advocates of the proposed system.

#### SECTION 4. PLANNING THE DECISION PROCESS

As a basic management principle, all ADS proposals, small or large, for the maintenance or modification of an old system or the development of a new one, should be reviewed and approved at some organizational level above that of the proposal's sponsor. Otherwise, a great proliferation of uncoordinated developments having uncertain usefulness would soon appear. The review and approval process should in all cases concern itself with the essential considerations contained in the methodology presented in this report:

- Identification of a real need (as in the Requirements Statement specified herein).
- Consideration of the feasibility of alternative solutions (as in the Feasibility Study specified herein).
- Evaluation of the overall cost effectiveness of the preferred alternatives (as in the ADS Development Plan specified herein).

However, the proposals relating to minor projects should touch on each of those considerations in much less detail and with much less expenditure of effort and time than those for major projects. Minor projects should be reviewed and approved at lower levels in the organization.

Another dimension to be considered is the basic character of the ADS proposal. If it is a proposal for making changes in the name of maintenance of an ongoing system, whereby that system will be restored to operational status, or permitted to run, or to meet its original design specifications, then the proposal carries a certain presumption of desirability growing out of the ongoing system's original approval. If the proposal calls for the modification of an ongoing system, whereby the original system design specification is not merely to be fulfilled, but is to be changed in a significant way and then fulfilled, then the proposal deserves closer scrutiny since its new design objectives have never been reviewed. Furthermore, if the proposal calls for a completely new system, it demands the fullest consideration and evaluation since neither its utility, its feasibility, nor its cost effectiveness have ever been reviewed.

The resources spent on preparing and reviewing an ADS proposal can be looked upon as a kind of insurance against ultimate failure of the proposed system. If the proposal preparation, review, and evaluation are done thoroughly, the proposed system will either be approved because it offers a high probability of success, or be rejected because it does not. Without this preparation, its chances of success would remain virtually unknown; hence, there should always be a proposal preparation and review for even minor proposals.

But what level of resource should be invested in such a preparation and review process? It is a matter of establishing a rational relationship among the factors of estimated system benefits, estimated system costs, and management's demand for a reasonable return on investment.

If we take the project's potential return on investment (ROI) as a measure of its merit, and assign a 20% ROI as the minimum measure of "success,"\* then the basic purpose of the review process is to ensure that the ROI will be maximized, and that it will be no less than 20% (if the project is to be approved). In mathematical terms:

$$\text{Maximize ROI} = \frac{B_A}{C_P + C_{DI}} \geq 0.20$$

where

- $B_A$  = estimated annual net benefits of the proposed system  
(annual benefits less annual operating costs)
- $C_P$  = cost of proposal preparation and review
- $C_{DI}$  = cost of system development and implementation following  
a favorable review

thus,

$$\frac{B_A}{0.20} \geq C_P + C_{DI}$$

or

$$C_P + C_{DI} \leq 5B_A$$

---

\* This corresponds to the five-year "payback period" currently demanded, for example, of proposed Navy energy conservation projects.

which provides a useful rule for calculating the maximum resources to be invested in proposal preparation and review:

$$C_{P_{\max}} \leq 5B_A - C_{DI}$$

$C_P$  plays dual roles in the equations; both of those roles must be carefully considered in choosing the proper level for the  $C_P$  investment. Indirectly, an increase in  $C_P$  can provide resources to make a thorough analysis of the feasibility and potential benefits of alternative systems. That may help ensure high values for  $B_A$  and low values for  $C_{DI}$  (thus increasing the estimated ROI), and it can provide the desired high confidence in the estimates. However, every increment in  $C_P$  directly increases the investment cost ( $C_P + C_{DI}$ ) and reduces the ROI, which the USMC is seeking to maximize. Both influences must be considered in choosing the appropriate level for  $C_P$  investment.

Obviously,  $C_P$  should be set as low as possible while still remaining high enough to perform its confidence-producing function. For example, a proposed ADS promising annual net benefits ( $B_A$ ) of \$100,000 if successful, and costing \$300,000 to develop and implement ( $C_{DI}$ ), would warrant an expenditure of up to \$200,000 (or about 48 man-months) for proposal preparation and review as necessary to establish the  $B_A$  and  $C_{DI}$  values with a high degree of confidence, or at least to provide confidence that  $5B_A$  will exceed  $C_{DI}$  by a substantial margin. If the circumstances are such that the attainment of that relationship appears doubtful, then the substantial expenditure of  $C_P$  to prove it or disprove it is called for. If, on the other hand, it appears highly probable to everyone concerned that  $5B_A$  will exceed  $C_{DI}$ , then a minimal effort on  $C_P$  is appropriate, and the ultimate ROI will be increased by the saving of  $C_P$  resources.

In applying these rules to specific ADS proposals, it should be noted that the annual benefits,  $B_A$ , used in the equation refer to the net annual benefits (in excess of annual operating costs) that accrue specifically to the proposed change. Thus, in the case of a maintenance proposal,  $B_A$  would represent the net incremental benefit to the USMC of

bringing the current system up to its original design specifications, not the total benefits of the system as a whole. Similarly, in a modification proposal,  $B_A$  would represent the net incremental benefits accruing to the improvement of the system beyond its original design specifications. In the case of a new system,  $B_A$  naturally refers to the total benefits of the new system, because no predecessor system exists.

At what level in the organization should the authority for final approval of an ADS proposal be assigned? Large projects that might have an important effect on the Marine Corps, either financially or operationally, should be approved at higher echelons than small projects. It is suggested that any ADS proposal (whether for the maintenance or modification of a current system, or for a new system) in which the cost of development and initial implementation ( $C_{DI}$ ) is estimated at \$100,000 or more should be considered to be a major proposal. It should therefore be processed fully in accordance with the methodology described in these volumes, using the previously described decision rule as a guide to the amount of preparation and review to be invested. Proposals whose  $C_{DI}$  is in the range \$20,000 to \$100,000 should be approved by the Headquarters Functional Manager, whose DP resources would be primarily required to carry out the development of the proposal if it is approved. Proposals for  $C_{DI}$  values of less than \$20,000 should be approved by the originator's local command with an after-the-fact record report to the affected Headquarters Functional Manager(s). In all such proposals, regardless of size, the subjects specified in the methodology presented herein should be addressed, the depth of such analyses to be determined from the decision rule.

Thus, a project costing \$100,000 or more would be processed fully according to the 21 steps prescribed in Figure 3-01. A project between \$20,000 and \$100,000 would follow the same general procedure except that the "functional manager" and the "approval authority" of Figure 3-01 would become the same office, and steps 3, 10, and 16 would not be applicable. A project costing less than \$20,000 would follow the same

general procedure as shown in Figure 3-01, except that the local commander in this case would be authorized to perform all the functions of the HQMC offices shown in the figure. In this situation, steps 3, 4, 5, 6, 10, 12, and 16 would not be applicable.

Certain special situations would qualify as exceptions to the preceding general rules. When an ADS is embedded as a subset in a larger weapon system or is a specialized tool for a specific research and development project, and performs a single function that has no significant utility outside its role in that particular context, it should be proposed and reviewed as a part of the normal procurement review procedures for the larger system of which it is a part, rather than as specified in the ADS methodology presented herein. During that review, however, the subjects addressed in the methodology of these volumes should be given consideration, when applicable. Also, any systems whose detailed specifications are directed by higher authority need not be reviewed according to this methodology since, under those circumstances, no decision options exist.

## SECTION 5. THE RS DECISION

When the RS is completed (Box 1 of Figure 3-01), it is submitted to the originator(s)' local command for critical review, and approval or disapproval (Box 2). (Appendix A provides a list of questions for use by the local command in reviewing the adequacy of the RS.)

One possible outcome of the review is the rejection of the RS and the discontinuation of any further effort on the idea as a result of the reviewer's: (1) determination that the user requirements cannot be sufficiently defined or sufficiently validated to justify further development, or (2) judgment that the resources required for subsequent processing of the idea are too high to justify further development.

If the RS is approved by the local command, it is forwarded with the local command's comments through channels to the Command, Control, Communication, and Computers (C4) office at Marine Corps Headquarters (Box 3), which is responsible for Headquarters staff coordination of all Marine Corps ADS activities. Headquarters action at this stage of the process is necessary to bring the RS to the attention of approval authorities who: (1) have a complete staff of functional experts capable of discerning any Marine-Corps-wide impacts that the proposed idea might entail, and (2) have the authority to provide resources in the amount and kind required to perform the Feasibility Study, should the RS be approved.

Upon receipt of the RS, C4 determines which functional area (e.g., fiscal, manpower, logistics, aviation) would be most affected by the proposed idea, and assigns approval authority to that office. C4 then routes the RS for critical review to all Functional Managers at Headquarters whose functional areas would be significantly impacted by the proposed idea (Box 4). The questions in Appendix A are for the reviewers' use. The purpose of the review is to critique the RS and either support or oppose it as a basis for further development. The reviewers will:

- Pass judgment on the validity of the user requirements in the RS.
- Analyze, and, if necessary, suggest adjustments in the estimates made in the RS for the resources required to perform the Feasibility Study and ADS Development Planning.

- Determine whether the expenditure of resources to produce an FS and an ADSDP is warranted.

C4 integrates the reviewer's responses (Box 5) and submits them with the RS to the RS approval authority for decision (Box 6). Approval at this point does not authorize development of an ADS but only commits resources for the next development subphase: the Feasibility Study. Rejection will terminate, either finally or provisionally, any further development. It is the task of the approval authority to:

1. Reject the RS, or
2. Approve the RS, commit resources for a Feasibility Study, and appoint a System Sponsor (Box 7).

The System Sponsor will be responsible, under the auspices of the RS approval authority, to organize the Feasibility Study (FS) Team (Box 8) and lead the further development effort as its chairman. He will normally have a broad background in Marine Corps operations and in ADS applications. If practicable, he should be assigned full-time to his System Sponsor tasks.

In all cases, regardless of the findings of the Feasibility Study Team, an FS document will be prepared and submitted for consideration by approval authorities.

## SECTION 6. THE FS DECISION

When the FS is completed (Box 9), it is submitted to C4 for assignment to an FS approval authority (Box 10). The FS approval authority will normally be the same office as the RS approval authority. In a rare case it could be a different office if the perceived principal impact of the proposed ADS has shifted to a new functional area as a result of new system features introduced by the FS. C4 then routes the FS for critical review to all Functional Managers whose functional areas would be significantly impacted by the proposed system (Box 11). (The questions in Appendix B are for the reviewers' use in this process.)

The reviewers should include functional area specialists attuned to questions of operational feasibility and benefits, and technical specialists attuned to questions of technical feasibility and costs.

The reviewers will:

- a. Pass judgment on the adequacy of the analyses, estimates, and recommendations contained in the FS.
- b. If the FS is acceptable and the selected solution approach(es) are ADS approach(es), endorse the selected approach(es) for further development.
- c. Reconsider, and, if necessary, recommend adjustments in the estimates of resources required to carry out ADS Development Planning for the endorsed ADS solution approaches.

C4 integrates the reviewers' responses (Box 12) and submits them with the FS to the FS approval authority for decision (Box 13).

Disapproval of the FS terminates, either finally or provisionally, further ADS development. Approval of an FS whose selected approach(es) are non-ADS approach(es) also terminates further ADS development. Approval of an FS whose selected approach(es) are ADS approach(es) does not authorize development of the ADS, but only commits resources for the ADS Development Planning subphase. Upon approval of the FS, the System Sponsor organizes the ADSDP Study Team (Box 14), which requires a broader range of expertise among its members than did the FS Team because of the technical demands of producing the ADSDP and its supporting documents (Box 15). The supporting documents include the system Functional Description (FD), Data Requirements Document (RD), ADP Equipment Specification (ADPES), and the Economic Analysis (EA).

## SECTION 7. THE ADSDP DECISION

7.1 General. This section describes the procedure to be used in evaluating the ADSDP and approving or disapproving its implementation. The procedure consists of the following elements:

- a. Preliminary review of the ADSDP by the C4 office at HQMC.
- b. Organization of an ad hoc ADSDP Evaluation Team under C4 chairmanship at HQMC.
- c. The Team's evaluation of the ADSDP on its own merits as a cost-effective proposal.
- d. The Team's development of a range of alternative allocations (of the manpower resources at the affected CDPA) to the ADS projects competing for support.
- e. The Team's evaluation of the relative merits of those alternatives.
- f. The approval authority's decision regarding further implementation of the ADSDP.

7.2 Formation of the ADSDP Evaluation Team. When a new ADS Development Plan is received in C4 that office will conduct a preliminary review of the ADSDP to ensure that it has been prepared completely and accurately in accordance with procedural instructions for ADSDP preparation. If the ADSDP fails in the review, it will be returned to the development team for correction and resubmission. If it passes the preliminary review, the Director of C4 will designate an ADSDP approval authority (Box 16), and will send a copy of the ADSDP to each Headquarters Functional Manager with the request that he review it for any possible impact on his functional area. If none of the nonsponsoring Functional Managers sees any impact on his functional area, the sponsoring Functional Manager will unilaterally conduct the ADSDP evaluation. If a nonsponsoring Functional Manager finds that the proposed development will have a significant impact on his functional area, he will assign a representative from his functional area to act as his representative on an ad hoc ADS Evaluation Team, which will be convened under the chairmanship of a C4 representative (Box 18) to evaluate the ADSDP (Box 19).

It is important that the members of the Evaluation Team be carefully selected to perform this important role. Functional Managers who are

affected should select as their representatives people who possess the following qualifications:

- An appreciation of FMF operational problems (to provide an understanding of the advantages and disadvantages that AD systems may offer to Marine combat units).
- An expert knowledge of the major mission programs and the ADS supporting programs sponsored by the functional areas they represent.
- Good oral and written communications skills.
- Of the same or nearly the same rank as other team members (to avoid any rank-generated bias in the evaluation results).
- Not members of the prospective ADS user group, of the Sponsor's immediate office, or of any of the teams that have previously prepared inputs to the ADSDP under consideration, or have previously reviewed these inputs at the preceding Requirements Statement or Feasibility Study approval points. (The purpose of this provision is to ensure as completely as possible the absence of bias growing out of former personal identification with the ADSDP under consideration.)

The Chairman of the Evaluation Team will assign as members one or more technical specialists in the areas of computers, data communications, and economic analysis, including at least one representative of the Central Design and Programming Activity (CDPA) at which the proposed system would be developed, if approved.

It should be recognized that portions of the ADSDP under consideration by the Evaluation Team will have already received substantial review and approval at the preceding Requirements Statement and Feasibility Study approval points, as well as the expert attentions of the Development Team during preparation of the ADSDP and its supporting documents.

The proposed ADS can, therefore, be assumed to be a system whose usefulness and feasibility as an individual system, have already been well demonstrated; otherwise it would not have cleared the earlier reviews and been approved for the substantial expenditure of resources that were required to prepare the ADSDP. The main purpose of the ADSDP Evaluation, then, is to determine (1) whether the proposed ADS is worthwhile in terms of the benefits it promises for the resources it demands and (2) how it fits into the larger Marine Corps picture in terms of its competition for

the limited, virtually fixed, manpower resources allocable to ADS development at the sponsoring Functional Manager's CDPA.

7.3 Analysis of the ADSDP on its Own Merits. The first step of the Evaluation Team's review of the ADSDP is devoted to an analysis of the worth of the proposed system on its own merits, not yet considering its competition (for resources) with other Marine Corps projects. (This competition is treated under the second step of the evaluation, and is discussed in the following section of this report.)

For this purpose, each member of the Evaluation Team will be requested by the Chairman to analyze carefully the incoming ADSDP, addressing at least the questions listed in Appendix C of this report. The Chairman will then convene a meeting of the Team, wherein each member will present orally his considered position as to whether the ADSDP: (1) adequately presents a valid case for an AD system, that (2) appears to be a worthy (i.e., cost-effective) candidate for further consideration in the second phase of the evaluation. After the general discussion, a consensus among the members will determine the Team's answer to the above two questions. If the Team decides that the ADSDP is lacking in either respect, the ADSDP will be returned, with documented reasons for its rejection, to the System Sponsor for reconsideration and possible resubmission at the Sponsor's option. On the other hand, for compelling reasons that it will document, the team may simply reject the ADSDP as being unworthy of further support, and will return it to the System Sponsor via the ADSDP approval authority.

Rejection of the ADSDP would be unlikely under static conditions. However, given the real-world conditions of changing internal requirements, as well as external directives, the underlying assumptions or conditions for which the earlier FS and RS approvals were given could now be so significantly changed as to effectively void the earlier approvals.

If the Team decides that the ADSDP is acceptable in both respects, it will be further processed under the second step of the evaluation, as described below.

#### 7.4 Evaluation of the ADSDP Relative to Other Marine Corps Projects.

The second step of the evaluation compares the ADSDP with other ongoing projects and considers several alternative allocations among them of the available ADS resources, principally manpower resources.

##### 7.4.1 The Generation of Resource Allocation Alternatives for Evaluation.

At a typical CDPA, the available manpower resources at any given time might be allocated to one large development project, a few medium-sized projects, and a large number of small projects devoted to maintenance and/or modification of existing ADS, each bearing its own priority relative to the total project population.

Because the proposed ADS is in competition (with other systems under development at the sponsor's CDPA) for available development resources, in the second step of the evaluation the alternatives at issue make up the several ways that the proposed system development might be introduced into the CDPA. The possibilities range from full-scale, full-speed development down to postponed development (i.e., where the proposed system must wait in queue until the required resources can be made available for its development).

The Team's next order of business is to establish a systematic range of alternative ways to introduce the proposed new project (or delay its introduction). The alternatives are designed by the Team to indicate, in effect, a range of priorities that might be assigned to the proposed new project, in relation to its competitors, based on an overall evaluation of the merit of each of the competing projects. Thus, if the proposed project is considered more important (i.e., more meritorious) than its competitors, it will be assigned a more generous allocation of the available system development resources (at the expense of its competitors) and vice-versa.

Table 7-01 is a sample of the outcome of this process, as it would appear if the new project were, for example, sponsored by the DCS for I&L, and were being evaluated by the Evaluation Team for possible development at the I&L CDPA activity at Albany, Georgia. In the left column are listed

Table 7-01

SAMPLE TABLE OF ALTERNATIVES TO BE CONSIDERED

Affected CDPAs: Albany  
 ADSDF Under Evaluation: "MCPM"

Project Identification	Alternative Manpower Resource Allocations					
	Within Current CDPAs Resources			With Additional Resources		
	1 Current Allocation	2 Allocation with Optimal Effort on New Project	3 Allocation with Intermediate Effort on New Project	4 Allocation with Lowest Acceptable Effort on New Project	5 Allocation Using Added Personnel	6 Allocation Using Contract
Project A (a large development)	30	25	25	30	30	30
Project B (a medium size development)	15	10	10	15	15	15
Project C (a medium size development)	20	15	15	15	20	20
Group of small projects devoted to the Supply function	20	10	15	15	20	20
Group of small projects devoted to the Maintenance function	15	10	15	15	15	15
Proposed project "MCPM"	0	30	20	10	30	20
Total (% of Current resources)	100%	100%	100%	100%	130%	120%

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the projects currently under development at the CDPA, as well as the (hypothetically) proposed ADS "MCPEM."\*

- a. Alternative 1--Current Status. Under Alternative 1, the current allocation, are entered the levels of effort currently devoted to these projects, presented as a percentage of total man-hours available for development work at the CDPA. Under this Alternative, the effort devoted to Project "MCPEM" is zero because it has not yet been approved for implementation.
- b. Alternative 2--High Priority to New Project. Under Alternative 2, the Evaluation Team gives highest priority to "MCPEM" and allocates the full amount of manpower resources that would be necessary to develop "MCPEM" on an optimal schedule to ensure its earliest possible operational capability (30% in our example). The resource allocations to the current projects must, of course, be scaled down appropriately to make these resources available for Project "MCPEM." The necessary scaling down can usually be accomplished readily by generally following the relative priorities that the current projects have earlier been assigned.
- c. Alternative 3--Medium Priority to New Project. Alternative 3 is designed to give support to "MCPEM" at an intermediate level between those assigned to "MCPEM" under Alternatives 2 and 4. This alternative would provide a development pace for "MCPEM" that is inferior to optimal Alternative 2 in terms of efficiency and completion date, but is superior to the minimally acceptable program represented by Alternative 4.
- d. Alternative 4--Low Priority to New Project. Under Alternative 4, "MCPEM" is allocated the minimum resources considered necessary to make it a successful project; i.e., if fewer resources were allocated, the development process would be unacceptably inefficient, or the promised operational capability would be made available unacceptably late, perhaps so late as to render its product useless to the Marine Corps.
- e. Alternatives 5 and 6--Additional Manpower for New Project<sup>†</sup>. As noted in Table 7-01, Alternatives 1 through 4 are designed on the assumption that only the current CDPA manpower resources are available to accommodate "MCPEM" along with the other projects currently underway. Two additional alternatives must, therefore, be added to represent the possibility that the current projects might be maintained at or near their currently

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\*"MCPEM" is only an illustrative acronym.

<sup>†</sup>These alternatives should be used if additional resources can be obtained for either the new project or other projects competing for the same manpower.

assigned levels of effort without interference, while the new project "MCPPEM" might be developed by adding new personnel to the CDPA through personnel transfer, for example, (as represented by Alternative 5) or by use of external contractors (as represented by Alternative 6).

Before the ADSDP evaluation task can begin, the Evaluation Team must arrive at a consensus on the definitions of the alternatives to be evaluated. With the above general guidelines in mind, the Chairman of the Evaluation Team will issue to each team member a worksheet in the form of Table 7-01, having filled in only the identifying blanks at upper left and the numerical entries under Alternative 1 (which reflect the current factual status of workload at the affected CDPA). Each team member will then be requested to complete the numerical entries under Alternatives 2 through 6, using his best judgment to reach an appropriate balance among the competing systems. When these have been returned to the Chairman, they will be compared in a general discussion by the whole team. Each member will be encouraged to present his reasons for reaching his choices on the alternatives. The discussions will continue until a clear consensus is reached wherein a single set of numerical entries (perhaps even a set which is different from any of those submitted originally) is acceptable to the majority of team members. If no clear consensus emerges, the Chairman will choose the final set of numerical entries.

If possible, more than six alternatives for evaluation should be avoided because of the increased complexity of dealing with a large number of alternatives in the evaluation.

7.4.2 Evaluation of the Alternatives. Once the alternatives have been defined, the team members must determine their relative values to the Marine Corps so that the most valuable alternative may be chosen for implementation. The Chairman will ask each team member to rate the six alternatives subjectively on a scale of 0 to 100 (assigning the grade 100 to the best alternative), after asking himself the questions listed in Appendix D.

Each team member will submit his ratings of the six alternatives, together with a written presentation of his analysis of the advantages and disadvantages of each alternative, to the Chairman. Copies of all submissions will be provided to each team member, and a general meeting to discuss them will be convened by the Chairman with a view toward reaching a consensus. At the meeting, the proponent of any exceptional point of view will orally present his rationale and be subjected to questions from his fellow team members. If Alternatives 5 or 6 are advocated, the proposed sources of additional manpower or of contract funds must be identified. When there are no more questions, another iteration of the rating process will be performed, in the meeting room if desired, and the Chairman will compile the results, including all the numerical ratings assigned by each team member. To reach the final choice, the Chairman will average the numerical ratings of all members for each alternative. The final ranking of alternatives will be based upon the average ratings, and the alternative with the highest average numerical rating will be the Team's final choice. The numerical ratings provided by each team member will be preserved to indicate the range of uncertainty that existed in the Team's collective judgment.

Table 7-02 is a sample display of evaluation results in which Alternative 5 would be chosen.

The results will be documented by the Chairman and submitted to the ADSDP approval authority for decision (Box 20).

If the ADSDP is approved, C4 will coordinate the necessary implementing action, utilizing resources authorized by the approval authority (Box 21).

This final step in the ADSDP approval process not only evaluates the proposed ADS on its own merits but also in relation to its impacts, positive or negative, on other ongoing ADS development or maintenance/modification projects.

Table 7-02

Sample Display of Evaluation Results \*

	Alternatives					
Team Members	1	2	3	4	5	6
A	15	65	20	55	100	15
B	25	85	35	60	100	40
C	0	100	60	10	75	35
D	30	40	100	40	60	50
E	65	50	70	100	80	20
F	20	100	45	50	45	25
Average Rating	25.83	73.3	55.0	52.5	76.6	30.8
Range of Ratings	0-65	40-100	20-100	10-100	45-100	15-50

\*Entries indicate the team members' subjective evaluations of the alternatives on a scale of 0-100.

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Appendix A

QUESTIONS FOR USE IN REVIEWING THE  
ADEQUACY OF THE REQUIREMENTS STATEMENT (RS)

QUESTIONS FOR USE IN REVIEWING THE  
ADEQUACY OF THE REQUIREMENTS STATEMENT (RS)

Is each need adequately justified?

Were user needs adequately analyzed, e.g., by extensive interviews and by "decision table" analysis? Are the needs described fully, in terms of subject matter, criticality, relative priority, level of detail or aggregation, frequency of reports, full or exception reporting, the decisions or actions they support?

In what respects are the existing systems considered to be inadequate? Are these hard deficiencies whose resolution is essential to Marine Corps effectiveness, or are they merely bothersome?

Has adequate consideration been given to upgrading the existing systems (to overcome their deficiencies) through non-automated means such as personnel changes, organizational changes, procedural changes?

Are all obvious needs expressed?

Were existing systems adequately investigated for applicability in satisfying the user's needs?

Does the validation of the user's requirements include specific documentary references to the original source of the requirement, such as an OMB directive?

Was due consideration given to the timing and frequency of the user's data requirements, i.e., is there a statement as to when each element of data input and output is required and whether at an hourly, daily, weekly, monthly, or annual frequency?

Is it made clear by whom and at what location each element of output data is required?

Were the user's needs for output data analyzed from the viewpoint of all the functions the user must perform, e.g., forecasting, planning, programming, budgeting, authorizing, monitoring, evaluating, reporting, administering, commanding?

Were the user's needs analyzed with regard to all the types of resources the user is concerned with, e.g., manpower, money, energy, aircraft, ground vehicles, shore installations, equipment, ammunition, supplies?

If the user's needs were not met, what operational disadvantage would the Marine Corps suffer?

Which of the user's requirements could be left unsatisfied without significant detriment to the USMC?

Are all the documentation requirements set forth in the ADSM fulfilled?

Appendix B

QUESTIONS FOR USE IN REVIEWING THE  
ADEQUACY OF THE FEASIBILITY STUDY (FS)

QUESTIONS FOR USE IN REVIEWING THE  
ADEQUACY OF THE FEASIBILITY STUDY (FS)

Will the selected approach meet all of the user requirements expressed in the RS?

Does the selected approach produce information that the intended user does not need, or will not use?

Does it produce information that no one needs?

Is the selected approach sufficiently described to serve as a starting point for ADS development?

Does the selected approach duplicate or overlap other ADS systems which exist or are currently under development?

Does the selected approach provide for adequate access (e.g., for input, interrogation of the data base, output) by all appropriate potential users in the Marine Corps?

What is the estimated life expectancy of the proposed system?

Does the selected approach require a high level of expertise in programmers or operators?

What elements of the existing system(s) can be carried over and used by the selected solution approach, e.g., talent, equipment, forms?

Has the rationale for automatic data input from sensors been considered so as to economize on the need for manual intervention?

Will the selected approach's outputs be accurate enough to be credible and reliable, and thus forestall the maintenance of redundant, time-consuming manual systems "kept in a drawer"?

Is the selected approach likely to fulfill the needs of later incumbents in the user organization, as well as the current user/sponsor?

Is the selected approach adaptable to possible future changes in planning procedures, or operations of the user organization(s)?

Will the system be readily adaptable to wartime conditions should they occur?

How complex does the selected approach appear?

Are the system techniques called for in the selected approach all within the current state of the art?

What is the estimated probability of successful development and implementation of the selected approach? Are there substantial technical or operational risks involved?

Has the proposed system been used in other organizations? With what results?

Are the numbers and skills of personnel required for development and operation of the selected approach currently available in the user and data systems organizations?

Is the selected approach inherently capable of handling the projected workload?

What undesirable impact may the selected approach have on morale or organizational effectiveness?

Has the sponsor of the proposed system considered all the alternatives to the proposed system, and evaluated their relative cost-effectiveness?

Are all expected obstacles identified and evaluated?

Does the selected approach impose a requirement for additional data collecting?

Are all the documentation requirements set forth in the ADSM fulfilled?

Will the outputs of the selected approach be consistent with the outputs of existing systems treating similar subject matter? If not, how is it proposed to resolve the inconsistencies?

Will the selected approach employ programming language that is operable in view of the training and background of the USMC programmers and operators who will use the system?

Is the selected approach clearly superior to the other alternatives?

Appendix C

QUESTIONS FOR USE IN  
REVIEWING THE ADEQUACY OF THE ADSDP

QUESTIONS FOR USE IN  
REVIEWING THE ADEQUACY OF THE ADSDP

Does the originally stated need for the proposed system still exist?  
How long is it likely to exist?

Are any of the user requirements in the RS that cannot be satisfied by the system?

Can all stated ADS objectives be tested or otherwise checked for fulfillment during system development?

Are there adequate provisions in the proposed system for security: physical? communications? user access? software?

Is system flow adequately described to ensure harmony among the various processing steps, intermediate user actions, sources and destinations of inputs and outputs, and responsibilities of organizational units?

Are the non-automated elements of the system integrated with the automated elements to show a complete operating entity?

How survivable is the selected approach in the event of military action?

Is the system adequately protected from the hazards of pollution, rough handling, and other environmental effects?

Is the system designed for easy maintenance?

Is it reliable?

Is there provision for graceful fallback of operations in the event of trouble in the system? Are redundancies or backups provided for critical elements?

Is the system organizationally located for maximum benefit to the Marine Corps?

What provisions are made for obtaining the new personnel skills required by the system? for placement of displaced employees? for needed organizational changes?

Is the required processing of each element of input described?

Does the proposed system provide a level of information quality that exceeds the user's needs?

Are system components readily available on the commercial market to meet the planned development schedule?

Is the system development schedule realistic?

Does the proposed development/implementation schedule meet the user's requirements for initial availability of the new system?

Does the proposed system provide a frequency and speed of response that exceeds the realistic needs of the users?

What are the expected benefits of the proposed system (a) to the intended users? and (b) to the Marine Corps as a whole?--in dollar savings, morale, inventory reductions, personnel released, working conditions, decision-making, response time, transportability, maintainability, training time, vulnerability, simplicity, efficiency, and combat effectiveness of the FMF. (The new system may be faster than the old, but how important is speed in the intended application?)

Other possible benefits might include:

Equipment displacement: the value of equipment that will be freed because of the proposed system, e.g., calculators, accounting machines, or earlier generation computer systems.

Direct cost displacement: cost of tasks that are currently being performed by people and which will be performed wholly or partially by the proposed system, e.g., preparation of routine documents, collection and summarization of data, analytical computation.

Indirect cost displacement: cost savings derived from the proposed system's enhanced information handling capabilities of speed, accuracy, and information retrieval, e.g., reduction in inventory costs.

Improved responsiveness of the user organization to the needs of supported organizational units: due to improved information regarding USMC requirements, trends, problem areas, organizational performance, etc.

Improved managerial planning and control: quicker preparation of planning documents through quicker data collection or through the use of planning models or simulations designed to give answers to "what if?" planning questions regarding various plans, assumptions and contingencies; also more frequent iteration of planning cycles; deeper insight into the factors affecting organizational performance.

Organizational benefit: organizational improvements resulting from the new system, e.g., better operational discipline in performing accurately and on-time, more flexibility in personnel recruitment and assignment.

Have these benefits been quantified in terms of their dollar impacts?

Over what time period is the system expected to pay back (through savings) the required initial investment?

Which costs or wasteful practices associated with existing systems will be reduced, eliminated, or avoided by the new system?

Are all costs of the new system identified, e.g., for R&D, studies, system design, training, programmers, operators, programming and debugging, development of new forms, parallel operations of old and new systems, site preparation, hardware and software procurement, hardware and software maintenance?

Are the estimated resource requirements reasonable for the contemplated development?

What valuable resources other than dollars are affected by the proposed system: manpower? energy?

What was the cost-effectiveness of the existing system(s) in comparison with the proposed system?

Is the estimated system accuracy consistent with the purpose to which the results will be applied?

Does the system include adequate error alarms and diagnostic routines to signal and trace any errors that may occur?

Is the proposed system capable of performing useful tasks other than those required by the current user/sponsor?

Is there adequate provision for the system's workload capacity or functional capabilities to be expanded, such as by adding modular subsystems?

Is the system designed to grow to meet the estimated future, as well as the current needs of the intended user?

Does the system contribute to the desirable standardization of data elements and codes, terminology, programming languages, source documents, systems documentation, education and training?

What safeguards are provided against failure of the development project, e.g., generation of test data, documentation, system modeling, progress reporting?

What confidence level (in percent terms) is associated with the plan's estimates of the performance and cost of each system element?

Does the plan identify goals, resources, assumptions, dates, responsibilities, and measures of progress?

Have the required outputs been identified? What do they contain? At what time intervals are they produced? Where do they go? What form are they in? Who is responsible for receiving them?

Have the required data and parameter inputs been identified? What do they contain? At what time intervals are they produced? Where do they go? What form are they in? Who is responsible for generating them?

Is the proposed system compatible with other AD systems with which it must interact, e.g., in data formats, data sources, data base, input parameters, programming languages, output schedules, processing cycles, lag times, error rates?

Is the proposed system consistent with the objectives and constraints set forth in the USMC ADS Plan? Is it compatible with the overall ADS architecture envisioned for the USMC?

Does the proposal meet the requirements for OMB Circular A-76, which is designed to encourage Government movement toward greater use of commercial ADP services in lieu of Government ownership and operation of ADP facilities?

Does the proposal comply with the "Brooks Bill" (Public Law 89-306, 80th Congress, H.R. 4845, 30 Oct. 1965), which authorized and directed GSA to coordinate and provide for the economic and efficient purchase of ADP equipment by Federal agencies?

Is the proposal consistent with the provision of Draft DoD Instruction 79XX.XX of 22 Oct. 1976, "ADP System Life Cycle Management," and Draft DoD Instruction 79XX.XX of 29 Oct. 1976, "Acquisition by Contract of Automatic Data Processing Equipment, Software, and Services"?

What, if any, organizational changes would be required to implement the proposed system?

Are the interfaces between the proposed system and other existing systems fully described and evaluated?

Are all the ADSDP supporting documentation requirements set forth in the ADSM fulfilled?

Does the ADS plan include effective plans for system management, design, development, testing, parallel operation, conversion, control, evaluation, team organization, documentation, training, accounting, file retention time, quality controls, cost controls?

Appendix D

QUESTIONS FOR USE IN EVALUATING  
THE CDPA RESOURCE ALLOCATION ALTERNATIVES

QUESTIONS FOR USE IN EVALUATING  
THE CDPA RESOURCE ALLOCATION ALTERNATIVES

To what extent does the alternative:

- Provide a good balance between economy and effectiveness in supporting the Basic Marine Corps Objectives?
- Comply with real-world constraints in the availability of personnel skills, facilities, equipment, and budget, and in directives from higher authority? (If the preferred alternative does not comply with the directives from higher authority, a reclama will be necessary to gain the higher authority's approval of the deviation.)
- Simplify and facilitate Marine combat operations?
- Avoid "gold-plated" features that look good at first glance but will not really help FMF combat effectiveness? (For example, delivering a report in one hour instead of three days is not worthwhile unless the added speed significantly improves the quality of an important decision that is based on the report.)
- Contribute to the Corps-wide standardization of ADS programs, equipment, and procedures?
- Provide for a family of USMC information systems that complement rather than impede or duplicate one another?

Can the system be funded within existing USMC budgetary limitations?

To what degree can action be taken to minimize the new system's undesirable effects?

What will it cost to minimize the new system's impact on other, existing, systems or other systems under development?

Is it amenable to economy through consolidation with other existing or planned systems?

When and at what level of funding should the proposed system be initiated so as to minimally impede the existing AD systems or those currently under development?

What is the relative importance of the output of the proposed system compared with that of other existing or proposed systems for the same organizational unit?

What priority should be assigned to the proposed system among all proposed systems currently competing for funding authorization?